Reviewing recommendations of root cause analyses

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Abstract

Objective: To determine the opinion of medical and nursing clinicians of recommendations arising from root cause analyses (RCAs) conducted between 1 April 2003 and 30 September 2004 in one Sydney Area Health Service.

Methods: Twelve doctors (response rate 86%) and 17 nurses (response rate 100%) reviewed 328 recommendations arising from 59 RCAs and completed a self-administered survey.

Results: Nurses were significantly more likely than doctors to rate recommendations made by the original RCA team as "relevant to the causal statement", "understandable", "measurable" and "achievable". Doctors and nurses involved in the original RCA were significantly more likely to state that recommendations would "eliminate" or "control" the risk of a similar event occurring in the future.

Conclusions: This is one of the first studies to analyse RCA data at the area health service level. That nurses reviewed recommendations more favourably may have implications for successful adoption of recommendations at the clinical level. We recommend further detailed analyses of recommendations arising from RCAs in order to determine their usefulness to inform strategies for improved patient safety.

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What is known about the topic?

There has been little rigorous evaluation of the implementation of the root cause analysis (RCA) processes in health care.

What does this paper add?

This is one of the first studies to explore the opinions of doctors and nurses on the recommendations arising from RCAs.

What are the implications for practitioners?

The authors recommend that RCA teams include a balance between medical and nursing staff and that all members of RCA teams complete training before participating in an RCA.

IN DECEMBER 2002 New South Wales Health and the Institute for Clinical Excellence introduced a new system of incident reporting.[1] The Patient Safety Improvement Program,[1] based on a successful program developed by the Veteran's Health Administration in the United States,[2,3] moves from the historical system of reporting of incidents/adverse events at the local level to a uniform statewide reporting and monitoring system. The aim of the Patient Safety Improvement Program is to identify, report, analyse and act on all incidents, thus making health care safer.[4]

The Program uses root cause analysis (RCA) as a process to identify systemic causes of incidents that occur in the health system including, where possible, analysis of "near miss" events.[1] RCA is a systematic method of analysing an incident or adverse event to determine how and why the event occurred and whether there are steps that could be taken to prevent a recurrence. A severity assessment code (SAC) is assigned to every adverse event by the person reporting the incident. The SAC is confirmed by the direct line

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1 Definitions of terms[4]

Eliminate: recommendations that remove, fix or replace a piece of equipment or put a measure in place to prevent the problem reoccurring.

Control: recommendations focused around development of checklists or cognitive aids etc; those that aim to reduce noise and disturbances.

Accept: recommendations that acknowledge that there is an associated risk and accept it — eg, putting up a warning notice, advise staff at orientation etc.

manager and again at the area health service level. The SAC codes range from "extreme risk" events such as death (SAC 1) to "low risk events" such as a patient fall or medication error where there was no injury to the patient, no increased care required or increased length of hospital stay (SAC 4). NSW Health has developed a matrix to determine the SAC based on the consequence of the event ("serious", "major", "moderate", "minor" or "minimum") and the likelihood of it recurring ("rare", "unlikely", "possible", "likely" or "frequent").[5] SAC 1 adverse events must be reported to NSW Health within 24 hours while SAC 2, 3 or 4 adverse events are reported to NSW Health at the Chief Executive Officer's discretion.[4]

Following allocation of a SAC, a reportable incident brief (RIB) is prepared and forwarded to the appropriate Divisional Head and the General Manager of the facility. The RIB provides initial information about the adverse event and lists further planned immediate action. Following receipt of a RIB, the General Manager of the facility confirms the SAC. RCAs are required for all SAC 1 adverse events, for adverse events likely to attract external attention and for those requiring notification under existing NSW Health legislative reporting requirements that have not been reported via other mechanisms.[5]

When an RCA is required, a detailed multidisciplinary analysis is conducted to identify the root causes and contributing factors. The RCA team, appointed by senior management, formulate causal statements and make structured recommendations to *eliminate*, *control* or *accept* the risk of a similar event occurring in the future (Box 1).[6] While eliminating or at best controlling the risk of a similar event occurring in the future are the most preferable options, at times this may not be possible. Constraints, such as financial, logistics or factors outside the control of the organisation may result in the RCA team acknowledging that in a particular instance, the risk of the event recurring in the future may have to be accepted.[6] In those cases where the risk is acknowledged to be accepted, regular monitoring is required.

