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Review

Succeeding with rapid response systems – a never-ending process: A systematic review of how health-care professionals perceive facilitators and barriers within the limbs of the RRS

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Abstract

Background: Meta-analyses show that hospital rapid response systems (RRS) are associated with reduced rates of cardiorespiratory arrest and mortality. However, many RRS fail to provide appropriate outcomes. Thus an improved understanding of how to succeed with a RRS is crucial. By understanding the barriers and facilitators within the limbs of a RRS, these can be addressed.

Objective: To explore the barriers and facilitators within the limbs of a RRS as described by health-care professionals working within the system.

Methods: The electronic databases searched were: EMBASE, MEDLINE, CINAHL, Epistemonikos, Cochrane, PsychInfo and Web of Science. Search terms were related to RRS and their facilitators and barriers. Studies were appraised guided by the CASP tool. Twenty-one qualitative studies were identified and subjected to content analysis.

Results: Clear leadership, interprofessional trust and collaboration seems to be 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.

Conclusion: To succeed with a RRS, the keys seem to lie in the administrative and quality improvement limbs. Clear leadership and continuous quality improvement provide the foundation for the continuing collaboration to manage deteriorating patients. Succeeding with a RRS is a never-ending process.

Keywords: Rapid response systems, RRS, RRS barriers, RRS facilitators, Healthcare professional perceptions, Deteriorating patients, RRS collaboration, RRS simulation, Succeding with RRS, Continous quality improvement

Introduction

The implementation of rapid response systems (RRS) to improve patient safety is strongly supported by quality improvement organizations such as the Institute of Healthcare Improvement,[1] and is recommended in international guidelines.[2−4] A successful RRS may be defined as a hospital-wide system that ensures observations, detection of deterioration, and tailored response to ward patients.[5,6] Time is essential, as delayed management has been associated with increase mortality.[7,8]

Two previous systematic reviews[5,9] have found moderate-strength evidence that implementation of RRS is associated with reduced rates of cardiac arrest and mortality. However, because many RRS fail to provide appropriate outcomes, there is debate about their effectiveness, and how to evaluate them.[10−13] Studies focusing primarily on outcomes often have limited assessment of the context, processes or mechanisms leading to those outcomes, and thus provide limited explanations of why RRS work or do not work in clinical practice.[14]

There is general consensus about what constitutes an RRS (Fig. 1), but great variation in how RRS components are constituted and operate.[9]

This highlights the need to identify the factors that contribute to their effectiveness in different operational contexts. If the RRS is not used as intended, expecting results is futile. Even if a hospital has officially implemented an RRS, compliance with the system may be low.[13,15] Cultural barriers may persist,[5] and understanding these is highlighted as essential.[16]

To improve our current understanding of the factors affecting the RRS we performed a systematic review based on the following question: "How do healthcare professionals perceive potential facilitators and barriers within the limbs of a RRS?"

Methods

The present systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[18] A broad search strategy was used to ensure inclusion of all relevant papers.

Search protocol and eligibility criteria

In October 2017 we systematically searched EMBASE, MEDLINE, CINAHL, Epistemonikos, Cochrane, PsychInfo, and Web of Science, for the period 2000−2017 and updated the search on March 20, 2019. The search terms used were: "rapid response team", "medical emergency team", "critical care outreach team", "evaluate", "implement", "utilize", "adopt", "success", "fail", and "barrier" (Appendix 1). An expert librarian assisted with this search.

Inclusion criteria

- Papers published from January 1, 2010−March 20, 2019.
- Original research
- Peer reviewed

Rapid Response System (RRS)

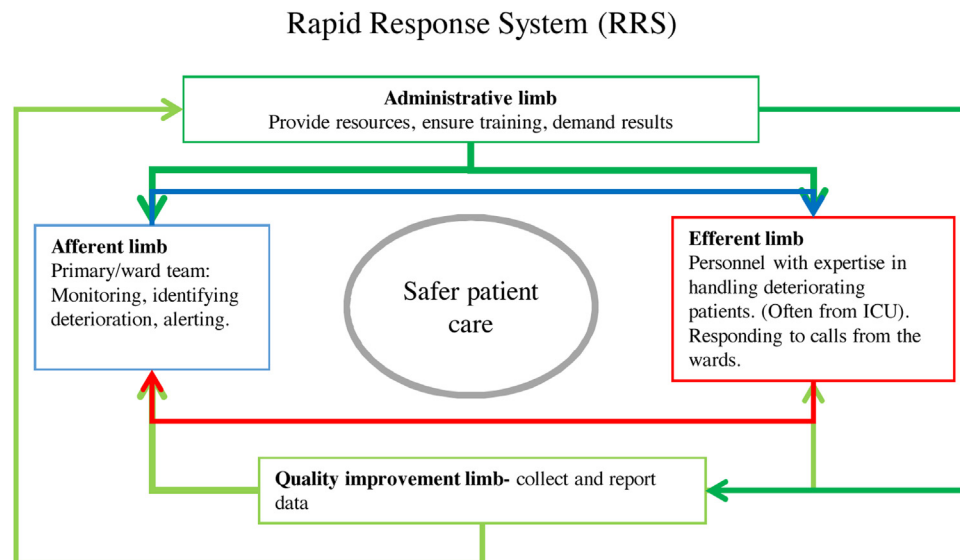Fig. 1 – The structure of a Rapid response system (RRS), adapted from the findings of the first Consensus Conference of Medical Emergency Teams.[17]
The four limbs of the RRS[6]:
The afferent limb: the systematic process of monitoring patients and detect deterioration supported by predefined criteria.
The efferent limb: the response team with expertice in handling deteriorating patients. The team configuration most commonly used: Medical Emergency Teams (MET), often led by a physician from the ICU, Rapid Response Teams (RRT), in Australia used synonymous with MET, but in US often led by nurses. Critical Care Outreach Teams (CCO) most commonly used in UK, often staffed by ICU nurses.
The administrative limb: oversees the system. Ensure personnel and equipment resources, training and education.
The quality improvement limb: collect and report data, provide feedback and thereby improve the system.

- All study designs
- Languages: English, Norwegian, Swedish and Danish.
- RRS with at least an afferent and an efferent limb.

Exclusion criteria

- In consensus it was decided to exclude articles published before 2010, to focus on the newest publications.
- Articles on paediatric RRS and subgroups (example: pulmonary embolism RRT's, obstetric RRT's).

