Root Cause Analysis and Health Informatics

Richard W. JONES [a] and George DESPOTOU[b1]
[a] *Department of Computer Science, University of York, U.K.*
[b] *Institute of Digital Healthcare WMG, University of Warwick, U.K.*

Abstract. Root Cause Analysis (RCA) is the most widely used system analysis tool for investigating safety related incidents in healthcare. This contribution reviews RCA techniques, using a Health Informatics example, and discusses barriers to their successful uptake by healthcare organisations. It is concluded that a critical assessment to examine the uptake and evaluate the success of RCA, and other safety related techniques, within healthcare is long overdue.

Keywords. Root Cause Analysis, NHS, 5-Why's, Cause and Effect Diagram.

1. Introduction

Root Cause Analysis (RCA) is, by far, the most widely used system analysis tool for investigating healthcare safety related incidents either as a stand-alone technique or as part of a continuous improvement methodology such as Lean Sigma [1]. A systems-based approach RCA is, ideally, a team-based exercise that seeks to identify why adverse incidents happen by determining the underlying cause(s) of the problem, while avoiding focusing on mistakes by individuals.

RCA has been used in healthcare since the mid 1990's and is currently prevalent in the US, UK and Australia while in the process of being adopted in many other countries [2]. In the US its use has been mandated by the Joint Commission (since 1997) for the analysis of sentinel events while in the UK the National Health Service (NHS) has endorsed RCA as the main tool for incident investigation since 2001, including the development of a RCA toolkit for healthcare [3]. The RCA process is sequential in nature comprising the following main steps: (1) identify the incident, (2) organise a team to carry out the RCA, (3) study the work processes, (4) collect the facts, (5) search for causes; (6) take action, (7) evaluate the actions taken [4]. Successful IT organizations are increasingly implementing RCA for problem solving purposes with it being recognized, within healthcare, that RCA plays a major role in helping to understand cognitive factors related to Health Informatics (HI)-related adverse events, for example, adverse events related to the introduction and use of Electronic Health Records (EHR) [5] in the clinical environment.

An overview of the RCA techniques recommended by NHS England is provided with the '5-Why's' approach being applied to an EHR related example. Pros and cons of the RCA approach are briefly outlined with some challenges relating to the successful uptake and use of RCA, and safety analysis techniques in general, by NHS hospitals are then discussed.

2.0 RCA Approaches: 5 Why's and Cause and Effect Diagrams

[1] Corresponding Author: g.despotou@warwick.ac.uk

The Institute for Safe Medication Practices states that for the RCA to be effective, an accurate sequence of events and timeline are needed to understand the relationship between contributory factors and the underlying cause [6]. After the determination of an accurate sequence of events NHS England supports the use of the '5 why's' method for root cause determination, a Cause and Effect diagram for graphically illustrating the possible multiple causes that contribute to a specified problem and a Pareto chart to identify the most effective RCA actions to be carried out [7].

2.1 The 5-Why's and Cause and Effect Diagrams

The '5 Why's' method of root cause determination involves repeatedly questioning 'why' to an initial problem statement (more specifically, questioning the answer to each specific 'why') so that the reasons the problem exists are critically explored. If used properly, the '5-Why's' traces the 'chain of causality' back to the root cause. It may take fewer or more than five Why's before the team agrees that the root cause of the problem has been revealed. Figure 1 shows a simple example where the root cause is related to software upgrades of the EHR.

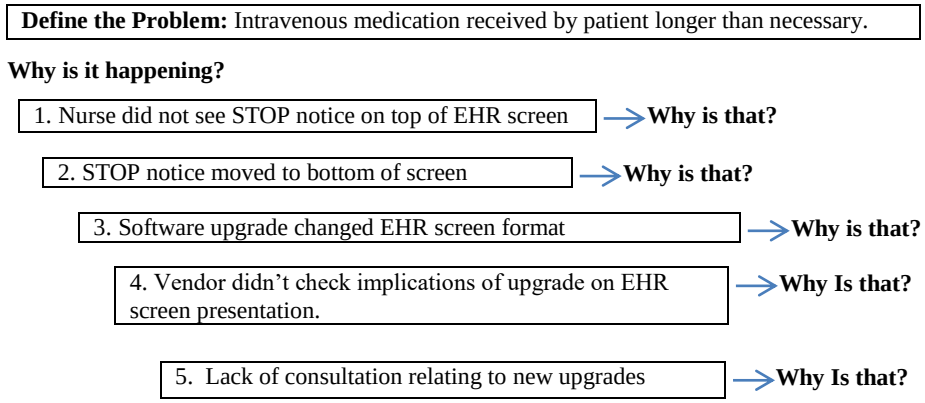

Figure 1. 5 Why's example related to intravenous medication received longer than necessary [10].

