

Given the results of the MERIT and the ICNARC outreach studies, how do we prove that rapid response teams are worthwhile?

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Statistician, ICNARC

Outline

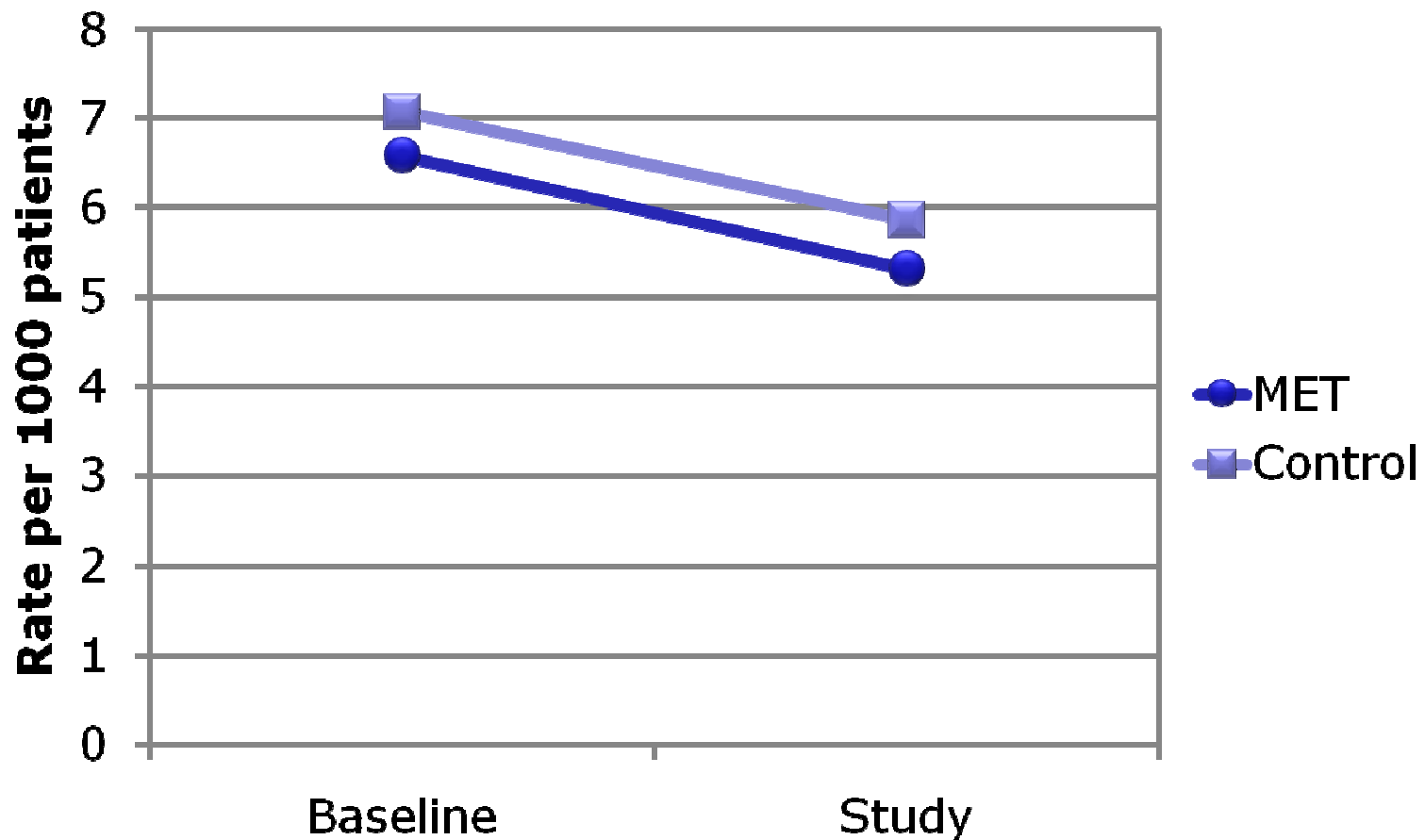
- Brief summary of MERIT
- Slightly less brief summary of ICNARC evaluation
- Do we need a new RCT of RRTs...?
- Breaking down the complex intervention
- Priorities for research

MERIT – summary

- Multicentre cluster-RCT
MERIT Study Investigators. *Lancet* 2005; 365:2091-7.
- 23 hospitals in Australia
- 12-month study:
 - 2-month baseline period
 - 4-month implementation period
 - 6-month study period
- ~120,000 patients

MERIT – results

Primary outcome: cardiac arrest, unplanned ICU admission or unexpected death



MERIT – explanations...?

