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Non-technical skills used by Public Health professionals working in an emergency response environment

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Non-technical skills used by Public Health professionals working in an emergency response environment.

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Declaration of any previous submission of the work

The material presented here for examination for the award of a higher degree by research has not been incorporated into a submission for another degree.

Andrew Black

Declaration of authorship

I am the author of this thesis, and the work described therein was carried out by myself personally.

Andrew Black

ABSTRACT

Public Health staff responding to emergencies with a health impact, work in increasingly complex environments, where multiple stakeholders work alongside each other. These complex, multiteam systems produce a unique set of challenges for responders, due to their fluidity and lack of central leadership. Non-technical skills (cognitive and social skills that complement and enhance technical skills) have been identified as requirements for successful emergency and humanitarian response and are particularly relevant where multiple teams from different sectors are required to work together.

The aim of this study, is to describe the use of non-technical skills at a meso (systems) level, used by Public Health professionals working in emergency response.

Data from 10 key-informant cognitive decision method interviews and a cross-sectional qualitative survey of 46 public health staff, were used to compare core non-technical skills used in a variety of sectors, with those used by public health responders working in a multiteam emergency response. Thematic analysis was used to develop a description of the multiteam response environment and the non-technical skills used by public health staff working in it.

This study adds to research on non-technical skills used in multiteam systems. It indicates that multi-sector emergency response should be examined in the context of multiteam systems; and that the response environment combines formal emergency management systems and a series of ‘formal’ and ‘informal’ networks which are used by public health responders to collaborate across teams. Collaboration in this complex environment is enhanced by enabling leadership, joint sensemaking, joint decision-making and personal relationship building to establish and enhance mutual trust.

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LIST OF ABBREVIATIONS

AAR	After Action Review
AHRQ	Agency for Healthcare Research and Quality
ALNAP	Active Learning Network for Accountability and Performance
ANTS	Anaesthetists' Non-technical skills
CAA	Civil Aviation Authority
CDM	Critical Decision Method
Cluster	Clusters are groups of humanitarian organizations, both UN and non-UN, in each of the main sectors of humanitarian action,
CRM	Crew Resource Management
CTA	Cognitive Task Analysis
DSA	Distributed Situation Awareness
DM	Decision Making
EOC	Emergency Operations Centre
FAO	Food and Agricultural Organization
GOARN	Global Outbreak Alert and Response Network
HF	Human Factors
HFCAS	Human Factors Analysis and Classification System
IASC	Inter-Agency Standing Committee
IFRCRC	International Federation of the Red Cross and Red Crescent Societies
IMS	Incident Management System
JESIP	Joint Emergency Services Interoperability Programme
MTS	Multiteam System
NDM	Naturalistic Decision Making
NGO	Non-Governmental Organization
NHS	National Health Service
NOTECHS	Non-technical skills
NOTSS	Non-technical Skills for Surgeons
NTS	Non-technical Skills
OIE	World Organization for Animal Health
OneHealth	'One Health' is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes.
OSCE	Objective Structured Clinical Examination
RPD	Recognition Primed Decision-making
SA	Situation Awareness
SAFE-T	A decision-making model which outlines the following steps: Situation Awareness, Formulate Plan, Enact Plan and Team learning
SAGAT	Situation Awareness Global Assessment Tool
SARS	Situation Awareness Rating Scales
T-NOTECHS	Trauma Non-technical skills
T-STEPPS	Team Systems Training for Emotional Predictability and Problem Solving
UN	United Nations
UNDP	United Nations Development Programme
UNOCHA	United Nations Office for Coordination of Humanitarian Affairs
WHO	World Health Organization
WOCRM	Well Operations Crew Resource Management

CHAPTER 1: INTRODUCTION

The 21st century has seen an increase in the number and complexity of emergencies with wide ranging impacts (WHO 2017a). When emergencies happen, men and women from multiple disciplines work together to protect and save lives. In recent years the West Africa Ebola outbreak (2014-2015) and the COVID-19 pandemic have highlighted public health staff as a key group in the response to emergencies (Gostin and Friedman 2015, Heymann et al. 2015, Moon et al 2015 and WHO 2015a). This thesis will examine non-technical skills (NTS), at a meso (systems) level, used by Public Health staff working in emergency response, to better understand what NTS they use and how they use them. The findings from this study can contribute to the development of understanding of the multi-sector response environment; the ways of working in this environment and the training and preparation of staff to work effectively in it.

This chapter has three sections: the first introduces the premise for this thesis; the second introduces the key concepts of NTS and multiteam systems (MTS); the third provides context around the history and study of NTS.

SECTION A: The premise for this thesis

This section will introduce the premise for this thesis that:

- There is evidence that emergencies are becoming increasingly frequent and complex
- Complex emergencies require a response from a range of specialist individuals and agencies working in MTS
- To work within complex emergency response systems, staff rely on NTS to help them adapt to, and meet, the changing demands of a complex environment
- MTS present a unique set of challenges for staff working in public health emergency response which may reflect in their use of NTS

Frequency and complexity of emergencies is increasing

The number of disasters and outbreaks to which national governments and the international community respond has increased in frequency in the 21st century (WHO 2017a). Emergency response is becoming more complex, as societies are increasingly urbanised and the world more interconnected. Previously localised disease outbreaks can now travel around the world within weeks, natural disasters or industrial accidents can impact thousands living in densely populated areas (UNDRR 2022). Governments and organisations are recognising that natural disasters, animal and human health and their effects on society are increasingly interconnected (FAO, OIE and WHO 2020).

The COVID-19 pandemic exemplifies the complexity and interconnectedness of a disease impacting beyond health into economies, politics and society (Independent Panel for Pandemic Preparedness and Response 2021). Actions taken to protect citizens from the pandemic harmed economies and exacerbated societal inequalities (Perznieto and Ohla 2021). The global pandemic is an extreme example, of the challenges and complexities that face responders in all emergencies, that require collaboration between governments, organisations, and communities.

Multiple sectors need to work together to respond to complex emergencies

To prepare for and respond to emergencies, governments and organisations have developed emergency management systems, that bring together people with a range of technical expertise (JESIP, UK Cabinet Office; Luciano et al., 2018). For emergencies with a health impact, the International Health Regulations (WHO 2008) mandate that this response should include not only the management of health consequences but also limit the spread and impact to trade. The response to a health threat may therefore require a

wide range of expertise, as its impact threatens to spread beyond health, to include the economy, schooling, transport and other services.

As emergencies have increased in complexity, countries and organizations have sought to develop increasingly resilient response systems, engaging a wider range of stakeholders. Developments in these systems are often triggered by system failures. Lessons from the 2010 Haiti earthquake and subsequent cholera outbreak prompted reforms to the UN Cluster system (WHO Global Health Cluster 2020, Global Policy Institute 2020); and the 2014-15 West Africa Ebola outbreak prompted changes to WHO's response structure (Gostin and Friedman 2015, Heymann et al. 2015, Moon et al 2015 and WHO 2015a). These reviews culminated in developments to two key systems used to manage public health response: The Incident Management System (IMS) used by organisations and various national governments (Brooks 2016, Brencic et al 2017) and the Cluster system which is used by the United Nations (UN OCHA 2015). A description of these systems is at Appendix A (p.189).

If national governments lack the resources to respond to an emergency, they may ask the international community for support. However, this assistance brings with it additional complexity, as multiple organizations seek to work alongside national governments (Mobula, Nakao, Walia et al 2018). Even in relatively localised emergencies, the response effort can be huge: over 450 humanitarian agencies responded to the 2015 Nepal earthquake (UNDP 2016).

The challenges of working in a response environment

Bringing together a range of expertise can help provide a wide range of knowledge and skills. However, it can also create challenges for collaboration and coordinated action (Marks et al., 2005; Flestea et al 2017; Brown et al., 2021). Failures in the response are often, in part at least, attributed to human failure. Studies of large-scale international and domestic responses such as the 2010 Haiti Earthquake and 2005 Tsunami response

(ALNAP 2012); the 9/11 attacks, Hurricane Katrina and the French 2004 heatwave point to challenges in leadership, decision-making, communication, and coordination between multiple agencies (Knox-Clarke 2019; Comfort 2004, 2006, 2007, Farazmad 2007, Lagadec 2004 and Waugh and Stribe 2006). Coordination of responses involving multiple stakeholders, can be made more challenging by the involvement of parallel response systems - governmental response systems, humanitarian organisations and communities - competing for scarce resources (Lanzara 1983, Hicks and Pappas 2006, Global Public Policy Institute 2010, ALNAP 2012, Junger 2016).

This complexity increases pressure on response staff who are often called to work with more groups than usual, many of which will be unfamiliar to them (CARE 2005, Global Public Policy Institute 2010, UNDP 2016); operate to different standards (Owen and Hayes 2014); work under stress (McLennan et al 2014); and adapt to rapidly changing environments (Comfort and Kapacu 2006, Rees-Gildea and Moles 2012). Staff working in emergencies use NTS to help them address these challenges. Academics and practitioners, are therefore increasingly paying attention to the personal skills and training, needed by people to ensure that they can work effectively within response systems.

Public health staff responding to emergencies use NTS

Emergency management and response has two core components: emergency response systems (described above); and the people that operate and work within them. Early research, based on rationalist thinking, saw humans as the weak link in systems compared to the more reliable technological or systemic components (Hollnagel and Woods 2005). The classic model of systems failure put forward by Reason, Hollnagel and Paries (2006) suggests that accidents happen because of series of flaws between the system design and human error. Planning, training, and after-action reviews have tended to concentrate on improving systems, instead of people’s skills, to eradicate these errors. A sample of After-Action Reviews

(AARs) from the Humanitarian sector reflects this tendency to focus on systemic lessons, high-level leadership (CARE 2005, Global Public Policy Institute 2010, Rees-Gildea and Moles 2012, UNDP 2016) or blanket calls for staff with “more experience” rather than the development of individual NTS which are increasingly recognised as a key component of the response (ALNAP 2012, Global Public Policy Institute 2010).

Cognitive science challenges the assumption that the design of increasingly complex systems, addressing all eventualities, provides the answer to system failures. In complex emergencies, the possible variations of constantly changing factors with which the system must cope, are so numerous that it is inevitable there will be gaps in that system. Systems are designed to address complete and well-defined problems, whereas humans are creative, flexible and can quickly adapt to changing environments (Bram and Vestegren 2011). Unlike systems, people can rapidly compensate for changes in the environment that impact system performance; and cope with uncertainty, to make decisions with incomplete information (Elbright, et al. 2003). In complex emergency environments therefore, technical knowledge and systems alone are not enough. Response systems must allow for the interaction between static procedures and a human-being’s capacity to learn, innovate and adapt to changing circumstances (Comfort 2007).

NTS enacted by PH staff are different in a multi-team context

Studies into NTS have concentrated on the members of single teams engaged in particular tasks (e.g.: surgical teams). However, most emergencies require a response from multiple, interdependent but autonomous teams (Janssen et al 2010, Weick 1998, Comfort et al 2004, Comfort and Kapacu 2006, Comfort 2007 and Farazmad 2007). This can increase the challenges facing emergency responders. The Humanitarian Sector – in which many public health staff find themselves working - can provide additional challenges because it is more loosely coordinated than domestic emergency response activities (Care 2005, Global Public Policy Institute 2010, and UNDP 2016).

Studies of complex responses, indicate that a traditional teamwork model does not explain the operational reality of the multi-sector environment (Lanaj et al 2013, Luciano et al 2018, Zaccaro et al 2012): Conventional teams operate with a degree of stability in terms of membership and place within an organization. Complex emergencies, however, take place in a fluid environment (Luciano et al., 2018) comprising *ad hoc teams* of individuals from different disciplines and organisations (Miller at al 2008; Khan et al., 2018) where coordination is challenging as multiple response systems operate simultaneously and compete for resources (Lanzara 1983, Hicks & Pappas 2006; Global Public Policy Institute 2010; ALNAP 2012; Junger 2016). Staff working in complex emergencies often need to balance their own organisational priorities, whilst acknowledging the over-arching distal goal of all the different teams acting in the response (Luciano et al., 2018; Rico, Hinsz, Davison and Salas, 2018; Marks et al., 2001, Keyton, Ford and Smith 2012, Ward et al 2020). These factors may cause responders to draw on a different set of NTS than those required for intra-team working alone (Gregory et al 2009, Janssen et al 2010).

The purpose of this study

Staff working in emergencies use NTS to help them navigate the demands of the emergency environment. In a complex emergency, where multiple teams are engaged, there can be additional demands placed on staff which are different from those of working in single formed teams. Most studies that have examined NTS have done so in the context of single teams (or single roles within teams) without considering the broader context in which the team was working. Much of the leadership and emergency management training focusses on working within individual teams. However, examining the skills and behaviours within small distinct teams, conducting well-defined tasks, does not help to explain the skills required to work in the more complex multiteam environments. Nor does it account for potential differences in organisational and cultural practices that permeate multi-

sectoral working (Maldonaldo, Maitland and Tapa 2010 Tsasis and Cooke-Lauder 2015 and Campbell and Knox-Clarke 2018).

The study of NTS used by public health staff at a meso level has been limited. No study of how these skills are used in the context of an emergency response, involving multiple organisations, was identified in the literature review for this research. However, this is the context in which public health responders are increasingly working. This study will examine what NTS are used by public health responders working in emergencies and how they use them.

SECTION B: Definitions used in this study of NTS and MTS

There is a broad and varied literature and terminology used to describe the skills needed by people to work within systems in dangerous or emergency environments, and the emergency response systems themselves. In this section the terminology around NTS and MTS used in this study will be explained.

Terminology: human factors, crew resource management and NTS

The most referred to terms identified in this study to describe the ‘human skills’ required by people to work effectively together are ‘human factors’ (HF), ‘crew resource management’ (CRM) and non-technical skills (NTS).

Human Factors is an extensive area of research around human behaviour (Roche 2016). It is also identified with the interactions of humans and machine and system design (Franca et al 2020). HF is defined in studies on emergency response as “the interactions amongst humans and other elements of a system [that] optimize human well-being and overall system performance.” (p.2). (Karowski in Owen 2014).

Whereas studies in HF examine all aspects of human interactions with the workplace including technological; environmental; organizational; individual

and all other factors; NTS focusses on individual knowledge and skills and organisational characteristics (Franca et al 2020).

Non-technical skills are “cognitive, social and personal resource skills that complement technical skills and contribute to safe and efficient task performance” (Flin et al 2008 p.1). There are seven core NTS which are common across much of the literature (Flin 2008) and listed in Table 1 (p.20). NTS are divided into cognitive (intra-personal) skills of situation awareness and decision-making[1]; and ‘social’ (inter-personal skills) of team-working, leadership and communication. Two further skills are labelled as ‘management of personal resources’ by Flin (2008) (p.12) which are the ability to deal with fatigue and stress.

An individual’s knowledge and skills to complete their work can be described as explicit and tacit. Explicit knowledge is that which is easy to categorise and formalise through standards procedures and rules (Crandall 2006). This includes knowledge of response systems and the plans, processes and standard operating procedures that are included within these systems (WHO 2015b)[2]. Explicit knowledge also includes the technical skills and knowledge needed to ‘work a machine or conduct an operation’ (Franca et al 2021). Tacit knowledge is difficult to recognise and formalise despite being present in all worker activities. However, there is evidence that better non-technical performance equates to better technical performance (Krage et al 2017, Casali, Lock and Navoa 2021). NTS can be taught and developed by providing learners with basic concepts (for example around what constitutes effective communication in a particular setting), allowing them to practice and then debriefing them (Roche 2016, Hayes et al. 2021 and Casali, Lock

[1] Cognitive skills are defined by the American Psychological Association Dictionary of Psychology (VandenBos,2015, p. 203): “all forms of knowing and awareness, such as perceiving, conceiving, remembering, reasoning, judging, imagining, and problem (Kell 2018) solving.” In an emergency context these elements are contained in a person’s ability to take in information and understand their surroundings (situational awareness) problem solve (decision-making)

[2] The WHO Framework for a Public Health Emergency Operations Centre 2015 provides a useful break down of Legal Frameworks, Plans and the processes and procedures that fall under them.

and Navoa 2021). NTS complement technical skills and knowledge, making them more efficient and effective (Franca et al 2021). Indeed, where external pressures such as stressors are present, improved NTS can lead to improved technical skills (Saunders et al 2021). Essentially, NTS enhance workers' technical skills: poor NTS can increase the chance of error, good NTS can reduce it (Flin and Maran 2015).

During this study other terminology including 'error management' and 'soft-skills' were identified and considered for inclusion in the literature review. The use of 'error management' was discounted as it would have detracted from the focus on how NTS can enhance technical skills. It would also have been necessary to examine recognized operational failures which would have required a high-level of cooperation from distinct organisations[3]. Furthermore, both terms were discounted as they would have made the number of results in the literature review unwieldy and were not terms commonly used in the health sector.

The term "non-technical' skills will be used in this thesis because it helps to differentiate "non-technical" from the "technical" clinical or professional skills that form the backbone of a public health professional's competency. "Non-technical skills" is also the term used widely in the medical literature.

Terminology: Multiteam Systems, multi-agency, multi-sector and inter-organisational systems.

A variety of terms is used to describe how organizations work together to respond to an event. 'Multi-sector' and 'multi-agency' were two commonly identified terms. In a national context 'multi-sector' refers to different areas of the economy (for example Health and Education) (WHO Europe 2018). In the United Nations context a 'sector' is used to denote areas of humanitarian

[3] See p.67 for an additional explanation of why a methodology of incident review was discounted.

action[4] headed by different agencies (UNHCR 2022). Sectors denote a strategic or national policy level demarcation of activities. At the operational and sub-national levels, the term ‘multi-agency’ is common. ‘Agency’ includes public and private organizations (Jansen et al 2009). In the humanitarian context groupings of agencies working together is called a ‘Cluster’.

Response systems made of multiple teams, each with different expertise, structures and norms are required for responding to increasingly complex emergencies. Zaccaro, Marks and DeChurch (2012) define these kinds of organisational structures as MTS “Two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals. MTS boundaries are defined by virtue of the fact that all teams within the system, whilst pursuing different proximal goals, share at least one common distal goal; and in doing so exhibit input, process and outcome interdependence with at least one other team in the system” (p.5).

Zaccaro, Marks and DeChurch (2012) acknowledge that MTS share similarities with other collective forms of organization, such as matrix management or task forces. They argue that MTS consistently have a much higher degree of interdependence which sets them apart from these other models, these are:

- Input interdependence: teams in MTS share resources
- Process interdependence: teams share the functions necessary for collective action
- Output interdependence: teams rely on each other to produce

The way multiple sectors, agencies and clusters work together meets many of the characteristics of a MTS. However, MTS (rather than the other terms cited in this section) were chosen as the focus for this study because:

[4] Health, Logistics, Nutrition, Protection, Shelter, Waster Sanitation and Hygiene (WASH), Camp Coordination and Camp Management, Early Recovery, Education, Emergency Telecommunications and Food and Security

- It allows for a systemic study of NTS used in response work as opposed to the mechanics of particular response systems such as the IMS and the Cluster system.
- Multi-sector and multi-agency responses may exclude communities, the private sector, volunteers or individuals who may contribute to the response effort, or impact on it.
- Studies and accounts of formal response systems focus on established teams within organizations and the linkages between those teams both inter and intra-agency. The MTS model recognizes that teams in response can be *ad hoc* and made up of members of different organizations. It therefore provides a more useful model to examine the realities of working in public health response.

The terms ‘multi-sector’, ‘multi-agency’ and ‘multi-organization’ were not included in the initial literature review because: the scoping review did not indicate that including these terms would generate information about NTS. Furthermore, it is possible that inclusion of these terms would have generated an unmanageable number of results, that would likely have focused on individual formed teams within organisations and the way they liaise, rather than how people work in highly interdependent teams.

SECTION C: Context and background on NTS and MTS

A brief history of NTS in healthcare and emergency response

The story of NTS starts in the airline industry where they were labelled as Crew Resource Management (CRM). CRM describes both the skills and training programmes which focus on the human aspects of maintaining safety (Hayes et al 2021). Although CRM and NTS are sometimes used interchangeably (Flin and Maran 2015, Hayes et al 2021) most of the health sector research identified during this study referred to NTS.

CRM was first studied when concerns around safety prompted an effort to systematically identify and address, the role of humans in errors which had led to accidents (Flin and Maran 2015, Hayes et al 2021). In health, the Institute of Medicine's 1999 report 'To Err is Human: Building a Safer Health System' galvanized the conversation around the role of human error and NTS in patient safety (Department of Health 2001, Kodate et al 2012, WHO 2011 and WHO 2017b). The failure of NTS has been documented in studies examining a wide range of responses including the Three Mile Island, Chernobyl, Piper Alpha, Deepwater Horizon disasters (Hayes et al 2021), the French Heatwave (Lagadec 2004), Hurricane Katrina and the 9/11 attacks (Comfort 2006, 2007, Comfort and Kapacu 2006, Faramzand 2007)

Examples of the human role in systems failure and the use of NTS to avoid accidents, are shown in the case studies below. The first from the aviation industry and the second from an environmental event (heatwave) involving multiple teams.

Case Study 1 NTS in the airline industry: *In 1978 United flight 179 crashed in Oregon because the plane ran out of fuel. The plane circled the airport, steadily losing fuel, whilst the crew searched for a technical solution to an unfamiliar minor issue. They became so engrossed in this that they failed to notice the lack of fuel. The lack of NTS such as: situational awareness, communication and adaptability contributed to the accident (Flin 2008, McChrystal 2015).*

Case study 2: The French Heatwave – a complex emergency: *The French heatwave of 2003 killed 15,000 people in just over a week. In his review of the incident Lagadec (2004) identified the complex nature of emergencies and the need for teams from different disciplines to work together. In this case, the responders failed to identify the threat which might have been more evident had they had better situational awareness, communication and inter-teamwork in place. This lack of national level situational awareness amongst responding staff in multiple agencies across France meant that the risk was not well understood or prioritised because there was no picture of the cumulative effect of the heatwave. Organisations acting alone were unable to gather a wide range of data and use it to predict the impact of a myriad of small changes. They also became distracted by a number of small-scale, acute challenges such as forest fires, ignoring the larger impact of the heatwave until it was too late.*

Describing NTS

Much of the work on NTS has been led by Rhona Flin, who provides a list of seven core NTS, listed in Table 1 (p.20). Four or five of these NTS appear across a range of literature (Hayes et al 2020) from the US Airforce (Bell and Waag 1997), firefighting (Weick 1993), the oil industry (Sneddon et al 2006) and power systems, emergency management and medicine (Endsley 2015).

Table 1: Core non-technical skills with a brief explanation (adapted from Flin 2008)

Skill	Elements
Situation Awareness	Gathering and interpreting information, anticipating future states. Situational awareness is the ability to picture and assess a situation. It plays a major part in decision-making. A lack of situational awareness can lead to staff fixating on relatively minor problems and failing to acknowledge larger dangers or failing to identify the most important problems to be addressed.
Decision-making	Defining a problem, considering and selecting options: In the context of emergencies decision-making requires reaching a judgement about the situation, choosing a course of action (often rapidly and with limited information) and then reviewing that decision as part of an on-going process
Communication	Sending, receiving, and contextualising information. Poor communication has often been cited as a cause of accidents. It can be shaped by policy (for example the use of jargon) but also requires staff to not only send but to receive information appropriately.
Team working	Supporting and coordinating. A key factor is about making individuals more effective in the teams in which they are working. This focusses on how team members define tasks and roles to work more effectively.
Leadership	Planning, use of authority, maintenance of standards and discipline. Effective planning and coordination within a team and with other teams is a key element of the response.
Managing Stress	Identifying causes of both chronic and acute stress, recognising the symptoms and effects and implementing coping strategies
Coping with fatigue	Identifying the causes of fatigue, recognising the effects of fatigue and implementing coping mechanisms

NTS can be learned and exhibited by teams and individuals, they are not innate ‘characteristics’ (Prineas et al 2021). NTS are identified in two stages: conducting a task analysis then organizing the resulting list into a hierarchical structure or taxonomy which can be used as a basis for training and assessment (Flin and Maran 2015). The taxonomy usually includes the category broken down into elements and each element assigned positive and negative “behavioural markers” which can be measured. An example of

the taxonomy can be seen in the Anaesthetists' NTS tool (ANTS) at Figure 1 (p.22).

Identification and measurement of NTS are mostly achieved through three methods: observation of people in real-time or undertaking a simulation exercise; retrospective interviews covering the actions of individuals in emergency situations or event analysis using reports from incidents. Checklists known as "Tools" have been developed to assist researchers and trainers to identify and assess NTS. The example at Figure 2 (p.23) is an extract from the NTS Tool used to assess surgeons (NOTSS).

Although four to five of the NTS identified by Flin are seen across a range of industries, the elements and behaviours for each of the NTS vary widely between settings (Hayes et al 2020). There is a broad range of behavioural indicators, each relating to specific professions, or roles within a profession. For example: even within surgical teams the behavioural markers for surgeons, anaesthetists and scrub nurses are different and different tools have been developed to measure them. This high level of specialisation means that studies into NTS need to be conducted in the context in which they are being used and that blanket application of the 'generic' skills list runs a risk of misapplication. The high degree of specialisation causes difficulties for those studying NTS: studies run the risk of being biased and difficult to generalize; and there are a wide range of studies using inconsistent terminology.

Multiteam Systems (MTS)

In academia the multi-sector response described above has been studied as MTSs. MTS provide greater resource capacity than single teams or organisations and more flexibility than traditional bureaucratic system structures. To deal with complex environments, organisations have moved away from a Weberian bureaucracy model based on hierarchy, towards flatter organisational structures which rely on information sharing and constant adaptability to survive (Ashkenas 1995). This ability to bring

together resources including technical expertise and to adapt to react in complex environments has seen MTS adopted in business (Ashkenas 1995, Grobman 2005), the military (McChrystal et al 2015, Fussell 2017) and disaster and emergency response (Comfort 2006 and 2007).

Studies of complex emergencies have shown that a traditional teamwork model does not explain the operational reality of the response environment where multiple teams work together (Lanaj et al 2013, Luciano et al 2018, Zaccaro et al 2012). Research on teamwork concentrates on standing or permanent teams whereas teams in healthcare and emergency response tend to be *ad hoc*, made up of people from different disciplines, even different organisations, brought together to resolve issues (Miller et al 2011). Furthermore, most of these studies have examined interoperability between teams using traditional teamwork models (Brown, Power and Conchie 2021) rather than how teams function as part of a complex MTS.

