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## **Healthcare emergency planning and management to major hazards in the UK**

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**Abstract:** This study aims to examine the challenges and opportunities UK healthcare emergency planners and responders have to cope with major hazards. The study followed a qualitative research methodology where data was collected from a comprehensive literature review, an international workshop and interviews. The findings established that the UK healthcare emergency planning process needs to: consider the integration of soft and hard resources in planning; involve independent experts for further support; and use IT systems innovatively to develop a comprehensive emergency model, predict vulnerabilities and optimise effectiveness and efficiency. The major recommendations are to: identify and evaluate risks more accurately; enhance opportunities and reduce risks associated with multiagency approaches; ensure that soft and hard resources are well integrated in planning; involve and integrate more with independent parties such as academia for extra support; and innovatively use IT systems to develop a comprehensive emergency model, predict vulnerabilities and optimise operability.

**Keywords:** emergency planning; emergency management; UK; healthcare; major hazards; infrastructure; effectiveness and efficiency; multi-agency; integration; collaboration; process.

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Federica Pascale has over five years of international research experience in healthcare facilities design, resilience and performance, including emergency healthcare infrastructures, special requirements for vulnerable population (e.g., aging population, dementia sufferers) and mass casualty events. She developed a design methodology to improve the physical performance of healthcare accident and emergency departments (A&E). Her current research focuses on the impact of the built environment on people with dementia and currently she is in the process of developing the new Health Building Note 08-02: Dementia friendly environments. She has a substantial international consultancy experience, and has been invited as a Keynote Speaker for the Center for Health Design and for the Harvard Medical School.

Robby Soetanto is Lecturer of Construction Management at Loughborough University, UK. His current research focuses on two key areas; disaster resilience and managing the integration of construction project team. His research has been funded by government bodies (EPSRC, EU, HEA, British Council) and private companies (Lloyds TSB and Hewlett Packard). As a principal or co-investigator, he has been involved in research projects valued at over £2 m (with over £400 k funding his works in the last five years). He has published over 90 works, including two books and 31 referred journal papers. He was a Visiting Professor at Ryerson University, Canada, and lectured at the Universities of Reading and Salford (UK).

Andrew D.F. Price has over 30 years design, construction and industry-focused research experience. He obtained BSc in Civil Engineering from Nottingham Trent University. He worked for four years as Structural Engineer for Jackson Peplow Consultants before joining Loughborough University as Research Assistant in 1981. He became a lecturer in Construction Management in 1984. His research focused on measuring and improving the socio-economic aspects of construction performance. His current research includes: innovative design and construction solutions for health and care infrastructure; continuous improvement; and sustainable urban environments. He has graduated 50+ PhD students from 25 countries and acted as External Examiner at 12 Universities as well as a Visiting Professor at four overseas Universities.

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## 1 Introduction

Many countries succeeded in reducing the death tolls associated with natural disasters, owing to the significant improvement in infrastructure, technology and disaster risk reduction techniques and understanding (UN, 2011). Despite this important step toward resilience, there are massive challenges facing humanity such as those caused by the Hurricane Sandy which hit East coast of the Americas in 2012, major 2011 floods in Thailand, or by the complex disaster initiated by the mega-earthquake of 11 March 2011 in Japan. Risks tend to be the combination of four elements: hazard, exposure, location

and vulnerability. Most of these are changing dramatically owing to issues such as climate change, population growth and development of mega-cities, and increased infrastructure and properties vulnerability, which is driven by lack of finance, building practices and appropriate standards.

The United Kingdom (UK) is rarely exposed to major hazards; consequently, the country has been following legislations dated back to the Second World War where the main focus was on 'civil defence'. However, the 2000 fuel crisis, 2000 flooding and 2001 foot and mouth disease demonstrated that the legislation was limited and unable to cope with 'modern risks'. Consequently the central government decided to conduct a comprehensive and formal review that led to the development of the 2004 Civil Contingency Act (CCA). Most of current resilience strategies and plans, such as the *Emergency Response and Recovery* and the *National Risk Register*, were driven by the new Act. However, recent experiences demonstrated that these plans should be comprehensively revised to consider issues related to infrastructure, logistics and planning. Previous experiences such as the 2007 summer floods demonstrated that there was weak coordination between responding agencies and organisations (Pitt, 2008); the 2009 Cumbria floods re-emphasised the critical role of infrastructure after the severe damage or collapse of 23 bridges; and the 2009/2010 severe weather conditions showed that severe weather could also be complex and has the ability to paralyse the country, and cause major disruptions to emergency services owing to the failure of many roads, power supply and telecommunication (Cumbria Intelligence Observatory, 2010).

