Online-only content for "Critical Appraisal of the Evidence: Part III," by Fineout-Overholt and colleagues in the *American Journal of Nursing*, November 2010, p. 43-51.

Table 1. Final Evaluation Table

First Author (Year)	Conceptual Framework	Design/Method	Sample/Setting	Major Variables Studied (and Their Definitions)	Measurement	Data Analysis	Findings	Appraisal: Worth to Practice
Chan PS, et al. *Arch Intern Med* 2010;170(1): 18-26	None	SR Purpose: effect of RRT on HMR and CR • Searched 5 databases from 1950–2008 and "grey literature" from MD conferences • Included only 1) RCTs and prospective studies with 2) a control group or control period and 3) hospital mortality well described as outcome • Excluded 5 studies that met criteria due to no response to e-mail by primary authors	N = 18 out of 143 potential studies Setting: acute care hospitals; 13 adult, 5 peds Average no. beds: NR Attrition: NR	IV: RRT DV1: HMR (including DNR, excluding DNR, not treated in ICU, no HMR definition) DV2: CR	RRT: was the MD involved? HMR: overall hospital deaths (see definition) CR: cardio and/or pulmonary arrest; cardiac arrest calls	• Frequency • Relative risk	13/16 studies reporting team structure 7/11 adult and 4/5 peds studies had significant reduction in CR CR: • In adults, 21%–48% reduction in CR; RR 0.66 (95% CI, 0.54–0.80) • In peds, 38% reduction in CR; RR 0.62 (95% CI, 0.46–0.84) HMR: • In adults, HMR RR 0.96 (95% CI, 0.84–1.09) • In peds, HMR RR 0.79 (95% CI, 0.63–0.98)	Weaknesses: • Potential missed evidence with exclusion of all studies except those with control groups • Grey literature search limited to medical meetings • Only included HMR and CR outcomes • No cost data Strengths: • Identified no. of activations of RRT/1,000 admissions • Identified variance in outcome definition and measurement (for example, 10 of 15 studies included deaths from DNRs in their mortality measurement) Conclusion: • RRT reduces CR in adults, and CR and HMR in peds Feasibility: • RRT is reasonable to implement; evaluating cost will help in making decisions about using RRT • Risk/Benefit (harm): benefits outweigh risks

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McGaughey J, et al. *Cochrane Database Syst Rev* 2007;3: CD005529	None	SR (Cochrane review) Purpose: effect of RRT on HMR • Searched 6 databases from 1990–2006 • Excluded all but 2 RCTs	N = 2 studies Acute care settings in Australia and the UK Attrition: NR	IV: RRT DV1: HMR	HMR: Australia: overall hospital mortality without DNR UK: Simplified Acute Physiology Score (SAPS) II death probability estimate	OR	OR of Australian study, 0.98 (95% CI, 0.83–1.16) OR of UK study, 0.52 (95% CI, 0.32–0.85)	Weaknesses: • Didn't include full body of evidence • Conflicting results of retained studies, but no discussion of the impact of lower-level evidence • Recommendation "need more research" Conclusion: • Inconclusive
Winters BD, et al. *Crit Care Med* 2007;35(5): 1238-43	None	SR Purpose: effect of RRT on HMR and CR • Searched 3 databases from 1990–2005 • Included only studies with a control group	N = 8 studies Average no. beds: 500 Attrition: NR	IV: RRT DV1: HMR DV2: CR	HMR: overall death rate CR: no. of in-hospital arrests	Risk ratio	HMR: • Observational studies, risk ratio for RRT on HMR, 0.87 (95% CI, 0.73–1.04) • Cluster RCTs, risk ratio for RRT on HMR, 0.76 (95% CI, 0.39–1.48) CR: • Observational studies, risk ratio for RRT on CR, 0.70 (95% CI, 0.56–0.92) • Cluster RCTs, risk ratio for RRT on CR, 0.94 (95% CI, 0.79–1.13)	Strengths: • Provides comparison across studies for: ○ Study lengths (range, 4–82 months) ○ Sample size (range, 2,183–199,024) ○ Criteria for RRT initiation (common: respiratory rate, heart rate, blood pressure, mental status change; not all studies, but noteworthy: oxygen saturation, "worry") • Includes ideas about future evidence generation (conducting research)—finding out what we don't know Conclusion: • Some support for RRT, but not reliable enough to recommend as standard of care