Figure 1: Anaesthetists NTS (from Hayes et al 2020) showing taxonomy of NTS

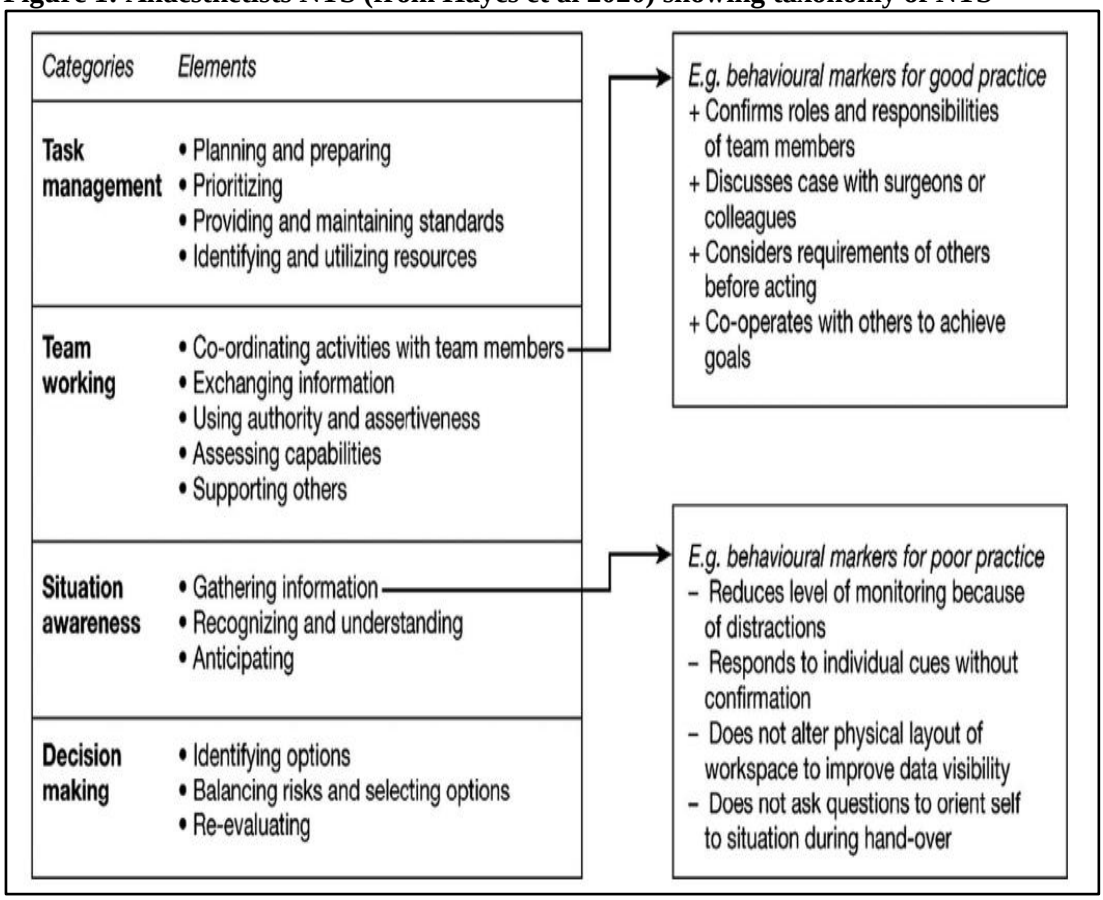


Figure 2. An extract from the Non-Technical Skills for Surgeons (NOTSS) System Handbook produced by University of Aberdeen The Royal College of Surgeons Edinburgh and NHS Education for Scotland. Showing Behavioural Indicators for Situational Awareness (2012 p.8)

NON-TECHNICAL SKILLS FOR SURGEONS

Situation Awareness: Developing and maintaining a dynamic awareness of the situation in theatre based on assembling data from the environment (patient, team, time, displays, equipment); understanding what they mean, and thinking ahead about what may happen next.

Gathering information — Seeking information in the operating theatre from the operative findings, theatre environment, equipment, and people.

Good behaviours:

- Carries out pre-operative checks of patient notes, including investigations and consent
- Ensures that all relevant investigations (e.g. imaging) have been reviewed and are available
- Liaises with anaesthetist regarding anaesthetic plan for patient
- Optimises operating conditions before starting e.g. moves table, lights, AV equipment
- Identifies anatomy/ pathology clearly
- Monitors ongoing blood loss
- Asks anaesthetist for update

Poor behaviours:

- Arrives in theatre late or has to be repeatedly called
- Does not ask for results until the last minute or not at all
- Does not consider the views of operating room staff
- Fails to listen to anaesthetist
- Fails to review information collected by team
- Asks for information to be read from patient notes during procedure because has not been read before operation started

Understanding information — Updating one's mental picture by interpreting the information gathered, and comparing it with existing knowledge to identify the match or mismatch between the situation and the expected state.

Good behaviours:

- Acts according to information gathered from previous investigation and operative findings
- Looks at CT scan and points out relevant area
- Reflects and discusses significance of information

Poor behaviours:

- Overlooks or ignores important results
- Misses clear sign (e.g. on CT scan)
- Asks questions which demonstrate lack of understanding
- Discards results that don't 'fit the picture'

Projecting and anticipating future state — Predicting what may happen in the near future as a result of possible actions, interventions or non-intervention.

Good behaviours:

- Plans operating list taking into account potential delays due to surgical or anaesthetic challenges
- Verbalises what equipment may be required later in operation
- Shows evidence of having a contingency plan ('plan B') (e.g. by asking scrub nurse for potentially required equipment to be available in theatre)
- Cites contemporary literature on anticipated clinical event

Poor behaviours:

- Overconfident manoeuvres with no regard for what may go wrong
- Does not discuss potential problems
- Gets into predictable blood loss, then tells anaesthetist
- Waits for a predicted problem to arise before responding
- Operates beyond level of experience

8

Teams brought together in a multiteam environment may be made up of individuals from organisations or functions that have conflicting goals. In a MTS responding to an emergency all the teams have a common (distal) goal of saving lives, but this is set against differing proximal goals which vary according to the role of the specific team and their view of the response operations and priorities (Luciano et al 2018, Rico et al 2018, Zaccaro et al 2012). For example, the fire service's proximal goal may be to put out a fire whilst that of public health responders is to ascertain the potential risk to health from the smoke and chemicals produced by the fire. Both share a distal goal of saving lives (Brown 2020).

Additionally, Luciano et al (2018) propose that MTS, unlike traditional teams in established organizations, are not static. They vary in shape, composition and size over time, with certain teams working more intensely or closely together for different phases of the response. MTS are dynamic, so the size and configuration of the teams will change according to the needs of the response. Poole and Contractor (2012) argue that MTS should be seen less as a group of interlinked teams but more as an eco-system of networks made up of teams and individuals which activate and deactivate according to the demands of the response.

MTS have not been studied in the context of public health emergencies. However, the description of the response systems fits the definition of MTS provided by Zacarro, Marks and de Church (2012). This study will therefore examine NTS used in response through the lens of MTS.

Introduction Summary

Public health is increasingly recognized as a key element of the multi-sector response. Response staff – including Public Health staff - work in complex MTS environments. The use of NTS can assist staff to work effectively in these challenging environments. Although NTS is an established area of study across a range of sectors what constitutes 'positive behaviour' in the use of NTS is highly contextualized by both the environment in which they

are used and the technical skills they are used to augment. The identification of NTS can assist with more effective training and assessment of staff working in emergencies and help to avoid errors.

This research seeks to contribute to the discussion and analysis around NTS and MTS in the following ways: (1) There is a dearth of literature examining the NTS required of public health staff working in emergency response at a meso (systems) level. The identification and analysis of these NTS can contribute to training, assessment and evaluation of public health emergency response by recognizing the importance of the human factors alongside response systems. (2) Research into NTS has focused on individuals working within static traditional teams. This does not reflect the reality of large-scale multi-sector response. Clearer definition of the environment in which Public Health responders work and the NTS they use to work within it will aid understanding of the challenges of working in response that are currently being assessed through the lens of traditional teamwork models. (3) Finally, it is hoped that this research can ignite a conversation around the need for developing NTS for public health staff; balance the debate between the need for response systems and NTS; and recognise the dedication and skill of public health staff working to save lives.

CHAPTER 2: UTILISING NON-TECHNICAL SKILLS IN EMERGENCY RESPONSE: A LITERATURE REVIEW

INTRODUCTION

A Literature Review was conducted to develop knowledge about NTS and how they are used in the emergency response environment by Public Health professionals.

This chapter describes: the initial reading around the subject of NTS which helped to identify the subject matter; the review methodology; the review process and findings.

Setting the scene

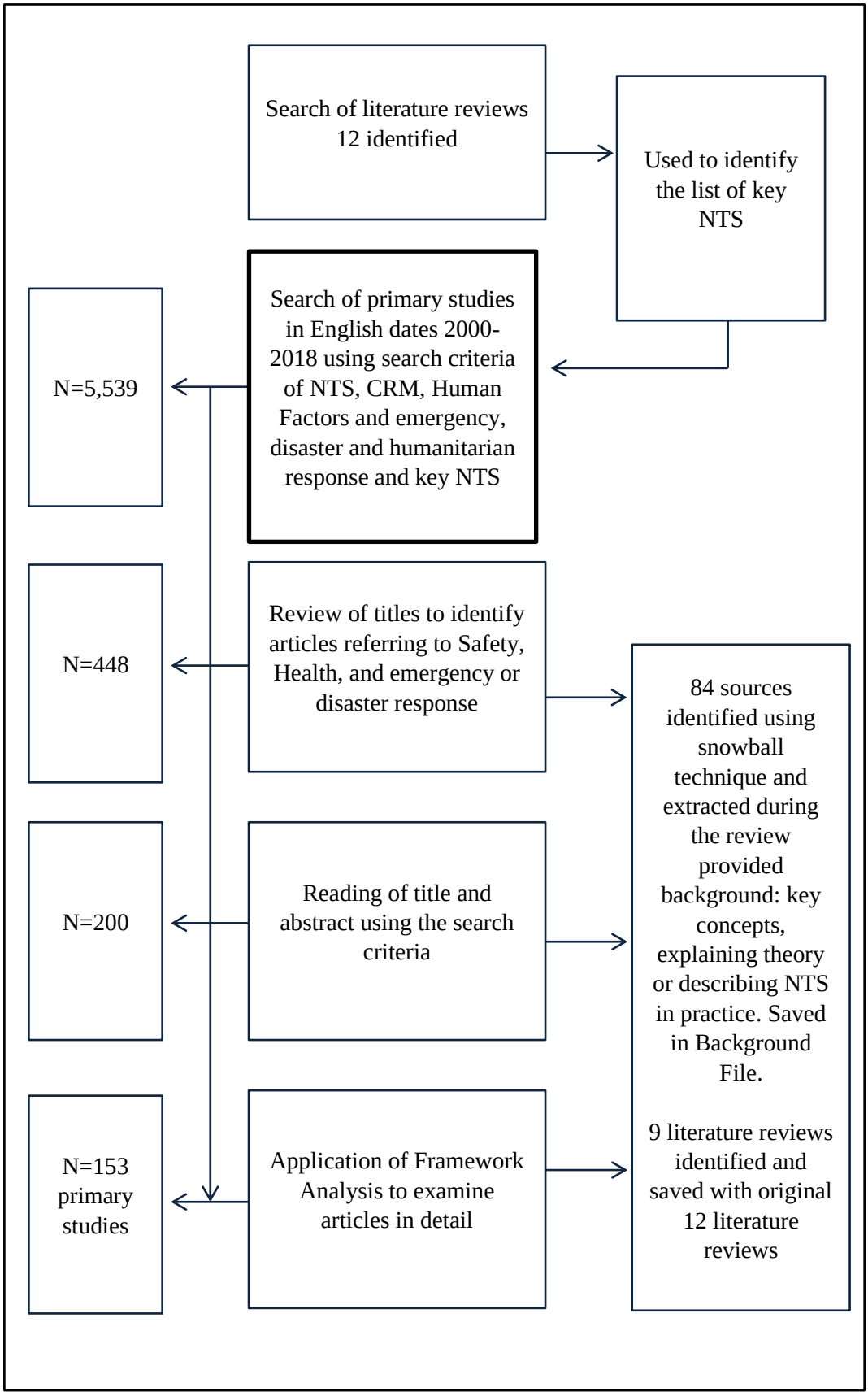
Contextualising the problem space was guided by a rapid literature review and recommended reading by colleagues working in health emergency response. Two key texts were identified: Rhona Flin's "Safety at the Sharp End" (2008) and Christine Owen's "Human Factors Challenges in the Emergency Environment" (2014). Both these texts introduced the key themes around NTS, CRM and HF. This initial scoping was used to identify research questions and to guide a more detailed review of literature.

Aim and Objectives of the Review

The aim of the literature review was to better understand the topic of NTS by examining:

- NTS in emergency and disaster response and the health sector
- The methods used to study these skills
- Studies of NTS in a complex or multiteam environment

Figure 3: A flow diagram of the search strategy used to identify relevant literature from the Bath University Library which includes the following databases: Web of Science, Scopus, PubMed and APA Psych Net



Review Methodology

The research problem and questions required a systems perspective. It was therefore necessary to produce a broad review of the literature examining a wide range of NTS and theories rather than focussing on a single literature domain.

The literature review presented two key challenges. Firstly, NTS literature is drawn from a wide variety of sources and disciplines and secondly the wide variety language used to describe NTS made establishing appropriate search terms and saturation difficult. This challenge has also been reported in the field of healthcare where sources include not only primary research, but policy documents, editorials and secondary research (Dixon-Woods et al 2006).

To address these challenges the literature review was conducted in two stages: a scoping review of systematic reviews and literature reviews was used to gain an insight into the subject and develop search terms for an in-depth review. An overview of the search strategy for the literature review is contained in Figure 3 (p.27).

Information gathered during the literature review process was examined using a framework analysis which offers a highly structured approach to categorising, organising and analysing large amounts of data (Barnett-Paige and Thomas and Arksey and O'Malley 2006) including qualitative data (Strauss and Corbin 1998). Background reading and a search of the systematic reviews indicated that most studies used to describe NTS would have a large qualitative element. The framework used in this review was based on criteria identified by Barnett-Page and Thomas (2009) and Bromley et al (2002) in their criteria for assessing qualitative studies. The framework categories used were: authors, year of publication, purpose of the study, research question, methodology, theoretical basis for study, location (country), setting (industry or profession), sampling (including the type of subjects and numbers), research instruments and / or ‘Tools’ used as a

basis for gathering or analysing information, the method of data analysis, major conclusions, implications of the research and / or gaps identified and the NTS or Tools identified, trained to or used as a basis for the development of profession specific NTS.

The information was entered into an Excel spreadsheet. Themes were developed using a mix of iterative and deductive technique. Before the analysis of the literature, codes were developed to designate non-technical skills (NTS), studies that were concerned with identifying those skills in groups (ID), studies that examined methods of training or the efficacy of training in NTS (ASSESS). Codes were also developed to identify the core technical skills as identified by Flin et al (2008) which were Situation Awareness (SA), Decision Making (DM), Communication (COMM), Teamwork (TEAM) and Leadership (LDR). A code (CRM) was also included for Crew Resource Management.

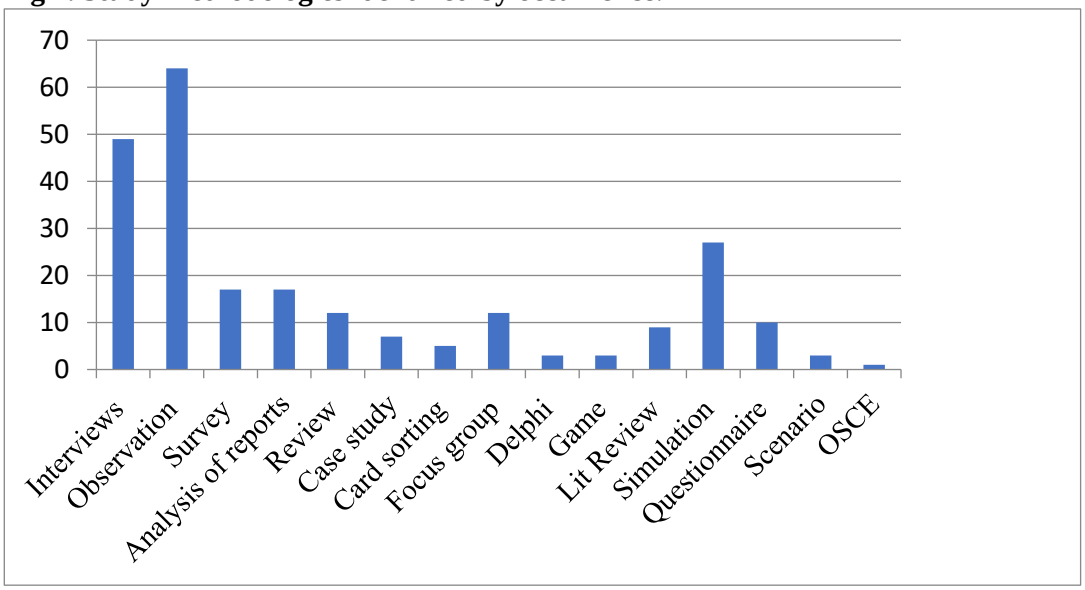
Additional codes to distinguish the primary purpose of the study were developed iteratively as studies were examined. This was normally stated as part of the study aim and where not explicitly stated was developed from the contents of the paper. The additional categories developed were studies examining the use of NTS by professional groups in the conduct of their duties or during simulation exercises (USE), the development or assessment of a behavioural marker tool used to assess NTS (TOOL), personal or systemic factors impacting on the use of NTS (FACTORS) and the use of NTS in a complex system or multiteam system (MTS).

- *Objective 1*: was addressed by including lists of identified NTS or Tools in the "NTS or NTS Tools identified" column. NTS are reported as skill (such as leadership) followed by behavioural indicators.
- *Objective 2*: Code words were used to identify the primary methodology used in the "methodology column". These codes were developed deductively (from the Reviews examined) and iteratively as the studies were analysed. The text of the studies was examined to

extract details about the sampling, research instrument, tools and data analysis. Where possible, sampling strategies and sizes were also extracted. Figure 3 shows the range of methodologies identified.

- *Objective 3*: studies examining the use of NTS in complex systems or MTS were included in the search.

Fig 4. Study Methodologies identified by occurrence.



The principal inclusion criterium for the literature was the relevance to the research question following the methodology adopted by Thomas and Harden (2008) and the "Appraisal prompts for informing judgements about the quality of papers" which Dixon-Woods et al (2006) extracted from the National Health Service (NHS) National Electronic Library for Health contained in Table 2 (p.31)

Given the breadth of the literature available the decision was made to review only primary studies to give the best opportunity of answering the objectives. Studies which provided an overview or discussion around the subjects of NTS and the methodologies used in the primary studies identified were saved as "Background" information and used to support the development and analysis of the research.

The results of the literature review provide a descriptive analysis of the breadth of the studies identified and the design that would be most applicable to the proposed area of study. These are presented in a thematic analysis.

Table 2: Appraisal prompts for informing judgements about quality of papers (Dixon-Woods et al 2006)

• Are the aims and objectives of the research clearly stated? • Is the research design clearly specified and appropriate for the aims and objectives of the research? • Do the researchers provide a clear account of the process by which their findings we reproduced? • Do the researchers display enough data to support their interpretations and conclusions? • Is the method of analysis appropriate and adequately explicated?

THE REVIEW PROCESS

This section describes the conduct of initial scoping review followed by an in-depth literature review.

Scoping review: A search of systematic and literature reviews

A scoping review was conducted to map the wide range of literature available. Scoping reviews can be used as a preliminary investigation to guide further action and identify the theories, concepts and methodologies associated with a particular subject matter (Levac, Colquhon and O'Brien 2010). Arksey and O'Malley (2006) identify scoping reviews as a suitable tool where there is little information about a complex subject or where the subject has not been reviewed before. In cases such as these Levac, Colquhon and O'Brien (2010) suggest maintaining broad search parameters with clearly articulated areas of enquiry.

A search for systematic reviews and literature reviews was conducted on the University of Bath's Library database (the details of which are listed in following paragraphs) and Google Scholar. The search terms used were "non-technical skills" AND "literature review" OR "systematic review". Articles were selected based on the title of the paper. This initial search identified 12

reviews. A further nine systematic reviews were identified during the literature search (see below). A total of 21 reviews were identified which are broken down into the following types: not stated (2), meta-analysis (1), systematic (9), integrative (2), literature (4), scoping (1) and critical (1) reviews. Information from the first twelve reviews identified is included at Appendix B (p.193).

All except one of the reviews was drawn from the domain of health and concentrated on particular specialisms. Therefore, they provided a limited overview of NTS. They reported on the following topics: evaluating the impact of NTS on technical skills (1); evaluating the impact of NTS and use of tools for their measurement (1); examining tools and techniques used to examine situational awareness (1); evaluating tools / behaviour markers to assess NTS (2); the impact of crew resource management training (1); identifying factors affecting communication and teamwork (2); identifying factors contributing to effective leadership (1); identifying NTS for healthcare specialists (5); identifying NTS and behavioural markers for measuring them (1); identifying factors to improve team effectiveness (1); identifying current literature around NTS and suggesting areas for further research (1); assessing the effect of crew resource management training (1).

The review also identified several behavioural marker tools used to measure NTS. The tools identified were: Human Factors Analysis and Classification System (HFACS), Non-technical skills (NOTECHS), NTS for surgeons (NOTSS), Anaesthetists NTS (ANTS), Trauma NTS (T-NOTECHS), Well operations Crew Resource Management (WOCRM), Team Systems Training for Emotional Predictability and Problem Solving (T-STEPPS), UK Civil Aviation Authority Crew Resource Management Training (CAA CRM) and the University of Texas Behavioural Marker System.

Analysis of the papers identified during the initial scoping review

The reviews identified during the search indicated that studies into NTS are concentrated around particular professional specialisms or activities and tend to be small scale. The smallest number of articles included in a review was three the largest was 74. An additional challenge reported by reviewers was that the terminology used in the study of NTS is not clearly defined, making it possible that studies may have been missed in the reviews.

Non-technical skills were for the most identified using established and validated tools. A search of the systematic reviews identified 30 NTS although most of the NTS were similar because they were identified using validated behavioural marker tools. A list of those tools and the NTS identified in the reviews is at Appendix B (p.193).

The primary methodologies identified were questionnaires, interviews, observation, adverse events analysis and surgical education or competencies. The main criticisms of these studies and the tools developed from them is that they were largely developed through observation or interviews based on activities undertaken during simulation exercises. In simulated environments there is potential for bias in both the observer and the participants, who may act differently in an exercise than they would do in reality. Simulated environments also tend to compensate for many of the challenges of the real world by presenting simplified scenarios compared to the complexities of reality (Patterson, Bilke and Nadkami 2008).

The small sample sizes used in most of these studies and the fact that they concentrated on specialist professional groups also limited the generalisability of the results. In the studies identifying NTS the level of evidence was rated very low or low, with only one of the reviews citing moderate levels of evidence.

None of the reviews referred to the study of NTS in a complex or multi-team environment. They all examined the role of NTS in small well-defined teams within a clinical setting.

Although an examination of the reviews provided an insight into the role of NTS in health care, the decision was taken to undertake a more thorough review of the literature to examine the use of NTS in more varied contexts and within domains more likely to reveal the use of NTS in dispersed teams such as civil emergency and humanitarian environments.

A search of the wider literature

The scoping review helped identify the terms for a more detailed literature search. These were derived from key words identified in the reviews and the NTS tools which confirmed that the most reported NTS are those listed at Table 1 (p.20).

A second search was made of the Bath University Library which includes the following databases: Web of Science, Scopus, PubMed and APA Psych Net. The search terms used were: "NTS AND NDM", "naturalistic decision making" AND ("emergency" OR "disaster"); "crew resource management" AND ("emergency" OR "disaster") OR ("decision making" OR situation* awareness" OR "communication" OR "leadership"); "crew resource management" AND ("emergency" OR "disaster")"non-technical skills" AND ("emergency" OR "disaster") AND ("leadership" OR "communications" OR (situation* awareness) OR (team work)); "naturalistic decision making" AND ("non-technical skills" OR "crew resource management"); "decision making" AND "complex environment" AND ("emergency manag*" OR "emergency response" OR "disaster response"); "decision making" AND "complex environment" AND ("emergency manag*" OR "emergency response" OR "disaster response"); "decision making" AND "complex environment" AND "humanitarian""cognitive skills" AND "complex environment" AND "humanitarian" "non-technical skills" AND "health". This search revealed 5,539 items

Included in the search were journals, in English dated between 2000 and 2018. The year 2000 was identified as a cut-off because major changes to key response systems (the Cluster system and the IMS) took place following the Haiti Earthquake in 2010 and the Ebola West Africa response (Gostin and Friedman 2015, Heymann et al. 2015, Moon et al 2015 and WHO 2015a, WHO Global Health Cluster 2020). The aim therefore was to capture studies that would have been conducted after the introduction of these systems.

Three sifts were conducted using the following criteria: original primary research conducted to examine NTS or CRM; variations on both these terminologies such as human factors were included in the criteria. Articles discussing the validation of training were included where part of the process of designing and implementing the training had been to identify skills.

- *First sift*: The article titles were used to identify research relevant to “non-technical skills” or "crew resource management" used in a "safety", "health", "emergency" or "disaster response" context. Where the content was not clear from the title the abstract was used. Where an item met the criteria, it was added to a collection on the Bath University Library web tool. From this initial sift 448 articles were retained.
- *Second sift*: A second sift was conducted using the inclusion criteria reading the title and the abstract. Two hundred articles met the inclusion criteria and were transferred to Mendeley library and backed up on DropBox and hard drive. Articles which provided overviews and background information on NTS, CRM and any of the key NTS were identified and saved in a “Background information” folder. Nine systematic and literature reviews as well as meta-analysis were extracted and saved in a separate file.
- *Third sift*: A third sift was conducted during which a framework analysis was used. Articles which met the inclusion criteria were input

on the matrix. An extract[5] from the framework is included at Appendix B (p. 193). The following headings were used for the framework: Authors, Year of publication, the purpose of the study, the title of the study, research question, type of study, basis for study, location, setting, sampling, research instrument and tools, data analysis, major conclusions, implications / gaps and NTS identified and / or trained to. Articles that did not meet the inclusion criteria were removed. In all 153 articles were retained.

Snowballing, scanning reference lists from primary studies, (Greenhalgh and Peacock 2005 and Vasser, Atakpo and Kash 2016) was used to identify sources that provided background or theoretical information useful to develop a broader understanding of NTS. These sources and others identified during the sifting process were saved in the "background information" folder.

The search was made more difficult because of the lack of clear definitions for many of the concepts discussed under NTS. The term "non-technical skills" for example was used mainly in studies in health from the UK, studies from the USA referred to "crew resource management". Similarly, issues surrounding NTS are also referred to in terms of 'failings in safety' which was not searched (see p.16 and p.67).

Analysis of the studies identified in the wider literature review

One-hundred and fifty-three articles were retained from the third sift covering the following disciplines: health (83), civil aviation (16), the military (including military aviation) (14), fire-fighting (9), oil-industry (7), nuclear industry (5), police force (4), cognitive skills (1), earthquake (1), emergency management (1), emergency response (1) , humanitarian work (1), automotive industry (1), processing industry (1), lab work (1), mining (1), various organisations

[5] *The original framework runs to over 50 pages and so an extract has been provided in this thesis.*

(1), outdoor education (1), psychology (1), railways (1) , road users (1) and shipping (1).

The articles relating to health were broken down as follows: surgery (22), emergency department (12), anaesthetists (10), not defined (4), cardiopulmonary resuscitation (3), general hospital (3), intensive care unit (3), paramedics (3), trauma care (3), medical students (2), critical care (1), emergency care practitioner (1), emergency department and intensive care unit (1), Emergency Medical Dispatch (1), Emergency Medical Team (1), Low Acuity Care (1), Maternity (1), Military (1), NGO (1), Nurse Anaesthetists (1), Nurses and Paramedics (1), Nursing (1), Obstetrics (1), Pharmacists (1), Physicians (1), Paediatric Intensive Care (1), Pre-Hospital Rural setting (1), Resuscitation Nurses (1), Surgery, Intensive Care Unit and Emergency Department (1), Surgery (Paediatric) (1), Trainees (1). One paper discussing NTS in the public health context was identified however, because it was a report and not a primary study it was not included in the sift and was saved in the background folder.

Studies were identified from the following countries: UK (41), USA (23), USA military in Iraq (1), Australia (12), Switzerland (7), Germany (6), Norway (6), Canada (5), New Zealand (5), Denmark (4), France (4), The Netherlands (4), Unknown (3), European Union (3), South Korea (3), Sweden (3), Joint UK and Nigeria (2), Greece (1), India (1), International (1), Japan (1), Joint between Norway, Sweden and Bosnia Herzegovina (1), Rwanda (1), South Africa (1), Singapore (1), Slovakia (1), multiple countries in South America (1), Joint between Sweden and Finland (1), Taiwan (1) and Turkey (1).

CRITICAL REVIEW OF THE STUDIES

The diversity in range of epistemological and theoretical approaches and paradigms to qualitative research presents challenges in assessing the quality. Some studies also use more than one theoretical model. The critical review form (Letts et al 2007) was used as the basis for this review. It considers the following: whether the methodology is appropriate for the

study; the relevance of the study and generalisability of results; validity of the study, whether the study is reflecting actual behaviour; and reflexivity, the researcher's awareness, and mitigation of, their own bias.