- MET ineffective?
- MET poorly implemented?
- Contamination – arrest teams functioning as MET?
- Short time-frame – effective implementation requires culture change/education of ward staff
- Clustering greater than anticipated
→ underpowered

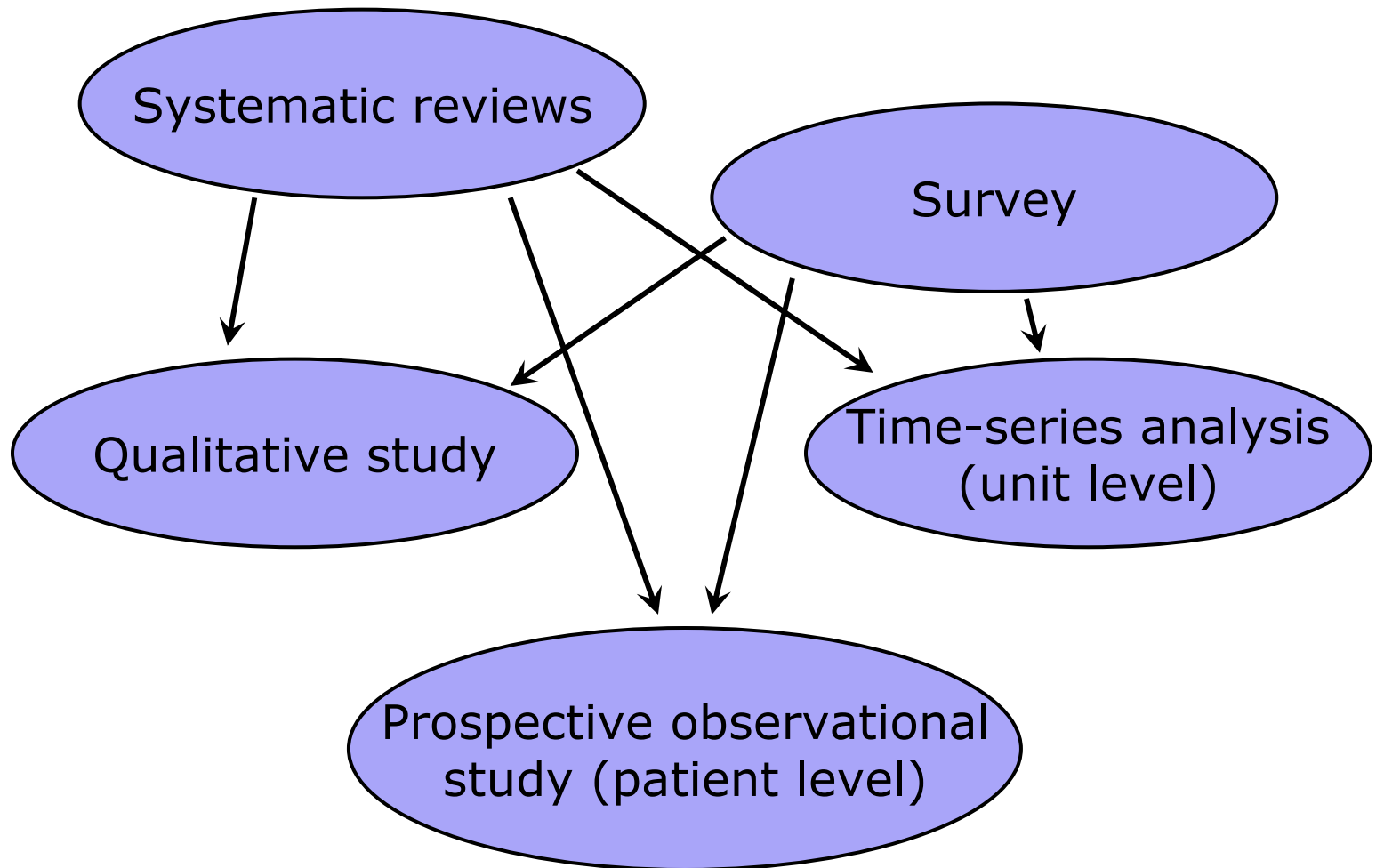
MERIT – lack of power

- Sample size calculation
 - Anticipated rate 3.0%
 - ICC 0.00127
 - 90% power to detect 30% ↓ to 2.1%
- Observed results
 - Rate in control hospitals 0.6%
 - ICC 0.0666 – 50 times anticipated
 - 90% power to detect 30% ↓ requires 4,600 hospitals!

ICNARC outreach evaluation

- Mixed methods study
- Utility of physiological track and trigger warning systems (TTs)
- Effectiveness of critical care outreach services (CCOS)

ICNARC outreach evaluation



Our evaluation of TTs

- Systematic review
Gao et al. Int Care Med 2007; 33:667-79.
- Survey of use
McDonnell et al. J Crit Care 2007; 22:212-8.
- Assessment of ability to detect established critical illness
Gao et al. (as above)
- Assessment of inter-/intra-rater reproducibility
Subbe et al. Int Care Med 2007; 33:619-24.
- Qualitative evaluation
Baker-McClearn et al. JHSRP (in press)

Systematic review/survey

- 25 different TTs most UK and Australia
- Only 5 studies developing/testing TTs – variable reporting and none satisfied Level 1 clinical decision rule
- 80% (191/239) survey response rate
70% use TT (70% of these use EWS~)
64% have response algorithm
- Primary respondents to response algorithm
 - CCOS or junior doctor or nurse-in-charge