Study selection

We performed an initial screen of publications (3024) to remove duplicates, then read all titles and abstracts; full-text articles were retrieved if they appeared to meet the inclusion criteria and addressed the predefined review question. The full-text was also retrieved if the

title and abstract gave insufficient information to allow immediate exclusion. Four papers used multiple designs, and only the qualitative component addressing the review question was included[19–22] (Fig. 2).

Data extraction

The data extraction process involved familiarization with and comparison of the included studies. The papers that addressed our research question used a qualitative approach, so we performed a qualitative content analysis[23] (Table 3). The findings were organized according to the four limbs of the RRS model (Fig. 1)

Quality and risk of bias

Study quality and risk of bias were evaluated using the Critical Appraisal Skills Programme (CASP) tool[24] (Table 1). Two papers were excluded because of low quality.
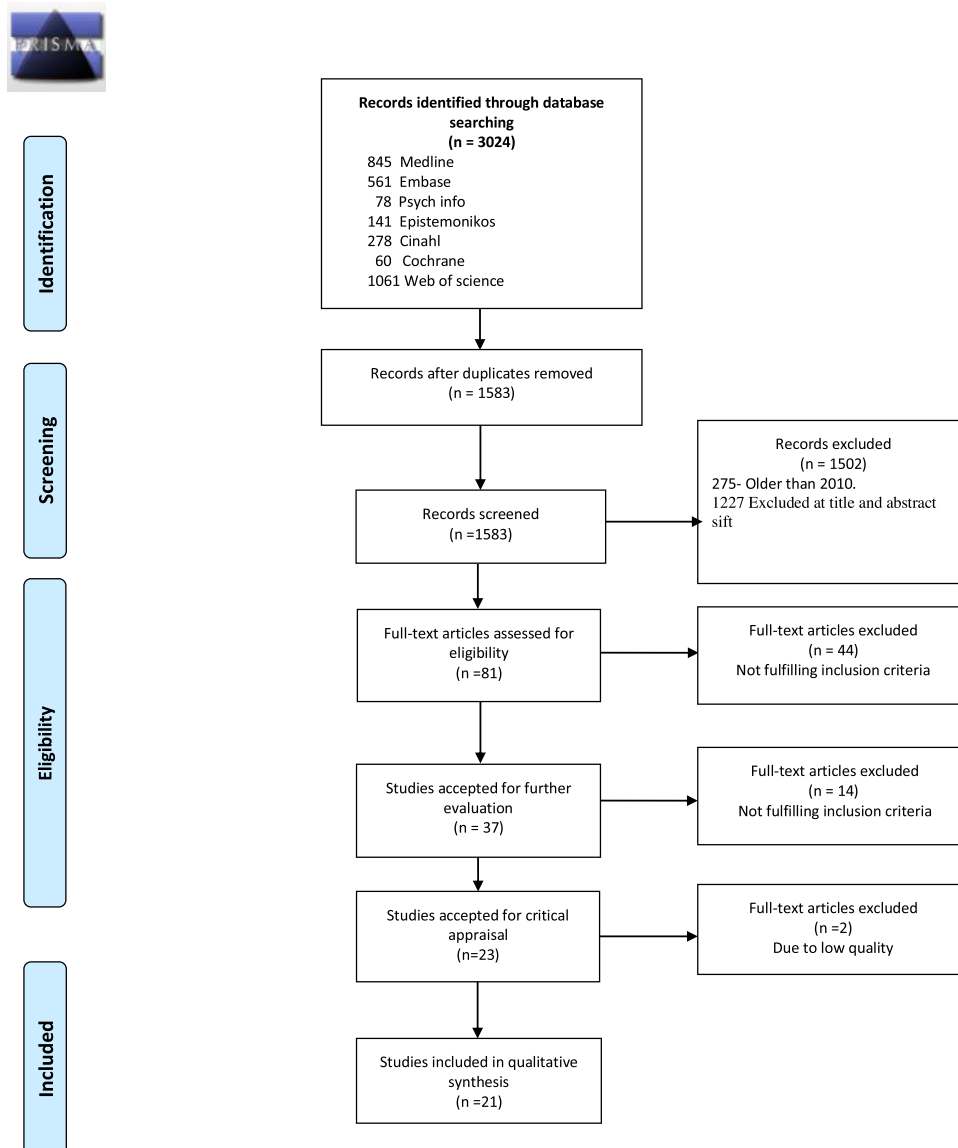

Fig. 2 – PRISMA flow chart.

Table 1 – Critical appraisal: critical appraisal skills programe (CASP) tool.

Journal	Author, year	Valitidy - is it worth continuing?						What are the results?			Will the results help locally?	Comments
		CASP 1: Clear aim statement	CASP 2: Qualitative methodology appropriate	CASP 3 Appropriate research design to adress aims?	CASP 4: Appropriate recruitement strategy	CASP 5: Data collection to address research question	CASP 6: Consideratation of releationship between researcher and participants	CASP 7: Ethical considerations	CASP 8: Rigorous data analysis	CASP 9: Clear statement of findings	CASP 10: How valuable is the research	
Journal of clinical nursing	Astroth et al., 2012	YES	YES	Yes	YES	Yes	NO	YES	Yes	YES	Valuable findings: addressing review question.	Cannot use the qualitative part on its own. It supplements the survey. Excluded
Americal Journal of Critical Care	Bagshaw et al., 2010	YES	Used as part of survey	Yes	Yes	Yes	NO	NO	NO	NO	Valuable findings: addressing review question.	
BMJ Quality and Safety	Benin et al.	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addresing review question.	
The Americal Journal of Nursing	Braathen, J., 2015	YES	YES	YES	YES	YES	NO	Yes	Yes	YES	Valuable findings: addressing review question.	
Australian critical care	Curry et al., 2017	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
Journal of nursing care quality	Douglas et al., 2016	YES	Yes	Yes	YES	YES	Not relevant	YES	No	No	Valuable findings: addressing review question.	
BMJ Quality and Safety	Elliot et al., 2014	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
International Nursing Review	Jeddian et al. 2017	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
Journal of Interprofessional Care	Kitto et al., 2015	YES	YES	YES	YES	YES	NO	Yes	No	Yes	Valuable findings: addressing review question.	
Americal Journal of Critical Care	Leach LS, and Mayo AM. 2013	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
Social Science and Medicine	Mackintosh et al., 2014	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
BMJ Quality and Safety	Mackintosh et al. 2012	YES	YES	YES	YES	YES	No	YES	YES	YES	Valuable findings: addressing review question.	