The relevance of the studies

The purpose for the studies was well-defined as they tended to concentrate on singular aspects of NTS or their use in particular settings. The primary purpose of the studies was divided into four broad categories: assessing NTS training (49); assessing the use of NTS by particular professional groups (47); identifying the NTS used by particular professional groups (35); and the assessment of behavioural marker tools (18). Two additional categories with relevance to objective three were also identified: the effect of external factors on the use of NTS by particular professional groups (3) and the use of NTS in a complex system (1). Most of the studies comprised two of more of these elements as part of a broader study.

Sixty-one of the studies concentrated on a single aspect of NTS: decision-making (32), situation awareness/analysis (16), leadership (6), teamwork (6), communication (3), dealing with stress (2), task management (1), task management and teamwork (1), communication and leadership (1).

The justification for the studies was based on developing training or guidance to overcome operational concerns that had been raised as part of a review into existing procedures or into incidents that had occurred. For the most part these were safety issues. In that sense the justification for the studies was clear and compelling. The use of NTS in training for aircrew, the military and surgical teams is also well-documented and has been used since the 1980s (O'Connor et al 2008).

The generalisability of results

Non-technical skills are studied in multiple work domains and academic disciplines. This gives rise to two challenges: inconsistent terminology

makes it difficult to bring together a base of literature around the subject; additionally, the sample sizes in studies are generally small and constrained to one organisation; this makes generalisability difficult.

Sample sizes varied by methodology. The largest reported sample was 9,400 and smallest five. The largest sample sizes were seen in those studies that used questionnaires for self-assessment of NTS in the airline industry. There were two sample sizes over 1,000 (9,400 and 1,751); 20 over 100 (ranging between 104 and 684), the remainder were under 100 sample sizes.

However, there is a base of common or key skills which can be applied across most of the sectors. A review of the behaviours listed in the studies matches those listed in Table 1 (p.20).

Validity of the studies

Fifty-three of the studies reported using a single study methodology; the remainder were mixed-methods studies. The following methodologies were identified: observation (64), interviews (49), simulation (27), analysis of accident or incident reports (17), survey (17), reviews of documentation other than academic studies and incident reports such as employment competencies (12), focus groups (12), questionnaire (10), literature review (9), case studies (7), card sorting exercise (5), Delphi method (3), game (3), scenario (3) and Objective Structured Clinical Examination (1).

A variety of interview methodologies were reported: semi-structured (15), critical decision making or reported to be based on critical decision making (15), critical task analysis (4), critical incident method (2), Informal (2), mapping (2), contextual enquiry (1), content process (1), convergent (1), process tracing (1), dyadic (1). The mean number of interviewees was 22.

Each of the study methods is at risk of bias from both the researcher and participants. The challenges of studying NTS are described in more detail in the next section.

THEORY and BACKGROUND

Non-technical skills are defined by Flin (2008) as the cognitive and social skills that complement technical skills. They are studied in the context of providing training to staff working in safety critical roles as skills they can use to complement their technical skills to improve safety.

Non-technical skills are studied under various names: in the aviation industry Crew Resource Management (CRM); in the military and emergency services as Human Factors; in health the term NTS is widely used. Regardless of the terminology the main purpose for identification of, and training in, NTS is to develop and provide selection and training programmes to address safety and operating issues which systems of working and technology alone cannot address.

Flin (2008) identifies seven key NTS reflected in the literature review. These consists of two cognitive skills: situation awareness and decision making; three social skills: leadership, communications and teamwork; and two personal management skills: dealing with stress and fatigue. Each of the skills is identified by a series of behavioural indicators which can be measured by a variety of techniques, the most common of which is observation of the subject undertaking a simulation exercise.

The behavioural indicators are developed in response to the challenges presented by the particular environment or task in which they are used. The result is that there is a wide range of behavioural indicators each relating to specific professions or roles within a profession. For example: even within relatively small teams in the operating room the behavioural markers for different members of the team such as surgeons and anaesthetists have had different tools developed to measure them (NOTSS and ANTS).

There is a wide understanding around what the skills mean. Whereas the cognitive skills (situation awareness and decision making) are more easily defined theoretically, other more generally used terms around the social skills (communication, teamwork and leadership) are far more broadly defined and as a result more difficult to identify.

The challenge to the development of behavioural markers can be overcome by situating the study of NTS in specific small teams (such as air crew or surgical teams) or by reviewing particular incidents (Klein, Calderwood and MacGregor 1989, Harris, Eccles, Freeman and Ward 2014, Roberts, Flin and Cleland 2015). Experts, defined as those with ten or more years' experience by Klein (1993) are asked to review the proposed behaviours or are interviewed to ascertain what they might be. However, this means that the studies run the risk of being biased and difficult to generalise. The definition and use of NTS professional contexts can vary based on team or organizational norms. There is also some evidence to suggest that NTS are culturally specific. Livingstone, Zolpys, Mukwesi et al (2014) conducted a study to examine the use of NTS amongst anaesthetists in Rwanda and concluded that cultural norms that had been used to develop the ANTS Tool, particularly around concepts of leadership and communication could not be applied in Rwanda in the same way as in Europe where surgical teams were less hierarchical and team members were more likely to speak up. The high level of specialisation has also created a wide range of studies using inconsistent terminology and a variety of methodologies.

A further challenge is that many of the NTS are interlinked. For example, developing situation awareness and effective leadership within a team both require effective communication (Endsley and Robertson 2000). Situation Awareness, one of the most studied of the NTS is defined either as a precursor to, or part of decision-making. Some commentators argue that situation awareness is itself a form of decision making (Stanton, Chambers and Piggott 2001).

A common methodology for identifying and studying NTS can be seen in the literature. This comprises of identifying potential behavioural markers, refining this list through an activity such as interview or observation and then testing the markers.

EXAMINATION OF THE KEY NON-TECHNICAL SKILLS

This section examines the key NTS as they are explained in studies captured in the literature review. They introduce the key concepts and theories further developed in the results and discussion chapters.

Sensemaking and Situation Awareness

The process of developing Situation Awareness is called Sensemaking. Situation awareness is a concept originally developed amongst fighter pilots and is defined as the “perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and projection of their status in the near future.” (Endsley 1995 p.36). It is the way in which responders understand their environment and is seen by many as critical to decision making (Endsley 2015) and by others as an integral element of decision making (Stanton, Chambers and Piggott 2001). Endsley’s is the most common model referred to in the literature. It comprises three levels: (1) gathering information from the environment which is the ability to perceive information and to be aware of its status (2) understanding the information in that environment, to be able to explain what is happening and (3) using that information to predict future states. Whereas Endsley describes situational awareness from an individual psychological perspective, Silstyawati, Wickens and Chui (2009) take a systemic approach and explain situational awareness in a similar three stages of (1) awareness of the external environment (2) systems awareness and (3) task awareness. Finally, Salmon, Stanton and Young (2012) present a theory of Distributed Situation Awareness (DSA) arguing that it is not necessary for each member of a team to have the same understanding of the situation, but for each to understand a piece of the overall picture. A failure of situation awareness

can lead to safety critical information being ignored, missing cues in procedures (Flin 2008) or the failure to understand the potential danger of multiple smaller failings (Lagadec 2004).

Klein (1993) and Endsley (1995) argue that responders use cues to categorise their situation. These cues are normally drawn from experience but can also come from training, simulation exercises and stories told by more experienced staff (Joung, Hesketh and Neal 2006). There is evidence that situation awareness can be affected by personal management factors such as fatigue, stress and stimulus overload and can be supported by good briefings, physical and mental fitness, minimising of distractions, continual updating of the situation, self-monitoring, and effective communication from other members of the team (Sneddon, Mearns and Flin 2013 and Havold 2015). Because the process of situation awareness is largely reliant on staff recognising cues that they have learned during their work or training there is also a danger of bias where staff can wrongly associate a factor in the environment (Weick1993).

Three tools used to measure situation awareness were identified during the review. Situation Awareness Rating Scales (SARS) are ratings completed by an observer watching an operator perform a task (Salmon, Stanton, Walker and Green 2006), the Situation Awareness Global Assessment Technique (SAGAT) tool developed by Endsley (1995) where during a simulated task the activity is stopped and the operator is asked about their understanding of the current situation and the Situation Awareness Rating Technique (SART) a self-reporting technique (Salmon, Stanton and Young 2012). In common with other NTS tools these are developed by grouping several behavioural markers under subject headings to measure activity.

There is debate about the scientific validity of situation awareness as there is no universally accepted definition of the concept, which is rooted in a variety of theoretical backgrounds. Despite this, situation awareness has been widely studied within the context of safety, the military, aviation, offshore oil and road users (Salmon et al 2009; Stanton et al 2017).

Decision Making

Decision-making is identified as a key NTS throughout the literature. The distinction is made between two theories of decision-making. Classical decision-making can be observed under laboratory conditions. Here the decision-maker chooses between a range of options to identify either a correct answer or a best possible option (Lipschitz et al 2001). The second theory is that of Naturalistic Decision Making (NDM) pioneered by Klein, Calderwood and Macgregor (1989) which argues that decisions are situational and should therefore be examined in a real environment. NDM concentrates on the process of problem solving through accurate situation awareness followed by the decision-making process rather than on the results of the decision itself as is seen in classical decision-making theory.

Klein, Calderwood and Clinton-Corocco developed NDM whilst studying the decision-making procedures of fire commanders (2010). They argue that decision-making is not a purely rational process based on a choice between courses of options. The uncertainty, stress and time pressures in the emergency environment force commanders to make rapid decisions which do not allow time for detailed consideration of different options. The rationale for using and applying NDM in emergencies is summarized by Klein (1993) as follows:

- Classical methods do not apply to many naturalistic settings
- Experienced decision-makers can be used as a benchmark for ideal individual performance
- NDM tries to build on the strategies that people use
- Experience lets people generate reasonable courses of action

Flin (2008) identifies four modes of NDM: (1) recognition-primed decision-making (RPD); (2) rule based or procedure-based where practitioners relate the situation to an ‘operating procedure’ similar to a checklist of activities; (3)

analytical decision-making: based on an analysis of the situation the individual develops a number of possible courses of action to respond to the situation (4) creative decision-making, when there is no precedent or the situation is so unexpected that the decision-maker cannot draw on learned models or previous experience.

The most studied NDM mode in emergency settings is Recognition Primed Decision making (RPD). It is seen by many (Sinclair et al, 2012) as suited to the emergency response environment because it allows decisions to be taken quickly and with poor information. In their study Klein, Calderwood and Clinton-Cirocco (2010) identified over 150 decision-making points and noted that the commanders rarely considered more than one option at each point. Since Klein's study this aspect of decision-making has been examined in a range of other services. They support Klein's assertion that although the analytic method is commonly used in planning prior to an incident, when they are 'on the ground' commanders short-cut the formal process, relying instead on learned cues. This is known as "heuristics" (Frye and Wearing 2017, Flach et al 2017).

The most used technique for identifying the processes that decision-makers go through was identified as cognitive task analysis (CTA), or a methodology based on CTA. CTA covers a wide set of tools based around four principal methodologies (1) review of documentation (2) observation (3) interview (4) questionnaire or survey. Most studies identified in this literature review either explicitly or implicitly were based on the NDM theory and CTA tools.

The social and personal management skills

The social and personal management skills (communication, teamwork and management of stress and fatigue) link with the situation awareness and decision-making processes. Both cognitive skills rely on proper communication, ways of working and the allocation and the setting of tasks, identified as intrinsic to leadership. Studies also indicate the negative impact of both stress and fatigue on the ability of individuals to use NTS (Havold

2015, Harris Eccles and Freeman 2017, Sneddon, Mearns and Flin 2013). The social NTS are particularly important when people work in teams. Klein, Wiggins and Dominguez (2010) have emphasised the role of communication in team situation awareness for example. All these aspects of NTS have been studied in their own right and behavioural indicators developed based on those studies.

Salas, Rosen and King (2009) provide a key text that has helped shape the behavioural indicators for teamwork. Salas et al (2015) define teams as a “set of two or more people working … towards a common goal.” (p.600) The behavioural indicators for teamwork in the NTS tools and literature concentrate on the ability of team members to support each other, to exchange information, to coordinate activities and solve conflicts. However, only one study was identified which addressed teamwork in the context of multiple teams working together as they do in an emergency response. Given the increasingly complex nature of emergency and disaster responses this is an area which merits further examination and forms the basis for the research question of this thesis.

Communication is defined as "the exchange of information, feedback or response, ideas and feelings" (Flin 2008 p.69). The behavioural indicators for communication centre around the ability to send and receive correct and relevant information and identify and address barriers to communication. The barriers can by physical (distance or the limits of technology) or cultural where there is a hierarchy which prevents people speaking up for instance. Poor communication can inhibit the dissemination of critical information which can impact situation awareness (Klein et al 2010).

Leadership is another area which has been examined in several different fields. The literature points to a series of behavioural indicators that constitute leadership. These are using authority, planning and prioritising, maintaining standards and managing workload and resources. Yukl, Gordon and Taber (2002) conducted a review of Leadership behaviours which have been used as the basis for the examination of Leadership in this study

because it provided a broad list of leadership functions that would be more easily identified and defined during interviews and surveys than bringing together functions identified in a series of narrower studies (Yukl 2012).

Complex environments and MTS

Studies into NTS have concentrated on the members of single teams engaged in a particular task (flight crews for example). However, emergencies take place in complex environments requiring a response from multiple, interdependent but autonomous teams (Janssen et al 2010, Weick 1988, Comfort 2004, 2006, 2007 and Farazmad 2007). This emphasises the complexity of dealing with an emergency which often have far reaching implications and impact on many organisations and local communities, who may respond to their situation in unexpected ways (Lanzara 1983, Junger 2016). The Humanitarian Sector can provide additional challenges because it is more loosely coordinated than domestic emergency response activities (Care 2005, Global Public Policy Institute 2010 and UNDP 2016).

Zaccarro, Marks and DeChurch (2012) examined how organisations have responded to the challenges of a complex environment. They argue that in complex environments responders form a 'Multiteam System' defined as "two or more teams that interface directly and interdependently in response to environmental contingencies towards the accomplishment of … at least one common distal goal." (p5). MTS theory has been applied to research on the responses to Hurricane Katrina (Farazmand 2007) and the 9/11 attacks (Comfort 2004) as well as humanitarian operations (Dzeidic and Seidl 2005). These studies argue that in a complex emergency or disaster response – which brings together multiple organisations, to work in a rapidly changing and challenging environment all competing for scarce resources (ALNAP 2012) – the ability of organisations to adapt their procedures is imperative. It is the staff within the organisations and their NTS which are key to this adaptability.

In MTS individuals need to look beyond their immediate team to those with which they will need to cooperate (Keyton, Ford and Smith 2012). This may cause responders to draw on a different set of NTS than those required for effective routine intra-team working alone (Gregory et al 2009, Janssen et al 2010). Teams and team leaders should concentrate on the interrelation of teams and how they work together within a system (Zaccarro, Marks and DeChurch 2012). Staff will need to consider the impact on other teams in their situational analysis, decision making and communication strategies when operate in multiteam environment.

AREAS FOR FURTHER EXPLORATION

The study of non-technical skills in multiteam systems

Non-technical skills are usually studied in the context of small well-defined teams. Additionally, most of the studies examined individual roles within teams. Emergency response requires multiple professions to work together with the additional challenge of working alongside teams with different skills, organisational structures and goals (Comfort 2004). This work is conducted in an environment with a lack of information, compressed timeframes and stress (ALNAP 2012). Numerous reviews from disasters in the 21st century have repeated calls for development of the humanitarian leadership to address shortcomings including a lack of coordination. A similar argument for effective leadership and an adaptable workforce has been made by academics examining the responses to the 9/11 attacks and Hurricane Katrina (Comfort 2004 and Farazmand 2007).

Decision-making, coordination with, and of, a variety of organisations and the requirement to be adaptable are all challenges that NTS can help to address. Klein and others have established the validity of studying NTS in the context of the emergency services. However, although the review identified some examples of multiple teams working together (Stanton, Rafferty, Salmon et al 2010) only one study was identified which examined

NTS in the context of multiple teams working towards distal goals (Bienefeld and Grote 2014).

Most of the studies examined NTS in single teams without considering the broader context in which the team was working. Only three of the studies identified addressed the impact of environmental context on the use of NTS. The link between organisational culture and national culture was alluded to in a further two papers. By concentrating on the skills and behaviours within small distinct teams in the process of conducting well-defined distinct tasks the studies have not accounted for the context in which these skills are displayed. However, in two studies identified from the Humanitarian Sector both emphasised the role of multiple organisations within the sector and the impact that had on situation awareness and decision-making (Maldonaldo, Maitland and Tapa 2010 Tsasis and Cooke-Lauder 2015 and Campbell and Knox-Clarke 2018)

The study of non-technical skills in Public Health and the Humanitarian Sectors

Only one paper referred to the use of NTS in public health and only one paper (a literature review) identified the use of situation analysis and decision making in the Humanitarian context. Campbell and Knox Clarke (2018) conducted a literature review reporting that the evaluations of humanitarian responses have revealed decision-making that is slow, dissociated from strategy, opaque and unaccountable. They classify it as "informal, emergent, ad-hoc and reactive". The accusation of reactive decision-making is not limited to the Humanitarian Sector; Li, Powell and Horberry (2012) make a similar observation about decision-making amongst control room operators in the Mining sector. However, it does point to a potential gap in research that may be of benefit to the Humanitarian Sector.

SUMMARY LITERATURE REVIEW

This review identified 29 systematic and literature reviews and 153 primary research studies examining NTS across a range of professions and sectors. The results were analysed using a framework methodology to identify a set of common NTS and the methods used to study them. Whilst several methodologies for identifying and assessing NTS are evident there is a common framework linking most of the studies. The most common method for identifying NTS amongst professionals or others carrying out tasks was based on CTA. The review also confirmed that there are no studies into the use of NTS by public health professionals and only a few dealing with the humanitarian sector. The challenge for this study will be to examine the NTS used by public health professional out of their technical roles; this will be achieved by concentrating on the environmental and organisational factors that impact on their roles when working in an emergency setting. It is expected that this study will provide an initial examination of the role of NTS in both the public health and humanitarian settings and provide new knowledge about the impact of multiteam environments on the use of these skills. This knowledge could be used to assist the development of training and behavioural markers for Public Health staff working in emergency response.

CHAPTER 2. Further theoretical considerations from the literature

INTRODUCTION AND RATIONALE

This thesis was completed as part of a Professional Doctorate over a number of years. A further examination of the literature was completed for the period 2018 -2022. This was to ensure a more contemporary review and ensure that any emerging research of relevance was included.

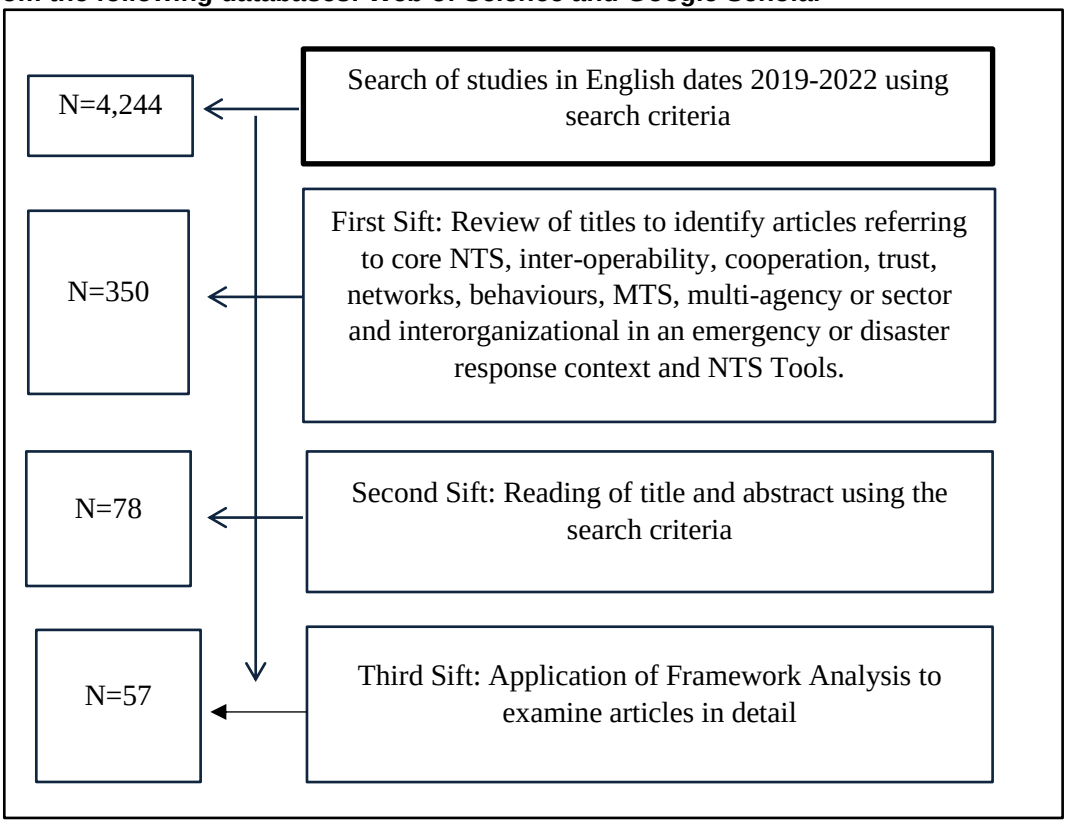
The original literature review for this study had date parameters from 2000-2018. The explanation for the choice of years is at p.35. Analysis of the data gathered during this research indicated that emergency responders used NTS to enhance their coordination across teams in multiteam settings comprised of fluid teams and networks. The element of inter-team coordination was not covered in detail in the initial literature review which had identified research focussing on single purpose, formed teams. Therefore, this additional literature review was conducted to examine more closely recent research around the use of NTS in inter-team and organisational coordination.

Aim and Objectives of the Review

The aim of the additional literature review was to better understand the topic of NTS by examining:

- Literature on NTS published between 2018-2022
- The use of NTS in organizational structures with multiple teams

Figure 5: A flow diagram of the search strategy used to identify relevant literature from the following databases: Web of Science and Google Scholar



Overview of the Review Methodology

The literature review used the same framework analysis and inclusion criteria as described in the main body of this chapter and Table 2 on p.34 (Barnett-Page and Thomas, 2009, Bromley et al 2002, Thomas and Harden, 2008 and Dixon-Woods et al 2006). The results of the literature review provide a descriptive analysis of the breadth of the studies identified and the key themes that emerged.

THE REVIEW PROCESS

This section describes the conduct of the literature review.

Search terms

The search was conducted on Web of Science and Google Scholar. The search term was “WHAT [non-technical skills OR practices OR routines OR behaviours OR tasks etc] are used by public health staff working in a

[multiteam OR inter-agency OR multi-agency OR interorganizational OR networked etc] environment in response to disaster or emergency and how are they enacted?"

A search of the wider literature

Three sifts were conducted using the following criteria: research conducted to examine NTS or crew CRM; variations on both these terminologies such as HF were included in the criteria in the context of multiple teams or multi-agency settings. Articles discussing the validation of training in these settings were included.

- *First sift*: The article titles were used to identify relevant research: titles that included "non-technical skills", "crew resource management", "human factors", "human behaviours", "error management" or "soft skills"; any of the core NTS identified by Flin: leadership, teamwork, communication, situation awareness, decision-making, dealing with stress and fatigue; references to 'trust', 'networks', 'multiteam' and 'inter-organisational, agency or sectoral systems' and 'collaboration'. Three-hundred and fifty articles were retained.
- *Second sift*: A second sift was conducted using the inclusion criteria reading the title and the abstract to examine the context for the studies. Seventy-seven articles matching the criteria of the first sift in an 'emergency', 'disaster' or 'multiteam' preparedness and response, or with tangential relevance to multiteam health response were retained.
- *Third sift*: A third sift was conducted by reading the articles and applying the information to the framework. 56 items were retained.

Analysis of the studies identified in the second literature review

Fifty-six items were retained from the third sift covering the following disciplines: health (23), emergency or disaster management (9), various or undisclosed (8), finance and business (5), public sector (3), transport and logistics (2), maritime (2), civil aviation (1), maritime (1), military (1), agriculture (1), Research and Development (1), motor sport (1), railways (1), Mining (1).

The articles relating to health were broken down as follows: emergency medicine and mass casualty incidents (6), collaboration and management across disciplines (6); public health (3); primary care (2); secondary and tertiary (1); general health care (1), , paramedics (1), COVID-19 response (1), nursing (1) and palliative care (1).

Studies were identified from the following countries: None stated (14), UK (8), UN or Humanitarian International (7), France (2), Germany (2), Ireland (2), The Netherlands (2), Norway (2), USA (2), Australia (1), Bangladesh (1), Brazil (1), Canada (1), Denmark (1), Finland (1), Greece (1), India (1), Italy (1), Kenya (1), South Africa (1), Sweden (1), Western Europe (1), Germany and Turkey (1) and UK and The Netherlands (1).

CRITICAL REVIEW OF THE STUDIES

The diversity in range of epistemological and theoretical approaches and paradigms to qualitative research presents challenges in assessing the quality of this work . Some studies also use more than one theoretical model. The critical review form (Wilkins et al 2007) was used as the basis for this review. It considers the following: whether the methodology is appropriate for the study; the relevance of the study and generalisability of results; validity of the study, whether the study is reflecting actual behaviour; and reflexivity, the researcher’s awareness, and mitigation of, their own bias.

The relevance of the studies

The purpose for the studies was well-defined as they tended to concentrate on singular aspects of NTS or their use in particular settings. The primary purpose of the sources was to improve working in multiteam settings. They were divided into the following categories: collaboration between and within teams (19); the impact of training, simulations or serious games on NTS development (11); identifying the NTS used by particular professional groups (5); leadership in distributed and agile settings (4); decision-making (4), teamwork (3), not known (3); information management (2); the role of NTS in personal resilience (1), the role of NTS in sensemaking (1), human factors and COVID-19 (1) and error avoidance (1).

The generalisability of results

As with the first literature review it is acknowledged that generalisability of results for studies in NTS are difficult as the use of NTS is dictated by the context in which they are used.

Sample sizes varied by methodology. The largest reported sample was 476 and smallest three teams (the number of individuals in those teams was not identified). The largest sample sizes were seen in those studies that used questionnaires for self-assessment of the impact of training. This literature review did not search for individual NTS as the first did. However, common NTS of leadership, decision-making, sensemaking, teamwork and resilience to stress were identified from the ‘core’ NTS in Table 1. Additionally, there was a focus on ‘relationship’ and ‘trust’ building in studies examining ‘collaboration’ and ‘leadership’ where the development of both personal relationships through the understanding of roles and responsibilities and organizational systems to improve inter-team working were emphasised.

Validity of the studies

Twenty-seven of the sources reported using a single study methodology; 21 were mixed-methods studies, nine were sources that provided an overview of the subject or the study types were not stated. The following methodologies were identified: interviews (13), questionnaire (10), , observation (8), literature review (8), expert review (7), case study (1), focus group (1).

Each of the study methods is at risk of bias from both the researcher and participants. The challenges and issues this raised have been discussed at p.43.

A comparison of sources identified in the initial (2000-2018) and additional (2018-2022) literature review.

The types of studies identified in this additional literature review were comparable in terms of the disciplines studied, countries in which the studies were carried out, types of studies, methodologies and limitations. However, there were differences around the focus of the studies. Notably, an emphasis on developing knowledge about systems and focus on system preparedness for emergencies. A comparison of the findings of the two reviews is in Table 3 below.

The types of journals identified varied between the two literature reviews. The initial review contained a number of health focussed journals with studies which emphasised: the identification and training of NTS (principal among these were the *American Journal of Surgery* and *Resuscitation*) the application of Human Factors in a range of industries (*Human Factors* journal); there was also a focus on individual NTS in journals examining Cognition and Ergonomics (*Cognition, Technology and Work,* the *Journal of Cognitive Engineering and Decision-Making* and *Ergonomics*); a further broader band of journal titles addressed Applied Psychology and

Organizational Psychology (*International Journal of Aviation Psychology* and *Journal of Occupational and Organizational Psychology*).