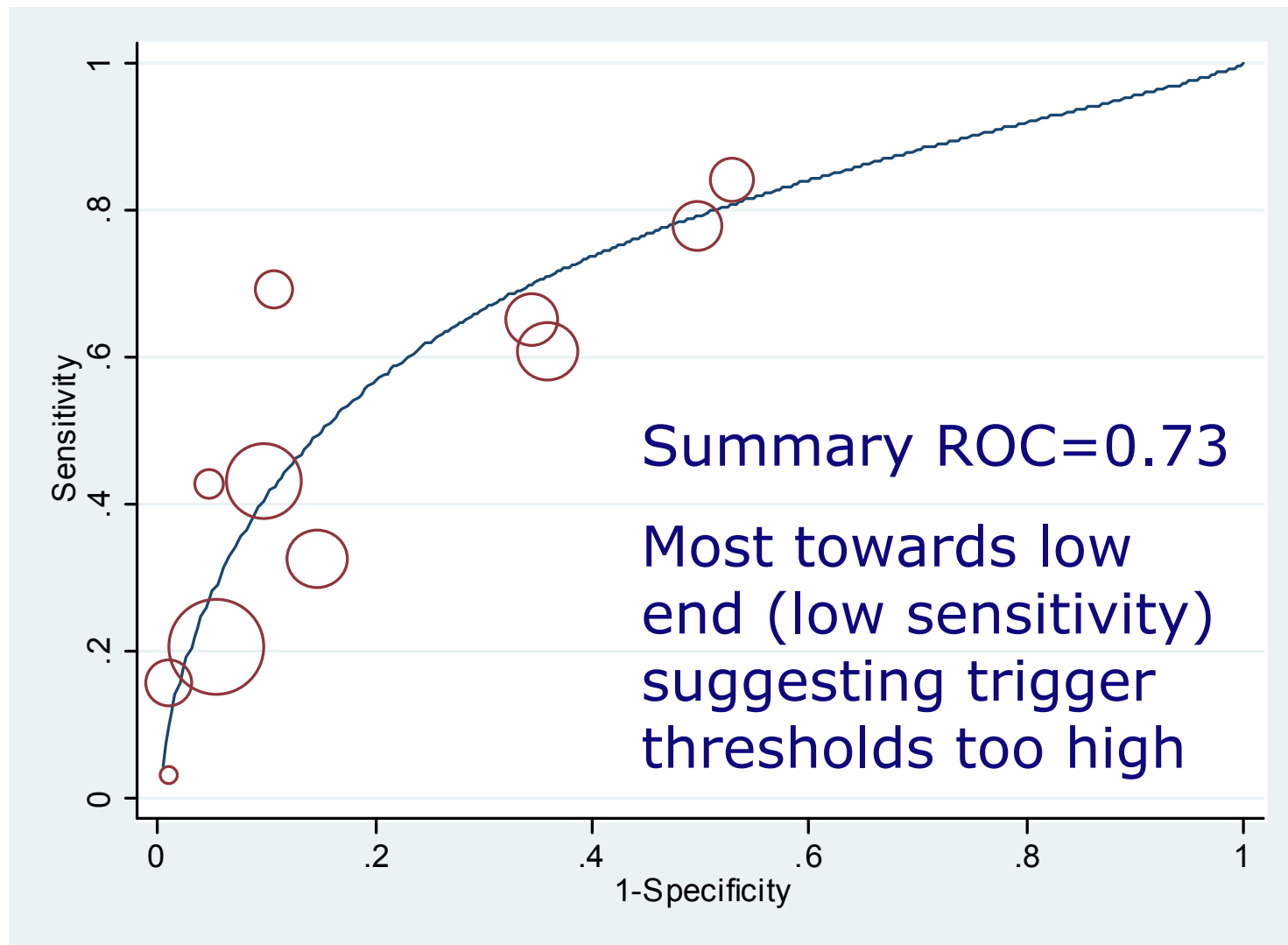
Assessment of TTs

- Available datasets from UK NHS hospitals
- 221 NHS hospitals - 63% responded
14% could provide electronic dataset
15 (6.8%) of sufficient quality (DoCDat)
- Period 2001-4, N=328 to 3000
- 15 TTs (8 EWS~) with response algorithms
- All included heart rate, respiratory rate, systolic blood pressure and level of consciousness but varied in choice of: other variables, score assignment, trigger thresholds and response algorithm

Assessment of TTs

- Established critical illness was defined as composite of CPR, DNAR, admission to critical care, death
- For graded responses:
trigger=involving more experienced staff
- Primary analysis:
 - sensitivity/positive predictive value
- Secondary analysis:
 - specificity/negative predictive value

Assessment of TTs



Assessment of TTs

- Differences in diagnostic accuracy among datasets not explained by TT parameters, outcome measures available or patients included
- Within hospitals, some difference in discrimination across age groups, wards, specialties but no consistent results
- Strong evidence of heterogeneity across datasets
- Significant variation in reproducibility – better for triggers (four raters/one hospital)

Interpretation/critique

- Evaluated established not potential critical illness (appropriate triggers may have not been reflected)
- Low sensitivities
 - infrequent measures/rapid decline
 - number of variables included in TT
- Wide variation in TT datasets
 - data collection, sample size, TT packages
 - generalisable only to setting due to TT package (TT/response algorithm/times)
- No data on lead time (time saved from TT response compared with usual response)

TTs: implications

- Use of (not reliance on) TT with graded response algorithm
 - reinforces need for routine obs
 - educates significance of abnormal obs
 - trigger reinforces obligation for experienced staff to attend patient's bedside
 - equitable access to higher levels of care
- Better defined TTs/response algorithms with training in competencies/authority for use
- Auditing of accuracy, reproducibility, ease of use, adherence to response algorithm

Our evaluation of CCOS

- Systematic review
Esmonde et al. *Int Care Med* 2006; 32:1713-21.
- Survey of use
McDonnell et al. *J Crit Care* 2007; 22:212-8.
- Interrupted time-series analysis – unit level
Gao et al. *Crit Care* 2007; 11:R113.
- Matched cohort study – patient level
(Manuscript under review)
- Qualitative evaluation
Baker-McClearn et al. *JHSRP* (in press)

Systematic review

- 23 studies, but only 2 RCTs:
- One multicentre RCT – MERIT (NS)
- One single centre UK RCT – hospital mortality (significant decrease), hospital LOS (NS)
- Other studies – some improvements in patient outcomes found; limitations of methodologies prevent robust/reliable conclusions