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Hillman K, et al. *Lancet* 2005; 365(9477): 2091-7	None	RCT Purpose: effect of RRT on CR, HMR, and UICUA *Method note:* documented RRT criteria, but low number of calls leads to questions about fidelity of the intervention (was the RRT implemented correctly?)	N = 23 public hospitals without prior RRT Average no. beds: 340 • Intervention group (n = 12) • Control group (n = 11) Characteristics: blocked assignment on academic vs. nonacademic status and number of beds Exclusions cases: if more than 1 event occurred during a single hospitalization, only 1 event was included in analysis; no patients who were < 14 years, who died on hospital arrival, or who weren't formally admitted Setting: Australia Attrition: none	IV: RRT protocol for 6 months • 1 AP • 1 ICU or ED RN DV1: HMR (all unexpected deaths, excluding DNRs) DV2: CR (no palpable pulse, excluding DNRs) DV3: UICUA	HMR CR UICUA rates All data collectors had standardized training	• Percent of actual events in which RRT criteria were documented > 15 minutes before event (more is better) • OR • Change scores	Rates by I/C %: • HMR, 50/55 NS • CR, 30/44 (P = 0.031) • UICUA, 51/55 NS • HMR OR, 1.03 (95% CI, 0.84–1.28) • CR OR, 0.94 (95% CI, 0.79–1.13) • UICUA OR, 1.04 (95% CI, 0.89–1.21)	Weaknesses: • Lack of data collection on existing code team function in nonintervention hospitals • Intervention integrity: not all intervention hospitals carried out intervention in the same way Intervention description: • 4 months' education on RRT o for RN and MD, about calling criteria first o multiple modalities: video, book, lectures on RRT use o badge visual reminders o reminders until RRT activated • Activated RRT calling system for 6 months prior to evaluating outcome data Conclusion: • Control hospitals' code teams actually performed like RRTs were expected to, therefore the study results weren't reliable enough to act on (that is, there's no difference between RRT and no RRT) Notes: • Lists criteria for activating RRT • This study has been quoted as the landmark study to refute RRT use, not sure why

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Sharek PJ, et al. *JAMA* 2007;298(19): 2267-74	None	Cohort study with historical controls Purpose: effect of RRT on HMR and CRO over 2 years	N = pre: 22,037 peds admissions/ 102,537 patient days; post: 7,257 peds admissions/ 34,420 patient days No differences between control and prospective cohorts based on age or severity of illness Setting: 76 beds in nonobstetric, nonnursery, non-ICU peds units in 218-bed hospital in western U.S. Attrition: NR	IV: RRT • Peds ICUF or AP • ICU RT • Nurse supervisor DV1: HMR (total no. of deaths in 1 month) DV2: CRO (cardio [chest compressions] and pulmonary [tracheal intubation] arrests occurring outside ICU) Process outcomes: • Reasons for activating RRT • Actions after RRT activation • Patient disposition after RRT intervention	HMR: all deaths/100 DC CRO: rates/1,000 patient days and 1,000 admissions; adjusted for CMS case mix index	• Chi-square • Frequency • Percentage	HMR reduced by 18% ($P < 0.007$) CRO decreased by 71.2% ($P < 0.008$) No. RRT = 143 over 19 months 36.3%, RRT initiation due to respiratory distress 38.5%, primary action after RRT was respiratory support 56.7% of RRT calls ended in transfer to ICU (none expired)	Strengths: • Historical controls help mitigate system confounders • Age of patients and severity of illness weren't confounders • Reasons for RRT, actions of RRT, and patient disposition after RRT • Discussion on the need to allow time for diffusion of the intervention (in this study, 19 months) • 33 children's lives saved over 19 months Weaknesses: • The issues that may affect the outcome and that are inherent within this system are unknown, therefore the relationship between RRT and outcomes cannot be considered causal • Race/ethnicity disproportionate in intervention and control groups Note: • This was a children's referral academic medical center whose populations are self-admittedly "sicker" than at other institutions; however, severity of illness was shown to have no impact on outcome Conclusion: • RRT significantly reduced HMR and CR