While the RCA, process is becoming more widely used in Australia, the United Kingdom and the US, there is little evidence for the effectiveness of this model of error investigation and action model.[7] One study undertaken by the National Center for Patient Safety in the US compared the recommendations following adverse events before and after the implementation of an RCA process. Following RCA significantly more adverse events had recommended actions.[2] Another before-and-after study, also conducted in the US, examined adverse medication events in a tertiary referral hospital and reported a significant decrease in the rate of voluntarily reported adverse medication events following introduction of the RCA process.[8] The authors attributed this to introduction of the RCA "blame-free" culture.[8]

We undertook a survey to determine the opinion of nurses and doctors of recommendations arising from RCAs conducted between 1 April 2003 and 30 September 2004 in one Sydney area health service.

Methods

All RCAs completed between 1 April 2003 and 30 September 2004 within South Western Sydney Area Health Service (SWSAHS) were identified. RCAs that did not result in causal statements and recommended actions (ie, no conclusions were reached) and any RCAs occurring in a service area with no related nursing component were excluded.

The relevant clinical specialties were identified from the RCAs by the Project Co-ordinator. One senior medical practitioner ("doctor") and one

2 Number of recommendations by specialty included in expert review (*n* = 328)

Specialty	No. of recommendations
Medicine (general)	53
Emergency medicine	52
Surgical services*	45
Mental health	37
Maternity	29
Neonatology	29
Cardiology	16
Geriatrics	15
Cancer therapy†	12
Alcohol & other drugs	11
Intensive care	10
Renal services	10
Radiology	6
Aged care psychiatry	3

* Includes general surgery, neurosurgery and operating suite. † includes oncology and radiotherapy.

senior nurse (Clinical Nurse Consultant or Nurse Unit Manager — "nurse") (collectively referred to as "clinicians") from each clinical specialty were chosen to review each RCA. Selection of the clinicians was undertaken collaboratively by the Area Patient Safety Officer, the Area Director of Medical Services and the Project Coordinator. All clinicians received an advanced letter from the SWSAHS Area Director of Nursing and Clinical Services (RC) informing them of the study and inviting them to participate.

One week later surveys were mailed to clinicians with a letter of explanation from the SWSAHS Area Director of Nursing and Clinical Services. Copies of the RIBs pertaining to each appropriate RCA were provided to each clinician. Each RIB was de-identified, with all references to individual staff or facilities removed. A glossary of terms was provided. Return addressed envelopes also were provided. Non-responders were followed up by email at 2 weeks and telephone at 4 and 6 weeks after mailing of the surveys.[9] A medical peer prompt was provided to medical non-responders 8 weeks following mailing of the survey.

Instrument

Because similar research had not been undertaken elsewhere, the data collection instrument was developed by the team for this project. To determine experience and training with the RCA process, our first section asked participants if they had participated in an RCA (one question — "yes", "no", "unsure"). Next, clinicians were asked whether they had undergone any RCA training (one question — "yes", "no", "unsure"), and if so, whether it was the 2.5-day *Safety improvement program* (SIP) conducted by NSW Health or the *Just-in-time* training conducted by SWSAHS (two questions).

Clinicians then were asked to assess whether each recommendation made by the original RCA team were: *relevant to the causal statement*; *understandable*; *measurable;* and *achievable* (four questions) ("yes", "no", "unsure"). Next, clinicians were asked whether each of the RCA recommendations had the potential to *eliminate*, *control* or *accept*[4] risk of a similar event occurring in the future or whether they were "unsure" (one question). Definitions were provided for these terms (Box 1).[4]

Clinicians then were asked to indicate whether recommendations made for a specific facility might have area-wide applicability (ie, were potentially generalisable outside the specialty area in which the adverse event occurred) (one question) ("yes", "no", "unsure").

Using a five point Likert scale ("highly likely" to "highly unlikely"), clinicians were asked to assess the overall potential for recommendations arising from the RCA to improve the quality of care and comment if their response was "unlikely" or "highly unlikely"(two questions).

