BARRIERS TO BUILDING RESILIENCE TO EXTREME WEATHER EVENTS IN AUSTRALIAN HOSPITALS

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Many countries are facing a future of more regular extreme-weather-events (EWEs) and hospitals will play a critical role in managing the significant health impacts of such events. This study integrates organisational and infrastructure systems for the first time, to explore the barriers which exist, in making Australian hospitals more resilient to EWEs. Employing a single in-depth case study of a major Australian tertiary hospital which has experienced significant EWEs, data was collected using semi-structured interviews, observations of disaster drills and disaster planning meetings, as well as additional documentary analysis of past incident reports. Findings indicate that disaster planning is compliance-driven, under-resourced, ad-hoc and non-inclusive. There is also widespread ignorance among key stakeholders of the influence of hospital design in delivering healthcare to the community during a EWE event. It is concluded that disaster management planning needs better resourcing and that procedures, systems and technologies must be put in place to foster better stakeholder communication around hospital facility disaster planning for EWEs.

Keywords: Australia, extreme weather, disaster, hospitals, planning, resilience.

INTRODUCTION

It is anticipated that Australia and most other countries will have more frequent extreme weather events (EWEs) such as heatwaves, floods and storms in the future (AAS, 2015). Resilience refers to the ability of an individual, group or organisation to adapt to such shocks and return to normal (Gunderson and Holling, 2002, Holling, 2001). As WHO (2015) points out, when such events strike, the resilience of health services is a matter of life and death. However, many hospitals have not been designed with EWE threats in mind (Carthey *et al.*, 2009), despite significant evidence that damage to health infrastructure can be enormous during such events. There is currently little understanding of the resilience of physical hospital infrastructure to EWEs (Achour *et al.*, 2014). Most of the research has been undertaken into health system organisational resilience although recently, some studies have started to highlight the importance of 'hard' health infrastructure, albeit in exclusion of the buildings themselves. For example, Zhong *et al.* (2015) identified a wide range of factors that could be used for assessing hospital resilience across eight domains, 17 subdomains, and 43 indicators. WHO (2015) also acknowledges that the building system has a major impact on the safety of patients during a disaster. In assessing the safety of a hospital during such events, WHO evaluates numerous potential built infrastructure risks such as the type of design, structure, construction materials, and

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critical components of the structure. It also considers a number of non-structural elements such as the facings, doors and windows to determine their vulnerability to water; the impact of flying objects; the safety of access to the facility and internal and external traffic; the lighting and fire protection systems; and false ceilings. Importantly, it also considers how hospital personnel are organised to respond and to function during and after a disaster, taking into account the general organisation of hospital management, availability and implementation of disaster plans and programs, resources for disaster preparedness and response and the level of training and disaster preparedness of the staff etc. Normally, considerations of built infrastructure are separated from research into organisational resilience. However, WHO (2015) shows that in reality these are inseparable since a critical aspect of re-organising for an EWE are considerations around the capacity of physical infrastructure to adapt, learn and perform in this new disaster setting. To this end, the aim of this study is to use contemporary resilience and learning theories to explore how hospital stakeholders learn from disaster response experiences and how these lessons inform future hospital disaster management planning around built infrastructure.

