

Resilience engineering in healthcare: Moving from epistemology to theory and practice

Anderson, J.E.,¹ Ross, A.², and Jaye, P.²

¹ King's College London, 57 Waterloo Road, London, U.K. SE18WA

² Simulation and Interactive Learning Centre, St. Thomas's Hospital, Westminster Bridge Road London, U.K.

Janet.anderson@kcl.ac.uk

Abstract. Few studies have taken a whole system approach to engineering resilience in healthcare. Doing so involves challenges in operationalising and measuring concepts, developing interventions and assessing their impact at a systems level. In this paper we have outlined a newly funded programme of work to operationalise key resilience concepts, develop and implement interventions to increase resilience, develop metrics to assess their effects and to make recommendations about how the insights of resilience engineering can be harnessed to improve patient safety. The results will provide evidence about the implementation and impact of four complex interventions in the areas of learning, responding, monitoring and anticipating, both singly and in combination, allowing future resilience interventions to be chosen based on knowledge of their effectiveness. The study will also yield an in depth picture of resilience engineering in action to inform the development of theory and the maturation of the approach.

1 INTRODUCTION

Traditional approaches to improving safety in healthcare are reactive and define safety as an absence of errors or adverse events (Woods et al., 2001; Sheps & Cardiff, 2009). Safety management practices are underpinned by a dominant technical/rational paradigm which is reductionist and based on linear causality (Wallace & Ross, 2006; Dekker et al., 2011). This approach does not take into account the complexity of healthcare systems, which can never be fully specified and therefore cannot be controlled via rigid procedures and rules (Dekker, Cilliers & Hofmeyr, 2011; Flach, 2012; Nemeth, 2011).

Resilience engineering represents a philosophical shift in safety science towards a proactive systems approach that addresses the need for organizations to adapt to changes in the environment in which they operate and to support workers to adapt safely when needed. Safety and harm are viewed as emergent properties of the system, (Flach, 1999; Rauterberg, 1996), both of which are caused by exogenous and endogenous variability. The focus is therefore on how to manage this variability safely

and this is proposed to be achieved by four abilities; responding to threats and disturbances, monitoring organisational performance as it unfolds in real time, learning from past experience (both successes and failures), and anticipating changes in the future (Hollnagel, 2009).

Resilience engineering is at an early stage of development and although the epistemological basis is well developed the practical application of these ideas to building resilient organisations is not. Engineering resilience, rather than simply proposing how resilient organisations behave, poses difficult practical questions about how interventions, methods and measurements might be developed and tested in a complex system in the real world, with the requirement to demonstrate outcomes in line with specified safety objectives. In this paper we outline a funded programme of work which will extend the theoretical basis of resilience engineering by testing its operation in context.

1.1 Aims and objectives

This research seeks to extend the theory and practice of resilience engineering by developing, implementing and testing interventions to improve organisational resilience. The overall aims are to identify how healthcare organisations can be engineered to be more resilient and to develop techniques to assess whether this has been achieved. The objectives of the research are to

1. Develop and implement multilevel tailored interventions to increase organisational resilience in different clinical settings
2. Evaluate their effectiveness, singly and in combination, in terms of quality and cost effectiveness, and a range of other outcome measures
3. Determine the relationship between resilience and other measures of quality and safety
4. Extend and develop the theoretical framework of resilience engineering, using insights from resilience in other domains and empirical evidence from the study

These high level objectives will be achieved by in depth work to

- Analyse existing data, model system performance and track it over time
- Develop measures of organisational resilience
- Examine aspects of resilient practice (eg. trade-offs and sacrifice judgements, gap between procedures and practice, organisational drift, sources of pressure) via ethnographic observations of clinical work
- Develop and implement, in collaboration with clinical teams multilevel (managerial and frontline) interventions to increase resilience
- Evaluate with mixed methods changes in system metrics, measures of

resilience, staff knowledge, skills and attitudes and costs-benefits

- Synthesise results and develop an empirically validated model of resilience.