In response to the CCA 2004, the Department of Health (DH, 2005) developed the *NHS Emergency Planning Guidance 2005* to guide all National Health Service (NHS) organisations to develop their ability to respond to major incidents and manage recovery. The Guidance emphasises that NHS organisations must have the ability to sustain high service provision despite any infrastructure disruption, and also the ability to collaborate with other agencies in order to ensure their ability in responding to major hazards (DH, 2005). However, experience demonstrated that this is an extremely ambitious target given the '*unforeseen problems*' that interrupted supplies, and threatened the safety of patients and staff, such as the case of Gloucestershire Hospital NHS FT (DH, 2008). The Guidance provided a high level of assistance and certain degree of flexibility for Trusts to plan according to their need and vision. However, it does not fully reflect the complexity and interaction between the processes and 'what works on the ground' which may 'mislead' professionals to plan for failure scenarios and modes. This combined with organisation structural changes will lead to extra-complex systems with less efficiency and higher risks of vulnerability that is often difficult to identify. The UK healthcare system is going through a major restructuration in which many organisations are 'disappearing' or re-integrating to originate new organisations. These will play roles in the delivery of healthcare in major emergencies. The development of a set of evidence will support emergency planners identifying the best way for a more resilient and integrated healthcare emergency system. This study aims to examine the challenges and opportunities the UK healthcare emergency planners and responders have to cope with major hazards, in order to develop a set of recommendations to support the development of a new model that will improve multi-agency emergency planning effectiveness and efficiency.

## 2 Research methods

### 2.1 Data collection

The study adopted a qualitative research method defined as a systematic and empirical strategy for extracting information from people (Fellows and Liu, 2003), and is “concerned with developing explanations of social phenomena” (Hancock, 2002) to obtain “a holistic view of the phenomena under investigation” (Bogdan and Taylor, 1975; Patton, 1980 cited in Matveev, 2002) and “a more realistic feel of the world that cannot be experienced in the numerical data and statistical analysis used in quantitative research” (Matveev, 2002). An intensive literature review was conducted including research papers, official documents and reports to identify national and international disaster management and emergency response policy and practice and theory applied in the resilience and performance of emergency response. Information was complemented by the outcomes of a workshop where 44 participants attended and made a significant contribution through discussions and debates. Participants were from multidisciplinary backgrounds, in order to reflect the complexity and dependency of the healthcare emergency activities, including: academia, public and healthcare authorities (decision making), emergency services, healthcare providers, professionals and voluntary sectors. Nine PowerPoint presentations were delivered covering three themes: *Acute hospitals and ambulance business continuity perspectives*; *Lessons from international practice*; and *Improvement of resilience through collaboration*. Participants were divided into groups to discuss: short and long-term priorities for emergency services; risks and opportunities associated with improving the resilience through collaboration; and potential impact of budget constraints on emergencies. The data was supplemented by in-depth interviews with eight experts in social science, healthcare management, utility supply, and emergency planning and coordination to provide more information about specific issues that have been identified during the literature review and workshop.

### 2.2 Data analysis

The literature review data was analysed according to the *Integrated Definition for Function (IDEF0)* modelling technique ([www.idef.com](http://www.idef.com)). This technique requires data to be classified into four categories: *input* (elements required to conduct the work, e.g., patient/injury); *output* (elements after going through the process, e.g., treated patient); *mechanism* (elements required for the process to operate, e.g., resources: skilled staff, emergency vehicles); and *control* (elements used to ensure that the process is operational, e.g., framework, law). The output is a graphical model elucidating the functionality and contribution of each agency to the treatment of injuries/patients and thus provides an illustration of the UK emergency approach. Literature data was also used to enhance the clarity of issues that the participants highlighted during the research activities (i.e., workshop and interviews).

The workshop and interview data was audio recorded, transcribed and analysed according to the thematic approach, where the participants’ and interviewees’ key statements have been organised according to the themes they cover. Seven themes have been identified (see Table 1) demonstrating the major aspects affecting the effectiveness of healthcare emergency response and providing answers to the three major driving questions:

- What are the strengths and weaknesses associated with improving resilience through collaboration?
- What is the potential impact of budget constraints on emergencies, and how resources could be better exploited to overcome this?
- What are the short and long term priorities for emergency services?