Survey

- 80% survey response rate
73% have formal CCOS
14% no longer had CCOS
- Variation in CCOS staffing: 71% no medical consultant input, 41% no nurse consultant, I or H grade input
- Variation in operating days/hours: Coverage of adult wards expanding, but only ~20% provide direct bedside clinical support 24/7
- Wide spectrum of activities/services: 96% provide clinical assessment, 62% intervene

Interrupted time-series analysis

- Did characteristics/outcomes of ICU admissions change (in a consistent way across different units) following introduction of CCOS?
- 108 units participating in Case Mix Programme (CMP) and returned survey
- 79 units introduced CCOS between 1996 and 2004 (median 36 months' data post-implementation)

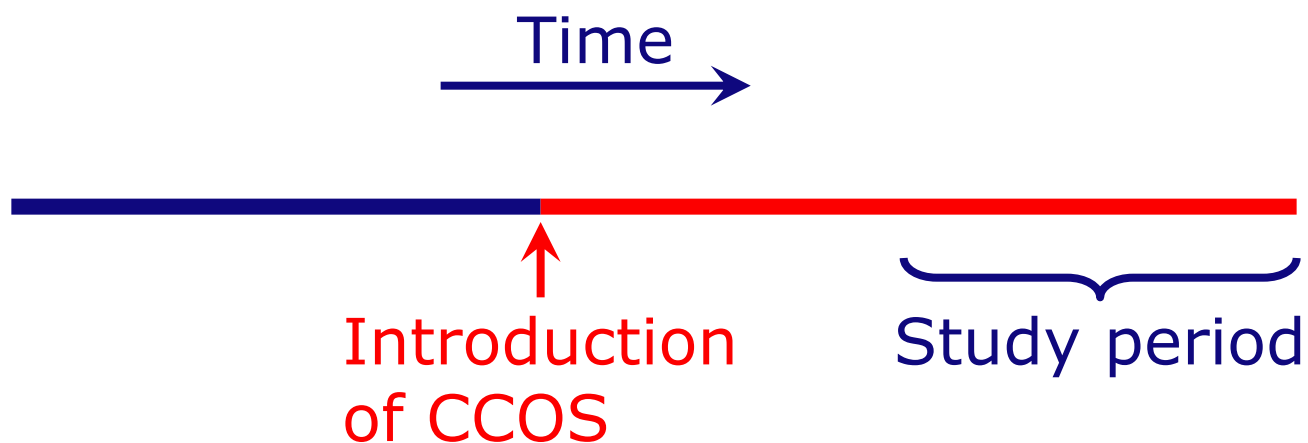
Interrupted time-series analysis

- For all admissions:
 - No change in % admitted from the ward
- For admissions from the ward:
 - ↓ CPR rate **0.84**
 - ↓ out-of-hours admission **0.91**
 - ↓ mean physiology score **0.30**
 - no change in treatment withdrawal/mortality
- For discharges to the ward:
 - no change in discharge out-of-hours, early discharge, mortality, readmission

