

Electronic supplement

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Table: Overview of monthly group debriefing intervention (Hospital one)

Why	<p>Whilst early data supports the use of cardiac arrest debriefing, some models may not be deliverable in the NHS setting.</p> <p>This intervention is intended to be deliverable in the NHS. Its aim is to improve delivery of CPR.</p>
What	<p>Materials</p> <p>Posters advertising the meetings were placed in staff areas throughout the hospital. Members of the research team regularly attended medical handover meetings to remind clinicians about the meetings. Clinicians that were known to have attended the cardiac arrest events planned for discussion were sent an email 1-4 days prior to the meeting specifically inviting them to attend.</p> <p>The debriefing meeting consisted of a discussion about cardiac arrest management. This was supplemented by a slide presentation (Microsoft PowerPoint 2007, Microsoft, Redmond, Washington) to show relevant data and potential discussion points.</p> <p>Procedures</p> <p>Debriefing meetings consisted of four sections:</p> <ol style="list-style-type: none"> 1. Introduction- this section summarised the rationale for the research study and set ground rules for the meeting, including emphasis of the need for a confidential and no-blame environment with a focus on improving practice. 2. Review of relevant research- this section was included in most meetings, and provided an opportunity to review and discuss key literature in the field of cardiac arrest, such as the importance of CPR quality. 3. Case review and discussion- 1-3 recent cardiac arrest events were reviewed. Summaries included background to the arrest and patient characteristics, review of the arrest event and CPR quality data, and patient outcome. Patient details were anonymised. Clinicians who had been present at the cardiac arrest were invited to share their insight in to events. Other debriefing attendees participated in discussions to share any similar experiences. 4. Summary of key learning points- the final section consisted of a review of key learning points and provided a further opportunity to ask questions.
Who provided	Debriefings were facilitated by KC (resuscitation research nurse), who also undertook all meeting preparatory work.
How	Group face-to-face debriefing meetings lasting approximately 45-minutes were held every month.
Where	<p>The intervention was delivered at a large teaching hospital with 703 beds. In 2013, there were 271 cardiac arrests which were attended by the hospital emergency team.</p> <p>Debriefing meetings were held in a seminar room located on the hospital acute medical unit, which was a central location on the hospital site. The room was large enough to accommodate up to approximately 30 people and was equipped with a computer and audiovisual facilities to show presentation slides. The table and chairs were arranged in a horseshoe shape. Lunch was provided at each meeting.</p>
When and how much	All meetings were open to all clinicians. This encompassed doctors, nurses, and allied health professionals, as well as medical and nursing students. Meetings were held on the second Tuesday of each month for eleven months.
Tailoring	Meetings were tailored each month, based on the cases being discussed and amount of discussion generated. This was a dynamic process, which sought to adapt to attendees' needs.
Modifications	No modifications were made during the study period. The meeting format had been developed during a previous study.
How well	<p>Planned: A data set was collected at each debriefing meeting, including a register of attendees.</p> <p>Actual: See data in paper.</p> <p>A median of two cases (IQR 1-2, range 1-3) were discussed per meeting. Of the nineteen cases discussed, someone present at the cardiac arrest event was present for the discussion for 9 (47%) cases, although this was typically only one (four cases) or two (three cases) clinicians.</p>

Table: Overview of individual oral debriefing intervention (Hospital two)