Table 1 *(continued)*

Journal	Author, year	Valitidy - is it worth continuing?						What are the results?			Will the results help locally?	
		CASP 1: Clear aim statement	CASP 2: Qualitative methodology appropriate	CASP 3 Appropriate research design to adress aims?	CASP 4: Appropriate recruitement strategy	CASP 5: Data collection to address research question	CASP 6: Consideratation of releationship between researcher and participants	CASP 7: Ethical considerations	CASP 8: Rigorous data analysis	CASP 9: Clear statement of findings	CASP 10: How valuable is the research	Comments
Australian Critical Care	Massey et al., 2014.	YES	YES	YES	YES	YES	YES	YES	YES	YES	Valuable findings: addressing review question.	
Journal of Advanced Nursing	McDonnell et al. 2012	YES	YES	YES	YES	YES	NO	YES	Yes	YES	Valuable findings: addressing review question.	
Journal of Advanced Nursing	McGaghey et al., 2017	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
International Journal of Health Policy and Management	Rihari-Thomas et al., 2017	YES	YES	YES	YES	YES	YES	YES	YES	YES	Valuable findings: addressing review question.	
Advanced Journal of Nursing	Shapiro et al., 2010	YES	YES	YES	YES	YES	NO	NO	YES	YES	Valuable findings: addressing review question.	
BMJ quality and safety	Shearer et al., 2012	YES	YES	YES	YES	NO	NO	Yes	NO	NO	Valuable findings: addressing review question.	The quality as a qualitative paper is not suffi-cient. Excluded.
Journal of Clinical Nursing	Smith D, Aitken LM, 2015	YES	YES	YES	YES	YES	NO	YES	Yes	Yes	Valuable findings: addressing review question.	
Intensive and Critical Care Nursing	Stafseth et al., 2016	YES	YES	YES	YES	YES	NO	YES	YES	YES	Valuable findings: addressing review question.	
Journal of Nursing Care quality	Stewart et al., 2014	YES	YES	YES	YES	YES	Yes	NO	YES	YES	Valuable findings: addressing review question.	
Australian Critical care	Chua et al., 2019	YES	YES	YES	YES	YES	YES	YES	YES	YES	Valuable findings: addressing review question.	
BMC Emergency medicine	Petersen et al., 2017	YES	YES	YES	YES	YES	YES	YES	YES	YES	Valuable findings: addressing review question.	

Results

We included 21 qualitative papers in the final review (Table 2). Different terms used to describe the efferent limb were standardised in this review as RRT.

Categories and themes that emerged in the analysis are presented in Table 3. Findings connected to the efferent limb were intertwined with the afferent limb, thus presented under the headline 'The connection of the Afferent and Efferent limb'. Key findings are presented in Table 4.

Administrative and quality improvement limbs

The barrier of disconnected leadership and vague lines of responsibility

The influence of leadership and vision

Organizational leadership support[14,25,26] and having a mission-driven organization[25] were described as essential: *"People who work in this hospital are really aware of our mission and they are committed to care for our patients and to our purpose".*[25] Conversely, poor governance associated with a lack of protocols or equipment, poor logistics and lack of commitment by senior staff and management were viewed as barriers.[27]

Unclear protocols with lack of integration in handover processes

Confusion around when to call the RRT and their optimal response[26–33] was a frequently reported barrier. By contrast, clear call-criteria, including the expectation that when in doubt, a call should be made, was described as a facilitator.[29] Normalization of breaches of RRS-protocol during busy periods were percieved to undermine the system.[34,35]

Cooperation and patient flow were facilitated by incorporating RRT events into the handover processes and daily use of early warning scores (EWS) in unit rounds.[22,28]

Inconsistent education

Low priority of education regarding the RRS and management of deteriorating patients[14,25,30] was a barrier while training was a facilitator,[25,27,36] with an emphasis on joint training sessions between ward staff and the RRT[35] and the use of simulation-based training.[25] Training in the use of EWS as early as in university was described as a facilitator.[36] Physicians worrying the system could deskill junior physicians was a barrier,[33,37] while viewing RRT calls as learning opportunities was a facilitator.[37,38]

Lack of equipment, personnel and integration with other hospital systems

HCP described that the RRS increased workload,[14,28,35,37,38] and staff shortages were seen as a barrier.[21,27–29,31,38] An example was too few RRT respondents: *"There is one [Registrar] in the whole hospital and there could be six [rapid response] calls at once, and how can they possibly get to six?".*[29] Nurses described applying an informal triage when wards were busy, allowing them to focus on sicker patients and reduce monitoring of other patients.[35] Not wanting to disturb a busy ICU-nurse or physician,[28,29] or knowing the ICU was

Table 2 – Included papers.

Author/ Journal	Year	Title	Aim/purpose	No of participants	Location/ hospital size	Study design	RRS model
Astroth et al./ Journal of Clinical Nursing	2013	Qualitative exploration of nurses decisions to activate rapid response teams	To identify barriers and facilitators to nurses' decisions regarding activation of rapid response teams (RRTs) in hospitals.	15 medical/surgical nurses	Three medial/surgical units at a Midwestern community hospital.155-beds.	Qualitative design; semi-structured individual interviews.	Monitoring: Calling criteria, not further described. Response: RRT (Rapid Response Team), includes ICU nurses.
Benin et al./ BMJ Quality and Safety	2012	Defining impact of a rapid response team: qualitative study with nurses, physicians and hospital administrators	To qualitatively describe the experiences of and attitudes held by nurses, physicians, administrators and staff regarding RRTs.	49 participants: 18 registered nurses, 8 administrators, 6 primary team senior attending physicians, 6 house staff members, 4 RRT attending physician, 4 RRT critical care (SWAT) nurses, 3 RRT respiratory technicians.	Yale-New Haven Hospital- academic hospital in Connecticut. 944 beds.	Qualitative design; semi- structured interviews.	Monitoring: Trigger criteria, expecting the nurse to call RRT and primary team when patient is triggering. The decisions could be made jointly. Response: Adult RRT from 2005, covering 43 units. RRT composed of hospitalist physician, a critical care "SWAT" nurse, and a respiratory therapist.
Braaten J./The American Journal of Nursing	2015	Hospital system barriers to rapid response team activation: a cognitive work analysis	To use cognitive work analysis to describe factors within a hospital system that shape medical- surgical nurses' RRT activation behaviour.	12 participants: medical/surgical nurses.	Medical-surgical units in acute care hospital, Colorado. 500 beds, non- for -profit, non- teaching hospital.	Qualitative design: 1) Document review, (RRT policy and protocols) 2) Individual interviews	Established 2005: Monitoring: Calling criteria Response: RRT, with standardized policy. Not further described.