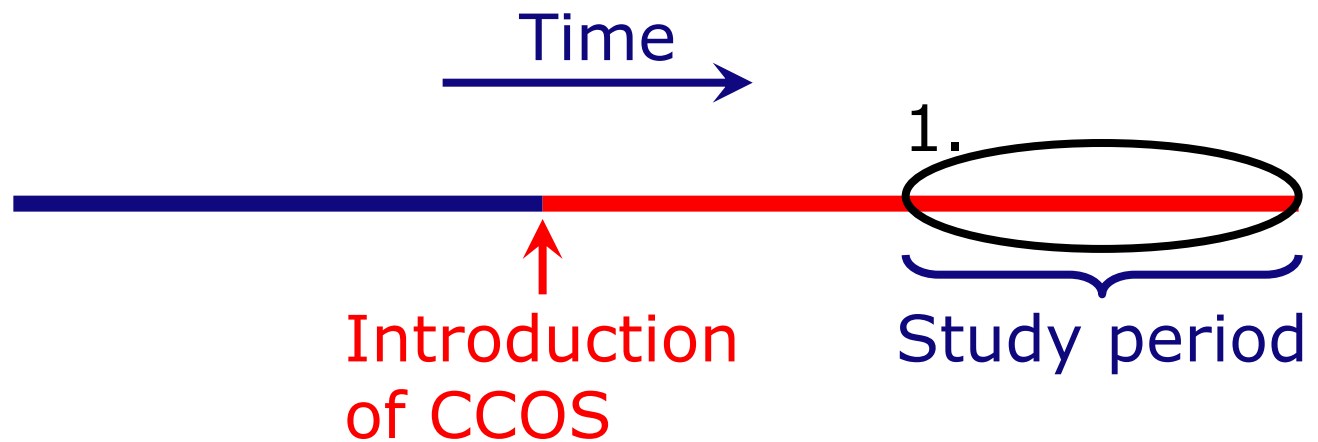
Matched cohort analysis

- Are characteristics/outcomes of patients receiving CCOS visits different from other (matched) patients?
- 52 CCOS, Oct 2005 to Sep 2006
- 71,660 visits to 23,234 patients
- 10,404 patients admitted to ICU or HDU, 7,078 to CMP units, linked to case mix and outcome data
- 2,203 patients had referral visit(s) pre-ICU, 5,924 patients had follow-up visit(s) post-ICU, 1,049 had both