**Table 1** Deducted themes

<i>Theme</i>	<i>Stakeholders key phrases/words</i>
Risk identification	Environmental disaster; natural events happen fairly often, natural events are predictable; natural hazard; volcanic ash; sea level; climate change; changing weather pattern; exceptional things; inclement, incredible, severe weather; weather very rarely kills people; ignore the weather is part of UK culture; careless and stoic towards environmental risks; people amazed and shocked by snow; everything shuts down for snow; severe winters is not a disaster; floods are recent thing in the UK; wide scale flooding; unusual flooding; intense rain; risk to flood; manmade events are sudden and catastrophic; history of terrorism in past; London bombing; emotional reaction to a bomb; scenario based route; build a history of failures; flu pandemic
Collection and recording of information	No information about the performance of healthcare in adversities; absolute measures; national patient data is not useful because it is not record in a timely manner; impossible to extract data from SystemOne; difficulties in discharging from hospitals; a lot of time in getting the information to make sensible decision; much information to be transferred but only a little of relevant; difficulties to transfer knowledge and skills; severe weather plan; security sensitivity of information; data protection; clearer guidance
Multi-agency collaboration	Communication; difficulties in communication due to agency structure and administration; hierarchical organisation; aptitude to communicate internally more than externally; no pattern of strategic communication; bottom-up initiatives; top-down initiatives; effective collaboration; need to share information; less information shared on events happening rarely; difficulties in getting utilities companies share their plans and information; difficulties in engaging utilities company in planning meetings; utilities companies good understanding of vulnerabilities protection measures; engage ambulance service in the planning process; different views, interest and agendas; language and cultural barriers; local priorities, strategies and processes; lack of awareness and communication; performance of emergency responders; ineffective emergency response; conflicts between the agencies
Impact of budget constraints on emergency planning	Lack of fair services for different regions; less appetite to expend; lack of multi-agency practice; less detailed planning and exercise on events happening rarely; ability to handle disruption effectively; partnership and prioritisation; share resources; information technology (IT) techniques; involvement of local community; local resilience forum; resilience of healthcare; no attention to resilience
Infrastructure performance to natural hazards and extreme weather	Drains could not cope; site access; sewers; combined sewers; road salt; design criteria; local draining systems; upgrading infrastructure; road infrastructure; vulnerable infrastructure; adequacy of infrastructure; critical infrastructure; piece of pipe; failure of a dam; gas; water contamination; shortage of electricity; waste water; we rely on telecommunications and IT utilities; maintaining the flood defences; cost to protect the coast; road gritting, short terms investments; reduction of resources for committees meetings

**Table 1** Deducted themes (continued)

<i>Theme</i>	<i>Stakeholders key phrases/words</i>
Professional and official committees	Loss of knowledge; lack of planning process for catastrophic event committees; prioritisation (strategic high level); burden of plan on local authorities; resources shortage; multi-agency exercises; training exercise around flooding; internal and external exercise with LRF; watch-out meeting; no attendance of Category 1 to LRF; regional massive evacuation plan; exercise to flooding and coastline inundation; issues of companies rigidity
Independent and academic investigations	Academic contribution is in finding measures, study impact, look at particular risk; no much academic response; suspicious of universities; no need for more academic; academic add no more value; report and recommendations not run by academic; cost of academics; healthcare professional not qualified to collect data and conduct qualitative research; no capability to benchmark practices; no time to read research; responsibilities; trusted figures; consultants; professionalism; rational statistic information got twisted by media; exercises between academia and the NHS chronically under-funded

### 3 UK emergency approach

The UK National Security Strategy has two high level objectives:

- to ensure a secure and resilient UK by protecting people, economy, infrastructure, territory and way of life from all major risks that can affect the country directly
- to shape a stable world, by acting to reduce the likelihood of risks affecting the UK or British interests overseas, and applying instruments of power and influence to shape the global environment.

Consequently, authorities developed an integrated and flexible framework to be adapted to particular needs. The framework is led by inter-ministerial committees and linked directly with the Civil Contingencies Secretariat, which in turns is linked nationally and internationally. Nationally, it is linked with government departments, voluntary sector, and civil protection working party and business continuity fora, which in turn are linked to other teams and fora (e.g., Local Resilience Fora (LRFs), and the Department for Communities and Local Government (DCLG) resilience teams). Within this framework, an emergency can be managed at an operational (known as *Bronze Commander*), a tactical (known as *Silver Commander*) or a strategic (known as *Gold Commander*) level. However, in case of significant or catastrophic event, coordination and/or directions will be given directly by the central direction of the Cabinet Office Briefing Rooms (COBR). In order to ensure that this strategy is well understood, many documents were produced explaining the role of each agency (e.g., *Emergency Response and Recovery*).

The DH, in accordance with the government generic emergency plan and the CCA 2004 legislation, developed the *NHS Emergency Planning Guidance 2005*. This provides generic principals to guide NHS organisations through the planning and development of their own emergency plans. However, this was found to be too generic and ‘difficult’ for many organisations to use in developing a clear and effective emergency plan. Consequently, more work was done to provide clearer documents and procedures to



the lead of LRF, will usually coordinate the activities of those responding at and around the incident (Cabinet Office, 2005). For this reason is connected to all major agencies (e.g., PCT, Army, Highway Agency and Ambulance services) through a ‘resources connection’, representing the flow of information for the decision making process. Emergency healthcare in the UK is thus highly dependent on the performance of multi-agencies, which are subjected to various risks that could reduce their performance and could lead to a less effective emergency response. It is critical therefore to explore the opportunities and risks associated with this planning in more detail to develop an understanding on its robustness specifically in times of decreasing budgets and increasing risks, and restructuration of the involved agencies. As part of the Health and Social Care Act 2012 (Parliament, 2012) and starting from 1 April 2013, new arrangements are made which will result in the abolition of agencies, such as the primary healthcare trusts (PCTs), strategic health authority (SHA) and health protection agency (HPA), and establishment of new organisations such as the NHS commissioning board (NHSBC) and public health england (PHE). This change will reflect on the resilience of healthcare to major hazards and thus there is a need to understand how these contribute to the healthcare provision so that the support is maintained even with this restructuration.