Next, clinicians were asked if there were recommendations related to the incident that they considered were not included by the original RCA team ("yes", "no", "unsure") and where applicable what this recommendation should be (two questions). Our final section asked clini-

cians whether they had knowledge of the particular adverse event before our survey (one question) ("yes", "no", "unsure") and, specifically, if they had participated in the particular RCA being reviewed (one question) ("yes", "no", "unsure"). Using a three point Likert scale, ("very difficult" to "not difficult at all") clinicians who had not participated in the specific RCA were asked how difficult it was to complete the survey without prior involvement in the RCA (one question).

Data analysis

Data were analysed using SPSS version 10.0.[10] McNemar's chi square tests were used for paired responses to determine differences between the doctors' and nurses' opinion as to whether or not recommendations were *relevant to the causal statement*, *understandable*, *measurable* and *achievable* and whether implementation of the recommendations made by the original RCA team likely would lead to improved quality of care. Similarly, McNemar's chi square tests were used for paired responses to determine differences between the opinion of RCA teams involved in the original review and the opinion of doctors and nurses as to whether recommendations would have the ability to *eliminate* or *control* the risk of a similar event occurring in the future.

Results

There were 65 RCAs conducted at SWSAHS between 1 April 2003 and 30 September 2004. Six RCAs were ineligible for inclusion: three had no recommendations and three were related to a service with no nursing component. Hence, 59 RCAs were included in the study.

The 59 RCAs occurred within 14 clinical specialties (Box 2). While one doctor reviewed the entire specialty of surgical services, three different nurses were asked to review sub-specialties of general surgery, neurosurgery and operating suite. Similarly, one doctor reviewed the specialty of cancer services while two nurses reviewed sub-specialties of oncology and radiotherapy. In total 14 doctors and 17 nurses were asked to review the 328 recommendations.

3 Participation and training in the root cause analysis (RCA) process*

	Doctors no. (%)	Nurses no. (%)
Participation in an RCA		
	n = 12	*n* = 17
Yes	10 (83%)	12 (71%)
No	2 (17%)	5 (29%)
Participation in RCA training		
	n = 12	*n* = 17
Yes	3 (25%)	8 (47%)
No	8 (67%)	9 (53%)
Type of training		
	n = 3	*n* = 8
SIP	3 (100%)	6 (75%)
Just-in-time	0 (0)	2 (25%)

* Where totals do not add to 100%, data were missing.

Completed surveys were received for all 59 RCAs. Of the 14 doctors asked to participate, 12 completed surveys forms (86% doctor response rate) reviewing 264 recommendations (80.5%) of the 328 recommendations from 48 RCAs. Of the 17 nurses asked to participate, all completed survey forms (100% nurse response rate), providing an opinion about all 328 recommendations from the 59 RCAs (100%).

The majority of doctors ($n = 10$; 83%) and nurses ($n = 12$; 71%) had participated in an RCA. Only a quarter of doctors ($n = 3$; 25%) had participated in SIP training while just less than half of the nurses had done so ($n = 8$; 47%); however, nurses were no more likely than doctors to have attended SIP training ($\chi^2 = 1.45$; df = 1, $P = 0.23$) (Box 3).

The majority of recommendations were reported by both nurses and doctors to be *relevant to the causal statement, understandable, measurable, achievable* and *applicable across the Area Health Service* (Box 4). Nurses were significantly more likely than doctors to rate recommenda-

4 Assessment of recommendations by clinicians*

	Doctors, no. (%) (*n*=264)†	Nurses, no. (%) (*n*=328)†
Relevant to causal statement		
Yes	179 (67.8)	271 (82.6)
No	22 (8.3)	14 (4.3)
Unsure	35 (13.3)	26 (7.9)
Understandable		
Yes	213 (80.7)	302 (92.1)
No	23 (8.7)	8 (2.4)
Unsure	11 (4.2)	17 (5.2)
Measurable		
Yes	174 (65.9)	280 (85.4)
No	45 (17.0)	15 (4.6)
Unsure	24 (9.1)	31(9.5)
Achievable		
Yes	157 (59.5)	261 (79.6)
No	21 (8.0)	4 (1.2)
Unsure	49 (18.6)	59 (18.0)
Applicable across the area		
Yes	201 (76.1)	233 (71.0)
No	26 (9.8)	38 (11.6)
Unsure	24 (9.1)	49 (14.9)

* Where totals do not add to 100%, data were missing.
† Number of recommendations.

tions as *relevant to the causal statement* (91.1% v 75.7%; McNemar's $\chi^2 = 24.50$, df = 1, $P < 0.001$); *understandable* (91.9% v 86.2%; McNemar's $\chi^2 = 5.28$, df = 1, $P = 0.02$); *measurable* (83.4% v 71.4%; McNemar's $\chi^2 = 10.74$, df = 1, $P = 0.001$); and *achievable* (77.7% v 69.2%; McNemar's $\chi^2 = 4.56$, df = 1, $P = 0.03$) (Box 4) (these percentages differ to those shown in Box 4, as missing data from the doctors limited the availability of data to be matched).