An overview of the research phases is shown in Figure 1

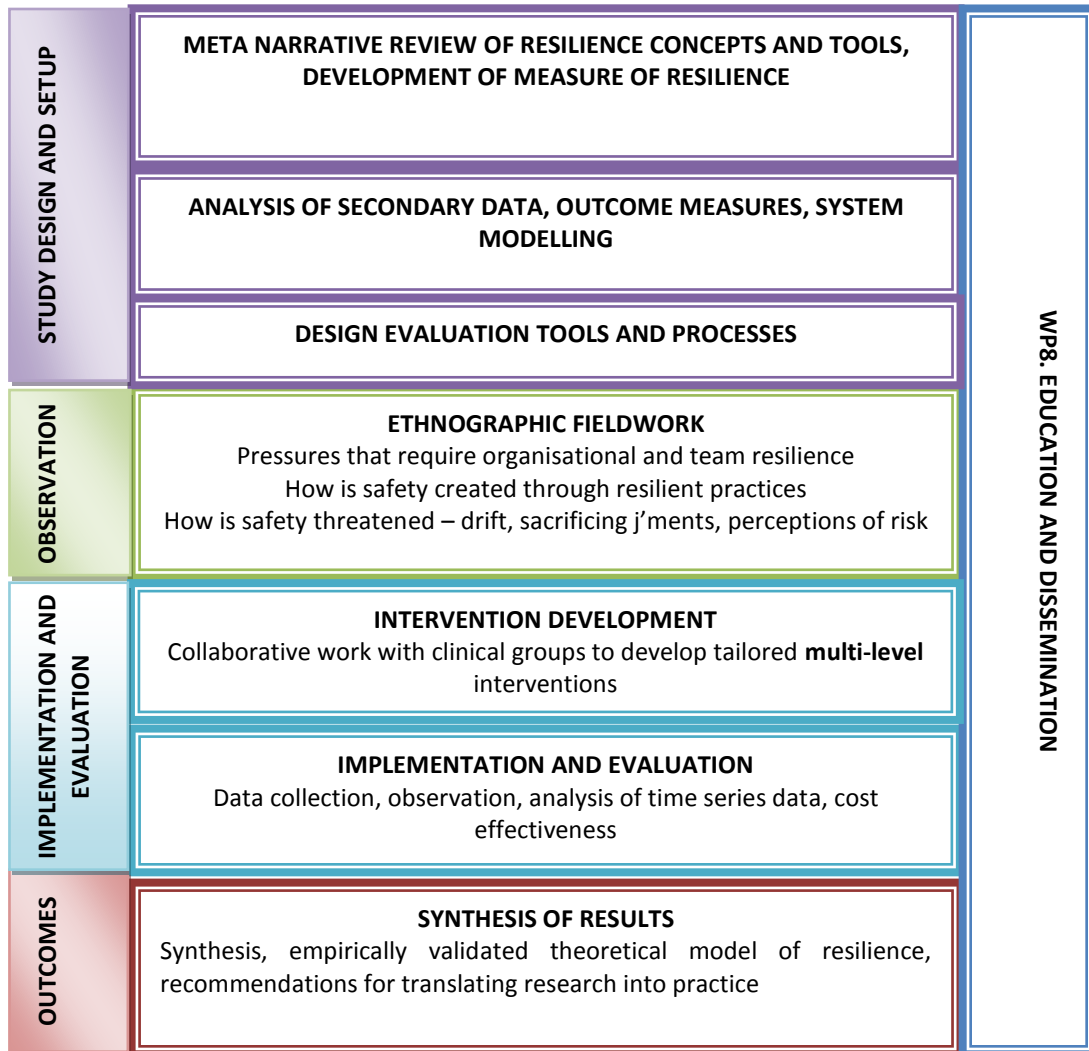


Figure 1. Overview of research design

2 METHODS/DESIGN

2.1 Meta Narrative Review.

Resilience is a concept being applied to diverse areas of human and organisational activity. It is grounded in different research traditions and has been applied differently depending on the context and the challenges faced in different areas of human activity. Although our research is based on the insights of RE we also intend to draw on developments and insights from other areas. To do this we are conducting a meta narrative review to identify how resilience has been conceptualised, operationalized and applied in 5 different disciplines – organisational/management, natural hazards and disasters, psychology, sport psychology and safety science/human factors. Meta narrative review (Wong et al., 2013) is a configuring or mapping approach to reviewing scientific literature. The aim is to identify how different research traditions have interpreted and studied the concept and to integrate these narratives into a meta narrative summary of the topic. The emphasis is therefore on how the concept was researched, rather than exhaustively summarising all the findings (Gough et al., 2013). The meta narrative review will inform all subsequent stages of the research.

2.2 Clinical areas.

We intend to study two clinical areas in depth; an older person's unit providing specialist care and accident and emergency. The aim is to contrast and compare the different clinical environments in order to start to understand the influence of context on the theory and practical application of the RE. These areas were chosen because they differ in terms of patient acuity and needs, multidisciplinary team requirements, temporal demands and co-ordination requirements. We hypothesise that threats to resilience and strategies to increase resilience will differ depending on these factors. Data will also be collected from control sites.

2.3 System modelling.

Assessment of the quality of care is currently based on tracking individual indicators such as numbers of falls or patient complaints. RE is a systems based approach that recognises that multiple aspects of system performance fluctuate over time, co-vary and interact. Therefore, the development of methods and metrics to understand and model system performance, rather than performance on individual variables, will be a key aim of the research. Leading and lagging indicators will be identified and modelled. Exploratory methods compatible with systems thinking (Byrne, 2002) such as trend analysis, cluster analysis, social network analysis and log linear modelling will be used to visualise and detect shifts over time, patterns, organizations and interactions. The unit of analysis will be the dynamic system as a whole rather than the individual atomised elements which make up the system. This system modelling work will underpin all later stages of the work and form the basis of our evaluation of the effects of resilience interventions.

2.4 Ethnographic fieldwork.

The whole programme of work will be informed by in depth ethnographic and qualitative analysis to understand the realities of clinical work, sources of pressure and stress on the system, sources of resilience, the gap between procedures and practice, goal trade-offs and interactions between management and frontline staff. This formative work will ensure that the development of interventions, the system modelling and the evaluation are grounded in a deep understanding of the work environment. Data will be collected with qualitative interviews and non-participant observation of clinical work and staff meetings.