## 4 Challenges associated with emergency planning

### 4.1 Risk identification, evaluation and perception

Public reports such as in Cumbria Intelligence Observatory (2010), DH (2008) and BBC (2008) have described the occurrence of extreme events in the UK as ‘unprecedented’, ‘exceptional’, ‘unexpected’ and ‘unusual’ due to the severe impact on the infrastructure and society. An interviewee stated that the 2007 flooding “*was unusual flooding. Normally flooding is river rising, over-topping river bank, but in summer 2007 we had intense rain, which caused local flooding because drains could not cope*”. This could be ‘a way for defence’, argued another interviewee adding: “*natural hazards are by their very nature unpredictable, flood water and the direction it can go and speed is what is going to take out which is very unpredictable element as well, so there is always a good defence to say it was a severe weather*”. The review of statistics, published by the Emergency Database (EM-DAT, [www.emdat.be](http://www.emdat.be)), demonstrates that natural hazards have been striking the UK for long time, causing serious disruption to society and economy (see Table 2). However, these do not seem to be well captured in the resilience strategies which require further investigations of techniques that can be used in identifying and evaluating risks.

Emergency planning is the path to improve resilience and mitigate the impact of risks, which are, typically, identified according to:

- consultation with local community and experts
- advanced and computerised techniques for monitoring and projection.

The consultation approach is easy to understand and does not require as much information and expertise as the advanced technique, for that it is adopted in many countries, such as in the UK. The central government suggests approximately 100 potential risks, every year, to the different regions of the country, where local resilience

fora (LRFs) are required to evaluate and develop relevant *Community Risk Registers* and publish on the LRF websites. Risks are analysed and prioritised according to their likelihood and their impact, often using *risk matrices*. Despite the fact risk matrices are simple and easy to use, their accuracy is limited which leads to ambiguity and inefficiency in resource allocation and thus need to be used with carefulness (Cox, 2008).

**Table 2** Natural hazards in the UK (1900–2012)

<i>Hazard</i>	<i>Number of events</i>	<i>Fatalities</i>	<i>Total affected</i>	<i>Loss (£billion)</i>
Seismic activity	2	–	4,501	0.040
Epidemic	4	71	194	–
Extreme temperature	7	319	47	–
Floods	25	83	382,768	10.769
Mass movement wet	1	140	–	–
Storm	35	4338	289,196	9.037

*Source:* EM-DAT (Version 12.07) (GB£1 is estimated to US\$1.5)

Risk identification is the intent to answer the question ‘*What can go wrong?*’ This answer is formulated based on information distilled from past experience, lessons learned from similar events occurred elsewhere and brainstorming (Department of Defence, 2006). It is very much driven by past experience and risk perception of industry and hospital leaders (Barbera et al., 2009), which in turn is predominated by voluntariness, level of fear and familiarity (Slovic, 1987; Slovic and Weber, 2002; Slovic, 2010; Sjöberg, 2000). There is a strong belief among some of the interviewees that “*the UK is used to disaster planning because of its history of ‘terrorism’ in the past, which may make it very disaster planning friendly...Based on the disaster planning we have had in the UK, we would cope with 9/11 in totally different way than the Americans did, much better way*” [interviewee]. Effective planning for threats does not necessarily lead to effective planning for natural hazards or technological emergencies and this ‘over-confidence’ could lead to major failure. For example, after the 1994 Northridge Earthquake (USA), Japanese engineers thought that they had better understanding of earthquake risk, which had led to developing better preparedness supported by better building codes, construction material, structures and labour (Katayama, 2008). However, the 1995 Kobe Earthquake demonstrated that this perception was erroneous, as it claimed over 6,000 lives and damages that are still perceived as a major disaster after two decades. People are often unaware of all risks, as such they plan only for immediate future and rely on emergency relief (Mileti, 1999), underestimating that emergency relief depends on the level of preparedness. The findings also established that for risks associated to environment, UK people are ‘*careless*’ and ‘*more stoic*’ as there always had been ‘*inclement weather*’, which could have been reflected on the physical resilience of infrastructure, as seen previously.