There were no such clusters of single journals in the additional review which was conducted for a shorter time-period. However, there were clusters of studies dealing with management and organisation studies, the social care sector, disaster management and two notable studies from *Disaster Medicine and Public Health Preparedness* which were not reflected as prominently in the initial review.

Table 3: Comparison of the Initial and Additional literature reviews

Literature review examining NTS 2000-2018	**Literature review examining NTS in multiteam settings 2018-2022**
Wide number of NTS examined >7	Narrower number of NTS: Leadership, Collaboration, Teamwork, Communication
Focus on the use of development and use of NTS by individuals to enhance working	Focus on systemic issues and how NTS may enhance system working
Focus on the use of NTS in permanent teams with limited scope	Focus on collaboration across teams and the use of networks
Focus on the use of NTS to deliver tasks by teams	Focus on the use of NTS to build relationships and trust and that enhance network and inter-team cooperation
Focus on training emphasised the development and use of individual NTS	Focus on training emphasised the development of knowledge of roles and responsibilities of other actors in the network
Journals deal with medical education; psychology (applied and occupational), cognition and ergonomics	Higher proportion of studies in management, business and with an emphasis on preparedness

THEORY and BACKGROUND

This additional literature review focussed on NTS in the multiteam environment. The most prominent theme from the articles identified was the development of collaborative practices in a multi-agency or multiorganizational setting. This section will discuss the additional information identified from this update to the literature review.

Collaboration in multiteam settings overview

There was no commonly used definition of collaboration identified in the literature review. For this study the definition cited by Tong et al 2018 will be used as it encapsulates the factors described across the literature examined: Collaboration is “the mutually beneficial relationship between two or more parties who work toward common goals by sharing responsibility, authority and accountability for achieving results” (p.5 Chrislip and Larson 1994 in Tong et al 2018). However, a common challenge to collaboration, particularly in emergency settings, is that of multiple teams striving for the same (distal) goal whilst maintaining their objectives, cultures and interests (Brown 2020, Lanzara 1983, Hicks and Pappas 2006, Global Public Policy Institute 2010, ALNAP 2012, Junger 2016) .

The factors that influence effective inter-team collaboration are well documented as mutual goals and trust, effective inter-personal relationships, active engagement in processes on behalf of the parties, an understanding of the other parties’ roles and responsibilities, effective communication, familiarity, (Tong et al 2018) shared decision-making, resources and critical information (Brown 2020). Effective collaboration within and between teams is dependent on a knowledge of the systems (Mele and Capallero 2018, Currie and Heslop 2018 and Lamb et al 2018) in which actions takes place and NTS to help develop that collaboration.

Many of the authors focussed purely on systemic issues that would enhance collaboration; the most common was a knowledge of roles and responsibilities of the other parties (Humboldt-Dachroeden 2018, Pakkenen et al 2018 and Nayak et al 2018). This reflects Bernards (2021) observation that uncertainty, which undermines effectiveness, derives from incomplete understanding of ‘goals and tasks’. Heetun, Philips and Park (2018) state that this should go beyond a simple knowledge of roles and responsibilities to include mapping of networks that exist in and can enhance multiteam collaboration. They also emphasised that a knowledge of other parties was insufficient and that NTS to enhance collaboration also need to be included

in training and preparedness efforts (Heetun, Philips and Park 2018). Other studies placed emphasis on the development of trust and inter-personal relationships for the development of effective collaboration (Tong et al 2018 and Latusek and Vlaar 2018) indeed one study (Connelly et al 2018) emphasised that 'integrity' (motives and character) built up through relationship building is more important in collaboration than 'competency' in effective collaboration.

In the multiteam response environment where teams are often transitory – because they are brought together and shaped specifically for the response - the building of familiarity and relationships that promote effective collaboration can be challenging (Brown 2020). Indeed, although organizations may promote inter-agency working, Sohrabizadeh et al (2021) argue that there is no formal effort in international public health to understand the way in which other organizations work in response. So, although a number of the papers – many of which focussed on the use of training and simulation exercises – argue that developing familiarity with response systems in the 'preparedness[6]' phase will improve inter-agency collaboration the reality of a multiteam response is that successfully training all responders, particularly where volunteer organisations and the public are involved would be challenging (Bodas et al 2022).

[6] Emergency management can be split into preparedness, response and recovery phases. The WHO includes readiness between the preparedness and response phases. (WHO 2020)

Training and simulation exercises can aid collaboration and develop NTS for working in a multiteam environment.

The role of training and exercising in the development of NTS is discussed in detail above. Two key learnings around the role of NTS in multiteam working were identified:

- There is a differentiation between learning to develop knowledge of other organisations' roles and responsibilities to improve inter-team working and the development of NTS.
- The development of NTS in a group context is particularly important as working effectively requires a shared understanding of the environment to enable joint decision-making and action to overcome individual misunderstandings and biases (L'Her et al 2020).

Eleven of the articles identified focused on the development and efficacy of training and simulation exercises for developing capability in response. These can be divided into studies that focused on the development of knowledge of and familiarity with inter-team and organizational roles and those that were focused on the development of inter-team working within particular professional settings. The minority of the studies examining working in the multiteam setting focused solely on the development of knowledge about the response systems of other agencies as a means of generating 'familiarity' that supports inter-team working (Paige et al 2020 and Currie and Heslop 2018). However, most of the studies reported that training, exercise and serious games developed both the knowledge and NTS of participants to support work across teams. A range of NTS were reported to benefit from these interventions to improve working in both single team (L'Her et al 2020) and multiteam environments (Pikoulis et al 2022 and Bodas et al 2022) including: decision-making (Quiroz-Palma et al 2020 and Savankari 2019) collaboration (Bodas et al 2022), communication (Bennett 2019) building relationships, teamwork, and personal resilience (Middlemiss 2020).

Leadership and the development of trust and relationships in multiteam settings

Five of the studies identified focused on leadership in a multiteam setting and the role of leadership in enhancing coordination and performance. These studies complemented and added to the view of predominantly inter-team leadership described above (p.50). There were no single definitions of the type of leadership that would aid collaboration identified from the literature review. However, the updated literature review did help to unpack the role of leadership as an aid to collaboration and decision-making in multiteam settings. Two broad trends were identified:

- The role of the leader in 'setting out a clear vision' to bring individuals, teams and multiple teams together and reduce uncertainty by focussing on shared outcomes.
- The development of trust and relationships between individuals and teams as a key role of shared leadership (Coffeng 2018, Southby 2018).

Leadership can help reduce uncertainty in multiteam settings. Bernards (2021) argues that visionary leadership (which he describes as 'providing clear direction to teams and giving employees a clear sense of purpose in their work' (p.2)) and servant leadership which focusses on the dyadic relationship between leaders and employees can help reduce cognitive uncertainty in public sector staff in organizations that are relying less on systems and bureaucracies to become more responsive to public needs. A common vision increases team cohesion, whilst a servant leadership encourages staff who are willing to learn and therefore adapt.

Effective Leadership can also help to develop the 'trust' between teams that is essential to effective collaboration (Coffeng 2018, Haugsvedt and Tuagstad 2018, Mutonyi, Buko and Hjortso 2018, Connelly et al 2018, Southby and Gamsu 2018, Lautsek and Vlaar 2018). Trust is established through a demonstration of technical competence but also through 'social capital' (Walsh and Martin 2018) and joint culture (Potosky, Gode and Lebraty 2018, Bennett and Ashley 2019). Walsh and Martin (2018) argue

that social capital is enhanced by the use of ‘relationship leadership’ which focusses on the development of social links to help work towards mutually beneficial goals. These social links lead to joint working with parties identifying their role and level of input to the development of commonly recognized goals (Mariotti and Haidar 2018). The theme of empowerment of multiteam members (teams within the multiple team settings) was identified as central to the development of trust (Bernard 2021), as was effective communication (Bearman et al 2018) and joint working particularly around decision-making (Coffeng et al 2018).

Summary

This additional literature review aimed to update findings from the initial review conducted for this study which identified studies between 2000-2018; and examine literature on multiteam settings. It examined studies between 2018-2022 which provided a systemic overview from a range of sectors. The review provided additional background information of the elements necessary for effective collaboration within and between teams. Effective collaboration this review concludes relies both on a detailed preparedness and knowledge of the roles and responsibilities of one’s own and others’ roles and responsibility in the organizational system; and the development of mutual trust and recognition between the parties; and that this trust and recognition can be developed and enhanced through empowerment of parties and joint working to create a sense of a common culture and goal.

CHAPTER 3: RESEARCH DESIGN

Introduction

This chapter explains the approach to and conduct, of the research and analysis. I have written this chapter in the first person to acknowledge the interplay between myself as the researcher and the data (Strauss and Corbin 1988).

Given the lack of research in this field I adopted a relativist approach and practical epistemology which would assist me to select the best method, or methods, of enquiry (Kelly and Cordeiro 2020). I took an inductive and reflexive approach to the research design, accepting that research design and analysis are not static processes and would be adapted as the research progressed.

In this chapter I outline how I developed the aim and objectives for the study before providing an account of the design and conduct of the sampling, data gathering and analysis. The decisions I made in the choice of design of the methodology and analysis will be justified. A reflection on my choice and use of research methodology is below and in Appendix C (p.231).

Selecting aim and objectives

The idea for this research came from my own work developing and delivering exercises for public health staff responding to emergencies. I noted the difficulty in implementing the lessons identified during exercise debriefs which concentrated on systems and processes as opposed to individual learning. My initial lines of enquiry were focussed on examining how learning for individuals in preparation for exercises and operations could be improved.

Reading and informal discussions with practitioners led me to research on Human Factors and Crew Resource Management. The design question was

further shaped by noticing that research concentrated on individuals working within small well-defined teams (such as an Army Platoon or Fire Service team) but that in the multi-sector response these teams were required to work together and coordinate. In other words, response teams needed to identify and react to the needs and actions of other teams working within the response.

Searches about interaction of multiple teams in emergency settings led to reading on MTS and a recognition that the characteristics of these systems matched the descriptions of multi-sector and humanitarian response environments. Based on this reading, I decided to study the use of NTS by public health staff in the context of a MTS.

The aim of the research was refined after the literature review to be: to describe the use of NTS used by Public Health professionals working in an emergency response environment by examining (a) which NTS they use (b) how they are used in the multiteam environment which characterises a response.

The literature review helped me to define the following research questions:

- Which NTS are used by public health staff working in disaster or emergency response environments?
- How does the environment of the multiteam response impact on the use of NTS by public health responders?
- How do public health responders adjust their NTS to account for the multiteam environment?
- Do different groups of public health professionals use different types of NTS in the multiteam environment?

As one of the key purposes for identifying NTS is to develop training, I envisaged that the insights from this analysis could be used to better understand the working environment of a multiteam response as it relates to public health responders and establish a set of common NTS and help

shape the type of training that is used to prepare them to work in public health emergencies.

The literature review was an essential step to identifying a theoretical basis and methodology for the study. The study of NTS was spread over a wide range of disciplines with little consistency in language used to describe this field. This, and the fact that there was no evidence of NTS having been studied in public health indicated that this study should draw from the lessons of sectors outside of public health. Identifying a set of methodologies used to study NTS helped to confirm that the study should use qualitative methods. This decision was taken based on the recognition that I would be working with a relatively small set of participants so that it would be difficult to generalise results; and that a qualitative study would provide a more in-depth enquiry of what was happening to individuals working in response.

Identifying a methodology

The literature review highlighted methods of identifying and testing NTS in a variety of environments. From this I was able to identify methods for which the most evidence was available, and which would be most practical. The literature review showed that NTS research is used to:

- Identify NTS that will help staff work in particular environments and
- Consider the impact of the emergency environment on an individual's or groups use of NTS or
- Develop behavioural markers that will allow the use of NTS to be measured and
- Validate the behavioural markers through simulation or questionnaire

Non-technical skills can be identified using literature reviews, qualitative interviews, Delphi method, focus group, questionnaire, informal consultation

with practitioners or observation of practitioners during operations or simulation exercises. Refining lists of behavioural markers is normally achieved by observation or semi-structured interview with expert practitioners.

Most of the studies examined were based on the CTA methodology developed by Klein (2010) to study decision-making in the context of emergencies. There are number of different CTA tools which can be divided into the following groups: observation (in the field or of simulation exercises), retrospective interviews and review of incident reports produced by organisations. CTA methodology is designed to identify not only cognitive processes but also the way in which the environment causes or impacts on them (Crandall, Klein and Militello 2006). CTA therefore provides a suitable methodology for studying the use of NTS in complex response environment (Elbright, Pattison, Chalko and Render 2003). Furthermore, basing the study on a commonly used family of techniques, Cognitive Tasks Analysis (CTA) would provide me with certainty that it would be methodologically sound. CTA is described in more detail on p.75.

As no studies on the use of NTS by public health staff had been identified in the literature review, I opted to conduct interviews followed by a qualitative survey. Interviews would provide the best method of obtaining detailed consultation on both the environment in which people worked and the skills they used which could then be validated against a larger sample using a survey.

Qualitative surveys have limited visibility in research textbooks but do have a history of use by social researchers (Terry and Braun 2017). They provide a method for examining and gathering textual data about diversity of cognition and behaviours within geographically dispersed populations whilst maintaining the depth of data provided by qualitative studies (World Health Organization 2007, Jansen 2010, Davey, Clarke and Jenkinson 2020). In qualitative surveys participants write answers to a series of open-ended questions. Although qualitative questions can be used in quantitative

surveys it is not only the questions but the methods of analysis which differentiate the two types of survey: In a quantitative survey qualitative answers are reduced to data that can be analysed statistically. In a qualitative survey the data is analysed using qualitative methods.

In this study the term ‘survey’ will be used to describe the process of data collection and analysis that formed Phase 2 of the study. The term ‘questionnaire’ will be used to describe the set of questions that was sent to participants.

The following methodologies were discounted from this research:

- *Simulation exercises*. Although simulation exercises are widely used to identify and study NTS, exercises are generally a group activity in public health and can be difficult to assess (Savoia et al 2009) and so would fail to concentrate on the individual skills required of a NTS study. Bringing together the right people and simulating the pressures of a multiteam emergency response would require a large budget without guarantee of results.
- *Observations in the field*. This would require prolonged deployment with responding organisations and would have captured only one team during one response unless the field observations were over a prolonged period. This was also discounted for budgetary and practical reasons.
- *Review of incident reports*. Although there are multiple reviews of the Humanitarian Response to Disasters none of those identified as part of the literature review concentrated on the actions of individuals. Furthermore, the release of documents from responding organisations could prove problematic and given the concentration on systemic rather than personal actions unlikely to yield useful results.
- *Focus groups and Delphi method*. Both methods tend to be used in the process of developing behavioural indicators for tools that can be used to assess NTS. These tools are normally developed for small

teams working in established environments. This research will concentrate on the impact of conditions in complex environments. Therefore, the development of a set of behavioural markers is not warranted.

A retrospective interview and a qualitative survey based on a CDM (see p.75 for an explanation of CDM) were selected as the most effective and feasible data collection methods. Both have been used in the identification of NTS in emergency environments. Using two methodologies would allow validation of the results from the interviews. The most common method identified in the literature review was survey followed by interviews to further examine in detail data identified from the survey. However, as no data was identified about public health staff in MTS, I chose to take an iterative approach. I would conduct interviews to better understand the content and context of working in emergencies, then design a survey based on that information to test the interview findings against a wider population.

Reports of large scales responses such as the Haiti Earthquake (Global Public Policy Institute 2010) and the West Africa Ebola Outbreak 2014-2015 (Heyman et al 2015, Moon et al 2015) tended to be critical of the organisations involved. An interview would allow participants to speak more openly about the environments in which they had been working. A survey similarly provided the opportunity to anonymise data and help individuals to recount experiences freely without fear of judgement from their peers.

This mixed-methods research based on CDM comprised two sequential phases.

- *Phase 1* used key-informant, semi-structured interviews based on CDM. Findings from Phase 1 were used to develop a codebook of categories reflecting environmental factors and a list of NTS that formed the basis for the development and analysis of the survey used in Phase 2.

- *Phase 2* used a cross-sectional qualitative survey based on CDM to explore the transferability of conclusions from the qualitative interviews in Phase 1 by testing them against a larger sample (Morgan 1998).

Advantages and limitations of chosen methods

The study methods chosen have limitations however, I balanced these against the practicability of completing the research. In this section I have set out the key limitations and advantages that I identified whilst designing the methodology.

Interviews were identified as the most practicable way to gather data. However, in addition to the dangers of my own potential biases, which I attempted to acknowledge and mitigate in the research design, there are additional potential limitations with the use of retrospective interviews. Interviews allow for the elicitation of rich data; however, they are time consuming and there is a danger of co-construction where the interviewer inadvertently influences the participant (Alsaawi 2014).

Similarly, I identified a cross-sectional study as the most practical approach given the timeframe for the research and the lack of access to participants over a prolonged period that would have been necessary for a longitudinal study. Cross-sectional studies identify segments of the population at a particular point in time which makes it difficult to attribute causality (Taris, Kessler and Kelloway 2021). It can also lead to potential bias because those who respond to the study may all be a particular group of people and therefore not representative of the population (Sedgewick 2014). The intention was to describe NTS at a systems level using as broad a sample as possible. I acknowledged that the results would be indicative only but would provide avenues for further research. I chose participants from of a range of professional public health backgrounds for the interviews and sent the questionnaire to a broad sample.

The qualitative survey provided a means of gathering detailed textual information from a group of public health experts during a pandemic response and in different locations around the world in a relatively short period of time. The use of the survey also allowed participants to provide information anonymously which arguably allowed then to be more self-critical than they might have been in a group, or even interview setting.

Both the phases of this research relied on participants self-reporting. This presented several challenges: the possibility that participants would not understand the questions being asked of them; that they may struggle to recall events accurately; and that they may alter their answers to be more socially acceptable and present themselves in a better light (Schwarz and Oyserman 2001). These issues were mitigated as far as possible in the study design by piloting both the interviews and the questionnaire; by conducting semi-structured interviews that allowed dialogue for clarification and repetition of the narrative; by providing background information and prompts in the surveys and by emphasising the importance of the experience of the participant without any judgement, reiterating that decisions made in the response environment are often imperfect (Klein 2010).

Finally, I was aware of the dangers of my own involvement as a researcher influencing the conduct of the interviews; development of the survey and analysis of results (Roulston 2013). I sought to address this by acknowledging my own biases based on my own professional, educational and cultural background. My experience of facing these biases during the study is contained in the reflection at Appendix C (p.231).

Interpretation always involves a degree of appropriation (Wilig 2013) which I sought to address by acknowledging my own potential biases and adopting a structured methodology following established methods of data collection using CDM method and a structured analysis.

Study participants

The target population and inclusion and exclusion criteria for both phases of the research were public health professionals who had worked in the response to public health emergencies with at least 10 years' experience. This included staff who have been re-roled to work in an acute disease outbreak or other emergency with health impact where multiple agencies or organizations were involved. CTA studies access experts because they are more likely to work outside of procedural norms applying expertise and the ability adapt to unusual situations (Klein 1989, Klein and Militello 2001).

Individuals with less than 10 years' experience of working in a response where the definition of an "emergency" or "disaster"[7] was not met or where multiple agencies were not working were excluded. Acknowledging that this work can be stressful, both the interview and survey participants were advised not to participate if they felt that taking part would trigger disturbing memories.

Sampling

The sampling for both the semi-structured interviews and qualitative survey was conducted so that the participants would have the characteristics required of the study (Ryan and Bernard 2000). In contrast with quantitative studies where the aim is to minimize bias and increase generalisability, qualitative studies aim to collect rich data to provide a window into the subject (Gill, 2020). Therefore, a purposive approach was adopted to ensure that participants would be able to provide the insight required of the study and the chosen CTA methodology (see below).

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[7] *A common definition of what constitutes an emergency could not be found. For both emergencies and disasters, the key element is that the event exceeds usual coping mechanisms and so would require either a redeployment of resources (UK Cabinet Office) or a recognition that available resources were not sufficient to meet the threat. A disaster is defined by the Red Cross as "a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources" (IFRCRC)*

In ascertaining the sample size, I considered the richness of the data that would be gathered along with the amount of data needed (Fusch and Ness 2015) and: the aim of the study; the sample specificity; the use of established theory; depth of the data to be gathered and the analysis strategy to be used (Malterud, Siersma and Guassora 2015). Each of these factors suggested use of smaller sample sizes: the aim of the study was to consider 'cognitive factors' which necessitated the collection of detailed data; the sample needed to representative of public health workers with the experience of working in large responses where multiple teams had been engaged; this group also needed to be senior staff with sufficient experience and expertise to have been decision-makers; and previous NTS studies identified as part of the literature review had used small samples to achieve the specificity required. Following previous studies is a recognised method of ascertaining sample size (Porte 2013). For CTA studies samples of 5-6 interviews had often been deemed to reach saturation (Klein et al 1989, Boulton and Cole 2016, Gore et al 2018). Additionally using the qualitative survey to triangulate the data and thematic analysis would increase data richness, therefore fewer participants would be required.

Sampling for the interviews

A purposive sample of individuals each with at least ten years' experience in public health and representing the most deployed roles as defined by the Global Outbreak Alert and Response Network (GOARN) were interviewed (MacKenzie et al. 2014). These roles are also included as part of the WHO IMS (WHO 2017a) and were selected as a means of obtaining a cross-section of the possible roles fulfilled by public health responders. These roles are listed in Table 4 (p.74). Three individuals known to me were interviewed to pilot and practise the interview and refine the selection criteria. It transpired two had not been decision-makers and a third declined a 'formal' interview. Following the pilot, I recruited for the interviews. Four individuals were known to me, three were recommended to me and a further three were recommended by the interviewees. All met the study criteria.

Initial email approaches explaining the study were followed up with a phone call to explain the process and book a time for the interview.

Sampling for the qualitative survey

Purposive and snowball sampling was used to distribute the questionnaire (as explained above). The initial approach was to distribute the questionnaire through existing public health networks. The hope was to obtain in the region of 70 - 90 questionnaires completed. This would put the sample in line with the upper end of the questionnaires identified during the literature review (see p.39) and provide a manageable sample size for the analysis of qualitative data (Fusch and Ness 2015). It was also recognised that a limited number of people would have the expertise and experience necessary to answer the questions. However, interest from these networks at the peak of the COVID-19 pandemic was very low. I therefore wrote directly to 68 contacts with over 10 years of experience in public health response who may have fitted the criteria for the study. To increase numbers for return I asked them to forward the questionnaire or provide names of others who fitted the same criteria following the guidance set out by Zmud (2001). This snowball sampling was adopted because it is a way of reaching hard-to-reach populations with the appropriate knowledge (Abubakir and Alkassim 2015 and Naderifar et al 2017). Email approaches to individuals were followed up with one more email, after which it was decided that no response would be received. (See p.79 for more detail on piloting and issuing the survey).

Forty-six responses were collected, 25 from the original approach. Of those who did not complete the study, the majority provided no reason and three stated that they did not feel that they had the right kind of experience. Twenty-one responses were gathered through the snowball sampling. The questionnaire was issued in English and French to allow for greater uptake in francophone responders many of whom would have been working in west and central Africa during Ebola responses.

Saturation can be deemed to have been reached when no new themes are identified (Fusch and Ness 2015, Gill 2020). On completion of analysis of the eight interview no new themes were being identified. The questionnaires identified variations on two of the categories identified as part of the analysis but no new major NTS were identified during analysis of the survey data indicating that saturation was reached.

PHASE 1 – KEY INFORMANT SEMI-STRUCTURED INTERVIEWS

Interview participants

Interviews were conducted with ten public health staff who met the study criteria. Seven participants were women and three were men. Six were of European origin, two from the USA, one from Africa and one from Southeast Asia. Two were medical doctors, two were communications experts, two were virologists, two were nurses, two were epidemiologists. Two had completed deployments as coordination leads, two as laboratory workers, two as social mobilisation and communications experts, two as case management experts and two as field epidemiologists. The subjects were working for the following types of organization during the events they described: International NGO (1), National NGO (1), International Organisation (5), National Public Health Institute (3). They described their experiences of responses in the 2014-15 West Africa Ebola outbreak, 2018 Democratic Republic of Congo Ebola Outbreak, 2019 Mozambique cyclones Kenneth and Idai and the 2017 Diphtheria outbreak in Cox's Bazar, Bangladesh.

Table 4: Most commonly deployed roles through Global Outbreak Response Network

Coordination in a headquarters setting	Laboratory	Social Mobilisation and Communications	Case Management	Epidemiologist

Cognitive Task Analysis

Cognitive Task Analysis (CTA) is a family of methods used to reveal the thinking behind performing tasks in a real-world context and to develop training to help staff face emergency situations (Clark, Feldon, van Merrienboer et al 2007 Crandall, Klein and Hoffman 2006). The method is particularly useful for analysing complex tasks where experts weigh options and make decisions based on varying or changing factors. This is particularly relevant for emergency response environments where experts are often making decisions based on poor quality information and where there may be no clear best option, instead experts are trying to act based on the information that they have at the time (Klein and Militello 2001).

Cognitive tasks are often not observable but are macro-cognitive processes that occur when individual knowledge and skills interact with the knowledge and skills of wider groups or a system. The macro-cognitive processes are used to share knowledge to conduct sensemaking, plan and re-plan, coordinate, monitor work and adapt to uncertain and changing conditions (AHRQ 2013).

The CTA family contains a wide variety of methods based around three common steps: knowledge elicitation to extract information about the judgement, knowledge and skills that underlie performance; data analysis to identify findings and discover meaning; and knowledge representation to present findings and communicate meaning (Crandall, Klein and Militello 2001).

The interviews and questionnaire used in this study were based on Critical Decision Method (CDM) which is a CTA tool (Klein and Militello 2001). CDM is a retrospective interview strategy using probe questions to gather information and analyse non-routine events which require the application of judgement. Non-routine events are examined because they provide a richer source of data to help understand how participants use tacit knowledge (Klein et al 1989). Klein et al (1989) describe the process as requiring five

steps. However, following the pilot interviews I adapted these steps to account for the fact that the participants often identified multiple decision points during their initial narrative. I have described these challenges in Appendix C (p.231). The interview process is described below and in the interview guidance and script at Appendix D (p.235).

Conduct of interviews

The interviews were divided into six steps based on those outlined by Klein et al (1989). They were designed to capture information around the seven core NTS identified during the literature review. Each interview lasted between 45 and 90 minutes.

Step 1. Select an Incident*.* Prior to the interview, participants were asked to select a non-routine event in which they had been the decision-maker and in which they had been compelled to take a decision that was beyond their routine knowledge. Participants often presented numerous options and were asked to choose the one they felt they could give most detail about. I then worked with the participant to select one event which we thought would give the best opportunity for describing a challenge in a MTS.

Step 2: Obtain an unstructured incident account. The participants were then asked to “tell the story” of the event and explain why they found it challenging. During this narration I developed a loose timeline of events based on the four stages of decision-making gathering information to develop situation awareness, taking a decision, making a plan and enacting the plan (Launder and Perry 2014). Where necessary I asked clarifying questions to ensure I could understand elements of the story.

Step 3: Construct Incident timeline. I reviewed the timeline I had constructed during step 2 with the participants and asked clarifying questions.

Step 4: Identify decision points. In this stage I worked with the participants to identify the decision that they had found most challenging to make and lesser decisions that led up to or followed the key decision

Step 5: Decision-point probing. I asked the participant to repeat the story but focussing on each of the four stages of the decision-making process: gathering information and developing situational awareness; the decision-making point; enactment of the decision through leadership and communication; the potential impact of stress or fatigue on the incident and finally any other issues that the participant felt that the participants wished to discuss.

- *Gathering information and situation awareness*. I asked participants where they had gathered information and specifically about different sources.
- *Decision-making*. I used prompts from the JESIP Joint Decision-making Guidance and SAFE-T (Situation Assessment, Formulate plan, Enact and review as a Team) template (Waring, Moran and Page 2020) to formulate questions about decision-making. These are set out in Figure 6 (p.78). I also asked about any frameworks or tools participants used to aid their decision-making.
- *Enacting decisions*. This phase included questions around Leadership, Teamwork and Communication. I used the frameworks from Yukl, Gordon and Taber (2002) to explore issues around Leadership, Teamwork and Communication; how planning was conducted, and decisions enacted. These are listed in Figure 7 (p.78).