COLLECTIVE LEARNING ABOUT BUILT INFRASTRUCTURE RESILIENCE TO EWES

Learning is the process of acquiring new, or modifying and reinforcing, existing knowledge and skills which produces relatively permanent changes in values, attitudes and behaviours (Argote and Miron-Spektor, 2011). Organisational learning is the process by which its members collectively learn and adapt its structure and performance, and remain either functional or competitive in response to external pressures (such as EWEs) (Wang and Ahmed, 2003). As organisations grow, they lose their capacity to learn as company structures and individual thinking becomes rigid, losing the critical elements that facilitate learning such as co-operation between individuals and groups, a shared vision, a holistic view, free and reliable communication, and a culture of teamwork and trust (Senge, 1990, Argyris, 1999). Argyris and Schon (1978) show that organisational learning occurs at three key levels: individually; collectively; and organisationally. Their work, translated to a hospital and EWE context suggests when new individual knowledge generated as a result of learning is internalised and shared between different hospital stakeholders it becomes collective knowledge, bringing about mutually understood changes in behaviours, values and preferences. This collective learning should then lead to changes in a hospital organisation's formal organisational systems, procedures and processes, as documented in its formal disaster management plans. More recent research into new institutionalist (NI) theory.(Lowndes, 2005) shows that effective organisational learning will also need to bring about changes to an organisation's *informal* rules, norms and procedures which in contrast to formal rules are unwritten and created, communicated, and enforced outside officially sanctioned channels. Importantly, informal rules tend to be more 'sticky' and resistant to change than formal rules since they are hidden, under-the-surface and taken-for-granted. Indeed, NI theory shows that if they do not change in response to a EWE then they may act to undermine changes to formal rules or replace them when the changes to formal rules are not seen as adequate by organisational stakeholders.

Another perspective useful for exploring hospital learning in response to EWEs is Wang and Ahmed's (2003) which shows that organisational learning can take place at three levels: single loop learning; double loop learning and; triple loop learning. All three levels of learning are necessary in responding to a EWE but it is the deeper

changes afforded by triple loop learning that are the most challenging to bring about. Single-loop learning is the lowest level of learning where individuals might 'react' to a situation and make small changes to specific practices or behaviours without examining or challenging our underlying reasons behind them. In a hospital, this may involve minor operational changes at the ward level to take more patients presenting as a result of a EWE. Double-loop learning is a deeper form of learning which addresses the causes of a problem and involves changing the underlying practices and procedures which lead to it. In a hospital, this may involve adapting the disaster management plans in response to a EWE (equivalent to changing the formal hospital rules under New Institutional Theory). Triple-loop learning is the deepest form of learning which involves 'unlearning' fundamental principles which might have led to those causes taking place. In a hospital these might be assumptions about the role of hospital infrastructure is responding to a EWE.

METHOD

Informed by theories outlined above, the process by which hospital stakeholders learnt about the role of hospital infrastructure in responding to a EWE was investigated through a single case study of a major Australian hospital network of four hospitals where there was a history of EWEs.

Using purposive non-probability sampling, fourteen respondents were selected for interview on the basis of their past experience of EWEs, their responsibilities for health facility management and planning and involvement in disaster management planning processes. These included: General Manager / Disaster Controller; Quality Manager; Physical resources Manager (Facilities Manager); Business and logistics Manager; Operations Manager (DON); Allied Health Manager; Clinical manager; Mental health acting manager; Environmental Manager; Emergency Department Director; Nurse Unit Managers (Surgical, Medical and ED); Nursing Managers (2); Senior ambulance service representative; and District Disaster Nurse Consultant. Disaster committee meetings and disaster management drills were also observed to understand of how different hospital stakeholders would come together to deal with disaster management challenges during an EWE and how collective learning and socialisation occurred in developing their future response strategies in relation to the built environment. Documentary analysis of Disaster Committee meeting minutes, disaster management plans, archival records of past events and post disaster and debriefing reports was also analysed to evaluate both printed and electronic documents where this tacit knowledge about the built environment had been made explicit. (Angen, 2000) before detailed qualitative analysis using content analysis.

These datasets were recorded in three categories: the transcript (the interview data), supported by field notes of personal reflections (observation data) and analytical memos (incorporating both data sets supplemented by the documentary analysis data). The final phase of data collection involved focus groups to present the preliminary findings to respondents for their feedback as a form of 'member-checking' to confirm the validity of the findings Informed by the literature above, the coding framework identified the coding variables such as staff capacity (to learn, to plan, to cope), structural and non-structural factors (such as building fabric, services, etc.) network capacity (to support hospital services and medical transfers) and organisational capacity (to deal with and prepare for EWEs). Qualitative data was also analysed using narrative analysis.