#### 4.2 Collection and recording of information and monitoring

A significant amount of emergency planning is based on collecting and sharing information from the various stakeholders, who gather information based on specific criteria that reflect their need and the way they use it. This approach provides

organisations with vast amount of freedom to choose the best way to collect information and take relevant actions independently; however, it may lead to ‘overlooking’ issues that could be crucial for resilience. An interviewee stated that they have developed a log where they record damage to their network and when the trend of damage increases, an in-depth investigation is conducted to see whether there is a need to renew the existing network components or otherwise. Other agencies collect information based on “*absolute measures...if the percentage of people runs out of the 4 h waiting measure, the fact you have had winter, floods took the road out etc. do not count, you are still measured on the absolute measure*”. Another interviewee supporting this by stating that these ‘absolute measures’ could be changed depending on views, including political views. Furthermore, the way information is recorded varies substantially between individuals as records, in some systems, are entered as free text. This often results in different spelling which makes the extraction of information difficult when needed. Information needs to be collected and recorded according to a particular process that reflects the need of the organisation and relevant emergency partners. This will lead to easy use of data to formulate clearer view, and consequently supports the identification of the optimum way for emergency planning. It will enhance the exchanging information between agencies, which also has been a ‘major challenge’. Sharing information has been formally recognised by the CCA 2004, which urges Responders Category 1 and Category 2 to share information. The Pitt Review (2008) emphasised that relevant organisations, such as the Environment Agency (EA), need to provide more technical information about natural hazards to support the planning process. Sharing information has often been considered as ‘sensitive’ for particular topics and sites which led to the difficulties to manage risks such as in the 2007 summer floods when the “*Gloucester Gold Command did not know and so did not protect*” the water supply side. An interviewee articulated that there is a need for clearer guidance about this as there are issues that they could not share with other agencies as these were perceived as ‘*sensitive information*’ by security services.

#### 4.3 *Multiple-agency collaboration*

Responses to major emergencies require collaboration between emergency services such as ambulance services, police and non-governmental organisations to ensure that the injured are safely transferred to hospitals for medical care. The findings demonstrate that there are many opportunities and risks associated with multiple agency collaboration summarised in Table 3. Communication was highlighted as an essential issue for effective collaboration between the different organisations which often have different views, interest, agendas and the way organisations are structured. For example, healthcare organisations are structured to communicate internally more than externally; whilst, emergency services such as police and fire department are structured to communicate externally and internally. Such collaboration could be hampered by language and cultural barriers. These barriers are caused by local priorities, strategies and processes, and, when combined with lack of awareness and communication, they will have the ability to affect the performance of emergency responders, and result into ineffective emergency response activities, and even conflicts between agencies. Conflicts can arise because of several issues such as “*who pays for what*” and “*who leads which activities*” which can introduce another layer of complexity on the coordination process. The workshop participants suggested that there is a need to: enhance the communication

between the responding organisations through better integration; share information about previous experiences and relevant lessons learnt; and better understand policies, strategies and practices to identify the potential connections and difficulties to be addressed prior to emergencies. However, sharing ideas and experiences does not necessarily lead to consolidation, but could lead to competition or poor lessons learning. For that, “*more collaboration and unification (or strategic partnerships) between military, police and fire in particular*” is needed [interviewee]. Military has excellent physical and human resources that could increase the performance of major emergency responses, however, its involvement could be very expensive and often needs political decision, for that some political parties “*produced a policy paper recommending exactly that there is a national structure that involves the military permanently*” [interviewee]. In all cases, this will not lead to an ‘ideal’ situation as there is “*no single solution that will fit all*” [participant] and that each emergency has its own characteristics and thus organisation policies need to provide a degree of flexibility where staff could take a decision when is needed (during the event).

**Table 3** Opportunities and risks associated with improving the resilience through collaboration

<i>Opportunities</i>	<i>Risks</i>
Enhanced communication	Higher risk for conflicts
Improved performance	Predomination of powerful organisations/individuals
Pooling resources	Higher risk for competency
Increased efficiency and effectiveness	Difficulty of management/coordination
Improved integration	Inappropriate strategies and policies of organisations

## 5 Challenges associated with budget constraints

### 5.1 Potential impact of budget constraints on emergency planning

The UK Government has been reducing budget of many public organisations, including emergency organisations, due to the pressure from current financial climate. Planning and financing for something that is hoped to never take place is an area that many people wish not to spend on because potentially *it may not be needed!* “*It’s like a home or car insurance, if I need to trim some money of my household expenditure for the year perhaps I can save £400 or £500 by gambling and assessing the risk yourself: ‘It is not going to happen to me!’*”, stated an interviewee. Findings demonstrate that the budget constraint will affect the performance of emergency organisations through many ways (see Table 4) such as “*lack of fair services for different regions*” and “*less appetite to expend the expense and time in preparing effectively for exercises*”, which will reduce the ability to handle disruption effectively and increase the risk of inadequate planning. It will also decrease creativity and could lead to blinkered approaches and short-termism that can miss the opportunity for future investment, which in turn will lead to a greater public dissatisfaction. Partnership and prioritisation could be useful approaches to pool and share resources and ensure the continuity of supply chain and prioritise the needs more efficiently especially if information technology (IT) systems are implemented. Also the involvement of local community in the process to identify better vulnerabilities based on

the same principle as ‘neighbourhood watch’ organisations could be managed by LRFs. Findings demonstrate that there is a lack of clarity on the best way to address all these challenges, and ensure that the resilience of healthcare is not affected by the major change the healthcare sector is going through. This was confirmed by one of the participants who stated that “*decision makers are aware of the issues related to the resilience of healthcare and the impact change could have; however, in terms of practicality we are not there yet!*”