Selection of controls

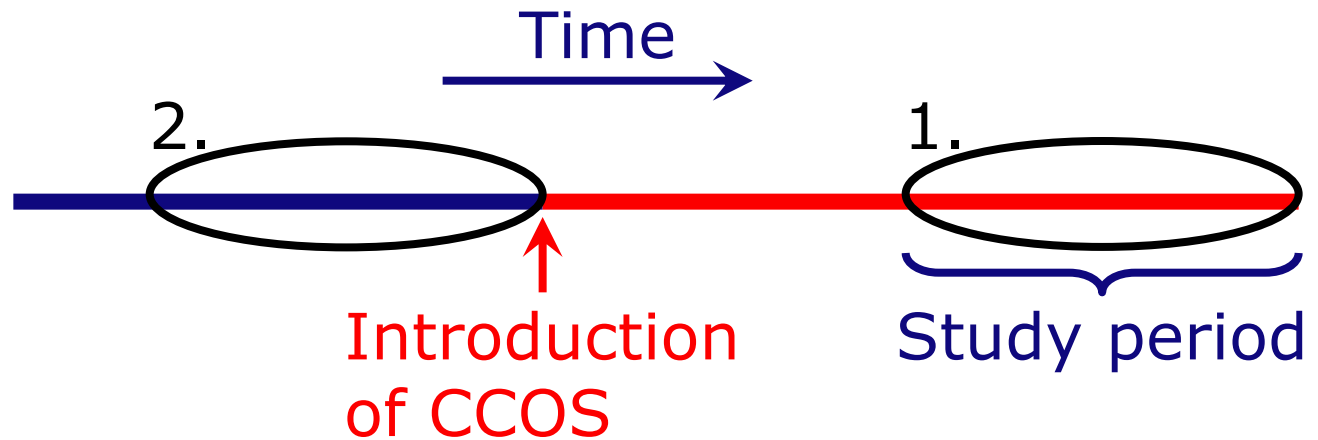


Selection of controls



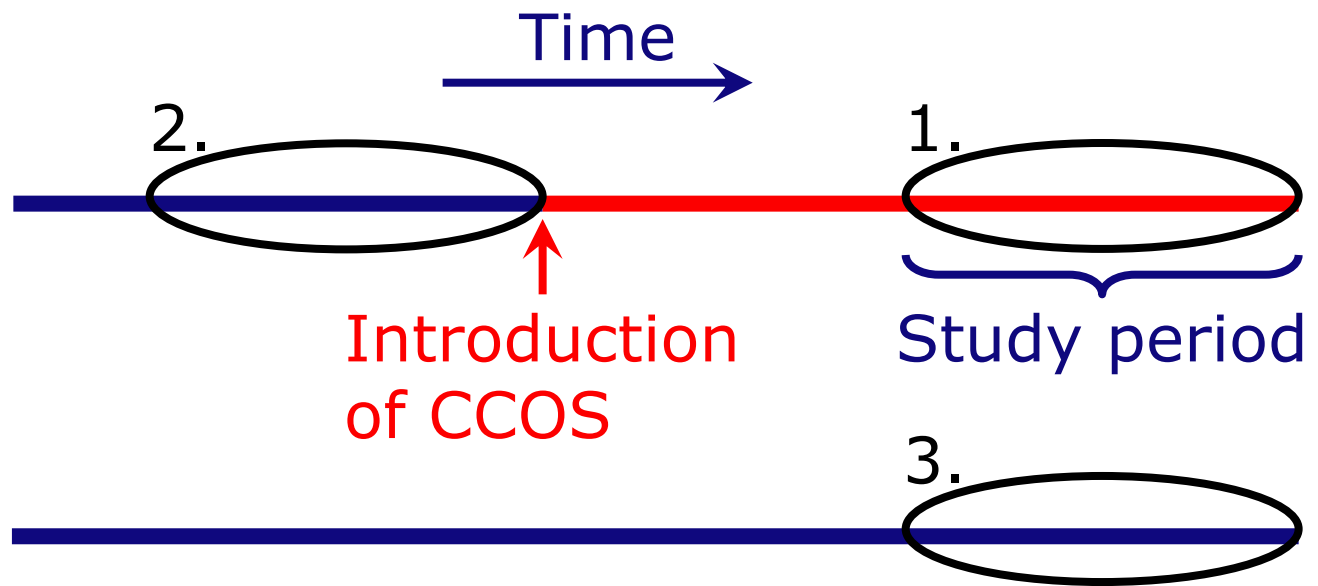
1. Same ICU during study period but not seen by CCOS