Recommendations rated as *relevant to the causal statement* by nurses were significantly less likely also to be rated as *achievable* by nurses (87.3% v 81.1%; McNemar's $\chi^2 = 4.98$, df = 1, $P = 0.03$). There was no similar finding between relevance and achievability of recommendations as rated by doctors.

Doctors indicated that 76.1% of the recommendations had the potential to be applicable across the entire Area Health Service, that is, not just limited to the particular specialty in which the adverse event occurred. Nurses rated 71.0% of recommendations similarly. The majority of recommendations were rated by both doctors (75.0%) and nurses (67.7%) as having the ability to *control* the risk of a similar event occurring in the future. RCA teams involved in the original review were significantly more likely to state that recommendations made by them would have the ability to *eliminate* and *control* the risk of a similar event occurring in the future when compared with the opinion of nurses (97.4% v 82.5%; McNemar's $\chi^2 = 32.81$, df = 1, $P < 0.001$) and doctors (97.2% v 86.1%; McNemar's $\chi^2 = 17.36$, df = 1, $P < 0.001$) (Box 5).

Nurses were significantly more likely than doctors to state that implementation of the recommendations made by the original RCA team would "highly likely" or "likely" lead to improved quality of care (87.0% v 58.7%; McNemar's $\chi^2 = 8.47$, df = 1, $P = 0.002$) (Box 6).

5 Potential effect of recommendations*

Recommendation	Doctors no. (%) (*n*=264)†	Nurses no. (%) (*n*=328)†	Original RCA team no. (%) (*n*=328)†
Control	198 (75.0)	222 (67.7)	272 (82.9)
Eliminate	27 (10.2)	48 (14.6)	26 (7.9)
Accept	21 (8.0)	23 (7.0)	8 (2.4)
Unsure	18 (6.8)	32 (9.8)	0 (0)

* Where totals do not add to 100%, data were missing. † Number of recommendations. RCA = root cause analysis.

6 Participants opinions, knowledge and experience of root cause analyses* (RCA)

	Doctors no. (%)	Nurses no. (%)
Likelihood of original root cause analysis recommendations leading to improved care		
	n = 48 RCAs	*n* = 59 RCAs
Highly likely	4 (8)	16 (27)
Likely	24 (50)	36 (61)
Unsure	9 (19)	5 (9)
Unlikely	10 (21)	1 (2)
Highly unlikely	0 (0)	0 (0)
RCAs requiring more recommendations		
	n = 48 RCAs	*n* = 59 RCAs
Yes	22 (46)	18 (31)
No	11 (23)	35 (59)
Unsure	4 (8)	5 (5)
Participants aware of the adverse event before this survey		
	n = 48 RCAs	*n* = 59 RCAs
Yes	17 (35)	25 (42)
No	29 (60)	34 (58)
Unsure	1 (2)	0 (0)
Participation in this RCA		
	n = 48 RCAs	*n* = 59 RCAs
Yes	7 (15)	12 (20)
No	39 (81)	46 (78)
Unsure	0 (0)	1 (2)
Difficulty in completing the survey for this RCA for those who did not participate in the relevant original RCA		
	n = 41 RCAs	*n* = 47 RCAs
Very difficult	3 7	2 4
Difficult	17 41	11 23
Not difficult at all	19 46	34 72

* Where totals do not add to 100%, data were missing.

There was some previous knowledge of the adverse events before this survey by both doctors and nurses (Box 6). Seventeen (35%) of doctors and 25 (42%) of nurses stated they were aware of the adverse event before this survey. Only 15% of doctors ($n = 7$) and 20% of nurses ($n = 12$) had participated in the same RCA they had subsequently been asked to review in the expert survey. Just under half of the doctors (48%, $n = 20$) and just over a quarter of nurses (27%, $n = 13$) who did not participate in the original RCA reported that they found completing the survey "very difficult" or "difficult" (Box 6).