In this example, Figure 1, the nursing staff expected to see a STOP notice at the top of the EHR screen. The position of the STOP notice changed with the software upgrade. The root cause of this problem was a lack of consultation, about the new EHR upgrade, between the vendor and the hospital.

Nicolini *et al*., [8] documented 10 incident investigations, within two large acute NHS hospitals, over an 18 month period to gain a deeper insight into how RCA was being used within the NHS. The 'timeline' was seen to be systematically used (in conjunction with 'brainstorming') to determine root causes, while Cause and Effect diagrams were seen in only two of the investigations and the '5-Why's' approach was not seen at all. Similarly Antony and Kumar [1] examined the use of the Lean Sigma methodology (within NHS Scotland), and the safety techniques therein, to find that RCA was used but no one used Failure Modes and Effect Analysis (FMEA) which is supposedly healthcare's main hazard and risk analysis tool. Lack of, or poor, training was a common staff complaint with Antony and Kumar concluding that 'In the NHS, it appears that there is clear lack of leadership and strategic vision with regard to continuous business improvement methodologies' [1]. A contributing factor, to the lack of uptake of systematic safety analysis methods, could be mismatch between current

safety analysis techniques and the healthcare domain. Work is being carried out on developing less time consuming, more transparent healthcare orientated analysis approaches [9] though it has also been suggested that tools that 'reflect the narrative nature of thinking amongst healthcare practitioners' [8] be developed, and used alongside traditional engineering-based analysis tools.

A series of RCA's relating to a specific outcome such as, for example, 'Unintended Consequences relating to the use of EHR's', should for transparency sake be presented graphically via a 'Cause and Effect' diagram, see Figure 2. From the '5 Why's' example, the determined root cause 'lack of consultation relating to new upgrades' would comprise a primary cause within the EHR (as designed) Infrastructure.

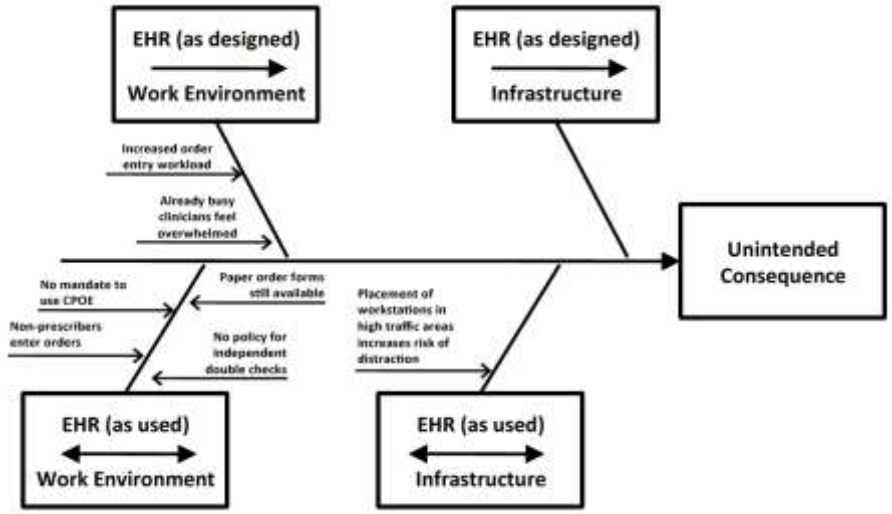

Figure 2. A Cause and Effect diagram for unintended consequences of EHR's [10].

2. Pros and Cons of '5-Why's' and RCA

The attraction of the '5-Whys' approach to RCA lies in its simplicity and transparency, especially when problems involve human factors or interactions, which makes it particularly relevant for the safe use of EHR's. Healthcare practitioners need to be made aware of its advantages over 'brainstorming'. '5-Why's' can also help determine the relationship between other root causes. The '5 Whys' method has a number of recognized limitations [11]:

- Its application to large-scale issues is limited.
- The results are dependent on user/team knowledge – causes cannot be found that are not already known. This is why a team approach is needed.
- There is a tendency to stop prematurely at symptoms rather than going on to lower-level root causes.
- Results are not repeatable – different teams using '5 Whys' will come up with different causes for the same problem.