Table 2 *(continued)*

Author/ Journal	Year	Title	Aim/purpose	No of participants	Location/ hospital size	Study design	RRS model
Chua et al./ Australian Intensive Care	2019	A call for better doctor- nurse collaboration: A qualitative study of the experiences of junior doctors and nurses in escalation care for deteriorating ward patients	To explore the experiences of junior doctors and nurses in escalating care for clinically deteriorating ward patients in an acute hospital with a MET service and to understand the barriers surrounding the escalation of care.	24 participants: 14 nurses and 10 junior doctors.	1000 bed acute tertiary care public hospital in Singapore.	Qualitative design: Semi-structured individual interviews.	From 2009: Monitoring: Single parameter MET (Medical Emergency Team) criteria. Including the "worried" criteria. Response: ICU based MET systems. Led by ICU physician (ICU advanced trainee or registrar in respiratory and critical care medicine or internal medicine) supported by ICU nurse and a respiratory therapist. Available accredited intensivist for immediate consultation. Patients with abnormal vital signs but not reaching the MET criteria: Nurses can initiate an ad hoc review by primary team doctors.
Currey et al./ Australian Critical Care	2017	Critical care clinician perceptions of factors leading to Medical Emergency Team review	To explore perceptions of intensive care unit (ICU) staff who attend deteriorating acute care ward patients regarding current problems, barriers and potential solutions to recognising and responding to clinical deterioration that culminates in a Medical Emergency Team review.	207 respondents in 31 group surveys. 49% ICU nurses, 27,8% ICU educators or liaison nurses, 2,1% ICU medical registrars, 11,9%consultans,7,7% nurse managers.	Participants attended the Australia and New Zealand Intensive Care Society Rapid Response Team conference in Melbourne 2014.	Descriptive exploratory design: Group survey, open ended questions with written responses, qualitatively analysed.	Do not describe the different RRS the participants work within. Refers to the consensus of a RRS with four limbs. "These components reflect the Australian Commission for Quality and Safety in Healthcare (ACSQHC) national standard for recognising and responding to clinical deterioration in acute healthcare".
Douglas et al./ Journal of Nursing Care Quality *Qualitative part of study*	2016	Nursing and Medical Perceptions of a Hospital Rapid Response System -New Process But Same Old Game?	To explore and compare nursing and medical staff perceptions of MERT use at a large tertiary hospital with a mature RRS.	129 participants had open ended text contributions-87 registred nurses and 87 medical staff.	929 bed hospital, teaching hospital, Queensland Australia	Qualitative design: Open ended questions in survey is qualitatively analysed.	Monitoring: A standardized observation and response chart. Single-parameter system, with 2 graded response-categories, yellow: clinical review, orange: MERT review. Response: MERT (medical emergency response team): Critical care expertise. Works alongside a code blue team.
Elliot et al./BMJ Quality and Safety	2014	Clinical user experiences of observation and response charts: focus group findings of using a new format chart	To report initial clinical user experiences and views following implementation of track and trigger charts in	44 focus groups with 218 clinical ward staff. (mostly nurses) Who had received training	8 trial sites, acute healthcare facilities in Australia.	Qualitative design; focus-group interviews.	Monitoring: A standardized observation and response chart. Single- parameter system, with 2 graded response-categories,

Table 2 (continued)

Author/ Journal	Year	Title	Aim/purpose	No of participants	Location/ hospital size	Study design	RRS model
		incorporating a track and trigger system	adult general medical- surgical wards	and used charts for 2-6 weeks.			yellow: clinical review, orange: MERT review. Response: MERT: Critical care expertise. Works alongside a code blue team.
Jeddian et al./ International Council of Nurses	2017	Implementation of a critical care outreach service: a qualitative study	To explore hospital staff perceptions of the perceived challenges and outcomes of the implementation of a critical care outreach service	24 persons: Focus groups of 21 participants.(2 homogenous groups one with CCOT one with ward nurses) and 7 individual interviews. Participants: 6 CCOT members, 11 ward head nurses, 5 ward nurses, 2 physicians.	Tertiary teaching hospital, Iran- Teheran. 800 beds. 5 critical units: 54 beds.	Qualitative design; focus-group interviews.	Monitoring: Criteria Patient categorized as being high, moderate and low risk by a outreach nurse. Response: CCOT (critical care outreach team): A supplementary service to 13 med- surg wards. Consisting of 6 nurses from ICU- 24 hour service. Responsibility remained with the admitting physician.
Kitto et al./ Journal of Interprofessional Care	2014	Rapid response systems and collective (in)competence: An exploratory analysis of intraprofessional and interprofessional activation factors	To explore the reasons why staff members do not activate the RRS.	10 focus groups across 4 hospital settings. Total: 27 doctors, 67 nurses.	Monash Australian hospital system. In four hospitals. Total of 2100 beds. 2 suburban hospitals, 1 elective centre, and 1 large teaching hospital	Qualitative design; focus-group interviews.	Monitoring: RRS Calling criteria, not further described. Response: RRS No specific description.
Leach, Mayo/ American Journal of Critical Care	2013	Rapid response teams: Qualitative analysis of their effectiveness.	To describe effectiveness of rapid response teams in a large teaching hospital in California. Investigating RRT performance in the context of organisational social processes.	17 participants: hospital leaders, RRT members, bedside nurses, physician leaders.	Large public tertiary care teaching hospital, California	Qualitative design; Semi-structured individual interviews.	Monitoring: Calling criteria not described Response: RRT- nurse-led, including bedside nurse, respiratory therapist, primary physician intern and resident. RRT-Nurses were exclusively hired for RRT, no other assignment that day. Responds to RRT calls, go rounds to identify RRT patients, involved also in cardiopulm arrests.
Mackintosh, Humphrey, Sandall/Social Science Medicine	2014	The habitus of 'rescue' and its significance for implementation of rapid response systems in acute health care	To explore the social and institutional processes associated with the practice of rescue, and its implications for the implementation and effectiveness of Rapid Response Systems (RRSs) within acute healthcare.	35 participants. doctors, ward nurses and critical care nurses, healthcare assistants, safety leads and managers.	Two hospitals NHS, UK. Called Eastward and Westward.	Qualitative design: Inidividual interviews.	Eastward: Monitoring: EWS (Early Warning Score), two wards piloting an IAT (intelligent assessment technology) and PDA (personal digital assistants) Response: Patients medical team, and on-call team. Westward: Monitoring: EWS, escalation