In this research the level of analysis was 'individual' respondents qualified by virtue of the sampling process described above. As Reissman (2008) points out, the key skill in good narrative analysis is an ability to produce a good narrative account on a phenomenon (in this case learning about built environment vulnerabilities to EWEs) by stitching together multiple insights of the various key stakeholders affected (in this case, the various members of the Disaster Management Planning Committee). Although there is some dispute among researchers who conduct narrative analysis about whether the product of narrative analysis should also be narrative or quantitative (Clandinin and Connelly, 2000), in presenting the results of this research it was decided to summarise the narrative of the discussions in selected quotes rather than reduce the data to quantitative counts of variables. As Meisel (2011: 2023) argues, the power of using narrative to report results is in translating respondent accounts into data that people can comprehend and understand by building a story around it. To this end, a narrative of the combination of data described above is presented below, drawing on selected insights from the interviews, analytical memos, documentary analysis and observations.

RESULTS AND DISCUSSION

The results highlighted three major vulnerabilities faced by the case study network hospitals. These were: Hospitals site and area vulnerabilities; Hospitals built environment vulnerabilities; and Hospitals organisational vulnerabilities. This closely reflects the WHO (2015) hospital safety assessment categories, although structural and non-structural building elements were not differentiated in the data. Site and area vulnerabilities relate to challenges created in responding to a EWE by the hospital site and broader surrounding hospital environment (surrounding infrastructure, typography, roads, rivers etc.). Built environment vulnerabilities relate to the structure, non-structural and services components of a hospital (structure, built fabric, power, water and telecommunications systems etc.). Organisational vulnerabilities are the organisational resources and structures or systems for disaster management (staff, supplies, emergency services etc.).

These vulnerabilities were identified by individual respondents from various backgrounds and thus were not collectively realised by all the key hospital disaster planning stakeholders. Failing to include all the key hospital disaster responders in disaster planning process further compromised the externalisation of various lessons learnt to be included in hospital disaster plans. Although hospital networks disaster management planning is coordinated by a multi-agency committee, the isolated understanding of the vulnerabilities and the lessons learnt from these vulnerabilities influenced the development of individual agencies disaster plans in 'silo' causing inter-agency coordination problems during an EWE, as indicated by a respondent.

> We do disaster planning [but] it will be contained at the local level …and that's very much silo, in a silo in that respect.

The lack of awareness and understanding of the built environment vulnerabilities amongst the hospital disaster planning stakeholders show their ignorance of built infrastructure's role when responding to EWEs. The impact of EWEs on buildings and how it influences hospital service delivery is not well understood. In addition, the current disaster and facility management practices that occur on isolation restrict built infrastructure vulnerabilities being integrated into organisational disaster planning process.

> We are human services, so our primary concern, and what we do in a disaster response, is going to be about people. We worry about people and what we doing about service delivery, that's the primary focus. If we gave it to [physical resources] and said you write a disaster plan, [they] would come [to] it with a different perspective. But [they are] not writing the disaster plan because we are doing it from a template, people who filling in the content largely are the people [in] service delivery, so that's what they think about, so maybe have the physical resources a section [called the] physical resources disaster plan response.

The findings indicate that despite evidence of increasing EWEs in the area, the hospital networks disaster planning focused on man-made type disasters, making disaster management planning compliance-driven. This according to our findings is potentially created by lack of resources for adaptation, path dependencies related to past disaster management experiences and strict delineations of responsibilities for doing so. Aside from that disaster planning can be very time consuming when people are pressed with time to focus on service delivery.

> …yeah, we have a bit of a blitz every time that we go through numerical profiling or accreditation, then it dies off and I would say you do not think about it for the next couple of years until the next round comes around.

> We are human services, so our primary concern, and what we do in a disaster response, is going to be about people. We worry about people and what we doing about service delivery, that's the primary focus.

The identification of three inter-related categories of vulnerability and the flaws in hospital disaster management planning support Loosemore *et al.*'s (2012) and Achour *et al.*'s (2014) calls for a more holistic approach to health facility and disaster planning management which better integrates the organisational and built environment aspects of hospital resilience. However, the findings also indicate that such holism will require a paradigm shift in hospital disaster management, which currently excludes built environment considerations from mainstream disaster management and planning processes. In addition to emphasising the need to involve all relevant hospital stakeholders in disaster management planning, our findings also demonstrate that learning from past involvement in responding to EWEs at individual, collective and organisational levels is vital in enhancing hospital resilience to EWEs. The findings support Argote (2011) who argued that experience is the foundation of knowledge creation in any organisation. These experiences can either be acquired during EWEs or through regular disaster training exercises and drills. This was reinforced by many of our respondents as indicated in the statements below:

> What I might learn would be different to [what] someone else might learn. What I saw as expense is different to [what] others see as expense. What I saw as bad someone else said no, that wasn't bad. So everyone could have a different experience and different learning. I might learn different things to the business manager next door.

