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| Question |
| **Should RRT/MET vs. no RRT/MET be used for hospitalized adults at risk of deterioration?** |
| **Population:** | Adults who are at risk of cardiac or respiratory arrest in hospital |
| **Intervention:** | Rapid Response System (includes Rapid Response Team (RRT) or Medical Emergency Team MET)) |
| **Comparison:** | No Rapid Response System  |
| **Main outcomes:** | Survival to hospital discharge with good neurological outcome (critical); Survival to hospital discharge (critical); In-hospital incidence of cardiac/respiratory arrest (critical) |
| **Setting:** | Adults, in-hospital |
| **Perspective:** | There is uncertainty if Rapid Response Systems are effective in improving patient outcomes after cardiac arrest and patient survival or reducing the number of cardiac arrests.  |
| **Background:** | Patients admitted to hospital with serious health issues are at risk of deterioration that can lead to cardiac arrest. Frequently, these patients will exhibit signs and symptoms of deterioration for hours or days before cardiac arrest. (1) A Rapid Response System is a program designed to evaluate patients early in their clinical deterioration to prevent serious adverse events in hospitalized individuals. (2) |
| **Conflict of interests:** | The ILCOR Continuous Evidence Evaluation process is guided by a rigorous ILCOR Conflict of Interest policy. The Task Force members and authors declare no conflict of interest. |