Table 2 *(continued)*

Author/ Journal	Year	Title	Aim/purpose	No of participants	Location/ hospital size	Study design	RRS model
							protocol Response: CCOT from 2001 with critical care nurse and physiotherapist. Operating on daytime, referring to a MET with intensive care physician if concerned.
Mackintosh, Rainay, Sandall/BMJ Quality and Safety	2012	Understanding how rapid response systems may improve safety for the acutely ill patient: learning from the frontline	To explore the RRS used in the management of escalation on two large hospitals, understanding what works in what circumstances - and why.	35 participants. Interviews of doctors, ward and critical care nurses, healthcare assistants, safety leads and managers.	Two hospitals NHS, UK. Called: Eastward and Westward.	Comparative case study. Qualitative method with observations, interviews and data analysis. Focus in this review: The semi-structured individual interviews.	Eastward: Monitoring: EWS, two wards piloting an IAT (intelligent assessment technology) and PDA (personal digital assistants) Response: Patients medical team, and on-call team. Westward: Monitoring: EWS, escalation protocol Response: CCOT from 2001 with critical care nurse and physiotherapist. Operating on daytime, referring to a MET with intensive care physician if concerned.
Massey et al./ Australian Critical Care	2014	Nurses' perceptions of accessing a Medical Emergency team: A qualitative study	To explore nurses' experiences and perceptions of using and activating a MET, in order to understand the facilitators and barriers to nurse's use of the MET.	15 ward nurses	Public teaching hospital in Australia, Queensland.	Interpretive qualitative approach, in depth semi-structured interviews.	Monitoring: Single parameter calling criteria. Response: MET A separate cardiac arrest team.
McDonnel et al./Journal of Advanced Nursing	2012	A before and after study assessing the impact of a new model for recognizing and responding to early signs of deterioration in an acute hospital	To evaluate the impact of a new model for the detection and management of deteriorating patients on knowledge and confidence of nursing staff in an acute hospital.	15 nurses.	District hospital in England (550 beds) - on 12 wards: all in-patient areas: medicine, surgery, orthopaedics, gynaecology, stroke services.	A part of a mixed-method study: Qualitative design: Semi-structures interviews	Monitoring: Two-tier track and trigger system- all patients monitored using two charts- the normal chart- and if triggering-the PAR chart (Patient at Risk chart). Response: CCOT not further described.
McGeughey et al./Journal of Advanced Nursing	2017	Early warning systems and rapid response to deteriorating patient in hospital: A realist evaluation	To test the Rapid Response program theory against actual practice components of the RRS implemented to identify those mechanisms which have an impact on the successful achievement of	28 participants in individual interview (senior managers, managers, junior doctors, EWS and ALERT champions. 34 participants in focus group interviews (staff nurses, student nurses and	Northern Ireland. 2 hospitals, 2 wards in each: 4 sites- one high-risk (med) one low risk (surg) in each hospital.	Qualitative design; semi-structured individual interviews and focus-group interviews. (Part of a realist evaluation, also reviewing the litterature regarding RRS, and a document analysis)	Monitoring: EWS Response protocols and ALERT training-Response: Ward physicians/on call physicians.

Table 2 *(continued)*

Author/ Journal	Year	Title	Aim/purpose	No of participants	Location/ hospital size	Study design	RRS model
			desired outcomes in practice	healthcare assistants			
Petersen et al./ BMC Emergency Medicine	2017	Barriers and facilitating factors related to use of early warning score among acute care nurses: a qualitative study	To identify barriers and facilitating factors related to the use of the EWS escalation protocol among nurses.	18 nurses: 7 surgical and 11 medical.	Urban hospital in the capital region of Copenhagen, Denmark. 700 bed	Qualitative design; focus-group interviews.	Monitoring: EWS implemented since 2012. Response: From 2007: MET constituted of a senior registrar or staff specialist in anaesthesia and a specially trained ICU nurse. All staff allowed to call MET regardless of EWS.
Rihari-Thomas et al./ International Journal of Health Policy and Management	2017	Clinician Perspectives of Barriers to Effective Implementation of a Rapid Response System in an Academic Health Centre: A Focus Group Study	Aimed to explore and understand how doctors and nurses experience this system, and how and negotiate care for deteriorating patients within the RRS environment: Objectives 1) ascertain factors that affects implementation and ongoing effect of the RRS, and ascertain clinicians perception of its efficacy and utility when the initial tier of medical response is led by the patients admitting team.	34 participants: 21 physicians and 13 registered nurses	Australia, academic health centre.	Qualitative design; focus-group interviews.	RRS in place for 5 years. Monitoring: A multi-tiered vital sign parameter track and trigger system. Response: Tier 1 clinical review. (The Unit RNs- performing a thorough exam) Tier 2: RRT: in this case: The admitting medical team, and out of hours- the dedicated facility physicians. Tier 3 activate MET from ICU. *Tier parameter criteria can be modified to create individual patient customisation.
Shapiro et al./ American Journal of Nursing	2010	Rapid Response Teams Seen through the Eyes of the Nurse - How nurses who activate such teams feel about the experience and why it matters	Aim to report the impact of rapid response teams as seen through the eyes of the nurse.	56 staff nurses	from 18 hospitals in 13 states: USA. teaching and non-teaching, different settings(wards)	Qualitative design, focus groups	Monitoring: Objective criteria, and worried. Response: 18 hospitals with RRT- great variations in response teams. *9 hospitals- viewed here as "early robust adopters" (Hospitals where nurses were enthusiastic about RRS) *9 hospitals" reluctant adopters (nurses not enthusiastic about RRS)".
Smith DJ, Aitken LM/ Journal of Clinical Nursing. *Qualitative part of study*.	2015	Use of a single parameter track and trigger chart and the perceived barriers and facilitators to escalation of a deteriorating ward patient: a mixed methods study.	To explore the barriers and facilitators percieved by the nursing staff relating to patient monitoring.	31 participants: 11 registred nurses, 7 pre registration nurses, 13 healthcare assistants. (from 4 wards)	Tertiary referral hospital within central London.	Qualitative design, Questionnaire with open ended questions: qualitatively analysed (As part of a mixed method study: Also includes a chart audit, results guiding the questionaire)	Monitoring: Single parameter track and trigger. Three vitals signs that could trigger response. Response: CCOT (Critical Care Outreach Team)
Stafseth et al./ Intensive and	2016	The experiences of nurses	To explore experiences of nurses	7 nurses.		Qualitative design; semi-structured	Monitoring: MEWS (Modified Early