Selection of controls



1. Same ICU during study period but not seen by CCOS
2. Same ICU prior to introduction of CCOS

Selection of controls

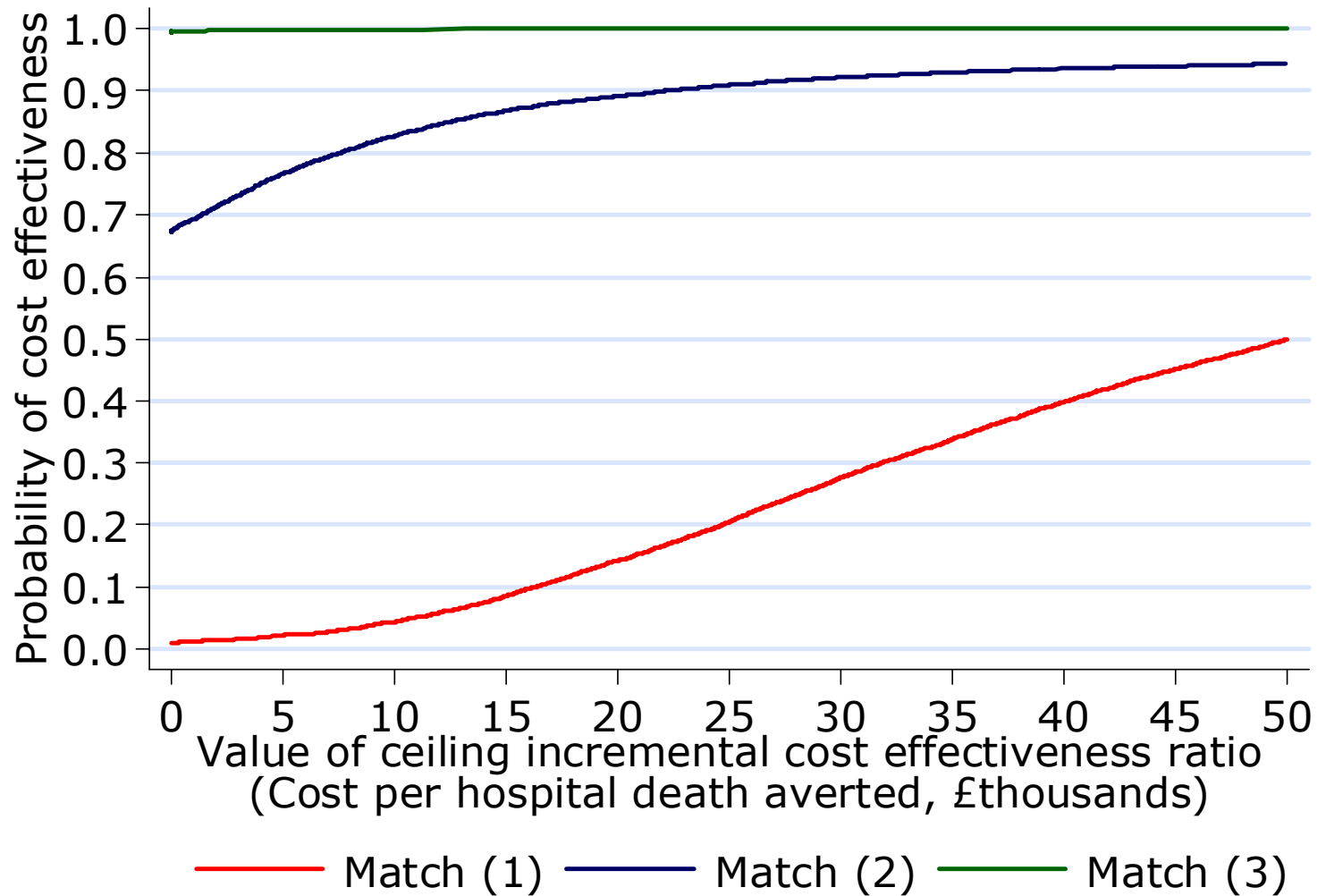


1. Same ICU during study period but not seen by CCOS
2. Same ICU prior to introduction of CCOS
3. ICU in a hospital with no CCOS

Matched cohort analysis

- CCOS referral visit(s) pre-ICU:
 - No association with severity of illness
 - ↓ CPR rate **0.40-0.78**
 - ↑ ICU LOS 1.17-**1.28**
- CCOS follow-up visit(s) post-ICU:
 - ↓ hospital mortality **0.67-0.90**
 - ↓ readmissions in 48h **0.26-1.26**
 - ↓ non-HDU readm in 48h **0.27-1.10**
 - ↓ post-ICU LOS **0.86-0.90**

Cost-effectiveness of follow-up



1=contemporary; 2=historic; 3=unit with no outreach

CCOS: implications

- CCOS-like activities should be in place
 - some evidence of cost-effectiveness
 - enhance communication/care across organisational and professional boundaries
 - provide reassurance and empowerment
- Need organisational entrepreneur
- No specific CCOS model can be recommended
- Speed and ease of access are important features of CCOS

ICNARC

Intensive Care National Audit & Research Centre

**Do we need a new
multicentre RCT
of RRTs...?**

Why might we need a new RCT

- Do not have Grade 1A evidence of effectiveness
- Little information on cost-effectiveness

Why might we need a new RCT

- Do not have Grade 1A evidence of effectiveness
- Little information on cost-effectiveness
- But, many of the effects identified by qualitative work are fairly intangible/hard to measure

Policy already favours RRTs