Step 6: Key personal skills. I added this step to the five described by Klein (1989) following the pilots and the first interview. It was introduced to cover the personal skills of dealing with stress and fatigue (Flin 2008). The participants were asked to describe whether they had felt stressed and fatigued and if so, how they had coped. They were then asked to talk about the feelings they had had during the incidents and how they had addressed

these feelings. Because the interview was semi-structured this step allowed for the participants to highlight any additional NTS, they felt were relevant to the discussion. These additional NTS were recorded in the notes of the interviews and used as additional categories for analysis.

Figure 6: The decision-making questions were adapted from the JESIP model

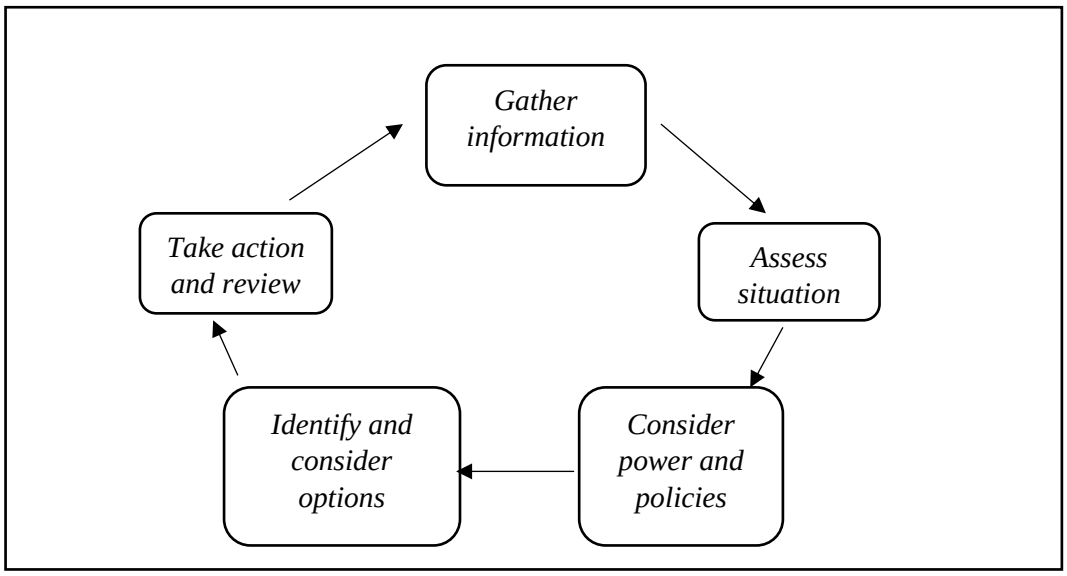


Figure 7: The Hierarchical Taxonomy of Leadership behaviour (Yukl, Gordon and Taber 2002) was used to shape questions around leadership

Task Behavior
- Plan short-term activities
- Clarify task objectives and role expectations
- Monitor operations and performance

Relations Behavior
- Provide support and encouragement
- Provide recognition for achievements and contributions
- Develop member skill and confidence
- Consult with members when making decisions
- Empower members to take initiative in problem solving

Change Behavior
- Monitor the external environment
- Propose an innovative strategy or new vision
- Encourage innovative thinking
- Take risks to promote necessary changes

Pilot interviews

The interviews were piloted with three volunteers to help practise and refine the structure and technique. These pilots provided the following learning.

- *Explaining what NTS are and how they are used before the interview helped with the conduct of the interview*. Where the role of NTS in the professional setting was not explained the participants had difficulty finding suitable situations to discuss.
- *Junior staff who had not had a management role were not suitable participants*. They either had no relevant examples of having made decisions (they had been following the guidelines or advice of more senior staff) or could draw only on examples from their non-work experience whilst deployed (for example the difficulty of dealing with living standards in the field).

Data collection recording

The interviews were conducted face-to-face or using Skype and WhatsApp video conferencing. The interviews were recorded, then transcribed using Microsoft Word and checked for accuracy and uploaded to the University of Bath's X File. Notes were taken during the interviews to map decision-points and key information.

Transcription

I decided to transcribe the entire interview including my questions. This is because on occasions I asked questions that clarify the context of what the participant was saying and for the practical reason that the initial transcription was conducted using software (which meant the transcription included the questions) and then checked for accuracy.

Analysis of interviews

I adopted a thematic analysis of the interviews data following a process described by Crandall, Klein and Hoffman (2006). The approach is adaptable which would allow me to analyse data methodically whilst juxtaposing objectivist and constructivist approaches to research (Charmaz in Handbook of Qualitative Research 3rd ed. 2005). This provided a clear set of guidelines which helped me establish a clear methodology and consistency of findings to analyse data based on similarity and contiguity (Thornberg and Charmaz 2013); finally, for the purposes of this study - which sought to describe the actions of individuals in a variety of response settings - the more subjective analysis delivered by the narrative, hermeneutic and ethnographic approaches to qualitative research were not required and would have made a comparison of the skills used across the settings more difficult to achieve. I opted instead for an analysis of the text, selecting blocks of text from the interview transcripts and identifying key words that would either become iterative codes or could be linked to deductive codes (Ryan and Bernard 2000). This approach provided a more objective analysis of the interview data and comparison of the participants' experiences to identify patterns that could be used as the basis for the qualitative survey in Phase 2 of the study.

The analysis continued through the writing of the results and discussion chapters as linking the results of the data collection to theory helped me to further refine the list of NTS. I followed broad steps for the analysis of data which do not need to run sequentially but can completed concurrently if required:

- *Describe the data in terms of concepts which represent the phenomena being observed*. These are the problems, issues or concerns facing the subject being studied.
- *Conduct Open Coding to group the concepts into categories and sub-categories based on literature, in vivo codes and observation*. These are used to describe what is happening when the phenomena occur.

- *Conduct Axial coding to fully describe the phenomena by identifying*: the conditions that give rise to the phenomena, any actions that are taken within it by the subject and the consequences of those actions.
- *Conduct selective coding to link the disassembled data back to theory* by reducing the data into concepts and sets of relational statements to create a hypothesis to explain when and how the concepts occur.

Applying these steps, I analysed the data to:

- Understand the response environment, the challenges it presented for the participants and how it related to the definition of a MTS.
- Describe the NTS used in this environment by the participants based on evidence from the literature review and the study data.
- Describe the forces in the environment that acted on the participants and how they used NTS to overcome the challenges they faced.
- Compare the data with the theory and concepts described in the literature.

I have outlined the data analysis process in Fig 9 (p.83) and described it in detail in the following paragraphs.

Fig 8: Strategy for acknowledging and minimising bias. Based on Panucci and Wilkins (2010).

a) The author's bias might impact at every level of the study causing data gathering and interpretation to be inaccurate. These potential biases will be minimised by:
   - Gathering feedback about the conduct of the interviews.
   - Reflecting after the interview to assess for bias in its conduct.
   - Use of a second coder.
   - Reflecting on and acknowledging the researcher's background.

b) Standardisation of the data collection methods to ensure consistency in data collection is addressed by using:
   - One researcher in Phase 1 to avoid interpretation bias.
   - Set interview methodology in Phase 1, amended only after review and if the interview technique is not eliciting the type of information required.
   - Using a standard questionnaire in Phase 2.

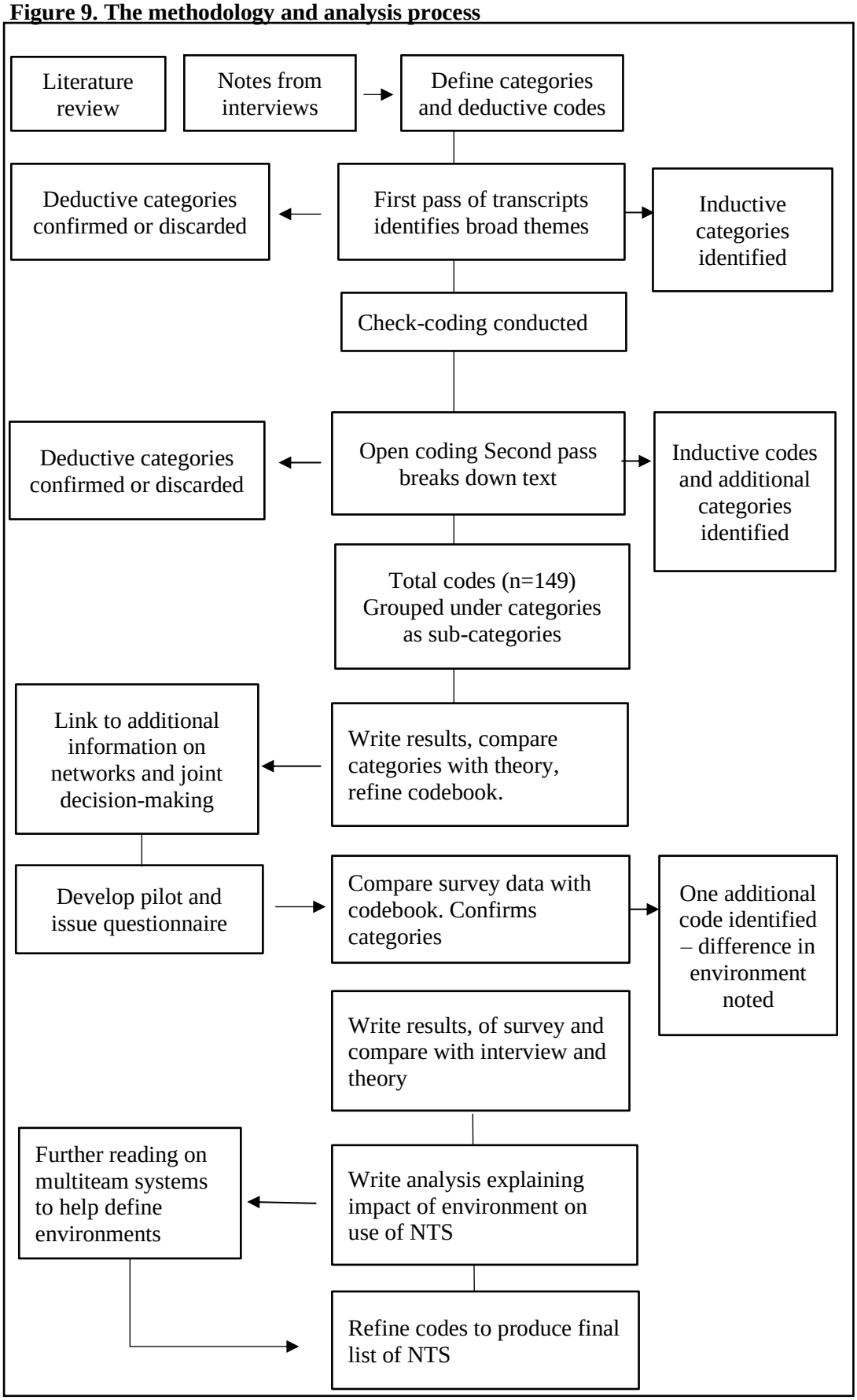
c) It is possible for the researcher to select participants who will share their point of view, or if the participants are all drawn from one organisation to have a biased outcome. Selection bias will be mitigated by:
   - Indirect selection of participants through colleagues for Phase 1.
   - Sending questionnaire out through a wide data-base.
   - Recruiting participants from a variety of organisations and deployment experience.

d) Participants will be asked to recall past events during which they may have been stressed or where another factor may affect their recall or understanding of events at the time. Stress can degrade cognitive performance (McLennan et al 2014) and impact recall (Hassan 2005). To mitigate recall bias the study will:
   - Use a standardised methodology.
   - Allow participants time to recall the information prior to interview
   - Not share the complete list of questions prior to interview.

e) Misclassification of data can affect its analysis. This will be mitigated against by:
   - Cross checking of data coding and analysis with at least one other person.

f) The interviews will be conducted with a small number of participants. Although internal validity of the study will be high the generalizability of the results will be less certain. The questionnaire is a method for externally validating the findings of the interviews by testing them against a larger group.

Figure 9. The methodology and analysis process



Step one: Describe the data in terms of concepts which represent the phenomena being observed

I was able to define the outline problems and issues facing the interviewees based on the literature review. These issues were defined as the steps of the decision-making process defined by Launder and Perry (2014) which formed the basis for the shape of the interviews: gathering information; deciding on a strategy, planning and enacting the plan. Alongside these steps I also needed to develop an understanding of the environment in which the interviewees had been working and using these skills. This was largely achieved in the first stage of the interview when participants were asked to describe the challenges they had faced. As I analysed the interviews, I made a category distinct from the NTS categories called "environment" which was used to identify and then describe common challenges faced by the participants and which they were using their NTS to address.

Step 2: Open coding of the interviews

I read through the initial transcripts, notes and timelines produced during the interviews and carried out an initial coding against the categories and sub-categories that had been identified deductively (shown in Table 5 p.85). These were the key NTS identified in the literature review and descriptions of the working environment. During the initial pass inductive concepts that emerged clearly were added as categories most notable among these were 'relationship building' and 'personal control'.

To conduct coding, I identified key words and selected text either side of the words which was enough to provide me with the context of the point being made by the participant. There was no set number of words identified either side of the key word. These chunks of text were then coded according to the key word. Key words were designated based on the literature or in vivo. Once keywords were identified I also identified synonyms that could be related to those keywords so that the same ideas expressed using a different word could be coded together. For codes identified inductively or in vivo, elements of text could be separated out for a line-by-line analysis which

helped to better define the coding criteria and the context in which that action occurred.

Table 5. Description of the stages of the analysis with codes identified from the literature review

Decision identified by participant	**Insert text from the interview instructions**			
Categories / Phenomena Derived from Launder and Perry 2014	Situation Awareness / Sensemaking	Deciding on a strategy: Decision-Making	Planning to implement or implementing: Leadership and Teamwork	Description of the environment
Sub-categories identified deductively through pilot interview notes, literature based on Flin (2008) and Yukl, Gordon and Taber (2002) were used as a basis for initial coding. Inductive categories were later added following the interviews	Previous experience Information gathering Prediction	Joint decision-making Recognition-Primed DM Individual DM Analysis of options	Individual Planning Joint planning Identifying options Risk assessment Establishing tasks Communication of tasks	Multiple parties Disparate goals Silo working
	Some sub-categories such as Communication, Stress and Fatigue would apply across multiple categories			
Axial Coding Inductive to link categories and sub-categories to phenomena derived from analysis of interviews	Conditions in the environment that caused the use of NTS. The use of NTS would be described as “Actions” and their “Consequences” recorded. It was anticipated that certain sub-categories would link across multiple categories.			
Selective Coding Describe how and why the NTS elicited in the interview are used. This is continual process throughout the analysis	Link back to theory by examining the process that is undertaken for each of the created paradigms. Comparing the paradigms across the participants’ interviews and comparing the descriptions of the process in each of the paradigms back to existing theories around: situational awareness, decision-making and teamwork. The theory of MTS and a description of the systems involved in response.			

This initial pass allowed me to better understand the content of the data and the types of information and themes that might be contained within it. Conscious that I may be in danger of imposing views from the literature and my own bias onto the data I then carried out a check coding with an independent colleague.

Following the check-coding I conducted a second pass at the transcripts using Open Coding technique during which I deconstructed and coded the transcripts based on keywords derived from the literature review and in vivo codes from the interview notes. This second pass was based on a line-by-line reading of the data in line with the microanalysis recommended by Strauss and Corbin (1998) at the start of a project. This close reading of the text and questioning of interpretation of words added considerably to the coding to re-examine themes and cross overs between categories. During this stage 149 codes were identified. This micro-analysis was a key step in identifying and attempting to negate my own biases of what I had expected to find from the data and the initial notes I had made during the interviews, some of which I now saw reflected my own interpretation of what I had expected the data to show.

Step 3: Conduct Axial coding

Axial coding is used to identify the context in which phenomena occur and explain how participants respond to the situation by examining the conditions surrounding the phenomenon (Strauss and Corbin 1998). The steps to axial coding are

- Lay out the properties of a category and their dimensions
- Identify the conditions, actions and consequences associated with the category
- Identify the relationship between these and the categories and sub-categories

Strauss and Corbin (1998) identify three types of conditions:

- *Causal conditions* which is a set of event or happenings that influence a phenomenon such as being present at an event.
- *Intervening conditions* that mitigate causal conditions for example an action that has an impact on the causal condition.
- *Contextual conditions* that intersect both causal and intervening conditions and create a set of circumstances to which people react such as a violent reaction from a colleague or community member.

As I proceeded with this deconstruction of the data, I grouped the concepts into categories that had been identified deductively and identified new categories and sub-categories that emerged from the data. Categories that initially seemed important such as Teamwork were reduced whereas others such as Relationship Building grew in significance. This process was carried out concurrently with the identification of categories. I created sub-categories and memos to note where categories overlapped and the potential causes and use of the skills captured in the categories.

Step 4: Conduct Selective coding

Selective coding reduces data from the Open and Axial Coding to explain what is happening. This process was undertaken by gathering codes into groups that related to each other to make up a broader category. From this process I developed a codebook which described sub-categories under each category. During the process of analysis, I made memos where this data was linked back to the theory and observations of phenomenon that crossed categories. The second part of the selective coding was conducted whilst writing up of the results section where the codes were linked back to theory to describe how and why participants used NTS in the way they did. Based on writing the Results the codebook was refined. This process was repeated in the writing of the Discussion chapter when I incorporated findings from the survey and further reading to refine the codebook. The questions I

considered when conducting axial and selective coding are listed in Table 6 (p.88)

Table 6. Questions used to help develop Axial and Selective Coding

Axial Coding Inductive to link categories and sub-categories to phenomena derived from analysis of interviews	What is happening? When is it happening? Where is it happening? What is the culture (including organizational culture)? What are the roles, beliefs, power relationships of the people involved? Which institutions to the parties belong to? What gender are the parties?
Selective Coding Describe how and why the NTS elicited in the interview are used	What is happening? What issues are being handled through action and interaction? What form does the interaction take? What conditions combined to create the context of action/interaction What is the same/different about the interactions across the participants accounts? Why and how are they the same/changing? Are (inter)actions (mis)aligned? What conditions or activities connect one phenomena or sequence of actions to another? What happens to the flow/form/continuity of actions when situations change? How is action taken in similar circumstances? How do the consequences of one set of interactions play into the next? What are the individual strategies/tactics/routines that the subject adopts to deal with issues and (inter)actions? How do these individual strategies relate to the NTS identified in the literature review?

PHASE 2 – QUALITATIVE SURVEY

A qualitative survey using Microsoft Forms was used to gather data from a purposive sample of public health professionals with experience of working in public health response.

Survey participants

Forty-six questionnaires were completed with public health staff from a range of professional backgrounds. Fifteen of the participants were female and 31 were male. Twenty-three were of African origin, eight from North America, five from Europe, three from the Middle East, three from South America and three from Central Asia. The participants were asked to indicate the type of organisation and roles they had been working in at the time of the events they were describing: International organisation (30), Ministry of Health or National Government (8); NGO (7); and Academic organisation (1). They were also asked to describe the “level:” at which they had been working: National (16), Sub-national (district, province or state) (7), local or community level (8) International (6) and Other (4). Participants were asked to describe what type of team they had been in during the response: Leading a number of teams (8), working across a number of different teams (16) or working in a single team (22). They were also asked to describe their role or technical background: Epidemiologist (7), Communications (3), Clinician (2), Health Operations (2), Health Cluster Coordinator (2), Administration (2), Monitoring and Evaluation (1), Logistics (1), Mental Health Care (1), Antimicrobial Resistance (1), Nutrition (1), Infection Prevention Control (1), Liaison (1), WASH (1), Planning (1). They described their experiences of responses in years from 1995 to 2020 however most of the responses came from 2014-2015 (8); 2018-2019 (14) and 2020 (5). The types of response covered in the questionnaire were: Ebola responses in 2014-2015 and 2018-2019 (10), Complex Humanitarian response (11) Flooding (6), COVID-19 (5), Cholera (4), H5N1 (3), Measles (2), H1N1 (2), Hurricane and Cyclone (2), Anti-Microbial Resistance (1). The participants had been based in 30 different countries when the events they described in

the questionnaire occurred. The countries are divided regionally as Africa (26), Middle East (6) Asia (6) North America (3), Europe (3).

Developing the qualitative survey

The qualitative survey was designed to further explore results from the interviews by comparing them with a larger sample. Key concepts that had arisen from the interviews were: the collection of information from multiple sources, the notion of informal and formal sources of information, the concept of joint decision-making and an absence of decision-making using templates such SAFE-T to guide actions. Therefore, I designed the questionnaire based on the CDM methodology but emphasised the information gathering, decision-making and action stages to further explore key findings from the interviews. General questions about the attributes required to work in emergency response were included to cover the personal control elements identified by interviewees.

The survey was piloted with six people. They reported struggling with identifying an event to report upon. The language originally used in the question was “incident” however this caused confusion for some who thought that this may only be referring to security incidents. The language was changed to ask participants to reflect on “a situation” they had faced when working in response.

The survey was run between January and May 2021. This period included an initial launch followed by a review of the method of distribution. The initial launch was to a group of 28 people known to have extensive experience in response management: of these, ten replied. I received feedback that some people had felt unqualified to take part in the survey because it has been called a “decision-making” survey and they felt they were too junior to have taken decisions. So, I adapted the language to call it a “team-work” survey and relaunched it - emphasising that this was part of a Doctorate thesis - using the snow-ball technique described above. The language used in the email followed the guidance set out by Zmud (2001) explaining that the

respondents had been selected because they had relevant experience, that the results could be used to develop training for the next generation of responders and the personal importance of the research to the researcher. Replies to the questionnaire were monitored. People who did not answer were sent one follow up email, after which it was assumed that they would not take part. At the request of a francophone participant the questions were translated into French and checked by a native speaker before being issued. With this information was an overview of the study aim and objectives. Copies of the texts of the emails used to send the surveys and the questionnaire are at Appendix D (p.235).

Qualitative Survey design

The qualitative survey was designed to provide respondents with an opportunity to reflect upon and describe challenges that they had faced when working in a response environment. As with the interviews the questions asked participants to reflect on a particular event as the best means of helping to recall their actions and thinking at the time (Crandall, Klein and Hoffman 2006, Jobe and Mingay 1981). There were 23 questions divided into of six sections designed to gather information about the participant and then to guide them through the decision-making process with prompts to aid recall (Schwarz and Oyserman 2001).

The qualitative survey consisted of prompt questions designed to encourage and aid reflection and descriptive questions. The prompt questions were based on the results of the interviews and designed to encourage reflection about the way in which participants may have approached the challenge that they had identified. Breaking up questions in this manner can aid with recall (Bradburn, Sudman and Wansik 2004). The descriptive questions were designed to allow participants to describe, in their own words the thinking behind their actions. Because people often find it difficult to think fully about a task, additional prompts were included to encourage them to “think carefully”, “include as much detail as possible” and suggested word counts for the qualitative questions were provided.

Qualitative Survey contents

This section describes the qualitative survey contents and the rationale for their inclusion. The narrative is summarised in Appendix E (p.249) which lists the questions, the rationale for their inclusion in the questionnaire and the relevant sources. I developed the table before writing the questionnaire to ensure that I understood the construct and reason for including the questions. The Table and the questionnaire were refined following the pilot. The questionnaire consisted of the following sections.

Section A was designed to gather information about the respondents. This was to ascertain the level of experience they had of working in public health emergencies and which country they were from. There is evidence that NTS are used differently by people in different cultures and at different levels of seniority, common variants would include the willingness of junior staff to communicate openly with senior staff and the way leadership is perceived (Livingstone et al 2014). Political and social systems which are more familiar with public debate (for example Scandinavian countries) can see increased levels of communication between junior and senior staff (Makinen et al 2007).

Sections B-D were concerned with the decision-making process. The process was broken down to aid recall. Each section comprised a series of Likert scale questions to aid recall of the events and assist with the coding of the qualitative data contained in the survey. I chose to use a Likert scale because the interviews had shown that the participants would have used multiple methods of information gathering, decision-making and decision enactment. A Likert scale would allow them to reflect a range of methods more accurately (because they may have used some methods equally, or not at all) than asking them to rank the methods used. Additionally, I wanted them to reflect on the methods they had used, and the situation rather than simply rank the methods which they felt might have been objectively most important. This qualitative data was collected at the end of each section

where participants were asked to describe in detail different facets of the decision-making process.

Section B asked the respondents questions about the environment they had been working in at the time of the event. These questions acted as aides for memory (Bradburn, Sudman and Wansik 2004); and helped define the working environment of the participants. Feedback from the interviews had indicated that certain roles and locations in the response may be more adept at working across boundaries and silos. There are also job roles which may require different types and levels of interaction with other teams. So, this section asked participants to identify the type of teams in which they had been working and their job role. The participants were then asked to describe the challenge they had faced. A reminder to give an accurate, full explanation and a word count guide were also provided.

Section C was concerned with how the participants had gathered information about the challenge they had faced. Participants were provided with options which described gathering information from formal and informal sources as well as an option that they relied on their own knowledge alone. Information gathering to develop situational awareness is the first stage of decision-making (Crandall and Klein 2010, JESIP, Alison and Crego 2008, Alison et al 2015) and is key to the performance of teams (Endsley and Robertson 2000). In the interviews, information gathering was the element of the decision-making process about which the participants had had most clarity. Kapacu (2011), Stephenson (2005) and Lipsom (2005) have argued that the only way of generating meaningful coordination in multiteam environments is through informal networks, so the participants were asked specifically about informal networks. Based on the experience of the pilot interviews the participants may otherwise have overlooked informal networks as unimportant or inconsequential.

Section D asked the participants to consider how they had made the decision. From the interviews this was identified as the most difficult element for participants to recall. This was partly because few people tended to follow a traditional decision-making model (assessing options and selecting the most appropriate) (Waring, Moran and Page 2020). The participants were provided with options which reflected a SAFE-T[8] (Waring, Moran and Page 2020) decision-making model, naturalistic decision making (Klein 2010) and Joint decision-making models (JESIP).

Section E asked how the participants enacted their decisions. In the interviews participants described how coordinating between multiple teams worked more organically than a traditional project management style of team leadership. The choices were designed to give an indication of which model of 'taking action' was favoured in practice. The options provided to the participants were based on the Leadership taxonomy of Yukl, Gordon and Taber (2002) and leadership checklists provided by Adair (2009).

Section F asked the participants to answer two free text questions. The first was to consider the key skills that people would require to work in emergencies. The second asked what advice they would give to people starting out in their career in public health emergency response. These questions were included to provide the participants with any other information that they wanted to share about personal skills. These types of final question had provided rich data in the interviews and so was repeated in the survey.

[8] *SAFE-T is a decision-making model which outlines the following steps: Situation Awareness, Formulate Plan, Enact Plan and Team learning*

Qualitative Survey analysis

The qualitative survey analysis followed the same broad steps as the interview analysis. I first read through the material to get an understanding of the broad concepts being discussed. As part of this first read through, I looked for indications that the qualitative survey data would differ from my analysis of the interview data. I was also looking to see if I could identify any trends in the data that would relate to the position the individual held in the response or their professional background. No significant differences were noted between the interviews and the survey data. There was no significant comparison across role types or professional background.

This initial analysis was checked against the answers to the multiple-choice questions. The answer to the multiple-choice questions were recorded and compared against the roles fulfilled by the participants during the response. I then conducted a second read through and examined the responses that required qualitative analysis. The answers provided by the participants were coded based on the codes in the code book.

SUMMARY – RESEARCH DESIGN

This research was designed using an interactive and pragmatic approach. The two phases of the study were based on CDM. The methods used were adapted as the research developed to ensure that the research was practical as well as methodologically sound. The limitations of the study design are further discussed in the Discussion chapter and the self-reflection at Appendix C (p. 231).