Nurses who participated in the expert survey and who also had participated in the original RCA were no more likely than those nurses who did not participate in the original RCA to state that improved quality of care would be "highly likely" or "likely" achieved through implementation of the RCA team's recommendations (91% versus 89%; Fisher's Exact Test $P = 1.00$). Similarly, doctors who participated in the expert survey and who also participated in the original RCA were no more likely than their colleagues who did not participate in the original RCA to state that improved quality of care would be "highly likely" or "likely" achieved through implementation of the RCA team's recommendations (86% v 54%; Fisher's Exact Test $P = 0.213$).

Doctors stated that 22 RCAs (46%) required more recommendations while nurses stated that 18 RCAs (31%) required more recommendations (Box 6).

Discussion

Our expert review found that nurses were significantly more likely than doctors to rate recommendations as *relevant to the causal statement, understandable, measurable* and *achievable*. Nurses were also significantly more likely than doctors to state that, on the whole, the recommendations from each RCA would lead to improved care. Of concern, those recommendations rated as *relevant to the causal statement* by nurses were significantly less likely to also be rated as *achievable*. These results may have implications for successful adoption of recommendations at the clinical level. Endorsement and implementation of recommendations by potential adoptees may depend upon the type of practitioner, and a balance between medical and

nursing staff in RCA team membership is recommended to offset this potential bias.

The clinicians were positive that recommendations would lead to improvements but this optimism could not be substantiated within this study. RCA teams are not obliged to use evidence to justify their recommendations. Recommendations that are evidence-based may be implemented more consistently or more quickly. We recommend further analysis of RCAs to systematically determine resulting improvements.

While an individual may learn from an experience and personally change practice, this can occur in a vacuum and may not lead to overall change within, or beyond, the immediate setting.[11] The clinicians in our survey concluded that the majority of the recommendations (doctors: 76.1%; nurses: 71.0%) had applicability outside the specialty area in which the event occurred. Hence, they may potentially be useful in a variety of specialty areas within the Area Health Service; whether these recommendations have been circulated or adopted area-wide is uncertain.

It was worrying that few of these participating senior clinicians (only a quarter of doctors and less than half of the nurses) who are most likely to be invited to participate in an RCA had not received SIP training. Our study was, by necessity, methodologically constrained by the fact that some nurses and doctors had prior knowledge of the adverse event, however they were in the minority. Less than one fifth ($n = 12$, 20%) of nurses and one sixth ($n = 7$, 15%) of doctors had participated in the same RCA they had subsequently been asked to review in the expert survey. We included these senior clinicians in our study as they would have been ultimately responsible for implementing recommendations and, as such, their opinion was important to represent.

Interestingly, having participated in the original RCA was not a predictor for either the doctors or nurses stating that improved quality of care would be "highly likely" or "likely" achieved through implementation of the RCA team's recommendations. Unsurprisingly, the original RCA team rated the recommendations they formulated as significantly more likely than the clinicians who participated in our independent review to have the ability to *eliminate* or *control* the risk of a future similar event.

It is difficult to be assured that RCA teams ascertain the real root causes of adverse events. Critics of the RCA method suggest that the quality of the result is dependent on the data input which, in turn, is dependent on the relationships within the RCA team.[12] RCA team members may come to the RCA with preconceived ideas and they may, unintentionally or otherwise, align the outcomes with "prior opinions and powerful audiences"[12] (p. 4). It is uncertain whether the original RCA teams involved in formulating the recommendations examined in our study, accurately identified the root causes of the adverse events;[13] however, determination of this was beyond the scope of our study.

There is insufficient published research on the RCA process to provide compelling evidence of its link to improved patient safety.[13] Proving this link may be impossible. However, research into elements of the RCA process in order to refine and broaden our knowledge of patient safety is of value. Whether the RCA process is used as an inward-focusing activity, examining individual clinical errors, or whether lessons learnt from the process influence hospital clinical governance remains to be seen.[14] Our findings invite further purposeful and effective analysis of RCAs and their resulting recommendations.

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Competing interests

The authors declare that they have no competing interests.

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