Resilience in Emergency Medical Dispatch: Big R and little r

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Abstract
Emergency medical dispatch (EMD) is integral to emergency health care provision. It involves interaction between humans and computers and needs to be resilient to fluctuating demands. Here we investigate resilience in the London Ambulance Service control room. We find it useful to distinguish between Big R and little r, the former relating to strategy creation and the latter strategy sharing and reuse. Systems can be designed to allow for Big R responses to the unexpected. Little r can facilitate the efficiency, effectiveness and safety of more mundane tasks. This distinction can help research studies in resilience for other health care contexts.

Keywords
Emergency medical dispatch, resilience

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Emergency medical dispatch (EMD) is on the front-line of emergency health care provision. Its effectiveness has direct consequences on patient outcome and quality of care. Emergency resources have to be directed to incidents in a timely fashion, but these resources are finite and demand for them can fluctuate greatly. This is especially pertinent for the London Ambulance Service (LAS) control room which handles

approximately 3,800 calls on a normal day [1]. In this paper we investigate the importance of different forms of resilience in the LAS control room.

Background

Resilience Engineering is a relatively recent area of study which is contrasted with traditional approaches to safety [2]. The rhetoric suggests that resilience looks at building capacity to deal with the unexpected, whereas traditional safety looks to make the system robust and error free against predicted threats. Resilience is commonly associated with coping with beyond design-basis events, i.e. rare and extreme events that systems are not designed to handle. A common example is the 9/11 attack on New York which required a response to something that had never been experienced before. However, it has also been associated with more mundane interactions, error avoidance, mitigation and recovery [3].

We subscribe to the view that unexpected errors can occur even for mundane interaction, and there is a constant risk of making these sorts of slips and lapses, particularly where processes, tools and artefacts are designed poorly. People will often reuse strategies and work-arounds to compensate for these poor designs and circumstances, which we define as resilience at the little r level. This contrasts with the Big R level which involves the 'creation' of novel strategies to respond to a vulnerability or threat. So the crux of this distinction is on the scale of innovation rather than the scale or frequency of the threat. In the following analysis of the LAS control room we see that both are relevant, and extra clarity can be gained by keeping these two types of resilience distinct.

Resilience in the LAS control room

To investigate resilience in the LAS control room this analysis builds on prior work [3, 4, 5]. The novelty in this analysis is its focus on resilience and the distinction we use between Big R and little r.

Distinguishing between Big R and little r

This distinction concerns the leap from established strategies and actions. Big R is to do with the creation of a strategy, whereas little r is in the propagation and reuse of a strategy. For example, in a overly busy Emergency Department Big R resilience might involve creatively thinking of using the corridor to extend the department's capacity to accept patients [6]. However, Big R would be limited to that first creative step. In contrast, little r might involve the reuse of this strategy to increase capacity to cope with other peaks in demand; it might also involve sharing this strategy with other hospitals that might find it useful too.

Big R in the LAS control room

There are different modes of control in the LAS control room: (I) normal routine work, (II) transition to a major incident, and (III) where a major incident is declared [4]. These three levels signify an increase in seriousness and scale of the incident. For example, a terrorist attack, such as the 7th July bombings in London in 2005, would entail reconfiguring to (III) where a major incident is declared. This most extreme mode means that the team that was dealing with the escalating incident is moved to a separate room whilst another team takes over their normal duties. This frees the team's cognitive resources to focus on the incident, rather than juggling many different incidents. This team also has special communication and command lines which makes it more tightly integrated with the other

emergency service' responses e.g. the fire-brigade and police. These reconfigurations in structure and resource allows the incident to be handled flexibly and resiliently, which is required as the incident is likely to be unexpected in type, detail and scale. This fits the observation that "you may not be able to design for the unexpected, but you can design to allow the unexpected" [7].

Big R relates to big innovation and these can also occur to address smaller needs, e.g. thinking of more efficient or less error prone ways of working. To facilitate this process a staff suggestion scheme was planned to be introduced to the LAS between 2000 and 2004.

Little r in the LAS control room

In [3] we described resilient markers that were evident in the LAS control room. These markers are at the little r level because they are part of ongoing activities, and strategy reuse, that dampen error and facilitate improved interaction. These work within and around the more formal design of the system; they are identified in five models [3]:

(1) the physical model concerns itself with the layout of the control room; an example of resilience was the physical co-location of individuals which allowed colleagues an augmented awareness to prepare for oncoming demand and better joint working;

(2) the information flow model concerns itself with the structure of the task and its progress; an example of resilience was 'buffering' because the LAS staff were observed to hold on to information before passing it on to colleagues so they were not overloaded or unnecessarily interrupted;

(3) the artefact model concerns itself with the design and use of equipment; an example of resilience was redundancy because a computer system and a paper based system ran side-by-side in case the technology failed;

(4) the social model concerns itself with the social structure in the system; an example of resilience was the social hierarchy because staff with more responsibility had greater experience through successive promotion so they could better anticipate and control what was going on and even fill in for others where needed; and

(5) the evolutionary model concerns itself with the development of the socio-technical system over time; an example of resilience was that new technological opportunities were exploited to better cope with increasing demand from the environment.

Little r relates to little innovation and so will include the sharing of best practice and reuse of past strategies that had not been entirely thought of or prescribed by designers. For example, control room staff used their initiative to preempt the needs of serious incidents and send more resource straight away even though this did not fit the automated system or procedure. One example of this included a report of a construction worker falling from a great height. The worker could not be seen so his condition was classed as 'unknown' by the automated system, and procedure advised one

vehicle to first attend to assess the situation. However, the dispatcher foresaw that one ambulance would not be adequate and sent more resource immediately.

Discussion

Resilience is a useful concept for understanding the performance in the LAS control room. Past performance measures have included shortening times to the most serious calls, reducing excessive utilisation of front-line ambulances, harnessing available technology, and making people more effective. Some of these very grounded measures demonstrate resilience e.g. having spare capacity in front-line ambulance use to absorb spikes in demand; however, resilience does not seem to be referred to explicitly. This may only be a issue when trade-offs are being made in services, especially where there is pressure on the service to be more efficient and effective as this can conflict with being more resilient, i.e. spare capacity to absorb peaks in demand may be reduced for efficiency gains.

A distinction between Big R and little r further refines a resilience view. The Big R involves innovation: reconfiguring to allow for responses to the unexpected and having processes to encourage new strategies to be heard and assessed. The little r involves reuse and sharing of strategies: to help to dampen error and provide a balance between working efficiently, effectively and safely.

Implications

The distinction between Big R and little r may be useful for other areas of research in health care. For example, we are planning a series of studies of resilient interaction with medical devices. These will be focused on the design of the devices, the vulnerabilities of the device coupled with the work context, and the positive strategies that clinicians have developed to work efficiently, effectively and safely with devices i.e. strategies that compensate for poor designs and poor circumstances. Big R will involve looking at how these strategies are created, and little r will involve how these strategies are shared and reused.

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