> It's really going to be the experiences that will inform the next level of the document [disaster plans] and I understand the responsibility to communicate that and I probably want to share that with my colleagues in conference [and] forums.

Certainly had enough runs [with disasters]…So part of [disaster management] is practising and also reflecting when you have had an event.

> Training and education initiatives are run to test the plans, conduct training and exercise, practice based learning…and based on the lesson learnt the plans are revised.

> What I tend to find is that people who work on site for a long period of time carry a lot of knowledge in their head .

The results also emphasise the significant role of the feedback process which allows the individuals lessons to be shared collectively across hospital internal and external stakeholders. According to Edson (2012) the feedback process is necessary as collective reasoning provides the diversity of adaptation options which increases flexibility in planning. Additionally, our results indicated that not all the lessons learnt individually were captured at the hospital organisational level. This finding emphasises the need to improve the feedback process by developing appropriate knowledge management structures and tools that not only capture lessons learnt but also allow effective use and sharing of information across the multiple stakeholders involved in disaster planning. This need to improve stakeholder management, engagement and consultation processes is a new potentially valuable avenue of action and research which needs to emerge from our findings. Our findings support Heng *et al.*'s (2005) social network analysis of health facilities managers which shows that they are too often disempowered and excluded from disaster management processes. As Bosher *et al.* (2009) explained, in the past the lack of clarity in the responsibilities of the various stakeholders and how they relate to each other has reduced a hospital's capacity to support its services delivery. Furthermore our respondents emphasised the importance of improving the process for knowledge recording and sharing across the hospital network (both vertically and horizontally), as indicated by the quotation below.

> It's about really sharing of information and taking it up. You still have to create opportunities [for knowledge sharing] because there's a huge amount of people who have got insights out there after these sorts of [disasters] and you really have to make an effort to gather them.
>
> If we could get more down into the ward level [to gather knowledge]… Part of what you need is the right people or the right positions in the planning group. [A] lot of corporate knowledge was walking out the door, so I sat down with a couple of [staff] and we nutted out a basic template for the things that needed to be identified… What I tend to find is that people who work on site for a long period of time carry a lot of knowledge in their head.

Our findings also emphasise the need to develop a process for collecting and sharing disaster information across multiple agencies which may be spread over a wide geographical area controlled by different governance systems and structures. Given these governance systems often conflict and overlap (Loosemore *et al.*, 2013), our research supports the need for further research into possible new communication technologies which can better facilitate the cross agency capture, distribution and use of information in responding to an EWE (Nonaka *et al.*, 2000, Niu, 2010). Whether technologies such as Business Information Modelling can facilitate this process and contribute to better disaster management is something that needs to be explored by future research. This avenue of research is supported by Mathew (2005) who has discussed the potential role information technology plays in facilitating collection and dissemination of information efficiently during health disasters, as well as post disaster evaluation.

Importantly, our findings also support a greater exploration of NI theory as a conceptual tool to explore responses to EWEs (Lowndes, 2005, Mahoney and Thelen, 2010). The results show that it is not just necessary to change the formal rules and procedures in building a hospital's resilience, but that there is also a need to reinforce the many unwritten rules that support hospital resilience to EWEs.

> I suppose [there's] a lot of unwritten rules that we have, or norms that we have here. If there is a flood, people that can get in would ring and sort of say they are available to come in to work, or something like that… We share staff (R2).