Why	<p>Whilst early data supports the use of cardiac arrest debriefing, some models may not be deliverable in the NHS setting.</p> <p>The intervention is intended to be deliverable in the NHS. Its aim is to improve delivery of CPR.</p>
What	<p>Materials</p> <p>Posters advertising cardiac arrest debriefing were placed in staff areas throughout the hospital.</p> <p>The debriefing consisted of a brief (approximately 5-minutes) discussion about the cardiac arrest. This was supplemented by a brief slide presentation (Microsoft PowerPoint 2007, Microsoft, Redmond, Washington) to show relevant data and key learning points.</p> <p>Procedures</p> <p>Following an eligible cardiac arrest, a list of attendees was identified through case notes and rotas. These clinicians were emailed and offered the chance to participate in an individual debrief.</p> <p>Debriefings consisted of a review of cardiac arrest event. This included a summary of the event and patient characteristics, review of electrocardiogram rhythms, and CPR quality. The participant was encouraged to reflect on events and ask questions. Patient details were anonymised.</p>
Who provided	Debriefings were facilitated by KC (resuscitation research nurse).
How	An individual oral debrief that lasted approximately 5-minutes was held following eligible cardiac arrests with event attendees individually.
Where	<p>The intervention was delivered at a district general hospital with 480 beds. In 2013, there were 134 cardiac arrests which were attended by the hospital emergency team.</p> <p>Debriefs were held at the hospital at a location convenient to the recipient. Locations used included ward areas and private offices. A laptop computer was used to show presentation slides.</p>
When and how much	All clinicians that attended the cardiac arrest were eligible to receive a debrief. Debriefs were held as soon as possible after the cardiac arrest, ideally 3-4 days after the cardiac arrest.
Tailoring	Meetings were tailored to the needs of each participant. The length of the debrief was determined by the case being discussed, the participant's reflective process, and amount of discussion generated.
Modifications	No modifications were made during the study period.
How well	<p>Planned: A data set was collected for each cardiac arrest event and each debrief.</p> <p>Actual: See data in paper.</p> <p>The median number of clinicians offered debriefing following each eligible cardiac arrest event was five (IQR: 4-6, range 1-9), of whom a median of two clinicians received debriefing (IQR 1-3, range 0-5). Median duration between the cardiac arrest event and intervention delivery was 6.7 days (IQR 4.5-12.0 days, range 1.9 hours to 28.6 days). Comparison of daytime and nighttime arrests showed a trend towards more clinicians being offered debriefing following daytime arrests, (Day: 5 (IQR 4-7) v Night: 5 (IQR 3-5), p=0.06), although the number of clinicians who received debriefing was similar (Day: 2 (IQR 1-4) v Night: 2 (IQR 1-3), p=0.34). However, the median number of days between the cardiac arrest event and debriefing delivery was significantly less for daytime cardiac arrests (Day: 5 (IQR 1-9) v Night: 12 (IQR: 8-16), p<0.001).</p>

Table: Overview of written feedback intervention (Hospital three)

Why	<p>Whilst early data supports the use of cardiac arrest debriefing, some models may not be deliverable in the NHS setting.</p> <p>The intervention is intended to be deliverable in the NHS. Its aim is to improve delivery of CPR.</p>
What	<p>Materials</p> <p>Posters advertising the intervention were placed in staff areas throughout the hospital.</p> <p>A feedback sheet was created using Microsoft Word (Microsoft Word 2007, Microsoft, Redmond, Washington) to show relevant CPR quality data, a summary of the cardiac arrest event, and key learning points. The length of the sheet was a single side of A4.</p> <p>Procedures</p> <p>Following each cardiac arrest, a list of attendees was identified through case notes and rotas.</p> <p>Defibrillator data were downloaded. In conjunction with information from the case notes, a feedback sheet was created.</p> <p>The feedback sheet was emailed to cardiac arrest attendees. The covering email requested that recipients reply to confirm that they had attended the cardiac arrest and reviewed the feedback sheet. Patient details were anonymised.</p>
Who provided	Feedback sheets were compiled by KC (resuscitation research nurse).
How	Feedback sheets were emailed to cardiac arrest attendees as soon as possible after each eligible cardiac arrest.
Where	<p>The intervention was delivered at a small district hospital with 248 beds. In 2013, there were 102 cardiac arrests which were attended by the hospital emergency team.</p> <p>Clinicians could review feedback sheets at any location where they could access their email account.</p>
When and how much	Cardiac arrest feedback sheets were sent via email to all clinical staff who attended cardiac arrest. The sheet was sent as soon as possible after an eligible cardiac arrest.
Tailoring	The format of feedback sheets were standardised. Free-text varied based on key learning points identified from the CPR data.
Modifications	No modifications were made during the study period.
How well	<p>Planned: A data set was collected for each cardiac arrest event and each debrief.</p> <p>Actual: See data in paper.</p> <p>The mean duration between the cardiac arrest event and the feedback sheet being sent by email was 7.1 days (SD=2.8, range 4 hours- 17.7 days).</p>

Table: CPR quality outcomes

	Treatment effect	P-value
Chest compression depth (mm)- mean difference (95% CI)		
Monthly group debrief (hospital one)	4.07 (1.22 – 6.92)	0.005
Individual debrief (hospital two)	2.06 (-1.39 – 5.52)	0.24
Written feedback (hospital three)	0.99 (-3.00 – 4.98)	0.63
Study phase two (all hospitals)	2.94 (0.92 - 4.95)	0.004
Chest compression depth ≥ 50mm- odds ratio (95% CI)		
Monthly group debrief (hospital one)	1.98 (1.13 - 3.47)	0.02
Individual debrief (hospital two)	1.43 (0.72 - 2.8)	0.31
Written feedback (hospital three)	0.99 (0.48 – 2.07)	0.98
Study phase two (all hospitals)	1.52 (1.05 - 2.20)	0.03
Chest compression rate (cpm)- mean difference (95% CI)		
Monthly group debrief (hospital one)	-1.52 (-3.91 – 0.86)	0.21
Individual debrief (hospital two)	1.00 (-2.27 – 4.28)	0.55
Written feedback (hospital three)	-3.73 (-7.22 - -0.24)	0.04
Study phase two (all hospitals)	-1.45 (-3.11 – 0.21)	0.09
Chest compression rate: 100-120 cpm- odds ratio (95% CI)		
Monthly group debrief (hospital one)	1.52 (0.89 – 2.59)	0.13
Individual debrief (hospital two)	0.65 (0.34 – 1.27)	0.21
Written feedback (hospital three)	2.01 (1.00 – 4.07)	0.05
Study phase two (all hospitals)	1.31 (0.92 - 1.86)	0.13
Chest compression flow fraction- mean difference (95% CI)		
Monthly group debrief (hospital one)	-0.90 (-2.62 – 0.83)	0.31
Individual debrief (hospital two)	1.55 (-0.55 – 3.64)	0.15
Written feedback (hospital three)	1.12 (-1.13 – 3.38)	0.33
Study phase two (all hospitals)	0.02 (-1.15 – 1.19)	0.98