CHAPTER 4: RESULTS

Introduction

In this chapter the categories created and identified during the data gathering phase are described and interpreted. In subsequent chapters, this process will be further developed, by relating the findings to the existing literature and outlining the contributions to research and practice of this study. Table 15 (p.165) provides an overview of the findings from this study described in chapters 4 and 5.

The chapter has two sections: the first sets out observations from the interviews and the qualitative survey; the second provides an interpretation of these observations. The names and other identifiable factors relating to individuals and organisations have been removed to anonymise the data.

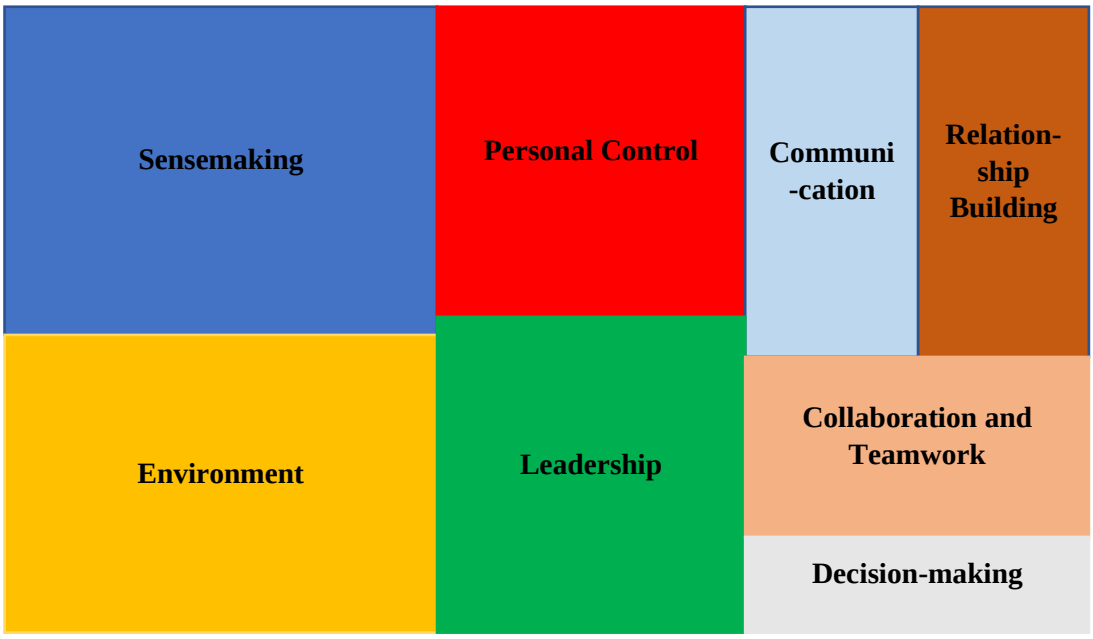
INTERVIEW RESULTS

Eight categories were identified during the coding process. One category described the response environment and seven categories related to behaviours demonstrated by the participants. The categories are in Table 10 (p.96). Each of the categories had sub-categories which are shown in the codebook at Appendix G (p. 272). The Hierarchy of categories at Figure 10 (p.97) provides an indication the number of sub-categories identified for each of the category areas. However, this cannot be directly related to the importance of the category in relation to working in the response environment.

Table 7: Categories identified using a mix of inductive and deductive coding based on the literature review and the NTS identified during the interviews.

1	Environment
2	Sensemaking
3	Decision-making
4	Leadership
5	Collaboration and teamwork
6	Communication
7	Relationship building
8	Personal control

Figure 10: Hierarchy table of the categories identified during the interview coding



Environment

The ‘environment’ category contained descriptions of the work and physical environment to which the participants had reacted. This information was required to understand the context in which NTS are used by the participants.

The participants described working and operating alongside teams and individuals from international organizations, national and local government, NGOs, private businesses and local communities. They reported that they needed to mediate their position between different organizations and individuals within organizations. They described how different teams within organizations could work within silos; failing to share information or understand the role of other teams; and that in some cases internal hierarchies could act as a block to gathering and sharing of information.

... all these actors and these power dynamics and these things, starting from the internal ones and then all these actors and government, you know, and, uh, UN agencies and other NGOs and other local civil society communities, different, uh, political parties, ethnic groups ... and then you have to ... understand how you can navigate that and be able to operate.

the epidemiologists, the anthropologists, they had information, but they were keeping it. And this information was very, very crucial. For example, anthropologists are people who go to the ground and figure out why are people running away from the treatment centre. Do you understand?

Participants also explained how teams or organisations had areas of responsibility delineated either by geographical boundaries (such as an area of a country, or smaller environments such as a refugee camp), or by response function (for example community engagement). Where organisations' missions or processes differed from one another, this could be a source of tension. The respondents also reported historical and cultural tensions between organisations which could spill over into criticism of each other.

I was challenged by the senior management here because these incidents were reported every day and there was a lot of confusion we didn't know where our partners were … we didn't really know what the situation was. The NGOs were criticizing [us] so I needed to find out what actually was happening.

Four of the respondents referred to direct contact with communities. Three of the four, spoke about building trust with communities and local workers. The fourth was involved in supporting communities to adopt appropriate disease mitigation strategies. Five of the respondents also referred to language barriers when working in francophone countries and the challenge of building trust when unable to speak the local language.

Three of the respondents spoke about having security concerns, although they described this as 'feeling insecure at times', rather than it being a barrier to their work. One participant described feeling physically threatened.

All the respondents spoke about pressure to succeed. This was sometimes exacerbated by the fact that they would spend a limited amount of time on deployment, so they felt under time pressure. Additional stressors or pressures, were those brought to bear by external actors and the national government; by a sense of responsibility to the local population; and by a desire to succeed and not appear unprofessional.

There was pressure from the government ... saying [we] don't want cases, [they] couldn't understand why we couldn't control the disease, you understand? So, there was pressure from the government, all that there was pressure both for the teams, and also the high turnover of staff.

All the respondents spoke at length about the importance of building trust with the disparate actors and the importance of being able to work outside of established meetings and formal channels. They described how personal relationships and informal conversations helped them to get work done in the response (see below in paragraphs on 'sensemaking' and 'relationship building').

Sensemaking

Participants spoke about three stages of sensemaking, gathering information, understanding it and then predicting future states. Most of the data from the interviews was about the challenges and methods of information collection and sharing. There was some data about building shared understanding with colleagues, and a few mentions about use of information to predict future states.

The participants described using 'formal' and 'informal' networks for gathering information. One interviewee, described how formal meetings would be preceded and followed by informal discussions, during which a more direct exchange of information could happen, and agreements could be made. Participants also spoke about gathering information outside of the response altogether, using information from local people to "connect with the reality" on the ground.

Interviewees gathered information from a range of sources to get an understanding of the broader context of the response. They described how they used an understanding of the roles and needs of other individuals and organisations to maintain good working relationships and avoid creating rifts.

.. yeah so there's a lot of that, after morning meeting discussions and that happens a lot everybody was staying in the same hotel so there would be a lot of ... post meeting discussion and by phone and text and whatever but there's a lot going on in the afterhours or on the side-lines of different meetings so there's always different meetings going on all day ... I think it augmented and contextualised different [information] and you got to know what people's opinion real opinions were ...

Four of the respondents spoke about the importance of being able to read atmospherics and body language. Two of these respondents were talking in the context of maintaining their own personal safety and preparing to deal with potentially dangerous situations and winning trust.

yeah, it was body language ... you could see his body language just relaxing and coming more forwards and, and then he would smile more. In beginning he wouldn't smile; he was not a big talker anyway so he would be very quiet in the first day and then we had to drag every word out of him and then suddenly he started chatting a bit

Respondents also reported that they relied on their own knowledge and experience, to help them develop an understanding of the situation in which they found themselves.

Decision-making

Decision-making was a deductive category used because the interviews hinged on decision points. However, compared with the other categories there was relatively little data captured. Decision making is a process that consists of stages including gathering information, assessing the situation, selecting a course of action and carrying out the action. Therefore, the act of the decision (selecting a course of action or identifying a strategy) is a relatively brief occurrence compared to assessing the situation or carrying out the plans. Where decisions were described by the participants, they often described a series of decisions, rather than a single decision.

None of the interviewees reported using a tool or analytical guideline to help them make decisions. Where the interviewees explained the rationale for their decision-making, it was normally based on previous experience.

... even at the start of Ebola when I started bringing all these sectors (together) that was from my work [experience] in pandemic influenza…

The interviewees also described making decisions as a group. They described how the group either worked together to suggest a solution to a problem, or how they as individuals, suggested a solution to the group which was then debated and adjusted it until there was consensus.

... yes very much so and that discussion went on quite a bit because based on people's backgrounds and their training, and I don't know maybe to some degree, their experience there were lots of different differing opinion, opinion so I very much, we sort of had, in these situations a committee formed and we started to talk about what we were going to do.

... and then as you debrief … the person … who is in charge of that of that investigation then also agrees to steadily shift from a set a set way of doing things to perhaps accepting some of your suggestions …I think you don't have to actually openly tell people if they're part of a meeting that probably people, people are subtle enough to understand that it's like a sort of bargaining action.

Two of the participants described making decisions because there was “no other choice”.

... it comes back to, it felt like we didn’t really have a choice. We were there and we had one mission to complete and I, I didn't want to go back home not having that.

Leadership

Coding for leadership presented challenges because there are many varying definitions and interpretations of leadership; and many of the leadership functions and behaviours (such as communication, planning, and decision-making) overlap.

Participants spoke about allocating tasks to different teams or team members and sharing of resources. Issues around monitoring of operations and performance were not discussed by the participants.

... there was a bit of confusion as to who's going to coordinate who's going to do this and that ... so I said the anthropologist would lead the social science data collection. And what we tried to propose from that is to triangulate the data on social science with the epi data while the two persons working on risk communication one would focus as the lead on coordinating the work with [partners]. The other would focus on strengthening the capacities of local people ...

Respondents described the importance of developing relations with other teams and their own staff. The data indicates a concentration on the former. Three of the interviewees referred to seeking support from senior staff when they needed to make a difficult decision, only one spoke about providing support to their own team members. Participants also spoke about building relationships with the communities they were working with.

You were part of the team which went in and convinced them (the local population infected with Ebola) to get out from their homes. And we told them we would look after you when he came back. You have to go back and grieve and tell them we are sorry. And if they recover you become part of the celebration. We told you he went, and he came back. and it's a success

There was significant reporting of activities that reflect change behaviour. All the respondents reported that their work had entailed initiating and proposing changes. This was almost entirely with other organizations and teams involved in the response. Change was initiated largely based on previous experience and adapting knowledge and experience to the current circumstances. The ability to adapt was reported frequently as both a leadership skill and as a mindset that people should adopt when deploying to support a response.

there is technical knowledge out there on it so it's not just making something up but how can we use the same technical standards and apply them to a different context? So, you know looking out at what technical information is out there and trying to pull that together that along with the operational piece.

it's being practical it is being pragmatic it's being like what needs to be done what is the priority now if we're humanitarians ...

I travel a lot and not always for outbreaks because we do a lot of endemic stuff so, so yeah every time it's different with good intentions and then you come there and then you have to adjust because, because of the people or what happened or different circumstances or but it makes it very interesting I love that

The participants reported initiating change through negotiation and coordination. They described shared leadership where groups made and enacted decisions together. There were also examples of different group members exercising leadership at different times.

The data indicated two-levels of leadership: the first, and most prevalent, was leadership demonstrated with *ad hoc* teams created by bringing together individuals from different organisations. The second – which was seldom reported – was the management of internal established, functional teams.

Only two of the subjects described their experience of managing smaller functional teams. Challenges in managing these teams included: the high turnover of staff which meant that the subjects had to be able to quickly assess an individual and assign them a role; and managing staff expectations when they were re-roled from their original task or when there were no tasks for them to perform.

The data on both *ad hoc* and functional teams is contained in the collaboration and teamwork section below.

Collaboration and Teamwork

The interviewees described how different organizations worked together in the response. They explained that teams made up of staff from more than one organisation or agency were pulled together to complete set tasks. Within these *ad hoc* teams individuals were assigned roles according to their organisation's mandate or area of responsibility. The coordination efforts described by the participants tended to be informal and conducted outside of large-scale meetings.

Yes, I always do behind the scenes lobbying. Because that's the only way I mean you cannot, cannot confront and embarrass somebody in a big meeting ... especially people at senior level.

Participants described that there could be a lack of knowledge about how other entities within the response contributed to the overall goal.

Yeah, and there was another layer of, um, challenge in that, as when social scientists were presenting their data in the incident management meeting. Their information was seen as something that there wasn't enough, not enough I should say, there wasn't much importance given to qualitative information versus quantitative information.

The participants explained it was important for stakeholders in the response to share information. This was often done by inviting people to share and hear information at an informal level. Much of the information sharing consisted of explaining the roles particular teams and their relevance to the response.

Teamwork was not widely discussed by the participants. The category of teamwork emerged as participants spoke about creating *ad hoc* teams consisting of personnel from multiple agencies, who were identified and recruited through ‘formal’ and ‘informal’ networks. To a lesser extent participants described working in established teams fulfilling a single function.

Actions taken to enact a decision were conducted jointly, participants described how the role of individuals in *ad hoc* teams were based on the remit of the organisation they represented. Roles and responsibilities that were not defined were negotiated within the group.

... we needed to work out how we worked ..., contact tracing was UNFPA, risk communication was UNICEF, and there’s co-partners, there’s WHO, there’s [Ministry of Health], MSF with IMC, there’s so many people and logistics which the military take... once we divided that, then during the meetings everybody used to use it ...

In some cases, team members would frequently change as they rotated in an out. Interviewees also described having to reassign staff to cover roles needed in the response.

[you must work out] how can you maximise the efficiency gains you have from your team to work on the different elements of the response and that means re purposing some staff members from what they were doing something else

Interviewees reported bringing together groups or organizations with expertise or resources to solve problems. This multidiscipline characteristic was present to a lesser extent in the functional teams.

Communication

Communication was primarily described in terms of oral communications: conversations or meetings with stakeholders. There were few mentions of formal, systemic and written communications such as situation reports or briefings. Rather, participants described using individual spoken communication to persuade others to adopt a course of action. This advocacy was often done outside of formal settings to avoid public confrontation. Formal communication, in meetings for example, was often preceded or followed up by more candid one-to-one conversations.

... especially in emergencies ... I think that personal relationships and informal channels are [key] ... because I mean formal channels are those full of confidentiality and ... you don't get access [to] information unless you are at the [correct] level of that information ... so the informal channels are the real way to, to access [information] and then you use the formal channels ... to make use of that information in the best way

Being able to communicate in a language with which locals were familiar was important to building trust. Anglophone interviewees reported the importance of using French to build trust with local officials in countries where French was spoken.

The use of clear, non-technical language to explain technical issues was described by three of the interviewees. They explained how messages

conveying essential information could easily be lost if language was too technical.

And then information, for example, if you give someone who is not a health professional and tell them malaria is transmitted like this, you need to put a mosquito net in your hotel. They appreciate that. Just tell them it is dangerous, and it can kill, how can you prevent it. did you understand?

Interviewees who had engaged directly with communities and local people, spoke about the importance of interpreting body language. They reported that they were able to read and react to the body language displayed by people from other cultures. This was usually used by them to help assess a situation or environment, rather than communicate with the person. However, one interviewee described using mime to impress upon a community the importance of maintaining distance from a dead body during the Ebola response in West Africa. Another described how skills developed during a career in nursing had helped them read the body language of an official with whom she was conducting negotiations.

when I was putting on the PPE I made a point of doing it in front of this crowd [from the village] not round behind the Land Rover so they could see me very carefully put it on a layer of PPE at a time, they could see me spray it, we sprayed our hands down with bleach in front of them all, we got the bleach sprayers out and we sprayed the zip down and sprayed the handle before we opened [the body bag] we probably hammed it up a little bit more than we needed to, to be honest.

Relationship building

Relationship building was an inductive category reported by the interviewees as essential to collaboration and decision-making through consensus. Participants reported that they worked to form bonds with people from other teams, both within and outside of the formal structures and workspaces of the response. Two described proactively inviting staff from external organizations to meetings to share information with them. They also formed multi-organisational teams to carry out tasks.

The interviewees reported building and using a network of contacts so that they had people to vouch for them when they moved into a new area or needed to work with new teams. They fostered this network by meeting outside of the workplace to socialise, gather information and plan in a way that could not be done in a formal open meeting. Participants reached out of the network back to their managers in different locations to get support when needed.

One interviewee described how they included communities into their informal network during the Ebola response. They described how different organizations, who were responsible for different stages of the patient's journey, would communicate with each other about the condition of the patient.

One of the participants reported being asked to represent the community at a meeting with government officials, another that they were part of celebrations when Ebola patients returned to their communities.

Personal control

Personal control was an inductive category which concentrated on managing personal emotions in response to difficult situations. Some participants described being intimidated due to security issues and the culture shock that they experienced when they found themselves in a new country and situation. All mentioned "pressure to succeed" that was both externally and internally generated.

Only one interviewee described being physically tired. Two described events where they had moral questions about the actions they conducted, considered, or were asked to conduct. This moral questioning was tied to a sense of responsibility for the affected population and colleagues. In one case, this questioning arose from conducting actions that deviated from procedural norms or standards. Finally, three subjects referred to the challenge of motivating teams.

The interviewees described different coping mechanisms for stress: most of them derived confidence to act under pressure because they were certain of their technical knowledge and had faith in their equipment. Others reported deriving confidence from their personal values or from the mandate of the organisation with which they were working. Four of the subjects reported seeking support by referring to senior staff within their organization.

The participants also described an attribute which was coded as a sub-category of “mental resilience”. This was described as the ability to be adaptable and to be able to detach oneself from events and to absorb setbacks.

I’ll talk about the pressure on a personal level, the pressure on a personal level was, I wanted to succeed. I also didn’t want [us] to be the last district to still be seeing cases. That was one pressure, I had to work extra hard to ensure cases, are going down, we are moving, we are pushing the team.

In some cases, individuals allowed decisions to be altered to preserve relations with individuals and groups and avoid disrupting the overall goal of the response. This ability to balance longer term interests with immediate concerns was described under the heading of personal control.

I was not happy with the quality of the plan ... but it was it was a decision that I consciously made because not to jeopardise relationships ... knowing that from a diplomatic or interpersonal relationship it's better to be fairly flexible initially ...

The coping mechanisms most referenced were prior experience, social support and confidence in one’s own technical knowledge. There are indications that the networks used by responders provided an element of social support: there was security in sharing the decision, with one respondent indicating that working as part of the group took the pressure out of the decision-making process. Whilst some respondents cited their technical knowledge as a coping mechanism, only one reported training. In this case it was training derived from their time in the military. No reference was made to physical fitness or other common coping strategies.

I made the decision but after consulting with my colleagues. I relied heavily on my experience, but it was useful to have someone to bounce ideas off because I had no concrete idea of what to do. We had to adapt to the circumstances ... I was certain of my actions, but it is interesting to note that I didn't have the ultimate responsibility. That lay with the medical director, I don't know if I would have been so certain if I had had full responsibility. But I felt compelled as someone with experience to do something, not to do so I would have seen as a crime of omission ...

QUALITATIVE SURVEY RESULTS

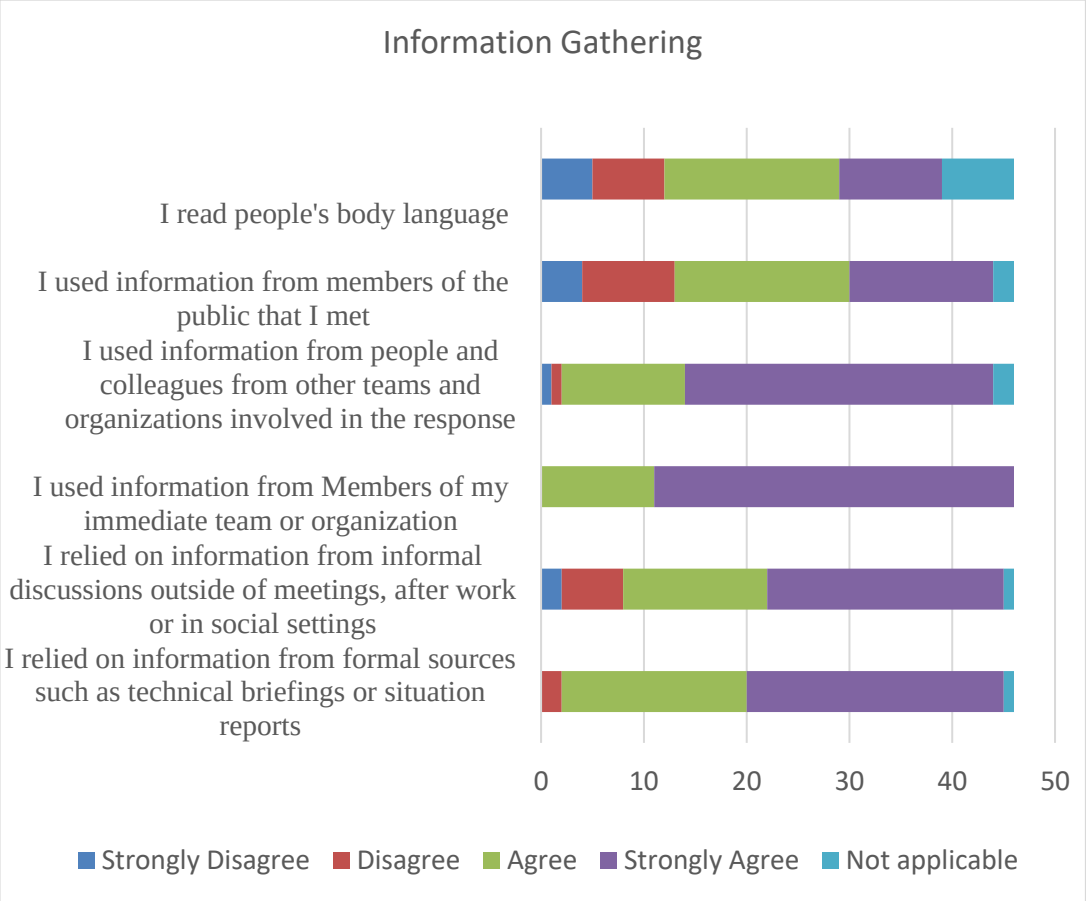
The qualitative survey was used as a way of checking and validating the interview findings with a larger and more diverse audience. The qualitative information from the questionnaire was coded against the categories identified in the interviews.

Gathering Information and Sensemaking:

The term ‘gathering information’ was used instead of ‘sensemaking’ because the pilot indicated that the latter may be open to misinterpretation. The multiple-choice questions were used to examine whether the description of using information from a range of resources from the interviews was replicated across the wider public health workforce. The answers to the multiple-choice questions are shown in Fig 11 (p.111).

The results indicated that participants did rely on a range of information, placing almost as much emphasis upon informal sources of information as formal ones. The participants also reported the need to combine information to form a coherent picture; the ability to triangulate and prioritise information from different sources and the ability to understand events in the context the communities within which you are working. Participants did report the importance of having good personal relationships across teams and agencies and with communities.

Fig 11: Sources of information reported by participants to develop situation awareness



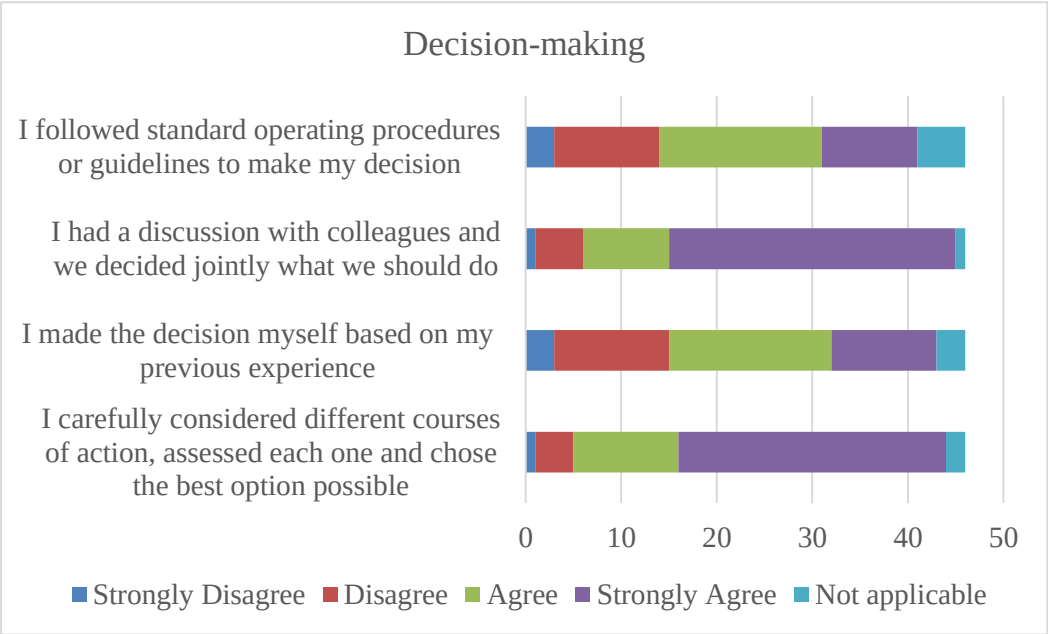
I conducted an analysis of the situation with a colleague who was a senior epidemiologist as they were able to give me an analysis of the outbreak situation. I also worked with colleagues from [another agency] who had been working with communities so that I could understand the concerns of the communities and try and understand the source of the insecurity. We needed to understand why the communities were hostile to response teams and what would happen if we stopped working. I also engaged with the UN peacekeepers who were providing security to take advice from them. So, I was using a combination of qualitative and quantitative data. I then brought this information to colleagues in other agencies and the government to get their perspective on the situation. For the informal information this involved speaking directly to people, especially the communities and NGOs. This was sometimes done in an informal setting for example inviting people for tea. There are sometimes sensitive issues that people can't talk about in public but that they can speak about in private.

I met with every person I could identify in professional settings and communities, I collected advice from essentially field colleagues in all agencies and organization, health care workers, spiritual and political leaders, officials, schoolteacher, patients, families, young and older, survivors and parents of deceased, etc. I listened for two weeks before making formal proposals taking decisions.

Decision-making.

Figure 12 (p.112) shows the methods of decision-making reported by participants. It indicates the importance of joint decision-making and of comparing different options before making a decision. Participants reported that the consideration of different options was often done in two stages: individually balancing information from various sources to develop a strategy which was then put before a wider group for debate and to gain a consensus.

Fig 12: Methods of decision-making reported by participants



Most participants referred to a joint decision-making process that was divided between two modalities. The first was that participants reported using RPD or an analysis of information to make a decision by themselves and then, used communication skills to influence and negotiate with groups to shape and enact a decision. The second was the use of ‘brain-storming’ to develop and deliver a plan jointly. Two of the respondents reported that in their experience there were few single decisions made about how to react to a challenge. Rather, what emerged, was a series of decisions where solutions were adopted and then adapted as they were rolled out to suit circumstances. Participants describing security situations placed emphasis

on ascertaining and assessing the risks associated with their decision. This contrasted with data from the interviews where risk assessment did not feature.

Naturally I am democratic, I rarely take decision alone, even if take it internally, I do some homework to convince others before announcing it. This was the same, except one time which I was forced to take a unilateral decision which I took risk. This later proved to be a good decision as I got feedback from the top managers.

I had worked in this type of environment before and so I knew what had to be done from a public health perspective. I understood the risks of stopping working and this initial thought was backed up by the epi data. However, what I then did was to present this decision to the people I was working with so that we could work through the problem together. In this way we were able to distribute responsibilities when we made the decision

The situations and challenges described by the participants unfolded over days and weeks, rather than minutes and hours, as described in the literature review. These situations were often more complex and ill-defined than those described in the literature review, which in many issues could be resolved with immediate action. The complex nature of tasks in public health response, meant that participants were often dealing with a series of decisions to address a challenge, rather than a single decision.

This is an evolving situation which necessitates many, many decisions all with consequence and careful consideration. They build upon each other. Sometimes I've made decisions myself and other times I've asked for consultation from the group or other stakeholder.