For example, our research suggests that smaller healthcare facilities in a network that formally relied on the referral hospital for disaster coordination, developed their own emergency contact lists of people that can provide quick information or support during an event. The smaller facilities indicated that the Disaster Control Centre at the referral hospital was unable to provide relevant information or support quickly enough for their needs which created disaster response challenges for these facilities. They emphasised that while they still coordinate their disaster planning through the Disaster Control Committee, they also needed some independence to move outside these formal systems to coordinate their disaster response efficiently. Unwritten rules were also created to move staff between the four network facilities and to accommodate both staff and visitors stranded on-site. The difficulty with using the DMPs during 2009 flood events led to the development of an emergency response checklist or action cards for all triage staff at the referral hospital.

> So these are the action cards or checklists created for triage team to assist them during an emergency. The triage team can pin the card to their uniform and it provides a quick guide of what they need to do.
>
> I actually like the action cards because we have got our delegation stuck in our emergency document that is pages long. You do it for triage in medical emergencies but actually [we can] have it for disaster planning and response.

This finding around the role of informal rules provides an entirely new perspective on the hospital resilience debate and suggests that past analyses may have been overly focussed on *formal* rules and policies and that new insights might emerge through a fuller examination of how *informal* organisational rules, norms and practices operate in conjunction with or to undermine formal rules in determining hospital resilience to EWEs.

Finally, in support of much disaster management literature our results show that inefficient communication is a common pitfall described in the (Unlu *et al.*, 2010).

> There was a lot of unhappy staff who were very unhappy with management at the time basically saying that they should have warned the staff more … so it was a lot of blaming post event over [lack of communication]. Talking to people post the event some people were aware that something was going to happen by other sources outside of the hospital, so yeah, there was no real warning.
>
> Our biggest communication issue is getting accurate roads information which makes it very difficult because in rural area we have major roads that are covered by roads and maritime then you have ummm council roads, so you have two different people who are responsible for road closure and opening and all those sorts of things.

However, this research extends the literature by focusing on the need for hospitals to also better manage the lateral incursion of information across the network during EWEs. During the 2009 flood event, lateral communication from outside unknown sources amongst staff and visitors created major challenges for the hospital facilities in coordinating their disaster response. The lateral communication caused panic and anxiety amongst staff and visitors, which the hospital was unprepared to deal with. The participants recognised the need for a more structured response to deal with the lateral information and to develop their communication processes.

> The other thing is that we are getting a lot more lateral [communication] coming into it, especially from social media. And so we are not controlling the communication and you are not sure of the accuracy of that information. That's why we really need to be

> sure that our communication, particularly within our organisation and externally to our stakeholders is really clear.
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> I think the key is when you actually instigate the disaster response then, it should be very clear where the information flow should be (and you know up and down essentially). So if your staff is getting information from wherever, they shouldn't just be thinking ok, I'll leave now, they should be then saying ok this is the information I have got and I am giving it to you and I need a direction. I think it's something that probably requires a little bit more development.

CONCLUSIONS

The aim of this study is to use contemporary resilience and learning theories to explore how hospital stakeholders learn from disaster response experiences and how these lessons inform future hospital disaster management plans. Research was undertaken through interviews with seventeen senior respondents involved in hospital disaster management processes, observations of disaster drills and analysis of disaster management records. The results provide useful new insights into the way that people from different backgrounds learn lesson from their individual experiences, however fail to share their lessons and understanding of the three vulnerabilities collectively with the key stakeholders involved in hospital disaster management process, influencing what goes in their disaster plans and creating potential challenges for inter-agency disaster response coordination.

While the findings must be interpreted within the clear limitations of the single case study, they indicate that if hospital facilities are to be made more resilient in the future then a paradigm shift is required in disaster management planning that is driven by a more holistic approach, supported by new systems, technology and governance structures. The newly exposed inter-relationships between site, area, built infrastructure and organisational vulnerabilities and the finding that health facilities managers are often excluded from disaster management learning processes adds to our limited understanding of how built infrastructure lessons are learnt in response to EWEs.

Our findings also stress the importance of regular disaster training exercises and drills to enable hospital managers to explore these system failings further so that individual lessons learnt during EWEs (either real or simulated) become collective learnings and in turn influence organisational responses at both a formal and informal level. Finally, the findings around the role of informal rules provides an entirely new perspective on the hospital resilience debate and suggests new avenues for future research in this important area.

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