**Table 4** Potential impact and resources associated with reducing the budget of emergency services

<i>Potential impact</i>	<i>Resources</i>
Increased work load, and less resources	Partnership: improve current strategies and practice to improve integration
Limitation of service and service quality (i.e., impact on public)	Improve planning to enhance efficiency in the use of resources
Less effectiveness and less opportunity to improve	Use of IT
Inadequate planning	
Potential threat and life	

## 5.2 *Potential impact of budget constraints on infrastructure*

In the UK, for many years, infrastructure investment was not seen as priority, for example the country was the least infrastructure-spending country amongst the OECD countries between 2002 and 2007, leaving it with an estimated deficit of approximately £500 billion (ARUP, 2011). Interestingly, spending plans were dedicated to improving security rather than upgrading the infrastructure network to cope with hazards. For example, between 2001 and 2011, £8.4 billion were allocated to reduce risks deriving from political violence (often referred to as ‘terrorism’) and floods; however, the majority of this budget was allocated to security, although statistics suggest that these had ‘limited impact’ on society in comparison to floods (see Table 5). Most of the UK sewage system was designed and built over 100 years ago and expected to deal only with sewage. Findings established that there is a strong debate between the private and public sectors to upgrade the state of infrastructure. An interviewee, from the private sector, stated: “*Under regulation, it only applies to maintain our sewers to cover 1/30 year event so any escape above 1/30 year event we can say: we are obligated only to 1/30 event*”, alerting that any costs associated with upgrading the infrastructure to the standard it will be affecting the water bill. Conversely, the Pitt Review *Learning Lessons from the 2007 Floods* (Pitt, 2008) recommends that local authorities need to be in charge of local drainage systems, in order to invest in them to increase their capacity and to provide regular maintenance. The Government is considering these recommendations seriously and has to report every six months “*to show progress made and what more has to be done*” [interviewee]. The infrastructure design criteria changed from 1/100 to 1/200 years floods scenarios which should provide more resilient infrastructure. However, if sewage system capacity is limited to 1/30 years flood scenarios, there is a high risk that cities will be covered with water, as it happened previously in Gloucestershire during the 2007 floods (ICE, 2010) and resulted in individuals and professionals, including hospital staff,

refusing to attend work places owing to flooded infrastructure (DH, 2008). Infrastructure failure therefore can be highly disruptive with low ability to predict its consequences (ICE, 2010). Reports such as those published by the BBC (2009) and Lean (2007) reported that a major proportion of the UK infrastructure is vulnerable to extreme weather disruptions and floods: 2,215 power stations and substations; 737 sewage and water-treatment sites; 680 health centres and doctors' surgeries; 99 police stations; 86 fire stations; 82 telephone exchanges; 46 ambulance stations; and 13 hospitals are at severe risk of flooding.

**Table 5** UK spending on flood defence and security

Disaster type	Disasters in 2000–2007			Budget allocated (£billion)
	Total No.	Affected people	Total losses (£billion)	
Political conflict (terrorism)	25	1011	No available data	1 (2001) 2.5 (2007/8) 3.5 (2010/11)
Floods	14	395,000<	9.1<	0.6 (2007/8) 0.8 (2010/11)

Source: www.darmouth.edu, EM-DAT and (Senpinar-Brunner et al., 2009)

The findings also establish that the dilemma of investment affects even the response to extreme weather events, for example, the Centre for Economics and Business Research (CEBR) argues that councils refuse to invest in snow removal equipment, as they do not consider it part of their duties to protect households and industry. This suggests that the way taxes are used need to be revised. Interviewees reported that the 2010 snow storms greatly affected their operations: “we had some site access issues; getting hold of road salt to make the site accessible was a nightmare for us as well as everybody else”. Failing to provide sufficient supply to cope with the high demand enabled some suppliers to take advantage of the situation, and to make larger profit: “some of the supplies started getting ‘profit-making’ a little bit which we just refused to pay some of the prices which were the top of the scale!” [interviewee].

In summary, to ensure the effectiveness of an emergency response, the UK infrastructure resilience needs to be upgraded. Ways to be more efficient with expenditure are always welcomed as long as they convince individuals that they will not compromise resilience: an interviewee stated that the situation “is so complex and so involved that we always are going to end up having what we always had”, specifically in the current economic climate and the belief that people “are in more control of extreme weather events...and know how to put up with them”.