Enacting decisions.

The answers to the multiple-choice questions about how participants enacted decisions reinforced the message that this was a joint process, carried with other parties. The way in which other parties were involved varied depending on the respondent and the situation they were facing.

Figure 13 (p.116) shows the methods of enacting decisions. The data shows the importance of joint working both to allocate resources to tasks and to allocate tasks. However, although a high level of participants saw

themselves as being in charge of allocating tasks, the data suggests that this allocation was done with consent of other members of the group. Most of the participants described the enactment of plans as a continuation of the joint decision-making process. Allocation of tasks took place as part of the discussions that made up the joint decision-making process, or as part of roles that had already been defined within the structure of the response.

The answers to the decision-making questions were compared between the participants who had led multiple teams; those who had worked across multiple teams and those who described themselves as working in a single team. There was no discernible difference in the types of problems faced or the NTS used to address them.

Non-technical skills outside of the decision-making process

In the final part of the questionnaire participants were asked to describe key personal skills required to work in response. The answers were coded using the coding sheet developed during the interview phase. The participants were asked to the describe the personal qualities they felt were needed by people working in emergency response. They were also asked what advice they would give to people who were considering a career in emergency response.

The results of this coding are in Tables 8 and 9 (p.117). The data from the survey was linked to categories developed during the analysis of the interviews. When asked about ‘personal skills’ participants reported skills relating to ‘personal control’ most frequently. ‘Communication’, ‘sensemaking’ and ‘collaboration’ were also reported. Within the ‘personal control’ category participants reported ‘stress management’ as a skill and an inductive code (not mentioned in the interviews) of ‘self-organization’ referring to the ability to manage tasks and time. The third group was either reported as ‘communication’ (non-specific), ‘listening’ and ‘persuasion’. Skills around receiving information were reported as ‘humility’ the ability to ‘listen’. The theme that brings all of these codes together is an emphasis on

situation awareness. This was a holistic and contextual situation awareness aided by “listening” to communities and partner organisations and “humility” to learn from stakeholders and colleagues.

Participants were also asked what advice they would give to people who were considering working in emergency response. This question was designed to help the participants think objectively about the NTS used by emergency responders here the answers were more introspective. “Personal control” was still the most highly rated of the coded answers, however answers coded as “Leadership” were the second most highly ranked followed by “communication”.

Fig 13. Approaches to enacting decisions reported by participants

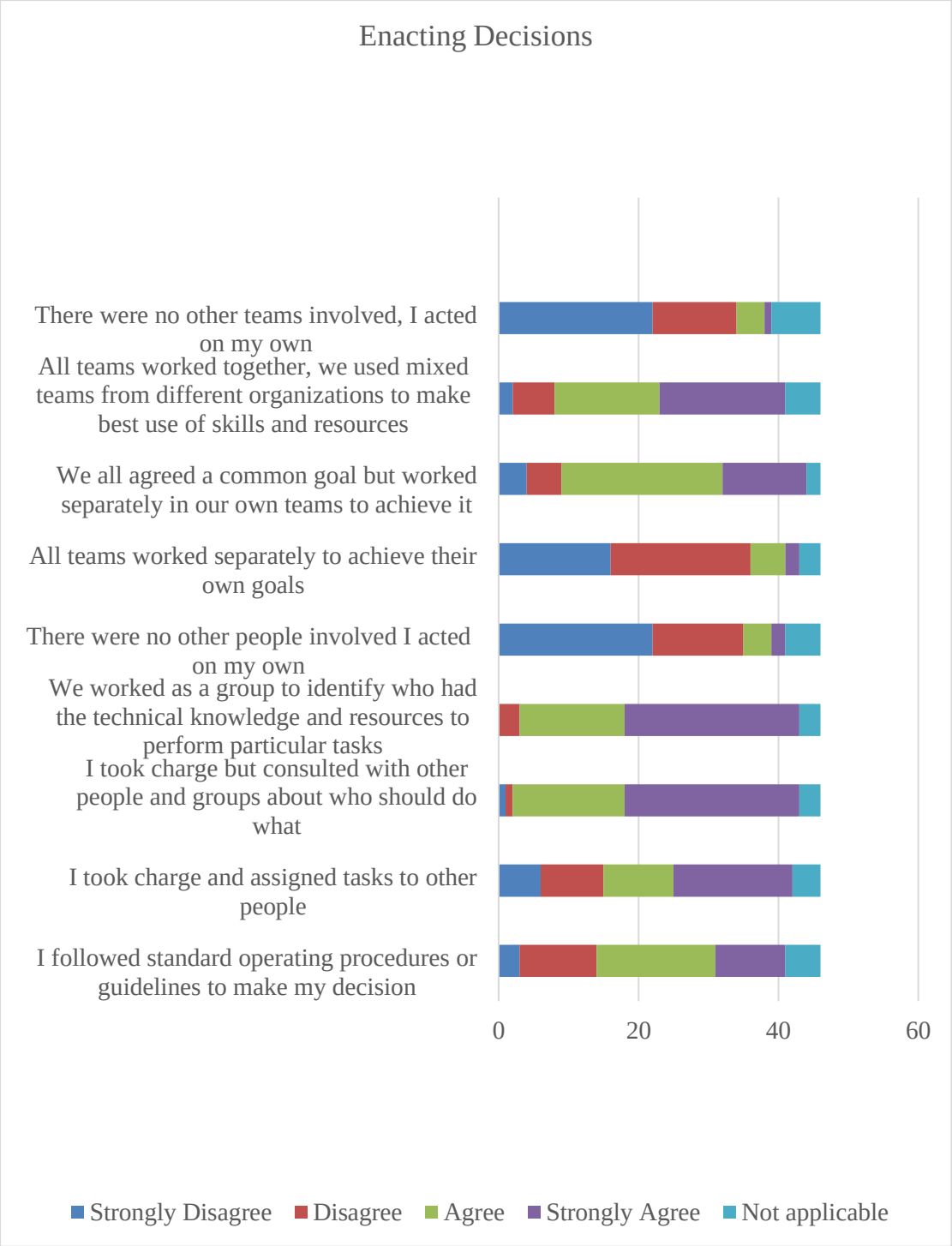


Table 8: Personal qualities reported by qualitative survey participants ranked by number of mentions

1	Personal control (34)	Stress management – 10 Humility – 6 Open mindedness – 5 Self-organization – 4 Perseverance – 3 Courage – 2 Patience – 2 Setting an example – 2
2	Communication (22)	Listen – 10 Communication (unspecified) 7 Persuade – 5
3	Situation awareness (12)	Situation Awareness (unspecified) - 7 Cultural awareness – 4 Assimilate information – 1
4	Coordination (7)	Collaboration – 7
5	Relationship building (4)	Building Trust – 3 Building relationships (unspecified) – 1
6	Decision-making (2)	Decision-making (unspecified) – 2
7	Leadership (2)	Initiative – 1 Delegation – 1

Table 9: Advice to people considering working in emergency response reported by qualitative survey participants ranked by number of mentions

1	Personal control (20)	Open mindedness – 5 Stress management – 4 Humility – 3 Perseverance – 3 Patience – 3 Self-awareness – 1 Ask advice – 1
2	Leadership (10)	Work to a distal goal – 4 Adaptability – 4 Take risks – 1 Initiative – 1
3	Communication (8)	Listen – 5 Communication (unspecified) 1 Negotiate - 1 Consult – 1
4	Coordination (7)	Collaboration - 7
5	Situation awareness (4)	Situation Awareness (unspecified) – 4
6	Relationship building (2)	Build networks – 1 Build consensus – 1

SECTION B - INTERPRETATION OF THE RESULTS

The challenges and skills most discussed by the participants were those around situational awareness, personal control, relationship building and communication. Coordination and leadership were often by-products of successful relationship building. Teamwork in fixed teams was seldom discussed. The participants described the work environment, the impact it had on them as well as relationships within and between organizations and individuals. Two categories not identified in the literature review were identified in the interviews: ‘personal control’ and ‘relationship building’.

The Response Environment

The participants provided a detailed account of the response environment which:

- Included national governments, international and national organisations and communities.
- Comprised ‘formal’ and ‘informal’ response systems. ‘Formal’ systems were mostly described as formal meetings and formal linkages between organizations and government. Formal meetings brought together multiple stakeholders. Formal linkages were those already established as part of the response structure.
- The ‘informal’ response systems consisted of meetings and discussions in the ‘side-lines’ of the response. Some took place immediately before and after ‘formal’ meetings others in a more social context. This ‘informal system’ was used to gather contextual information and to coordinate with other agencies in a way that may have not been possible through ‘formal’ channels.
- Within the ‘formal’ and ‘informal’ response systems the responders worked in *ad hoc* teams. Some of these teams were created through the ‘formal response’ system: for example, participants described

reaching out to contacts through established channels; others comprised groups that had little or no previous relationship.

- The networks from which these *ad hoc* teams were generated were either established as part of the ‘formal’ response mechanism or were generated by the participants themselves informally. Participants built and maintained networks through establishing relationships and trust. This enhanced collaboration between them.
- Both the ‘formal’ and ‘informal’ response systems existed within a larger response environment upon which they could act but which in turn acted upon them. For example, governments, communities, other agencies or individuals could exert pressure or deny access as well as assisting with the response. This environment was fluid; changing as the response progressed.

Sensemaking

Most of the data from the interviews was about information collection and sharing. Participants built up a detailed picture of both the broader context of the response and response activities, through a mixture of: ‘formal’ and ‘informal’ networks, information from communities and their own experience.

‘Formal’ and ‘informal’ networks were used for gathering information. ‘Formal’ information was regular and presented in ‘formal’ meetings and documents. It was augmented by ‘informal’ information which participants used to gather “the real opinions” of their colleagues. Informal discussions allowed for a more direct exchange of information to happen, and agreements to be made. Participants also gathered and used information from local people to “connect with the reality” on the ground.

Gathering information and understanding the wider response context was also important to understand how people from other organizations and stakeholder groups worked. This helped responders collaborate more

effectively because they could recognise the roles and requirements of their colleagues.

Decision-making

In the process of decision-making (selecting a strategy to enact) four elements standout from the data.

- There was no commonly used planning or decision-making process reported across the participants. Although some of the questionnaire respondents described analysing both ‘formal’ and ‘informal’ data, there was no recognised or established process for conducting this analysis.
- Decision-making was, with notable exceptions, a group process which happened in two ways. The first was where an individual developed a strategy which was then discussed and amended by the group until consensus was reached. The second was where the group generated the strategy which was then discussed until consensus was reached.
- The notable exceptions to these methods of decision-making were where the participants had felt that they ‘had no choice’ (so there was only one thing they could have done) and when there was an established process in place to deal with the challenge.
- The decisions described by the participants took place over a prolonged period (ranging from minutes to days). There were no examples of decisions made in an acute environment i.e., within a few seconds.

Leadership

The leadership behaviours described by the participants focussed on the abilities to influence, bring together and collaborate with other stakeholders in an *ad hoc* team. The task for a leader therefore centred around the following.

- Gathering and analysing information from a range of sources to build a holistic and coherent picture of the response environment including the “reality on the ground” and the roles, responsibilities and areas of concern for other stakeholders.
- Building and maintaining relationships with individuals to enhance the working of their own team or to bring together *ad hoc* teams to share information and collaborate.
- Identifying individuals or networks that could be activated to assist with efforts in the response.
- Advocating for actions across teams within the response structure or as part of an *ad hoc* team brought together to perform a particular task.
- Working as part of a group to influence collaboration in both decision-making and enacting decisions.
- Adapting their experience and knowledge to present solutions to challenges to ‘set direction’.

Collaboration and Teamwork

All the participants reported working jointly with colleagues from their own and other organisations. None of the participants mentioned formal response systems that are commonly associated with health emergency response: the IMS and Cluster Coordination or of work within an emergency operations centre (EOC). Although they did refer to ‘formal meetings’.

Collaboration was underpinned by successful relationship building (see below p.124) and happened in three ways:

- Responders pulled together *ad hoc* teams using ‘informal’ networks to identify and recruit team members to respond to a particular need.
- Responders used ‘formal’ established networks to perform urgent or foreseen tasks. In these cases, the constituent parts of the network that formed already existed within the response system but were directed to address a particular need.
- Individuals worked with colleagues in ‘informal’ networks to by-pass potential blockages in the response system and adapt established processes or guidelines to meet a particular challenge.

Collaboration played an important role in developing and maintaining trust between different groups and organisations. The emphasis was not just on the formation of these networks but also on maintaining them.

Teamwork was not widely discussed by the participants. The interview data indicated the existence of two types of team: first was an *ad hoc* team as discussed above. The second type of team might be described as ‘established’ where teams were created as formed entities by an individual organisation and had in them established roles. However, even established teams were multi-disciplinary comprising people from different organisations with particular specialisms. Team leads adopted one of the collaborative methods of working, being aware of the interests of the other people in the team who may represent different organisations.

The participants did not report any formal method of collaborating within or running teams. However, tasking different agencies based on their established roles, frequent information sharing, negotiation and trust building were common features. Collaboration therefore relied on advocacy skills and diplomacy.

Communication

The participants primarily described conversations and meetings they had with stakeholders. There were few mentions of formal, systemic or written communications such as situation reports or briefings. Rather, participants described using individual spoken communication. Communications was used to:

- Gather information about the environment and context using both ‘formal’ and ‘informal’ sources. They listened to members of the public and colleagues in an informal setting, to build a more detailed picture about the context of the response than they could gather from official briefings and information products alone.
- Share information with stakeholders and groups to maintain situation awareness and support decision-making.
- Persuade others to adopt a course of action. This advocacy was often done outside of formal settings to avoid public confrontation and formal communication in the setting of meeting for example was often preceded or followed up by more candid one-to-one conversations.
- Build and maintain trust. Participants described bringing individuals or groups into meetings as the first step in building a relationship that could lead to taking joint decisions and working together.

Relationship-building

Participants used ‘relationship building’; to develop and work within networks both inside and outside of formal response structures. Relationship building was a key activity for many of the participants and formed the basis of inter- and intra-organisational and team working. Personal relationships and the honest exchange of information and views outside of the formal response structure were key to:

- Developing links between stakeholder organisations by sharing information in ‘informal’ setting and by inviting stakeholders into one’s own team meeting to share information.
- Building trust which helped individuals representing different organisations to collaborate to take and implement decisions.
- Establishing *ad hoc* teams and networks as well being used to maintain and activate formal networks. This relationship building extended beyond response organisations to communities themselves.

Personal control

An inductive category identified by the interviewees was ‘personal control’. In the literature on NTS this function of personal skills was restricted to dealing with stress and fatigue. The data gathered in this study expanded this category and focussed on a ‘personal resilience’ which entailed an emotional robustness, acting in line with ethical principles, being adaptable and to be able to detach oneself from events and to absorb setbacks and frustration when it was perceived that other parties were ‘blocking’ work efforts. The data from the interviews included descriptions of situations that gave rise to negative emotional states and how these situations were addressed. Coping mechanisms were:

- Having awareness of one's own capabilities and weaknesses. Most of the subjects derived confidence to act under pressure because they were certain of their technical knowledge and had faith in their equipment. The other factor was a pragmatism borne out of experience of pressure experienced in previous deployments or roles.
- Having moral certainty based on their own moral upbringing or from the mandate of the organisation they represented. Moral certainty supported an ability to remain calm. This was reported particularly when participants became angry or frustrated with others in the response who they perceived as blocking or diluting response efforts. They reported that this calm was achieved by being able to keep in mind the longer-term efforts of the response, which meant that they needed to accept some dilution of the actions they wanted to take or of their own behaviour guidelines to achieve a longer-term aim.
- Support from peers and senior staff, participants gained a sense of security from acting as part of a group and 'sharing responsibility' for actions. In some cases, this support, or reassurance was gained by referring to senior staff within their organization.

SUMMARY – RESULTS

The emergency response environment described by the study participants is a complex environment. There are multiple actors who generally work collaboratively, but who at times work separately and even in competition. These actors include communities who play a pivotal role not only as affected populations but as active participants in the response as well as other agencies. The environment contains the response structures which sit within a broader series of 'formal' and 'informal' networks that support information sharing and collaboration between organizations. These networks are created and leveraged to create *ad hoc* teams which share information and jointly perform tasks. The environment changes constantly as the interests of the actors, and the tasks that need to be performed change.

The NTS reported by the participants have considerable overlap. The foundational skills used by the participants were those of relationship-building and communication. These skills were used to build, develop and maintain networks and working relationships that allowed for effective collaboration. Working relationships were developed through building trust, created through information sharing, listening and joint working in sensemaking, decision-making and enacting decisions. Leadership was exercised through advocacy or creating the conditions for individuals and groups to work together to problem solve and act. This collaboration was aided considerably by having a shared knowledge of each organisations' roles and interests.

Participants reported that relationship building also helped them to cope with the challenges of working in the response environment. Support from other people, certainty in their mandate and in their technical knowledge and skills helped participants overcome emotional challenges. In some cases, this was reinforced by experience that helped them to adapt their knowledge and skills as new challenges arose.

CHAPTER 5: DISCUSSION

This chapter will further develop analysis of the results, comparing them with information and theory drawn from the literature review and other studies identified while conducting the research (Strauss and Corbin 1998, Maxwell 2013).

This chapter has three sections:

- A. describes the response environment as an MTS
- B. explains the use of NTS in the response environment
- C. details the contributions of this study and implications for practice

CHAPTER 5 - SECTION A: The response environment as a MTS

The response environment described by the participants shared characteristics with the MTS where multiple teams from different organizations work towards a common distal goal (Mathieu, Marks and Zaccaro 2001, Zaccaro et al 2012). This complex environment included international organizations, national and local government, NGOs, private businesses, and local communities working side by side each with their own proximal goal and culture (Campbell and Knox-Clarke 2018, Bjerneld et al 2009). This environment could be “highly atomized” (Curnin, Owen and Trist 2014). There were few examples of formed teams. Most teams could be described as *ad hoc,* comprising people from different organisations brought together to perform a particular task (Brown et al 2021). And, whilst teams representing different stakeholders worked together to contribute to the response, there were also examples of them protecting their own interests (Knox-Clarke 2013).

The challenges of working in this environment also reflected those in the literature. Responders had to work with a wide range of individuals and groups, many of which were unfamiliar to them; (CARE 2005, Global Public Policy Institute 2010, UNDP 2016) having a different level of autonomy, authority, and role; operating to different standards (Owen and Hayes 2014); and working under pressure (McLennan et al 2014) in rapidly changing

environments to which they had to adapt (Comfort and Kapacu 2006, Rees-Gildea and Moles 2012).

Responders and the systems in which they work are an integral part of the response environment

All the participants described working alongside other teams or organisations from UN agencies, national or local government, NGOs and communities. Communities have been included here because, although not a formal organisation, they have been shown repeatedly to be an integral and active part of the response efforts (Rees-Gildea and Moles 2012, Katz, Nguyen, Lacerda et al 2012, Humanitarian Leadership Academy 2013, Ebola Gbalo Research Group 2019). This description of the response environment differs from the environments described in the literature reviews where the teams or organisations were seen in contrast to the environment or systems within which they were acting.

The response environment evolves and changes as the response progresses

Multiteam systems are temporal and changing; they acquire and shed members as the response evolves (Zaccaro, Marks and DeChurch 2012). This interaction can lead to unpredictability in the environment as the actions of one team impact on another creating a fluidity. The participants described a situation that was constantly changing as response activities were enacted. There is also a marked differentiation in time between the situations described in the literature review and those described in the data. Most of the studies examined as part of the literature review examined acute events whereas situations and challenges described by the participants unfolded over days and weeks rather than minutes and hours. These situations were often more complex and ill-defined than those described in the literature review which in many cases could be resolved with immediate action. The complex nature of tasks in public health response meant that participants were often dealing with a series of decisions to address evolving challenges.

The MTS contains networks which develop, evolve and may disperse

The complexity of the environment and tasks faced by participants, meant that they needed to rely on support from networks, to bring together expertise and resources to address them. A network is “a multi-organizational structure for solving problems that cannot be achieved or achieved with ease by single organizations” (p.2) (Du, Feng, Tang et al 2021).

Poole and Contractor (2012) describe MTS as being composed of networks and teams that interact with the environment and each other. Network theory presents three levels of network formation: at an individual level where groups of individuals are drawn together for mutual support or gain; at a network level where a network forms to conduct collective action; and auto-generative networks, seen in mature networks where the network creates off-shoots, splits and adapts according to growing needs and environmental factors such as geography (Poole and Contractor 2012).

The participants described networks operating within and alongside the response system which consisted of individuals working across organisational boundaries in joint teams, sharing information and resources to achieve focused aims. Contractor, Wasserman and Faus (2006) identify five goals - which reflect those reported by the participants - commonly found in these networks: searching for resources or information; sharing of resources or information; mobilising to work towards a collective action; providing social support and swarming to respond to an urgent situation.

The participants used networks to:

- Access to geographic areas, areas of work, resources, technical knowledge, or contacts.
- Access psychological support from different individuals and organisations in the decision-making role.
- Share information from a variety of sources to build situational awareness.

Du et al (2021) identify three types of networks existing in an emergency response environment these are: Planned; Emergent and Mixed (which combines elements of both planned and mixed). The evidence from this research matches these descriptions.

- A planned network is already active as part of the wider response system and comprises a group of teams working to achieve a particular task. These networks comprised groups that were already working together and used existing processes and procedures to respond to an event.
- Emergent networks are made by gathering differing teams together to enhance the response. Participants explained how they brought together groups of different actors to perform distinct tasks.
- Mixed networks consist of contacts between different teams who have already established relationships and are then activated in response to an acute need or created in response to a complex problem. For example: one participant described having to activate a network of contacts to rapidly collect and test samples. In this case the network existed within the system, the skill of the participant was in identifying the requirement and using processes and contacts to activate that network.

Although Du et al. (2021) concentrate their analysis on ‘formal’ networks participants in this research also emphasised the role of ‘informal’ networks, generated by individuals. These complement organizational structures and assist the exchange of information, support and collaboration outside of ‘formal’ settings. These ‘informal’ networks and ‘informal information sharing’ are explored by Kim, Andrew and Young (2017) and Soujaa, Nukpezah and Benevides (2021) in the public health context in Korea and the US respectively. They argue that informal networks bolster existing response systems that cannot cope for all eventualities and can hamper the

adaptability required by individual responders. The findings from this study support their argument.

Individuals also reported that acting alongside colleagues in ‘informal’ networks helped them by-pass potential blockages in the response system and provided them with a range of expertise and the confidence to adapt established processes or guidelines to meet challenges. Building these ‘informal’ networks by sharing information and bringing different groups together helped establish trust and paved the way for more effective joint decision-making and working. ‘Informal’ networks also provided a source of detailed information and opinion, used to help shape situational awareness and support decisions.

The interviewees provided most of the examples of “informal” networks. There were fewer descriptions of “informal” networks and the use of “informal” information in the qualitative survey data. The qualitative survey participants described making use of information from a range of sources, that can predominantly be described as “formal”. These included epidemiological data, advice from existing response teams (for example security) and information gathered from communities through formal surveys or community engagement activities. Both the qualitative survey respondents and interviewees described the importance of the support from colleagues in making and carrying out decisions.

To work effectively in the MTS responders had to:

- Work within networks.
- Adapt their ways of working to understand the broader context of the response and the role of response actors.
- Collaborate with stakeholders in a loosely coordinated environment and
- Address complex challenges over a protracted time-period.

CHAPTER 5 – SECTION B: The NTS used in the MTS response environment

The categories identified in the data analysis were compared with the list of core NTS at Table 1 (p.22). The key differences between the core NTS and those identified in this study are the inclusion of the social NTS of 'relationship building'; combining 'collaboration and teamwork'; and grouping 'coping with stress' and 'coping with fatigue' into one NTS labelled 'personal control'. Table 10 (p.132) compares the list of NTS from Flin (2008) in Table 1 (p. 20) with the categories based on the coding from the data analysis.

Table 10: A comparison of the non-technical skills listed by Flin (2008) and identified during coding of interviews and questionnaires in this study

Skill identified by Flin	Skills identified during this study
Situation Awareness	Sensemaking
Decision-making	Decision-making
Communication	Leadership
Team working	Collaboration and Teamwork
Leadership	Communication
Managing Stress	Relationship Building
Coping with fatigue	Personal Control

Sensemaking

Sensemaking is the process of collecting and analysing data and information to develop situation awareness (Endsley and Robertson 2000, Klein, Wiggins and Dominguez 2010). This is a key skill in emergencies where teams need to react to changes in the environment (Burke, Stagl and Salas. 2006). In a complex environment, the rapid transfer and collation of information is a key attribute (Andreassen, Borch and Sydnes 2020). Sensemaking, can be done as an individual but in an emergency response, is more often done as a team or group. Situation awareness in teams, has been defined as at least a partial, shared understanding of the situation, at a given point in time (Sulistyawati et al 2009). The challenge of shared situation awareness, is that different people or groups will understand information differently, according to their own frame of reference. The degree to which people have a shared understanding is difficult to measure, although one way of establishing shared understanding is by evaluating the

amount of consensus between individuals and groups (Yim and Seong 2016).

In MTS responders use Joint Sensemaking to develop understanding of the broad response context

Most of the studies in the literature review based their understanding of sensemaking and situation awareness on the model put forward by Endsley (1995). This adopts the perspective of an individual and sees situation awareness as a precursor to decision-making. It comprises three steps: perception of data and the elements of the environment; comprehension of the meaning and significance of the situation; and projection of future states and events. For elements of the environment Endsley lists: system capability; interface design, stress and workload; complexity and automation. The evidence from this study suggests that a key element of situation awareness and sensemaking should also include the role and motivations of other actors within the complex system. Although most studies in situation awareness adopt the individual viewpoint put forward by Endsley (O'Brien, Read and Salmon, 2020), Stanton et al (2006) and Salas (1995) have put forward theories on Distributed Situation Awareness and Situation Awareness in teams respectively. These considered the amalgamation of information from a variety of sources. Luokkalla and Viranthaus (2020) argue the importance of the broader context and a narrative approach to situation awareness. The evidence from this study supports this idea of a narrative approach and indicates that in complex systems a deeper understanding of the situation is required which seeks to understand not only the context of the response environment but the objectives and interests of the actors in it (Tong et al 2018, Sohrabizadeh et al 2021).

Responders collected and analysed formal and informal information to develop situation awareness

Responders used a mixture of information sources to gain an overview of the situation. They used ‘formal’ information sources, data and reports but emphasised the need to back this up with more detailed ‘informal’ information from direct engagement with individuals and communities.

Klein, Wiggins and Dominguez (2010) identified three modes of sensemaking: ‘hierarchical’ where a team leader dictates which information is to be gathered and by which functions; ‘collaborative’ where emergency responders hold regular briefings and ‘opportunistic’ where elements within the team identify a key piece of new information and share it. All three of these elements were described in the interviews and questionnaires. However, there were indications that information was also being passed through an “informal network” of private contacts, that operated alongside the response system. This “informal network”, in some cases, alerted participants to potential emergencies and was certainly used to check understanding of the situation. Networks existing within systems, play a key role in speeding up the dissemination of information, that could be slowed by being passed through formal bureaucratic channels (Katz et al 2012, Uitdewiligen and Waller 2012)

There were four broad types of information that the participants were using to make sense of the situation:

1. Formal information and data generated through situation reports was used to help provide an overall view of the emergency and response efforts.
2. Contextual Information helped understanding of the broader context of the country and affected communities. This information was gathered from formal reports the media and informal networks and was used to test decisions and hypotheses or simply to gain reassurance.

3. Detailed information gathered through ‘formal’ and ‘informal’ sources provided information about the “reality on the ground” that helped respondents shape decisions and take action.
4. Individual information gathered from the individuals own training or experience and applied to a challenge. This forms the basis of recognition-primed decision making (RPD) described on p.45.

All respondents placed a great deal of emphasis on understanding the roles and needs of other organisations in the response and communities as well as the wider context in which the response was happening. This was done by gathering information from a wide range of sources and using their own knowledge and previous experience. This recognition primed awareness is discussed under decision-making and has been observed in emergency responders (Weick 1988, Endsley 1998, Klein et al 2010) where people map their memories of previous experience or learning to the current situation to understand it. Information gathering was a continual process and relied on the existence of both ‘formal’ and ‘informal’ information networks, the latter were built by the respondents themselves.