# Assessment

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| ProblemIs the problem a priority? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no○ Probably yes● Yes○ Varies○ Don't know | Up to 86% of in-hospital cardiac arrests are preceded by a period of physiological deterioration, and in-hospital cardiac arrest confers a high mortality. Rapid response systems are based upon the premise that intervention during this period of deterioration is likely to reduce the incidence of cardiac arrest and death. | The ability of a healthcare institute to demonstrate a means of detecting the physiologically deteriorating patient (‘afferent limb’), a means of responding to this deterioration with a response team (‘efferent limb’), an ongoing evaluative component and an ongoing administrative component is now utilized by some healthcare jurisdictions and regulatory organizations to credential/accredit healthcare institutions.  |
| Desirable EffectsHow substantial are the desirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial○ Small○ Moderate● Large○ Varies○ Don't know | * There is low certainty of evidence that RRS improves survival to hospital discharge and reduces the incidence of cardiac arrests in adults.
* There may be other desirable effects of rapid response systems, such as to improve care of patients with end of life care and in reduction of medical errors. (67, 68)
* Included studies reported an expected increase in number of calls to rapid response system.
* There was no report of increased mortality or harm caused by rapid response systems.
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| Undesirable EffectsHow substantial are the undesirable anticipated effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial● Small○ Moderate○ Large○ Varies○ Don't know | * There is low certainty of evidence that RRS improves survival to hospital discharge and reduces the incidence of cardiac arrests in adults.
* There may be other desirable effects of rapid response systems such as to improve care of patients with end of life care and in reduction of medical errors. (67, 68)
* Included studies reported an expected increase in number of calls to rapid response systems.
* There was no report of increased mortality or harm caused by rapid response systems.
 | Studies have reported that increased number of calls did necessarily lead to change in treatment or patient admission to intensive care unit. (73) |
| Certainty of evidenceWhat is the overall certainty of the evidence of effects? |
| Judgement | Research evidence | Additional considerations |
| ○ Very low● Low○ Moderate○ High○ No included studies | There was high heterogeneity among studies. The overall certainty of evidence was rated as very low to low for all outcomes primarily due to a very serious risk of bias. The individual studies were all at a serious to critical risk of bias.  |  |
| ValuesIs there important uncertainty about or variability in how much people value the main outcomes? |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability○ Possibly important uncertainty or variability● Probably no important uncertainty or variability○ No important uncertainty or variability | In-hospital cardiac arrest is a major adverse event with an incidence of 1–6/1000 admissions. Long term survival from IHCA is poor at 13.4%. (74) Abnormal vital signs are prevalent 1–4h before in-hospital cardiac arrest on hospital wards. In-hospital mortality increases with increasing number of pre-arrest abnormal vital signs. (1) |  |
| Balance of effectsDoes the balance between desirable and undesirable effects favor the intervention or the comparison? |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison○ Probably favors the comparison○ Does not favor either the intervention or the comparison● Probably favors the intervention○ Favors the intervention○ Varies○ Don't know | Based on large desirable effects and small undesirable effects, rapid response system is probably favored. |  |
| Resources required |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs○ Moderate costs○ Negligible costs and savings○ Moderate savings○ Large savings● Varies○ Don't know | In a 2016 survey of 207 Australian and New Zealand hospitals revealed that ICU staff provided staff for most RRTs, and oversight for more than 80% of RRTs. However, additional funding for ICU RRT staff and dedicated doctors was relatively uncommon. (75) | Resources required is likely to vary depending on healthcare setting, make up and context of different rapid response systems.  |
| Certainty of evidence of required resourcesWhat is the certainty of the evidence of resource requirements (costs)? |
| Judgement | Research evidence | Additional considerations |
| ○ Very low○ Low○ Moderate○ High● No included studies | No included studies reported on resource use of RRS.  |  |
| Cost effectivenessDoes the cost-effectiveness of the intervention favor the intervention or the comparison? |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison○ Probably favors the comparison○ Does not favor either the intervention or the comparison○ Probably favors the intervention○ Favors the intervention● Varies○ No included studies | A study reported a cost analysis of an RRS on a surgical ward, including costs for implementation, a 1-day training program for nurses, nursing time for extra vital signs observation, medical emergency team (MET) consults and differences in unplanned ICU days before and after RRS implementation. (76) The authors reported a mean RRS costs were €26.87 per patient-day: implementation €0.33 (1%), training €0.90 (3%), nursing time spent on extended observation of vital signs €2.20 (8%), MET consults €0.57 (2%) and increased number of unplanned ICU days after RRS implementation €22.87 (85%). In the scenario analysis mean costs per patient-day were €10.18. The costs for extra unplanned ICU days were relatively high but the remaining RRS costs were relatively low.  | Costs for the number of unplanned ICU days can be reduced if RRS can detect clinical deterioration in time and less severely ill patients are referred to the ICU.  |
| EquityWhat would be the impact on health equity? |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced○ Probably reduced○ Probably no impact○ Probably increased○ Increased○ Varies● Don't know |  | As rapid response systems should be available to all hospitalized patients, it is unlikely to impact on health equity, but that has not been studied yet.  |
| AcceptabilityIs the intervention acceptable to key stakeholders? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no● Probably yes○ Yes○ Varies○ Don't know | High level of staff satisfaction has been reported by qualitative survey. (18) Clear leadership, interprofessional trust and collaboration are crucial for succeeding with a RRS. Clear protocols, feedback, continuous evaluation and interprofessional training were highlighted as facilitators. Reprimanding down the hierarchy, underestimating the importance of call-criteria, alarm fatigue and a lack of integration with other hospital systems were identified as barriers. (77) | Rapid response systems are recommended by the Institute for Healthcare Improvement. National initiatives such as National Safety Goals (2008 Joint Commission National Patient Safety Goal)  |
| FeasibilityIs the intervention feasible to implement? |
| Judgement | Research evidence | Additional considerations |
| ○ No○ Probably no● Probably yes○ Yes○ Varies○ Don't know |  | Rapid response systems are recommended by the Institute for Healthcare Improvement. The National Health Service in UK has adopted National Early Warning Scores 2 (NEWS2) widely as a system to recognize deteriorating patients (NHS England 2018). Many versions of rapid response systems exist in healthcare organizations around the world. It is unknown whether the provision of RRS service is universal across all patient types or during all hours of the day.  |

# Summary of judgements

|  | **Judgement** |
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| **Problem** | No | Probably no | Probably yes | **Yes** |  | Varies | Don't know |
| **Desirable Effects** | Trivial | Small | Moderate | **Large** |  | Varies | Don't know |
| **Undesirable Effects** | Trivial | **Small** | Moderate | Large |  | Varies | Don't know |
| **Certainty of evidence** | Very low | **Low** | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | Possibly important uncertainty or variability | **Probably no important uncertainty or variability** | No important uncertainty or variability |  |  |  |
| **Balance of effects** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | **Probably favors the intervention** | Favors the intervention | Varies | Don't know |
| **Resources required** | Large costs | Moderate costs | Negligible costs and savings | Moderate savings | Large savings | **Varies** | Don't know |
| **Certainty of evidence of required resources** | Very low | Low | Moderate | High |  |  | **No included studies** |
| **Cost effectiveness** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | **Varies** | No included studies |
| **Equity** | Reduced | Probably reduced | Probably no impact | Probably increased | Increased | Varies | **Don't know** |
| **Acceptability** | No | Probably no | **Probably yes** | Yes |  | Varies | Don't know |
| **Feasibility** | No | Probably no | **Probably yes** | Yes |  | Varies | Don't know |