## 6 Opportunities associated with effective use of resources

### 6.1 Professional and official committees

In the UK, detailed planning of emergency is conducted locally not only because of the complexity and difficulty to develop a single national plan that covers all emergencies, but also because “the most effective way is the local, as it shows the detail of problems

*and solutions adopted*" [interviewee]. Multiple agency teams are setup to develop the relevant plans; they meet and exercise frequently which often leads to improving members' skills and knowledge and when they move *'the knowledge is lost!'* Every time a committee is set up, it goes through the same difficulties which wastes much time and effort. Committees need to record their experience in a systematic way, in order to ensure that the experience they went through is available to others, and that time and resources are used more effectively and efficiently.

Committees are also subject to gradual reduction of resources, an interviewee stated that: "you got your resource then you think 'well, we can take 10% out of that' so in a quarter you lose 10% and in another quarter you lose 10%...and by the end of the year half of the people you used to have are lost. After 3 or 4 years, the people (from organisations committed e.g., county councils, city council, ambulance service, police service and fire brigade) who used to go to those meetings are told: 'do not go!' because they are needed elsewhere". The situation gets even more complicated with the adoption of 'prioritisation' as it is driven by not only the need, but also the political agenda. Prioritisation is an important process as it assists organisations to identify the most critical issues, and to allocate limited resources; however, any misuse could lead to less effective decisions. An interviewee stated that the way organisations are funded is what influences their priorities: "Let's take the 4 h wait time, which is an absolute and let's consider planning for swine flu. You look at that, 'we have to preserve our 4 h wait time' so that will create a set of admission processes. It is a 4 h wait so we have to get these people away within 4 h. The next government comes along saying: 'actually we are not interested in how long are waiting, we are interested in the outcomes!' Your previous plan is expensive, and now you are dealing with the problem that you already have so then you change your plan because now what is going to be looked is how fast these people get better, not only the swine flu patients but also the A&E patients, which mean you will get a whole set of prioritisations" [interviewee]. In conclusion, emergency planning needs to be independent from agendas and strategies that could compromise the resilience of such critical service.

## 6.2 *Independent investigations*

Over the last two decades the UK has experienced many extreme weather events which caused major disruption. However, most of these events often were only presented as 'news' due to the reluctance of scientists to investigate in detail the cause, and link them to the changing climate. They argue that it is impossible to establish an accurate link more than a generic expectation (Connor, 2011). This is true in a sense, however, information distilled from disaster stricken areas investigations and reports, i.e., reconnaissance reports, could provide more detail for the emergency planning process. These reports are often conducted by independent experts (e.g., academics and engineers) in relevant fields where they identify strengths and vulnerabilities faced during extreme events; however, this practice needs yet to be adopted. When a big incident takes place, enquiries follow that tend to be headed by "*trusted figures, such as Sir Michael Pitt who did the research on 2007 floods*" [interviewee] and reports are published with a set of recommendations. Although these 'trusted figures' could be people from academia, there are different opinions on the involvement of academia in conducting investigations and

developing relevant reports. Whilst some see it as ‘*suspicious*’ and avoid sharing information others see it as a source of knowledge and information and time saving; an interviewee stated: “*we would love to have the time doing the benchmarking of the practices and going to other businesses to see what everybody else is doing, to be able to read research and actually think that marries across is very useful*”. Academic independent investigations provide a good approach to monitor the processes and measures taken to reduce the impact of hazards; and often develop a set of recommendations that will support the process of emergency planning. However, the fear of information being ‘*twisted by media*’ in order to ‘*create news*’ that could “*give a person real hard time*” [interviewee] will: cause more reluctance; halt many academic independent investigations to be conducted; and potentially limit academic curiosity, which is viewed as one of the main routes for breakthroughs (Zewail, 2010).

### *6.3 Priorities for emergency services*

The workshop participants’ discussion led to identify two levels of priorities: short and long terms summarised in Table 6. Resilience (risk assessment, prediction and mitigation) has been viewed as an essential and pressing issue that needs to be addressed urgently. Historical situations, lessons learnt, and good practice were suggested to be a start for the assessment of risks and identification of vulnerabilities. Recommendations were made to use IT tools to test and simulate the operation of emergency services and the potential integration with non-emergency services to pool and better manage resources. Amongst resources, staff numbers, morale, and safety were seen as urgent issues to be addressed as well. Staff members need to have the required competence (skills, knowledge and experience) to deal with emergencies (e.g., understanding surge, exercising plans, potential reconfigurations and roles). This will increase effectiveness and maintain public confidence, whose concern includes lifesaving, safety, continuity of services and quality assurance, specifically in the potential healthcare system reconfiguration. Adaptation to reconfiguration, through improved integration and partnership, was also viewed as an urgent priority. This should meet the requirements of the CCA 2004 and statutes designated by relevant authorities, managing and planning for extra efficiency while providing excellent service.