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Chan PS, et al. *JAMA* 2008;300(21): 2506-13	None	Cohort study over 42 months Purpose: effect of RRT on HMR and CR over 12 months (data excluded over the 4-month active intervention period)	N = pre: 24,193 adult admissions; post: 24,978 adult admissions Setting: 404-bed hospital in mid-western U.S. Attrition: NR	IV: RRT • 2 ICU RNs • RT • ICUF or AP on request by RRT DV1: HMR (mortality rates/100 admissions) DV2: CR (hospital-wide CR/1,000 admissions [code = unexpected arrest requiring resuscitation and hospital alert]) Process outcomes: • Code location • Code type • Quality of RRT implementation	HMR: all deaths CRO: rates/1,000 patient days and 1,000 admissions; adjusted for CMS case mix index	Adjusted OR (AOR)	CR AOR, 0.76 (95% CI, 0.57–1.01) HMR AOR, 0.95 (95% CI, 0.81–1.11) CRO AOR, 0.59 (95% CI ,0.40–0.89) Reasons for RRT: • Altered neurological status, 27.4% • Tachycardia, 23.4% Top RRT interventions • ECG, 41% • Peripheral IV, 40% Immediate disposition after RRT • 51.6% stayed on telemetry unit • 41.2% transferred to ICU	Strengths: • Study was over 42 months • RRT interventions listed Weakness: • Pre- and postintervention groups differed significantly on age, gender, race, and case-mix Conclusions: • RRT significantly reduced CRO • There was some, but no significant, reduction in CR • No effect on HMR, but they included DNR

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DeVita MA, et al. *Qual Saf Health Care* 2004;13(4): 251-4	None	Retrospective descriptive study; analysis of RRT responses (historic controls) Purpose: change in CR after RRT	N = 3,269 RRT calls; 1,220 CR over 6.8 years Setting: 662-bed hospital in eastern U.S. Attrition: NR	IV: RRT • AP • ICU RN • RT • Floor RN DV1: FCR (same-day death) DV2: NSCR (died before discharge) DV3: RRT use DV4: CR	FCR: no. people who died on the same day as their cardiac arrest/total no. CR NSCR: no. people who had a cardiac arrest and died before they left the hospital RRT use: code team activations/ 1,000 admissions CR: rate of cardiac arrest	• Frequency • Percentages	FCR: no difference in same-day deaths after arrest or before and after RRT intervention period CR: reduced from 6.5 to 5.4/1,000 DC (17%) ($P = 0.016$) NSCR: increased over the project by 3.6% RRT use: increased from 13.7 to 25.8/1,000 admissions	Notes: • Criteria for activating RRT • Role description for each team member • Nonmedical personnel can activate RRT • Cultural barriers impeded RRT function without written protocol • When barriers encountered, written follow-up initiated Conclusion: • CR, very little reduction with RRT; is any reduction worth it?

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Mailey J, et al. *J Trauma Nurs* 2006; 13(4):178-82	None	Preexperimental (pre/post) Purpose: change in HMR, CR, LDC after RRT	N = 1,335 RRT calls 207 ICU DC over 8 months Setting: general practice units in large teaching hospital in mid-western U.S. Attrition: NR	IV: RRT • AP • ICU RN • Nurse supervisor • RT • 24/7 DV1: HMR DV2: CR DV3: LDC DV4: days between CR Process outcomes: • CR outside ICU • No. of RRT calls • Location, reason, time of RRT as well as outcome • Impact on resident MD perception of RRT	CR/1,000 DC HMR–overall mortality Resident perceptions, self-developed questionnaire	• Frequency • Percentages	1,335 RRT calls 30% from pulse oximetry CR reduced (no number) HMR reduced by 25% Resident perception of RRT was positive	Notes: • Nurses required to have 2–3 years ICU experience and be ACLS and BLS certified (nurses were ACLS instructors) • ICU nurses had difficulty with no monitoring capabilities • Had an RRT committee, but included no staff • Unclear about cost data Conclusions: • CR and HMR reduced with RRT • Clinicians liked and used RRT function