2.5 Measure of resilience.

Starting with Hollnagel's definition of resilience as "the intrinsic ability of a system or an organisation to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions" (Hollnagel, 2011, p. xxxvi), we will develop a measure of resilience contextualised for healthcare. Taking a multilevel perspective, we will ask how this ability might manifest itself at different but interlinked organisational levels. We know that managers and frontline staff have different opportunities and potential to contribute to organisational resilience (Flin, 2006) and the interactions between these organisational levels are possible key determinants of resilience (Woods & Wreathall, 2006). The process for developing the tool will involve qualitative data collection from clinical staff and managers and will involve iteration and development throughout the research.

Interventions. Multi-level interventions will be developed in each of the four areas of resilience, co-created with clinical partners and implemented in a stepwise manner to assess their individual contribution to system performance. Clinical agreement with and commitment to changes intended to increase quality and safety is a key factor in their successful implementation (Firth-Cozens, 2001; Dopson & Fitzgerald, 2005) and so we will convene a series of workshops for researchers, clinicians and stakeholders to design the interventions, based on our findings from all the previous phases of the study. Co-development of the interventions will be underpinned by an on-going process of engagement with clinicians and managers at all stages of the research.

We argue that Resilience Engineering at present provides sparse guidance for the development of interventions. It is thus necessary to draw on more developed theories that are relevant for each dimension of resilience. For example, theories of organisational learning (Argyris & Schon, 1978) and absorptive capacity (Harvey et al., 2010) will be relevant for designing interventions to increase learning. Such theories can inform interventions to improve the acquisition, assimilation and application of knowledge to improve organisational performance. Likewise, interventions to improve performance monitoring will use data modelling and presentation techniques to present data, but will also draw on other theories to embed monitoring into organisational routines. For example, theories of sense-making in organisations (Carroll

& Edmondson, 2002), groupthink,(Janis, 1982), and psychological safety (Edmondson et al., 1999) will inform our understanding of how the effectiveness of monitoring can be increased in the complex, multidisciplinary, political and hierarchical clinical environment. Interventions to promote the ability to respond to developing problems will involve simulation training with full video and audio playback and team debriefing. The training will aim to develop skills in dealing with and adapting to complexity, anticipating changes, prioritising and making sacrificing judgements, and identifying and responding to threats to safety. The design of simulation training will be informed by theories of learning and education including theories of cognitive skill acquisition (van Lehn, 1996) and social learning (Bandura & McClelland, 1977) to maximise learning and transfer to the clinical environment.

2.6 Modelling of resilience.

We will develop a theoretical model of resilience showing relationships between key variables, including relationships between resilience as operationalized and traditional indicators of quality, and highlighting the most effective ways to increase resilience.

2.7 Education and dissemination.

A key aim of this programme of work is to contribute to changing attitudes and practices in relation to risk and safety in the NHS in England. We aim to reduce the emphasis on incident reporting and procedural compliance for improving quality and safety, and increase knowledge of resilience engineering through discussions, education and dissemination of practical guidance. The outputs of the study will include detailed recommendations for implementing a resilience approach to safety in acute health care organisations.

3 DISCUSSION

A focus of the project will be processes of adaptation and trade-off in the context of a National Health Service pressured by large scale restructuring and budgetary constraints. It is known that staff face competing demands and inadequate resources across a variety of wards (Dixon-Woods et al., 2009). This paper argues that within the constantly fluctuating demands of the acute care environment we cannot completely specify what is safe and what is not, and seek to ensure that workers always adhere to a safe protocol. Although this approach will ameliorate some safety problems, a more powerful approach is to empower workers to safely adapt to the demands they face. This requires recognizing that workers in part will always have to set their own priorities. How they reconcile competing demands and what effect this has on safety and aspects of care quality such as patient experience and timeliness are empirical questions we will investigate in this study.

4 CONCLUSIONS

Improving safety in complex non engineered systems such as healthcare organisations requires a different approach. We need a change in emphasis from control of error and adverse events via arbitrary targets to a focus on proactive and adaptive processes and how they can be introduced, nurtured and sustained. In this study, we propose an approach that involves developing and testing interventions in four areas;

1. Knowing what to do
2. Learning from past experience
3. Monitoring the work environment for changes and
4. Anticipating demands in the future.

Few studies have implemented resilience engineering interventions in healthcare. Doing so involves challenges in operationalising and measuring concepts, developing interventions and assessing their impact at a systems level. In this paper we have outlined a funded programme of work to address these challenges and to make recommendations about how the insights of resilience engineering can be harnessed to improve patient safety and care quality. The results will provide evidence about the implementation and impact of four complex interventions in the areas of learning, responding, monitoring and anticipating, both singly and in combination, allowing future resilience interventions to be chosen based on knowledge of their effectiveness. The study will also yield an in depth picture of resilience engineering in action to inform the development of theory and the maturation of the approach.

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