# Type of recommendation

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| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | **Conditional recommendation for the intervention** | Strong recommendation for the intervention |
| ○  | ○  | ○  | **●**  | ○  |

# Conclusions

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| Recommendation |
| We suggest that hospitals consider the introduction of rapid response system (rapid response team/medical emergency team) to reduce the incidence of IHCA (weak recommendation, low-quality evidence).  |
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| Justification |
| * The task force emphasizes the importance of outcomes such as preventing in-hospital cardiac arrests and enhancing survival rates to hospital discharge, despite the considerable costs associated with these systems. Numerous healthcare institutions globally have effectively adopted rapid response systems. (78)
* The Institute for Healthcare Improvement (IHI) (http://www.ihi.org/Topics/RapidResponseTeams/Pages/default.aspx) and various national patient safety programs advocate for the use of rapid response systems to impove patient safety.
* Up to 33% of rapid response team activations involve patients nearing the end of life. Rapid response systems may also play a significant role in end-of-life care management and in mitigating medical errors. (67, 68)
* Implementing an effective rapid response system requires thoughtful integration of key components. Strong afferent (detection and activation) and efferent limbs (response by the RRS/MET team) should be supported by robust administrative and quality improvement measures.
* Adequate investment in resources is crucial, which includes:

(a) comprehensive staff training on recognizing signs of patient decline; (b) consistent and appropriate monitoring of vital signs; (c) clear protocols such as alert systems or early warning scores to facilitate early detection; (d) a standardized, tiered clinical response structure; and (e) a systematic approach to responding to assistance calls. However, the best practices for patient monitoring and how to implement these components are still unclear. * Monitoring the performance of rapid response systems is essential, and data should be utilized as part of a continuous quality improvement strategy. Healthcare organizations should follow the “Recommended Guidelines for Monitoring, Reporting, and Conducting Research on Medical Emergency Team, Outreach, and Rapid Response Systems: An Utstein-Style Scientific Statement” to gather meaningful data and enhance system effectiveness and clinical outcomes.
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| Subgroup considerations |
| Not done |

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| Implementation considerations |
| · Careful consideration need to be given to the elements of such system. Effective afferent and efferent limbs may need the support of administrative and quality improvement limbs. (79)· Adequate resources should be dedicated to such systems to include (a) staff education about the signs of patient deterioration; (b) appropriate and regular vital signs monitoring of patients; (c) clear guidance (eg, alert systems or early warning scores) to assist staff in the early detection of patient deterioration; (d) a clear, uniform system of tiered clinical response; and (e) a clinical response to calls for assistance. The optimal method of patient monitoring and delivery of these components remains unclear. (70, 79) |

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| Monitoring and evaluation |
| · The performance of rapid response systems should be monitored and used as part of quality improvement program of healthcare organizations. The “Recommended Guidelines for Monitoring, Reporting, and Conducting Research on Medical Emergency Team, Outreach, and Rapid Response Systems: An Utstein-Style Scientific Statement” should be used by hospitals to collect the most meaningful data to optimize system interventions and improve clinical outcomes. (80) |

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| Research priorities |
| * *There is limited evidence regarding long-term survival with positive neurological outcomes with the application of RRT/MET.*
* *The role of technology in enhancing rapid response systems (e.g. use of remote monitoring, wearable devices) is unclear*
* *The essential components of the “afferent limb” in a rapid response system needs to be determined (e.g. which vital signs, clinical observations, laboratory parameters should be monitored, and what is the optimal frequency for these assessments).*
* *Which is an effective education program to improve the recognition of patient deterioration.*
* *The most effective mechanism for escalating assistance, and how do conventional escalation methods compare to automated electronic escalation work needs further investigation.*
* *The ideal composition of the “efferent limb,” or the response team needs to be defined.*
* *The primary reasons behind ‘failure to rescue’ scenarios or the underuse of rapid response systems needs to be clarified.*
* *The cost-effectiveness of rapid response systems in practice is unclear.*
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