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Dacey MJ, et al. *Crit Care Med* 2007;35(9): 2076-82	None	Preexperimental (pre/post) Purpose: change in HMR, CRO, and UICUA after RRT	Specific N = NR; all patients seen within 17 months Setting: 350-bed community hospital in eastern U.S. Attrition: NR	IV: RRT (efferent arm of RRS) • PA • ICU RN • RT DV1: HMR DV2: CRO DV3: UICUA Process outcomes: • Airway management (in fewer than 2 tries) • MD review before transfer • RN satisfaction • 24-hour follow-up visits	HMR: compared overall death rate for the year before and after RRS CRO: CPR for any reason, for any duration UICUA: ICU admission not from operating room or ED	• Frequency • Percentage	All findings were statistically significant with $P < 0.05$ HMR: decreased from 2.24 to 1.98 CRO: decreased from 10.60 to 2.80 UICUA: decreased from 45.60 to 22.75 Cost: total RRS cost = $460,000; cost savings from single CRO outcome = $464,924	Notes: • Afferent arm of RRS: all health care professionals who had RRS training; this was the "detection" arm of the RRS and interfaced with the RRT • To establish criteria for calling RRT required major educational efforts • Objective of study to "prove" that a PA-led RRT had better outcomes seems like a biased approach • During control phase of study, it was known that an RRT was coming; did this introduce further bias, negating the "control" portion of the study? Conclusions: • HMR, CRO, UICUA: all reduced with RRT • Cost was recouped with a single outcome, which positively impacts feasibility and risk/benefit considerations

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McFarlan SJ, Hensley S. *J Nurs Care Qual* 2007;22(4): 307-13	None	Evidence implementation Purpose: change in HMR and CR after RRT	Specific N = NR; all patients seen within 12 months Setting: community hospital in eastern U.S. (472-bed, level-1 trauma center)	IV: RRT • ICU RN DV1: HMR (unadjusted deaths) DV2: CRO (% in acute areas) DV3: UICUA	HMR: no. deaths/1,000 DC CRO: no. cardiac arrests in acute care/ total in hospital UICUA: no. UICUA/ 1,000 DC	• Frequency • Percentage	HMR: didn't report outcome CRO reduced from 36% to 28% UICUA: *increased* from 16.8 to 19/1,000 DC	Notes: • December 2004 – IHI 100,000 lives recommended RRT • Confusion over what to call the RRT: MET, RRT, critical care outreach team • Require RN with 5+ years experience • No MD on team • Roles and responsibilities of RRT team members • Data on what initiated RRT call Conclusions: • CRO reduced • UICUA increased Note: • Best information in this article is its parts on process
Offner PJ, et al. *J Trauma* 2007;62(5): 1223-8	None	Evidence implementation Purpose: change in CR after RRT	Specific N = NR; all patients seen within 10 months Setting: community hospital in western U.S. (level-1 trauma center) Attrition: NR	IV: RRT • ICU MD • ICU RN • RT • 24/7 DV: CRO	CRO: no. cardiac arrests ×10,000 patient days	• Frequency • Percentage • Mann-Whitney U	RRT calls increased CRO decreased by 50% ($P < 0.02$)	Notes: • Criteria for activating RRT • Advocate extensive education to avoid political and logical barriers to RRT implementation • Question: why a different measure of CRO than other studies or projects? • 75% of RRT calls occurred between 7 AM–7 PM Conclusion: • CRO decreased—something was working right—but can it be repeated?

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Bertaut Y, et al. *J Vasc Nurs* 2008;26(2): 37-42	None	Evidence implementation Purpose: Change in HMR and CRO after RRT	Specific N = NR; all patients seen within 12 months Setting: 508-bed large teaching hospital in southern U.S. Attrition: NA	RRT • ICU RN • RT • MD PRN DV1: HMR DV2: CRO DV3: no. RRT calls	HMR: overall mortality CRO/1,000 DC RRT call rates	• Frequency • Percentage	HMR reduced by 0.22% CRO reduced by 6.49/1,000 DC RRT calls increased from 5.4 to 12.3 across the project	Notes: • Major education of all staff • Example of how to record the event when an RRT responds and how to evaluate the call • Criteria for RRT call • Called the RRT CORE (critical on-demand rapid evaluation) • Primary reason for RRT call reported as "worried about patient" Conclusions: • RRT was used • CRO decreased • Process info helpful • Question: can reduction in CRO be replicated?
Benson L, et al. *Jt Comm J Qual Patient Saf* 2008;34(12): 743-7	None	Evidence implementation Purpose: change in HMR and CR after RRT	Specific N = NR; all patients seen within 9 months Setting: 350-bed teaching hospital in midwestern U.S. Attrition: NA	RRT • APN • ICU RN • RT DV1: HMR DV2: CR	No. RRT calls CR: no. codes/1,000 DC HMR: mortality on medical–surgical units	• Frequency • Percentage	RRT calls increased from 45–90/month Reduced CR by 58% at 1 year ($P = 0.0065$) HMR reduced by 9%	Note: • No objective data to support assumption that RRT with APN improved communication and acceptance of RRT among disciplines Conclusions: • HMR and CR reduced • RRT used • Question: replicable?