Table 2 (continued)

Author/Journal	Year	Title	Aim/purpose	No of participants	Location/hospital size	Study design	RRS model
Critical Care Nursing		implementing the Modified early Warning Score and a 24-hour on-call Mobile Intensive Care Nurse: An exploratory study	implementing and using the MEWS and a mobile intensive care nurse (24/7- nursing support)		Oslo University Hospital, Riksho-spitalet, Norway.	focus group interviews.	Warning Score), Response: MICN (Mobile Intensive Care Nurse)-Using MEWS was voluntarily.
Stewart et al./Journal of Nursing Care Quality *Qualitative part of study*	2014	Evaluation of the Effect of the Modified Early Warning System on the Nurse-Led Activation of the Rapid Response System	To evaluate the use of MEWS as a framework in the decision-making-process for RRS activation by nursing.	11 nurses from 3 medical-surgical units.	Acute care hospital in Pennsylvania, 242 beds	Qualitative design; focus group interviews. (As part of a mixed methods study, also performed medical record review)	Monitoring: MEWS (Modified Early Warning Score) introduced in 2011. Response: Have an response team- not further described.

Table 3 – Categories and themes.

	Administrative and Quality improvement limbs				
Themes	The barrier of disconnected leadership and vague lines of responsibility				
Categories	*The influence of leadership and vision*	*Unclear protocols with lack of integration in handover processes*	*Inconsistent education*	*Lack of equipment, personnel and integration with other hospital systems*	*The value of involvement and continuous follow-up*

	Afferent limb						The connection of the Afferent and Efferent limb	
Themes	The barrier of underestimating complexity						The barriers lies in lack of trust and respectful behavior	
Categories	*The missing link between measuring and interpreting*	*Challenges in the use of observation and documentation systems*	*The value of knowing the patient*	*The complex inter-professional "knotworking" processes*	*The severity of clinical change*	*RRS protocol vs. reality*	*Lack of inter-professional trust and challenges of collaboration*	*Not knowing the patient*

full could prevent nurses from activating the RRT.[30] HCP describe lacking a system to determine how and when additional resources could be provided.[35] Other barriers were not having hospital-wide systems for end-of-life-care decisions and planning,[27,38] pain management and palliative care services.[38]

Missing electronic tracking of vital signs and non-integration of monitoring with other infrastructure was a barrier.[27] As were poorly designed documentation-charts, the simultaneous use of multiple charts[27,32] and different scoring-systems within one hospital.[39] Unreliable, outdated, inefficient and poorly maintained equipment hindered the RRS.[21,27]

The value of involvement and continuous follow-up

The involvement of HCP in continuous quality improvement was described as a facilitator.[25] The availability of training, followed up by local audits and positive written responses were considered important components to succeed with the RRS,[29,34] as was a process for immediately addressing problems, such as the intimidation of nurses.[25] By contrast, conflict was created by audits focusing solely on nursing assignments and not on the behaviour of the responding physician.[34] EWS-audits lost their effect when staff did not receive feedback.[14]

The afferent limb

The barrier of underestimating complexity
The missing link between measuring and interpreting vital signs

Due to high workload, vital-sign measurements were made by the least-qualified; health-care assistants and students,[14,21,34] leading to an interval between the measurements and their interpretation.[21,34] This was considered to increase the distance between nurses and patients[14,21,34] and to reduce vital-sign monitoring to a technical task.[14] Although technology was seen as a solution to facilitate monitoring, the time spent "doing the vitals" was also seen as an important opportunity to observe and interact with patients.[35]

Challenges in the use of observation and documentation systems
HCP perceived track and trigger charts[20] and EWS[22,39] as valuable for increasing awareness about deteriorating patients, assisting physicians in prioritizing care[34,39] and to enhance intraprofessional communication.[22,36] Clearly defined documentation-charts and protocols made staff more confident about seeking help.[20,32,39] Ward staff reported using a combination of the call-criteria and their clinical judgement[14,33,40]: *"It should be an in-hand system, but it shouldn't be the system."*[14] It was a facilitator when nurses could

RRS limb	Facilitators	Barriers
Administrative and quality improvement limbs	Leadership support	Poor governance
	Shared mission	Lack of commitment
	Involvement of healthcare professionals	Unclear protocols
	Continuous quality improvement	Lack of staff
	Interprofessional training	Lack of equipment
		Poorly designed and integrated monitoring- and documentation systems
Afferent	Knowing the patient	High workload
	Clearly defined protocols	Disconnection between vital-sign measurements and interpretation
	Empowered nurses and physicians	The existing hierarchy
		Challenges in use of monitoring- and documentation systems
The connection between the afferent and efferent limb	Expertise	Reprimanding down the hierarchy
	Patient centered teamwork	Waiting for the patient to get worse

Table 4 – Summary table of key findings.

call the RRT based on clinical impression and concern[29] or if they felt the primary physician/on-call physician was not "doing their job", was inexperienced,[40] or unavailable.[29,33,37,40]

The availability of real-time data via technological solutions facilitated the RRS by allowing doctors to access patient's vitals from other sites. However, this technology could be a barrier if access was cumbersome in emergency situations; e.g. having to log on to a computer.[39] Delays of vital-signs entry into the electronic health records could delay the detection of clinical deterioration.[31]

Barriers were described in HCPs use of documentation systems,[22,27,28,32] for example: charts had incomplete dataset and incorrectly calculated EWS,[14,22] deliberately not documenting vitals in the electronic management system when wards were busy, seeing this as only a bureaucratic task[35] and documenting altered call-criteria for patients on loose notes.[28] The introduction of a chart with ranges rather than exact numbers resulted in double documentation or nurses having to estimate numbers when speaking with physicians[32] posing as barrier.