- "...outreach links are likely to improve care outside the unit..." Audit Commission (1999)
- "Our vision for the future of critical care services includes the establishment of an outreach team..." DH (2000)
- "Robust track and trigger systems... should be linked to a response team" NCEPOD (2005)
- "A quality, effective critical care service will include... 24/7 outreach services..." DH/CCSF (2005)
- "Physiological track and trigger systems... ...call to personnel with core competencies for acute illness." NICE (2007)

A new RCT of RRTs...?

Would require...

- Large number of hospitals (at least hundreds maybe thousands)
- No existing RRT
- Long follow-up
- No other major service changes

A new RCT of RRTs...?

Would require...

- Large number of hospitals (at least hundreds maybe thousands)
- No existing RRT
- Long follow-up
- No other major service changes
- Identification of best RRT 'package'

Breaking down the complex intervention...

- Identification
 - Which parameters to monitor?
 - Who should measure/record these?
 - When to trigger a response?
 - Grading of response?
 - What outcome measure determines an 'appropriate' trigger?

Breaking down the complex intervention...

- Response
 - Availability of service – 24/7?
 - Composition of team?
 - Grading of response?
 - Activities performed?

Priorities for research

- First step: identify the right patients!
- We do not know what the best track and trigger system looks like
- For this, we need:
 1. A suitable outcome measure to determine an 'appropriate' trigger
 2. High-quality, multicentre data recording regular, timed physiology measurements and outcomes