Borrowing from Fault Tree construction rules, logical tests for necessity and sufficiency could be used at each level to help avoid the selection of spurious causes as well as also promoting the consideration of multiple root causes.

4.0 Discussion: How Effective is RCA?

RCA, within healthcare, should deliver improvement through promoting workforce involvement, fostering horizontal workplace relationships, liberalising the scrutiny of clinical expertise, and creating a democratised view of service transformation [4]. Nicolini *et al.,* [7] indicate that apart from 'promoting workforce involvement' the workplace hierarchy still persists within RCA team meetings coupled with a general lack of enthusiasm from clinician's regarding attendance. Though the clinician's attendance might be partly attributed to time constraints the persistence of a blame culture within the NHS continues to play a major role [12].

Though RCA is widely used, using 'Brainstorming' rather the '5 Why's'approach, there is little evidence to support its effectiveness from both an efficacy and cost perspective [2]. This is surprising given NHS England's continuing mission to 'optimise flow and reduce costs'**.** There seems to be no consensus on how NHS hospitals should follow up or analyze RCA data, which limits the utility of RCA as a quality improvement tool [7]. The US Veteran Affairs RCA toolkit explicitly includes steps to determine the 'approximate cost of the RCA' as well as 'reporting on the effectiveness of RCA actions' [4] with one rigorous US study, indicating that RCA developed actions reduced error rates related to preventable serious adverse drug events (ADEs) - reported serious ADEs/100,000 patient days decreased from 7.2 to 4.0 [13].

RCA is the most widespread safety analysis technique used in the NHS though root cause determination seems to be solely based on brainstorming with the recommended more systematic '5-Why's' approach not being used [7]. A critical assessment of the effectiveness of RCA, and also other safety related techniques such as FMEA, within the NHS, is overdue.

References

[1] J. Anthony, M. Kumar, Lean and Six Sigma Methodologies in NHS Scotland, *Quality Innovation Prosperity*, **16** (2012), 19-34.

[2] A.W. Wu, A. K. Lipshutz, P.M. Pronovost, Effectiveness and efficiency of root cause analysis in medicine. *JAMA*, **299** (2008), 685-687.

[3] NHS National Patient Safety Agency, A guide to Root Cause Analysis from the NPSA [online] *Available at: https://report.nrls.nhs.uk/rcatoolkit/course/iindex.htm*, accessed 2-04-16.

[4] Veterans Health Administration, VHA National Patient Safety Improvement Handbook, *VHA Handbook 1050.01 (March 4, 2011)*.

[5] Committee on Patient Safety and Health Information Technology and Institute of Medicine, *Health IT and Patient Safety: Building Safer Systems for Better Care*, (2012).

[6] Institute for Safe Medication Practices, Building Patient Safety Skills Common pitfalls when conducting a root cause analysis https://www.ismp.org/newsletters/acutecare/articles/20100422.asp, 2-04-16.

[7] NHS Institute for Innovation and Improvement, Cause and Effect (Fishbone), *(Online)*, http://www.institute.nhs.uk/quality_and_service_improvement_tools/quality_and_service_improvement_tools/cause_and_effect.html, accessed 2-04-16.

[8] D. Nicolini, J. Waring, J Mengis, Policy and practice in the use of root cause analysis to investigate clinical adverse events: Mind the gap, *Social Science & Medicine*, **73** (2011), 217-225.

[9] G. Despotou , R.W. Jones, A. Rae, S. White, M. Ryan, T. Kelly, Deviation-based Safety Analysis and Justification of Clinical Services, *Studies in Health Technology and Informatics*, **202** (2014), 91-94

[10] Office of the National Coordinator for Health Information Technology (ONC), *Case Studies (Online)*, https://www.healthit.gov/unintended-consequences/appendix/examples.html, accessed 2-04-16,

[11] M. Grissinger, Building Patient-Safety Skills: Avoiding Pitfalls in Conducting a Root Cause Analysis, *P&T*, **38** (2013), 728-729.

[12] GOV.UK News Stories, *Plans to end the cover-up culture in the NHS* (*Online)*, https://www.gov.uk/government/news/plans-to-end-the-cover-up-culture-in-the-nhs, accessed 2-04-16.

[13] J.H. Rex, J.E. Turnbull , S.J. Allen , K. Vande Voorde , K. Luther, Systematic root cause analysis of adverse drug events in a tertiary referral hospital**.** *Jt Comm J Qual Improv.*, **10** (2000) 563-575.