The customization by physicians of call-criteria for individual patients, was viewed as both a facilitator and a barrier.[19,22,28,32] One publication described how this practice had resulted in both inappropriate changes to avoid alarms and reluctance to change criteria resulting in unnecessary activation.[28]

The value of knowing the patient

Continuity of care and knowing the patient were perceived as important for the detection of subtle changes.[20] Nurses valued clinical intuition to monitor patients and take extra vital-signs when concerned, but resented being instructed to do so, without a good reason, by junior physicians.[35] Not having time to "lay eyes on the patient" was perceived as a barrier.[31] HCP worried focusing on EWS might mean overlooking cues such as blood results and overall clinical assessment[22,39] and decline in patient assessment skills.[19,32] HCP reported that in daytime, they preferred to call the primary team rather than the RRT because of their familiarity with the patient's condition.[40]

The complex inter-professional "knotworking" process

HCP believing that the RRT brought expertise and could expedite transfer of patients to higher-level care and improved patient outcomes[30] facilitated the RRS. However, the nature of the

detection/decision-making process differed between nurses (hierarchical and protocol-based) and physicians (autonomous).[19,27,33,34]

The process of deciding whether to activate the RRT, were described by Kitto et al.[33] as "knotworking"; nurses and physicians constantly collaborated vertically (with senior colleagues) and horizontally (between nurse and physician) to identify the appropriate place for the RRT. Physician autonomy could be a barrier to this process,[19,28,32,34] but when nurses could obtain help without seeking permission, the RRS was described as empowering.[29,37]

HCP described that calling the RRT could be a way of realigning the workload to ensure that other patients were not neglected.[29,35,37] Nurses reported that knowing they could get help from colleagues to care for other patients while attending a RRS event, was an important facilitator.[29,30]

The severity of clinical change

The perceived severity of a patients clinical condition influenced the likelihood of a RRT activation, with high EWS[35] or abrupt/serious changes being an acceptable trigger for RRT calls.[31,40] Physicians described the RRT as " . . . *the go-to team to provide urgent diagnosis and periarrest resuscitation* . . . " Being able to call the RRT when concerned was described as an important facilitator,[22,36] but subtle clinical changes often required navigation around system obstacles.[14,31,34,40] Nurses described being afraid the patient was not sick enough to require the call[26,30]; often waiting for "*it to get worse*", searching for support to validate clinical decisions[22,26,30,31] or using closer monitoring to find an objective trigger to justify a call.[14,31] In these situations, HCP highlighted the importance of communication, and the ability to articulate the exact patient problem clearly.[40]

RRS protocol vs. reality

Confusion and lack of clarity around protocols,[27,31,32] which introduced variations in response behaviour,[39] was reported as a barrier. Despite having a track and trigger system, escalation often went through the hierarchy of the system.[21,40]

Perceptions of the call-criteria influenced their usefulness.[14,19,26,28,30−32,35] Perceiving them as too sensitive[35] or non-specific[22,31] created alarm fatigue.[19,28,32] Nurses believing they could handle the situation themselves,[30,31,35] HCP finding EWS and their own clinical judgement conflicting[14,22] and disagreeing with the set parameters[26] were barriers. One publication described how it was

regarded as acceptable for nurses to falsify observations if they felt the patient was okay, to avoid having to explain why they did not react to an abnormal parameter.[32] Omission of monitoring at night because of nurses concern about sleep deprivation was also reported.[35]

The connection of the afferent and efferent limb

The barriers in lack of trust and respectful behaviour
The lack of interprofessional trust and challenges of collaboration

Multiple papers reported that ward physicians or RRT members reprimanded, criticized or had a negative attitude toward a nurse who called the RRT.[19,25–27,29–31,33,35,37,40] Nurses' believed that this behaviour might be caused by ward physicians feeling of failure if the nurse called the RRT directly: «*going over the head of the physician*».[25,29,31,37] This, provoked by physicians fear of being seen as clinically inept[28,40] or being ashamed to ask for help.[35]

Junior physicians described fearing criticism by senior staff for activating the RRT,[27,28,34,40] and had learned they should manage on their own.[34,40] Ward nurses were also concerned about being seen as incompetent by the RRT.[26,29–31] Perceiving RRT-calls as a failure disrupted the collaboration with the RRT.[25]

Ward nurses valued the RRT-nurse, regardless of *"their place in the RRT"*.[29] Having a dedicated full-time RRT-nurse working next to the ward nurses[25] or doing rounds on units,[31] were described as facilitators. Nurses also reported a lower threshold for calling a nurse-led RRT, than a physician-led RRT.[36] One study reported that a nurse-led RRT supported junior medical staff and facilitated communication with more senior staff,[39] but another reported that physicians found nurse-led RRT difficult to accept.[38] RRT-members acting as mentors for ward nurses[30] and providing education for all ward staff[34,37,38] facilitated the RRS.

Nurses were more inclined to reach out to physicians with whom they had a good relationship, and considered to be skilled.[35] RRT-calls were facilitated by supportive, professional and caring RRT-members,[30,35,36] who confirmed the nurses' findings, and gave positive feedback.[29,36] Conversely, differing task priorities between the RRT and the ward nurses were described as barriers.[38]

Familiarity within the RRT and between RRT-members and ward staff was reported to enhance teamwork, especially under time-pressure.[25] However, rotation and varied positions of ward physicians made it difficult for the RRT to establish effective relationships.[38]

Douglas et al.[19] stated that the effectiveness of an RRT was *"depending entirely on the people within the team on that particular day"*. A key factor in the effectiveness of the efferent limb, was reported to be the clinical expertise and crisis management skills. An RRT leader that managed to be *"an information gatherer and willing to have a dialogue"*, facilitated the function of the RRT.[25] By contrast, a lack of clear leadership could result in chaos.[26]

When junior doctors were the first tier of response, they reported feeling out of depth and anxious,[28] and nurses rarely found their contributions helpful.[35] The RRS effectiveness was further compromised if the junior doctors only reluctantly alerted the next tier (more senior specialist).[28]

Not knowing the patient

It was considered a barrier to the efferent limb that the RRT lacked detailed knowledge of the patient's medical history.[28,37,40]

Discussion

In this systematic review, we explored facilitators and barriers within the limbs of the RRS as reported by HCP working within the system.