Long-term priorities include the improvement of strategies and practice through modernisation initiatives and comprehensive review of resources (e.g., staff, vehicles, modern equipment, and supplies) and further engagement programs with other key organisations in a unification or strategic partnership between Army, Police and Fire in particular. This could be through having “*organisations and systems in place to anticipate future planning needs that can be affected by a variety of goal and national factors, needs and influences; for example, a national NHS emergency planning think-tank that bridges the gap between national planners and what works on the ground*” [workshop participant]. This will need to be enhanced further through policies to support planning, preparedness, mitigation, response and reconstruction and will be facilitated through the development of IT services for real-time and online emergency services. This will require investigating and improving the resilience of infrastructure and support of academia and consequently will lead to efficiency in addition to innovative ways of emergency planning.

**Table 6** Short- and long-term emergency priorities

<i>Short-term emergency priorities</i>	<i>Long-term emergency priorities</i>
Assessment, prediction and mitigation	Improve strategies, policies and practices
Human resources (including awareness and development of staff)	Improve regional planning, collaboration and partnership
Improve public confidence	Develop IT services for real time and online emergency services
Improve management and communication processes	Improve resilience of the physical emergency infrastructure
Improve partnership to integrate emergency and non-emergency services and the local community	Integration with academic and scientific support

## 7 Discussion, conclusions and recommendations

### 7.1 Discussion

The investigation establishes that there are many planning and financial challenges that have the potential to reduce the effectiveness and efficiency of the healthcare emergency responses. Conversely, there are many opportunities that could provide extra support to the planning and response processes if they are well integrated within the processes. Planning for emergency responses depends on a good understanding of the components of the risk: hazard, exposure, location and vulnerability. The absence of accurate techniques to evaluate risks; the lack of sufficiently accurate risk information; and the predominance of security risks on the current strategies risk overlook naturally driven hazards in emergency planning. More scientific evidence is needed to inform emergency planners not only on the potential risks, but also on the scenarios and the potential impact these could have on infrastructure and society. As for understanding vulnerability, there is a need to develop a clear vision and process to collect and record information for monitoring performance of emergency services and critical infrastructure. This would require agreement between all parties on the type of information that is needed and its format for an easy access when needed. Independent investigators (e.g., academics) and official committees are amongst the resources that need to be ‘utilised’ more in emergency planning. These will provide not only evidence/scientific support about the hazard and vulnerability, but also play a major role in identifying priorities, developing more robust emergency plans, while taking into account of the current financial climate through the use of modern techniques (e.g., IT systems), and increasing knowledge and awareness of professionals.

The findings of this research complement previous research work which focused on studying the resilience of healthcare from different perspectives such as: resilience strategies (Achour et al., 2008, 2009; Achour and Price, 2010), structural and non-structural behaviour (Achour et al., 2011), utility supplies and impact on hospital operation (Achour et al., 2014), and design and space planning (Pascale et al., 2014).

It explores ways to improve social resilience of healthcare and emphasises the need for developing a holistic view of resilience integrating the physical and social aspects of resilience. The implications and impact of this research are recognised in the revised versions of the *World Health Organisation (WHO) Hospital Safety Index (HSI)* and the UK *Health Building Note (HBN) 00-07*, where authors collaborated with responsible institutions to address on critical issues, including the connection between the healthcare facility and infrastructure; proximity to source of hazard; risk identification; risk reduction systems; and integration of the social and physical aspects of resilience. The major contribution of this work is the fact that the research team has been successful in providing a comprehensive set of information to benefit policy makers to take decisions when improving the resilience of healthcare, as have been documented in the HSI and HBN 00-07. Future research plan will be grounded on this work with a view to study the resilience of a regional and local healthcare system.

## *7.2 Conclusions and recommendations*

Within the last decade, the UK has made a significant progress toward developing a comprehensive strategy and plans to respond to major emergencies and thus increasing its resilience to cope with modern risks. However, recent extreme weather events demonstrated that this progress needs more refinement in order to achieve a higher level of resilience. This research has investigated arrangements made for healthcare emergency response with the aim to support emergency planners and responders to develop a more effective and efficient emergency model.

The main conclusion of this research is that healthcare emergency planning in the UK should be developed based on the holistic approach that considers the complexity of the inter-connected organisations that form the whole system. Strong leadership from the central government is required to allocate resources to this highly important area, and use them more effectively, especially with recent extreme floods which have inundated part of the UK in winter 2013/14. This leadership will encourage multi-agency collaboration to establish partnerships, joining-up policies and operational emergency plans. Certainly, this will not happen overnight, but will require nurturing and progressive steps over a longer time. This endeavour has the potential to lead to a more resilient, effective and efficient healthcare emergency system. Based on the findings of the research, it is suggested that the emergency planning process therefore needs to:

- identify and evaluate risks more accurately
- enhance opportunities and reduce risks associated with multi-agency approaches (e.g., good communication, and better integration)
- ensure that soft and hard resources (e.g., processes, staff and infrastructure) are well integrated in the planning
- involve and integrate more with independent parties such as academia for extra support
- innovatively use IT systems to develop a comprehensive emergency model, predict vulnerabilities and optimise effectiveness and efficiency.

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