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Hatler C, et al. *Medsurg Nurs* 2009;18(2):84-90,126	None	Evidence implementation Purpose: change in CRO and UICUA after RRT	Specific N = NR; all patients seen within 31 months Setting: 620-bed large teaching hospital in the southwestern U.S. Attrition: NA	IV: RRT • Nurse supervisor • ICU RN • ICU RT DV1: CRO DV2: UICUA DV3: ICU admissions after RRT DV3: RRT response time DV4: RN satisfaction with RRT process	CRO: codes outside ICU/1,000 DC Rate of emergent transfers to ICU No. RRT calls Time from RRT call to intervention Project manager created 8-question survey to measure RN satisfaction with RRT process	• Frequency • Percentage	CRO: 32% decrease UICUA reduced to 2% No. RRT calls increased from 8 to 15 over the project Time from call to RRT arrival: average 5 min Self-reported satisfaction by RNs at 97%	Notes: • RRT checklist • RRT flowchart • Assumed cost-effective due to decreased UICUA Conclusions: • CRO reduced • RNs satisfied with RRT process • Question: replicable?

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Bader MK, et al. *Jt Comm J Qual Patient Saf* 2009;35(4): 199-205	None	Evidence implementation Purpose: change in CRO and UICUA after RRT	Specific N = NR; all patients seen within 2 years Setting: 304 community hospitals in western U.S. Attrition: NA	IV: RRT • ICU RN • 24/7 DV1:CRO DV2: UICUA DV3: RRT call rate	CRO and UICUA, % transferred to cardiac ICU/DC No. RRT calls/1,000 DC Qualitative data: • Description of elements collected per RRT call • Criteria for RRT call	• Frequency • Percentage	CRO reduced from 36 to 17/year Non-ICU mortality reduced from 61% to 26% ($P < 0.05$) UICUA reduced from 21% (partial RRT) to 14% (full staff RRT) ($P < 0.05$) Average 338 RRT calls per month/1,000 DC	Notes: • RRT committee: first administrators, then staff nurses • RRT checklist • Goals: reduce CRO and non-ICU mortality by 50% (actual results were reduction of CRO by over 50% and non-ICU mortality by 35%) • RRT to provide critical ED patients ICU-level care • Qualitative data analysis results identified barriers to RRT function, such as education needs, interdisciplinary communication, and other process issues • Overall, RRT reduced focused outcomes, and process evaluation revealed other issues that improved outcomes further Conclusions: • CRO reduced • Non-ICU mortality reduced • Question: is there a substantive difference between HMR and non-ICU mortality?

ACLS = advanced cardiac life support; AP = attending physician; APN = advanced practice nurse; BLS = basic life support; CI = confidence interval; CMS = Centers for Medicare and Medicaid Services; CPR = cardiopulmonary resuscitation; CR = cardiopulmonary arrest or code rates; CRO = code rates outside the ICU; DC = discharge; DNR = do not resuscitate; DV = dependent variable; ECG = electrocardiogram; ED = emergency department; FCR = fatal arrest; HMR = hospital-wide mortality rates; I/C = Intervention/Control; ICU = intensive care unit; ICUF = ICU fellow; IHI = Institute of Healthcare Improvement; IV = independent variable; LDC = percent of live discharges after coding; MD = medical doctor; MET = medical emergency team; NA = not applicable; No. = number; NR = not reported; NS = not significant; NSCR = no survival arrest; OR = odds ratio; PA = physician assistant; Peds = pediatrics; PRN = as needed; RCT = randomized controlled trial; RN = registered nurse; RR = relative risk; RRS = rapid response system; RRT = rapid response team; RT = respiratory therapist; SR = systematic review; UICUA = unplanned ICU admissions; UK = United Kingdom; U.S. = United States