Major findings

A major barrier to succeed with a RRS seems to be the disconnection of the administrative and quality improvement limbs from the operational afferent and efferent limbs. The operational limbs often seem to be left operating on their own, dealing with inadequate monitoring and documentation systems,[14,21,22,27,28,31,32,39] under-staffing[21,27–29,31,38] inconsistent RRS education[14,25,30] and unclear protocols.[27,31,32]

Our analysis further presents the complexity of operating within and between the operational limbs. HCPs interpretation of and confidence in the call-criteria1[4,19,22,28,30–32] and alarm fatigue[19,28,32] are barriers to be taken seriously. Interestingly, the possibility of customizing the call-criteria for an individual patient was described as both a facilitator and a barrier, perhaps underlining the complexity of this process.[19,22,28,32] Our findings imply that it is important to incorporate clinical judgement as a valid call-criterion for both nurses and doctors.[14,19,22,28]

Lack of inter-professional trust may be one of the core barrier for succeeding with a RRS. HCP rapport being criticized and reprimanded when trying to follow the patient-centered intention of the RRS.[19,25–31,33,34,37] The conflicts between nurses and ward physicians regarding alerting the RRT seem to be enhanced in protocols where RRT is expected to be alerted directly, bypassing the ward physician.[25,29,31,37] Involvement of the ward physician in RRT calls might reduce conflict and facilitate RRT activation. It might also counteract the barrier of physicians fearing that the RRT will interfere with treatment despite being unfamiliar with the patient`s medical history.[28,37,40]

The RRT structure in the reviewed papers varies greatly (Table 4). This review highlights the importance of the members` clinical expertise and ability to work together for the patient[25,28] and a belief in inter-professional training and education to improve collaboration.[25,36]

Comparison with previous studies

Incomplete implementation and sustainability of RRS remains a major issue.[13,41] In this review the barriers for activation of the efferent limb were frequent and in line with the finding described by Chua et al.[42] By using the RRS model (Fig. 1) in the analysing process, we found that root causes for major barriers and facilitators for RRS may lie within the administrative and quality improvement limbs. The importance of leadership, for successful system-wide implementation implies the involvement and align-ment of leaders on all levels.[43,44] Disconnected leadership has been identified be a significant factor in health-care organizations struggling to improve quality.[45] Jones et al.[46] emphasised that an RRS needs to be part of the hospitals overall plan. A variety of approaches is available to assist the process of achieving successful implementation.[47,48] Successful systems engage in quality improvement which require commitment, focus on goals as well as on process, using data measurement and feedback.[2]

Regarding activation of the RRT, alarm fatigue is a known barrier.[41] Douglas et al.[19] found that increased familiarity, agreement, and perceived benefit of activation-criteria increases the frequency of RRT activation. The ongoing development of a validated scoring system such as National Early Warning Score (NEWS),[49] might help to overcome these barriers. The value of involving the primary team in RRT-calls[50,51] has also been demonstrated.

Previous research has highlighted inter-professional simulation-based training as a tool to improve both technical and non-technical skills.[52] Increased use of this approach might enhance the effectiveness of RRT in caring for deteriorating patients and breaking down silos between RRT and ward personnel.

By increasing the confidence and knowledge of nursing staff, training improves their ability to detect and handle clinical deterioration.[53] Wehbe-Janek et al.[54] suggested that a simulation-based training program could overcome system barriers and augment the use of RRT. Theilen et al.[55] demonstrated that regular in-situ simulation training of a paediatric RRT led to sustained improvement.

A RRS is a hospital-wide intervention with many interdependent parts and requires a complex chain of events to occur in a timely progression.

The health-care system is rapidly developing, continuously educating and employing new staff, integrating new technology and providing advanced care for patients with complex conditions. It is important to be aware that "*Any change in a work system element interact and produces changes elsewhere in the work system*".[56] Technological solutions to patient monitoring that alert staff and RRS-personnel of deteriorating patients,[57−60] could facilitate afferent limb, but their integration should be carefully tested in clinical practice.

We believe in increased involvement of HCP in the continuous follow-up on results and the process within and between the limbs of RRS. We suggest focus on inter-professional simulation-based training to improve communication and collaboration.

Areas for future research

To find the keys to succeed with a RRS, research should study the barriers and facilitators within the administrative and quality improvement limbs, as they should have the power and budget to provide a solid foundation for the operational limbs.

Continuously connected and involved administrative and quality-improvement limbs are essential to ensure the effectiveness of the operational limbs.[14,25,26] This work cannot be completed by a set date; it is a never-ending process.

Strengths and limitations

The strengths of this systematic review are its presentation of the perspectives of the HCP operating the RRS. It includes papers from 10 different nations, more than 20 hospital-systems and different professions, levels of experience and RRS structures, thus providing a broad picture of facilitators of and barriers to current RRS. Although there is great variation between health-care systems, we identified several common facilitators and barriers, which increases the transferability of the analysis.

Although the literature search aimed to be broad, the choice of search terms might have failed to identify papers with important additional insights. Because the studies included in the review were interview-based, sampled purposively or by convenience and always voluntary, inclusion bias may be an issue. As evident from the critical

appraisal (Table 2), most researchers do not adequately consider their relationship with the participants. This is a weakness, because the results of interviews are influenced by the moderator. Ethical considerations were handled differently in the studies, reflecting different countries and regions with different rules and regulations.

Conclusion

In this systematic review, we explored facilitators and barriers, as described by HCP, within all limbs of the RRS and their interconnections. The keys to succeed with RRS seem to lie in the administrative and quality improvement limbs. Clear leadership, the availability of consistent education and training, equipment, personnel and clear protocols were essential for the operational limbs. Further, we found that continuous work to mitigate barriers and improve the system was of key importance. We suggest increased use of interprofessional simulation-based training to increase technical and non- technical skills, establish inter-professional trust and build support for the RRS. Hospital environments change continuously with the employment of new staff, integration of new technology, and provision of more advanced care. Thus, to succeed with a RRS is a never-ending process.

Conflict of interests

None.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.resuscitation.2019.08.034.

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