Table: Estimate for time taken to deliver debriefing interventions per month

Process	Components	Hours required (per month)		
		Monthly group debriefing*	Individual oral debriefing†	Written feedback‡
Case identification	Review of cardiac arrest cases, downloading of defibrillator data, and initial review of data (MGD/ IOD/ WF)	4	4	4
Medical note review	Identify location of medical notes and review medical notes for relevant information (MGD/ IOD/ WF) IOD/ WF IOD/WF tend to require less data capture from medical notes and may sometimes be deliverable without access to medical notes.	2.5	2	2
Case analysis	In-depth case analysis based on medical notes and defibrillator data (MGD/ IOD/ WF) More detailed analysis required for MGD/ IOD	2.5	2	1.5
Review of research	Review of literature for relevant up-to-date information relevant to cardiac arrest (MGD/ IOD/ WF) More detailed analysis required for MGD	1	0.5	0.5
Creation of debrief information	Create presentation to show case information (MGD/ IOD) Create feedback sheet of case information (WF)	2.5	1.5	1
Informing of clinicians	Advertise debriefing at medical handover; Identify and email clinicians that attended case identified for discussion inviting them to attend (MGD) Identify clinicians that attended case and email/ phone offering them debriefing opportunity; Schedule time and location to meet (IOD) Identify clinicians that attended case and email feedback sheet (WF)	1.5	2.5	1
Delivery of debriefing	Deliver intervention (MGD/ IOD)	1.5	4	-
Total time (in hours) per month		15.5	16.5	10

MGD- Monthly group debriefing; IOD- Individual oral debriefing; WF- Written feedback. * Based on one meeting per month with a cardiac arrest incidence of ten events per month
† Based on ten cardiac arrest events per month, with debriefing delivered for four events and three clinicians receiving debriefing per cardiac arrest
‡ Based on ten cardiac arrest events per month, with debriefing delivered for four events

Table: Comparison of CPR quality data: Edelson et al 2008 and this study

	Edelson et al ¹ Control period (n=101)	Edelson et al ¹ Intervention period (n=123)	CODE Study Phase one (n=367)	Code Study Phase two (n=235)
CC Depth (mm)- mean ± SD	44 ± 10	50 ± 10	51.4 ± 10.4	54.3 ± 12.0
CC Rate (/minute)- mean ± SD	100 ± 13	105 ± 10	116.3 ± 11.1	114.8 ± 9.5
CC Flow Fraction (%)- mean ± SD	80 ± 13	87 ± 10	85.0 ± 7.05	85.0 ± 7.26
Pre-shock pause (secs)- median (IQR)	16.0 (8.5-24.1)	7.5 (2.8-13.1)	4.2 (2.3-11.0)	3.0 (2.0-5.9)
Post-shock pause (secs)- median (IQR)	7.1 (2.7-14.8)	2.4 (1.9-3.6)	2.30 (1.8-3.3)	2.30 (1.8-2.6)
CC- chest compression. SD- Standard deviations. IQR- Interquartile range				

Table: Comparison of patient outcome data: National Cardiac Arrest Audit and this study

	National Cardiac Arrest Audit (n=23,554) ²	CODE Study phase one (n=633)	Code Study phase two (n=353)
ROSC- n (%)	10607 (45%)	323 (51.0%)	183 (51.8%)
Survival to hospital discharge- n(%)	4153 (18.4%)	114 (18%)	78 (22.1%)
ROSC- return of spontaneous circulation			

References

1. Edelson DP, Litzinger B, Arora V, et al. Improving in-hospital cardiac arrest process and outcomes with performance debriefing. *Archives of internal medicine*. 2008;168(10):1063-1069.
2. Nolan JP, Soar J, Smith GB, et al. Incidence and outcome of in-hospital cardiac arrest in the United Kingdom National Cardiac Arrest Audit. *Resuscitation*. 2014;85(8):987-992.