After gathering information, the respondents described the need to assess and prioritise information. This process was either undertaken jointly or as an individual. Even where the participants described RPD, they also described checking their knowledge against available data. They did not rely on RPD alone. The results also indicate that respondents were using different types of information to build different levels of understanding.

The final element of sense-making - predicting future states - was not reported. As will be discussed under decision-making, little explicit reference was made to considering alternative courses of action, (at which point participants would have examined possible future states) at an individual level. Although, it is possible that this was a function performed by the group as part of joint decision-making.

Finally, the evidence from this study challenges the assertion that a more centralised network provides higher quality of information and information sharing. Kim, Andrew and Young (2017) argue that information from the smaller organisations and individuals at the edge of networks (i.e., those least connected to organisations at the centre) for example local NGOs, communities and individuals is less reliable than information held at the centre of the network. The evidence from this study disputes this. Participants reported that elements at the edge of the network provided essential contextual information against which responders could measure the 'formal' information they gathered from organisations closer to the centre.

Joint Sensemaking was used by the responders to develop trust and work within networks

Joint sensemaking and sharing information was a key method by which respondents developed trust and built networks.The participants reported that they would brief other key decision-makers and superiors on their understanding of the situation. This was partly an information sharing exercise, but it was also reported as a way of overcoming the tendency of different teams to apply their own viewpoint and context to information. Different teams within an organisation or structure can bring with them distinct perspectives which means that they can view information in a different way and apply different values to it (Grant 1996). They tend to represent a problem in accordance with the knowledge they hold and what they view as desirable (Cronin and Weingart 2007). This difference between viewpoints or understanding led to what some of the participants referred to as 'silo working'. Part of the role of communication (normally outside of formal meetings) was to present the argument for the inclusion of tranches of data into the response plan.

Decision-making

Most of the studies examining decision-making identified in the literature review focussed on the process of individual decision-making, and decision-making based around single events normally in an acute setting. The study highlighted key factors of decision-making in MTS.

In MTS decision-making is a group activity

There is little research into the processes used for decision-making in MTS (Waring, Moran and Page 2020). However, there are studies examining the dynamics of group decision-making in emergencies and humanitarian context. Group decision making brings together a range of experts to make complex decisions (Liang, Teng, Sun 2020), and in emergencies can ensure higher quality responses and increased likelihood of enacting the decision, by combining different character types in the decision-making process (Levy and Taji 2007, Wang, Wang and Martinez 2017, Wilkinson, Cohen-Hatton and Honey 2021). Group decision-making is also necessary because emergency decisions tend be complex and so require input from a variety of experts. Although most of the literature on decision-making focusses on individual decisions this is not what happens in reality (Wang, Wang and Martinez 2017). In humanitarian settings, particularly in the Cluster system, group decision-making is very common (Baharmand, Comes and Lauras 2020) and in field conditions is a social process (ALNAP 2016, Comes 2016). The respondents in this study echoed these assertions: working as a group was an essential part of the decision-making process. It served to build trust, gather a variety of views against which to test an analysis of the data and provide expert input.

The literature review identified the role of naturalistic decision-making (NDM) where the emphasis is on moving situations forward in emergencies (Sinclair et al 2012, Lipschitz et al 2001, Klein et al 2010). The four modes of NDM identified by Crichton, Flin and McGeorge (2005) shown in Table 11 (p.138)

will be used to structure the discussion around the decision-making category results.

Table 11: The four modes of Naturalistic Decision-making (NDM) Crichton, Flin and McGeorge (2005).

	Mode
1.	Recognition-primed decision-making (RPD) where an individual compares a current situation with past experiences and takes action based on that;
2	Rule based or procedure-based where practitioners relate the situation to an "operating procedure" similar to a checklist of activities
3	Analytical decision-making: based on an analysis of the situation the individual develops a number of possible courses of action to respond to the situation
4	Creative decision-making is used when there is no precedent, or the situation is so unexpected that the decision-maker cannot draw on learned models or previous experience.

The data from the interviews suggested that a fifth form of decision-making - joint decision-making or decision-making by consensus - was the main process by which actions were selected in the multiteam environment.

Participants used group consensus to analyse and ratify decisions

Group, or joint decision-making was identified in the literature review. Joint decision-making has been defined as the process by which commanders gather to combine information and make a decision together (JESIP). It is important in an emergency context where collaboration between teams is essential (Kapacu and Garayev 2011). Where people are not able to gather physically, staff in different locations take decisions to act towards a common goal using a shared mental model based on communication (Rafferty et al 2010, Smith and Dowell 2000).

However, the descriptions of the decision-making process by the participants in this study differed from these two models. Firstly, it was not only ‘commanders’ who were involved in the decision-making process. Secondly, the description of distributed decision-making does not account for the fact that teams in MTS may be *ad hoc* and therefore whilst individuals would

share a distal goal they are likely to bring to the decision-making process differing contexts and organisational goals.

The form of joint decision-making most described by the participants, can be best described as negotiated decision-making. Participants made decisions and then discussed them with the group until agreement and consensus was reached. This method of decision-making was not reflected in the literature review. However, the idea of negotiation as a decision-making process has been studied in political science, where it is described as the process of two or more parties combining their conflicting points of view into a single decision (this is described in more detail below) (Zartman 1977).

No formal decision-making methodology was followed

The methodology for this study was based on the steps in the SAFE-T model (van den Heuvel et al 2012)[9]:. Participants reported following a simplified process entailing gathering information, formulation, and enactment of the plan. There was scant evidence of formulating a plan by considering alternative courses of action (Marks et al. 2001). Although participants did describe triangulating information during sensemaking. It is also possible that the discussions within groups to arrive at a final decision contained elements of consideration of alternatives. This possibility reflects the findings of Wilkinson, Cohen-Hatton and Honey (2019) who observed that groups working in multi-agency simulation exercises rarely considered alternative courses of action whilst making decisions. Instead, they went from the sensemaking stage to action and then re-evaluated. The same behaviour has been identified in individual decision-makers operating in extreme circumstances (Cohen-Hatton, Butter and Honey 2015, Klein, 1993, 1997, 2003, 2008 Waring, Moran and Page 2020).

The joint decision-making observed in this research consisted of two types. The first can be described as a negotiated joint decision-making where a

[9] *Gathering information to develop Situation Awareness, Formulate a plan by considering alternatives, Execution of the plan and Team learning*

decision was made by an individual and then negotiated with other actors to a common position acceptable to all parties. Participants reported making a decision either based on RPD supported by an analysis of the data or an analysis of the data alone. They then briefed other individuals or the group on their decision and:

- used the group to affirm and validate their original decision or
- persuaded the group that this was the correct course of action or
- entered a process of negotiation with the other parties where the decision was altered until it was acceptable to all involved (Zartman 1977).

The common thinking behind advocating for group decision-making in the humanitarian context, is that it improves decisions because they are based on a broader knowledge base (Kruke and Olsen 2012). However, it is unclear from this study whether this is in fact the case. Where respondents described using a negotiated decision-making there were times when the group simply validated the original decision.

The second mode of joint decision-making was a decision made jointly through group discussion, to analyse a problem and present a potential solution. This differed from the description above in that the opinions of the group were sought to:

- gather additional information and / or
- identify and enact a decision.

Where participants made individual decisions, these were split between RPD, rule or procedure based and analytical decision-making. Most often it was RPD or rule-based, supported by an analysis of available information, including information gathered by partners, as part of a subsequent consultation. Where the participants described using rules-based decision

making, they did not report having discussed this with the group or conducting an analysis. The decision was simply enacted.

The reasons for the difference in decision-making style are not clear from the data. It could be related to the type of problem faced at the time. Certainly, there is evidence of simple and managerial problems being addressed with an individual decision followed by coordination to enact the solution; whereas more complex decisions were proceeded by a brain-storming session to gather information and share opinions about potential solutions

It is also unclear whether this process of joint decision-making delayed making critical decisions. Group decision-making relying on consensus, can be slow (Comes, Heit, Wijngaards et al 2011). In extreme circumstances there can be a tendency to decision-inertia, where individuals or teams are trapped into continually gathering and assessing information to avoid making decisions (Alison et al 2015, Power and Alison 2018). In cases where there is limited understanding between agencies of each other's roles, linear discussions are interrupted, and decisions delayed (Waring et al 2020). However, these descriptions of continually gathering and assessing information or interrupting discussion does not seem to be the case in this study. Instead, we are presented with a picture like that described by Wilkinson, Cohen-Hatton and Honey (2019) where the complex nature of the environment means that every decision has a follow-on task necessitating further rounds of information gathering and decision-making (Andreassen, Borch and Sydnes 2020).

A criticism of group decision-making in formal systems such as the IMS and Cluster System is that they increase reliance on 'centralised' information and ignore 'peripheral' information which may be key to the decisions (Kruke and Olsen 2012, ALNAP 2016). However, as discussed above, this does not seem to true in the cases reported by participants in this study, who reported using detailed information from individuals and communities to inform their decision-making.

Finally, across the literature on decision-making there is an assumption that decision-making is a logical and objective process (ALNAP 2016). However, the evidence from this study suggests that in some situations, there was a need to balance the longer-term interests of the response, with making a subjectively ‘best’ decision. In some cases, individuals allowed decisions to be altered to encourage the group to support the general direction of a decision, or indeed to preserve relations with individuals and groups, and avoid disrupting the overall goal of the response.

Leadership

Leadership behaviours rely on, and overlap with, many of the other NTS. Much of the description of how the participants demonstrated their leadership is in the paragraphs dealing with collaboration, communication and relationship building. Here the key aspects of leadership in relation to the literature review are outlined.

Yukl, Gordon and Taber (2002) define leadership as the process of influencing others to understand what is to be done and how to do it. They identify three elements of leadership that formed the basis of the deductive coding for the study: (1) Task behaviours: planning short term activities, clarifying tasks and monitoring operations and performance (2) Relations behaviour: providing support and recognition, developing and empowering staff, consulting (3) Change behaviour: proposing initiatives and promoting changes. Rydenfal et al (2015) provide a more detailed list of nine leadership activities: initiating activities, maintaining routine, managing patients, supporting staff, management of equipment, getting help

Although many of the behaviours listed above are recognisable in the data from this study, there are differences in emphasis when looking at leadership in the MTS context. The participants placed a great emphasis on their role in initiating change;. their role in relationship building was very pronounced to the extent that it has been identified as its own NTS in this study; the role of

the leader in planning and monitoring tasks was rarely discussed; and leadership was a shared process with different elements of the group exercising leadership at different times (Bienefeld and Grote 2014, Rydenfalt et al 2015,).

These differences may be attributed both to the nature of the response environment and ways of working. MTS present individuals with a complex, changing, structure of loosely affiliated units supplemented by networks. Within these networks teams can work together but also against each other as they perceive problems and potential solutions differently (Waring, Moran and Page 2020). Leadership is “as much influenced by an individual’s effectiveness in working in networks as it is by their narrower hierarchical parameters” Kapacu and van Wart (2008) (p.714).

In the MTS public health staff were often working in *ad hoc* teams or networks comprising individuals representing different stakeholders. These multi-disciplinary teams are particularly effective in complex environments where the situation is unclear, or keeps changing, because they bring to bear a range of skill sets both for interpreting the environment and addressing problems (Zajac et al 2014). Participants were very often not in a position of authority over others in the group in which they were working. They therefore placed emphasis on building and maintaining relationships and collaboration. Collaboration requires consensus for multiple leaders to work together, as one leader will not control all the resources. Consensus also requires a sense of membership (Uhr 2017). This contrasts sharply with the functional team and leadership roles described by Salas and Rosen (2009) and Yukl, Gordon and Taber (2002) that were used as the basis for the interview and qualitative survey questions.

Building consensus and creating a sense of membership referred to by Uhr (2017) was a key leadership role in the MTS. There was an absence of a single clear command structure and indeed some of the actors - such as communities or organizations which fiercely protect their independence – stood outside of any command system, whilst remaining an integral part of

the MTS. Among the actors inside the formal response structure, seniority and the ability to exert authority over other parties, remained a negotiated construct (Friedrich, Vessey, Schuelke et al. 2009). To counter this, the participants actively engaged in ‘relationship building’, by including other stakeholders into their sensemaking, decision-making and response activities both to assist with delivery, and to recognise and meet the needs and interests of parties in their networks.

Responders used relationship building and communication skills to build and maintain teams and networks, as well as negotiating sensemaking and decision-making, to a point where they were acceptable to all parties. In complex responses, leadership and cooperation therefore becomes as much a political as a practical issue (Kapacu and Van Wart 2008). Freidrich et al (2009) argue that what we see in networks is a form of collective leadership, where individuals or groups distribute leadership depending on the challenge faced, or roles required. And, that this sharing is the result and influence of a process, rather than a static condition. In their framework they emphasise that a leader defines the structure of groups and sets the goal, whilst joint leadership brings to bear the multiple skills of the team. This does reflect many of the descriptions by the respondents who identified a problem and suggested a solution which was then ratified by a wider group. However, in contrast to Friedrich et al (2009). the data from this study indicates that joint sensemaking is also an important facet of working in a MTS.

Only two of the participants described their experience of managing smaller functional teams. The list of their activities matches that of Rydenfelt et al (2015). Challenges were the high turnover of staff which meant that the subjects had to be able to quickly assess an individual and assign them a role and managing staff expectations when they were needed to perform tasks for which they had not been recruited or indeed when there were no tasks for them to perform. The data on functional teams is contained in the teamwork section below.

Most of the data focussed on the leadership of *ad hoc* multidisciplinary teams. Zajac et al (2014) argue that the effectiveness of teams can be identified by how well they plan, act and how the individuals within that team interact. However, the data suggests that the participants worked primarily in a 'relationship leadership' mode (Walsh and Martin 2022) to help create the conditions in which all teams could operate effectively by providing vision towards which they could work collectively (Bernards 2021); developing trust and relationships between individuals (Coffeng et al 2018, Southby and Gamsu 2018); and through effective communication and joint working.

Table 12: Team characteristics (Salas and Rosen 2009)

	Team characteristics
1	Leadership is present
2	Clear roles and responsibilities
3	Shared understanding of task
4	Shared understanding of the roles of teammates
5	Relationships within the team impact performance
6	Expertise is necessary but must be combined with NTS
7	The team has a clear mission valued by all
8	The team learns from its mistakes

Collaboration and teamwork

An NTS called collaboration and teamwork emerged from the analysis because there were few examples of formed teams and teamworking, as described by academics such and Salas and Rosen (2009), on whose work much of the study on teamwork was predicated. Instead, examples of behaviour more closely mirroring the definition of 'collaboration', used by Tong et al (2018), as a mutually beneficial relationship working towards common goals, were observed.

In MTS there is an emphasis on inter-team collaboration

The studies identified in the literature review emphasised the enactment of tasks through defined teams with an identified leader. Functional leadership theory posits that leaders perform two key roles in teams depending on a team's level of development: the first is strategy development; setting the

direction and allocating teams to task and the second is the coordination of team members as they carry out the task (Bell and Kozlowski 2002, DeChurch and Marks 2006). Teams cycle through these strategizing and action phases (Marks, Mathieu and Zaccaro 2001).

In an environment where multiple teams are operating there is a tension, between the need for clear command and control structures focussing on functional leadership, and a problem-solving model emphasising multi-actor coordination, improvisation and collective decision making (Janssen, Lee, Bharosa and Cresswell 2010). As seen from the previous sections the emphasis for public health responders participating in this study focussed on a problem-solving model. The adoption of this model may have more to do with the environment in which the responders found themselves working, rather than a conscious decision to act in a collaborative manner. Isabelle, Cecile and Carole (2012) argue that problem solving, and collaboration lend themselves naturally to a volatile environment where coordination is less dependent on the design of response system but rather on the need to deal with ongoing tasks.

Participants described how tasks were allocated according to pre-defined specialisms, geographic areas of work and roles within the response. This way of working reflects the experience of militaries and other organisations that have experimented with Network Centric Operations. The tenets of network centric operations are that: networks improve information sharing; information sharing, and collaboration improve situation awareness; shared situation awareness allows for self-synchronisation in collaboration phases and increases mission effectiveness (Janssen et al 2009).

For the coordination phase to be successful, members of teams need to align their actions to work together (Ancona and Chong 1999, Marks, DeChurch, Mathieu et al 2005). However, participants did not describe coordination of various teams, which is the most common perspective for examining coordination in MTS (Brown, Power and Conchie 2021). Instead, they described the collaboration between individuals who represented

different organisations in *ad hoc* teams. This way of working reinforces the argument made by Janssen et al (2009) and Isabelle, Cecile and Carole (2012) that examination of what happens during coordination should adopt a human-centric approach.

The MTS contains multi-discipline teams

There were few examples of teamwork within fixed teams, most of the teams described in the data were *ad hoc* and brought together from disparate groups to pursue a common purpose. The evidence presented in this research shows that traditional models of teamwork, leadership and decision-making are less prevalent in multi-discipline teams than in established teams.

Salas, Cooke and Rosen (2008) define teams as social entities composed of two or more members with high task interdependency and a shared common goal. They list eight characteristics of teams which are shown at Table 12 (p.145). However, most of the teams described by the participants did not match these characteristics. They align more closely with an idea of 'self-organizing teams' (Jobidon et al 2017). Leadership was present but not clearly defined by a hierarchy (Salas, Cooke and Rosen argue that hierarchy is present in teams), roles and responsibilities were often not clear and had to be negotiated. Participants managed through consensus, sharing resources and expertise. Missions or tasks were seldom singular or contained: a task would lead into ongoing tasks or link to other relationships, and so sensemaking and management was a continual process requiring collaboration and relationship building which were not features of the NTS described in the literature.

Communication

Communication in the MTS was used as more than simply a means of transmitting information to maintain situation awareness and support decision-making. It was used also as a means of building relationships and maintaining trust. Using communication to build trust and sustain networks is widely reported (Kapacu, Garayev and Wang 2013, American Psychological Association. 2020*,* Soujaa, Nukpezah and Benevides 2021). The participants placed emphasis on listening (described as 'listening' and being 'humble') as a key skill needed by public health workers in the response: to integrate information from other parties but also recognise their interests and needs (Henderson, Ward, Tonkin et al 2020).

Relationship Building

Building and maintaining relationships helped responders create and work within networks, to develop situation awareness, and make and enact decisions.

Relationship Building to help build and maintain networks

Relationship building was especially important for responders who were having to build or integrate into *ad hoc* teams or new networks. Relationship building was supported by creating organisational relationships, developing and maintaining trust and developing and maintaining networks of contacts. It was not identified in the initial literature review where the focus for the use of NTS was in established teams. However, 'effective inter-personal relationships' have been identified as a factor in successful inter-organisational working (Tong et al 2018, Sohrabizadeh et al 2021). In the MTS relationship building was used to develop, build and maintain networks that enhance collaboration and joint sensemaking, decision-making and acting and to help cope with stress.

Where new networks were created, this was done through the development of personal relationships, rather than formal approaches through the apparatus of organisations. This supports Moshtari's (2016) assertion that individual relationships have more influence on inter-organizational collaboration than the compatibility of organizations' goals and culture. Participants also reported using existing networks, drawing information from a range of partner organisations and in some cases direct contact with communities to make sense of the response. These networks provided detailed information that was used to back up decisions based on formal reports.

Building and maintaining trust was vital to develop and maintain networks. The role of trust is particularly important in increasing information sharing between organisations (van Panhuis, Paul, Emerson et al 2014) and when interacting and communicating with communities (WHO 2017b, American Psychological Association 2020, Henderson, Ward, Tonkin et al 2020). In all these interactions the role of communication was key to establishing and maintaining networks: communication was used to share information and bring people together and build trust.

Personal Control

Personal control was an inductive category covered in literature around emotional intelligence, which has been studied in leadership and in health in the context of emergency nursing. It has been defined as the ability of people to recognize their own and other's emotions and use that information to guide their actions (Durani and Zaidi 2014).

The ability to 'stay calm' and 'stress management' were frequently reported as key skills by the questionnaire participants. The interviewees described these as 'resilience' and 'personal management'. Lazarus and Folkman (2008) define stress as a "particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being "(p.19). McLennan et al

(2014) use stress to describe the “totality of an individual’s negative psychological experiences associated with a ... stressor: fear and anxiety in particular; but also worry, frustration and anger.” (p.19).

Stress has been shown to have a negative impact on performance (Flin, O’Connor, Crichton 2008, McLennan, Strickland, Omodei et al. 2014). Stress is also generated from multiple sources both external for example threats to safety (acute stress); and internal to the workplace (chronic stress) these are listed in Tables 13 (p.150) and 14 (p.151). The data indicated that both acute and chronic stressors were present in many environments described by the respondents (Cooper, Cooper and Eake 1988, Mumaw 1994).

In a humanitarian environment, chronic stressors can be heightened by poor management and inter-agency rivalries (Lister 2001, Fawcett 2003, Murray and Clarke 2008). However, these studies concentrated on internal team mechanisms. The data from this study indicated additional pressures came from treatment inflicted directly on responders from people within and outside their organisations. Most of the examples of chronic stressors came from within the response system. Possibly an indication that even though the agencies were all working towards a common goal there did not always exist a suitable cohesion across teams that prevented people acting in a way that could cause stress.

Table 13: Chronic Stress: Stressors and Resources (adapted from Flin)

Chronic Stressors	Resources
Job demands poorly defined tasks, poor environment	• Prior experience • Training • Practice • Personality • Fitness • Social support • Coping strategies
Control: Lack of involvement in decision-making or control over tasks	
Supervisor: Lack of support unrealistic expectations	
Relationships: poor relationships, bullying, harassment	
Role: uncertain objectives and role, conflicting behaviours required	
Change: uncertainty, fears about job security	
Home, work interface: life crises	

Table 14: Acute Stress: Stressors and Resources (adapted from Flin)

Acute Stressors	Resources
Environmental: Physical environment, fatigue	• Prior experience • Training • Practice • Personality • Fitness • Social support • Coping strategies
Novelty and uncertainty: novel events, expectation violated, missing information, multiple conflicting goals, unsuccessful implementation	
Task related: performance anxiety, high workload, time pressure, personal danger, fear of failure, exposure to casualties, threat	

The ability of individuals to manage their stress and frustrations and adapt to changing environments are key skills for responders

Stress can be examined as a two-way process: the impact of the environment and people's reaction to it (Nespereira-Campuzano and Vazquez-Campo 2017). The coping mechanisms most referenced were prior experience, social support and confidence in one's own technical knowledge. There are indications that the networks used by responders provided an element of social support. Whilst some respondents cited their technical knowledge as a coping mechanism, only one reported training. In this case it was training derived from their time in the military that helped them to deal with stressful situations. No reference was made to physical fitness or other common coping strategies. Nor did the data from the questionnaires indicate what possible sources of stress could be. No explicit reference was made to chronic stressors.

The second element identified under personal management was the ability to maintain personal control when faced with challenges and frustrations of working in the emergency environment. Respondents reported conflict between teams and demands by teams on others within the MTS causing feelings of frustration and pressure to succeed. Conflict or misunderstandings within and between teams, could cause information to be ignored and lead to delays. The respondents described the need to check this frustration as 'self-control' or 'patience'. They also described a further attribute labelled as 'resilience' which combined elements of 'perseverance' and 'courage'. The former referred to the ability to work through the delays to action experienced in the MTS the second referred both to physical courage

in the face of dangerous situations but more often the courage to act according to one's knowledge and the reading of the situation. In both situations the respondents drew on their technical knowledge, the support of other teams or members in their own team and in one case the mandate provided to them by their organisation for that courage. This support was garnered from peers for the most part, but a few respondents also reported that they looked to their managers for this kind of support.

The respondents also reported the need to adapt, even to the extent of altering set procedures to achieve immediate goals that would benefit longer term goals. Teams from individual organisations adapted to form networks and multi-disciplinary teams to share knowledge and resources. Individuals adapted to work in a role to which they had not been officially assigned or adapted their technical knowledge to deal with situations with which they were unfamiliar because they had a choice between adapting and inaction. There were also examples of individuals adapting set processes to expedite actions that would benefit the response. Adaptability has been recognised as a key skill for people working in emergency response (Ford and Schmidt 2000; Kapacu and Van Wart 2008; Pires, Monteiro, Pereira et al. 2017). This ability to adapt was reported as being based on sound technical knowledge or prior experience, either drawn from the individual themselves or from a wider group. One qualitative survey participant referenced taking advice from senior colleagues who had experienced similar challenges earlier in their career.

A summary of the NTS used by participants to work within the response environment is contained in Annex F (p.268).

SECTION C - CONTRIBUTION AND IMPLICATIONS FOR PRACTICE

This section summarises the implications of the findings from this study for both research and practice in the field of emergency response management. The study has identified a common group of NTS used by public health responders that help them to operate and collaborate more effectively in a MTS. This study has highlighted key differences between the use of NTS in established, defined teams working as distinct units and the *ad hoc* teams and networks found in complex multi-agency responses. Skill sets relating to relationship building and collaboration were emphasised over a more traditional view of teamwork.

Environment

The emergency environment described by the participants matched that of the MTS. Using the MTS as a model to examine response environments can help explain the relationships between the different organisations and stakeholders that make up the response, including communities and groupings that may emerge as the emergency unfolds. The response environment should be viewed as a complex and fluid system made up of interdependent communities, organisations, teams, and individuals working across boundaries to form, disband and act as networks. The creation, maintenance, and disbandment of networks to perform specific tasks creates opportunities to bring together a wide range of skill sets. The MTS described in this study contain both ‘formal’ and ‘informal’ networks with much of the work of the response done through the latter. Both these factors provide opportunities for sharing of information and ‘honest advice’ as well as challenges for management of the response.

Viewing the response environment as an MTS, where teams maintain their own objectives and interests whilst working towards a common distal goal, will allow public health responders to develop a more holistic view of the response environment, as well as the impact of emergencies, and response measures beyond the confines of health.

Acknowledging, and mapping, the existence and role of both ‘formal’ and ‘informal’ networks in the response environment, will allow responders to better understand the needs and resources of all stakeholders and factor these into their planning and operations. These networks can be a valuable source of information and support.

The data from this research has shown that the NTS used in a MTS are focussed on relationship building to develop, build and maintain networks that enhance collaboration and joint sensemaking, decision-making and action. However, how these networks related to each other and delivered against objectives was not identified in this study. Further research into the formation and relation of networks in the MTS using social network analysis (Brown et al. 2021) would help to better understand how networks are formed and interact with each other and the established response system.

Sensemaking

Sensemaking in the complex response environment required the gathering of information from a wide range of sources to develop an understanding, not only of the emergency itself, but of the context in which it was happening and the stakeholders impacted by and responding to it. Responders based their analysis of a situation on both ‘formal’ and ‘informal’ sources of information which allowed them better to understand the potential impact of their decisions and subsequent actions ‘on the ground’. Public health responders therefore should be actively encouraged to gather, prioritise and analyse a wide range of information that can be factored into decision-making. Both training and ways of working can be developed to emphasise the importance of gathering a wide range of information, and the analysis of the potential impact of actions on communities and individuals who will be impacted not only by the emergency but also by actions taken as part of the response.

Understanding the role, objectives and requirements, of other actors in the response is central to effective decision-making and joint working. In the preparedness phase (i.e., before a disaster or emergency strikes) public health responders should work and train with other organisations to better understand their interests, needs and ways of working. Training and planning should consider a wide range of stakeholders (not only those that make up the 'formal' response mechanism) and how they might be involved in the management of emergencies. It should also consider not only the location and activities of other stakeholders[10] but their motivation, goals and interests.

Joint sensemaking is a key component to building and maintaining trust. Sharing of information was identified in this study as a key element in the relationship building process and a way of allocating response stakeholders to tasks in *ad hoc* teams. The way joint sensemaking was conducted and the measurement of its impact on the effectiveness of teams working as part of a response should be examined and encouraged in practice.

Finally, this study reinforces the evidence that sensemaking is a continual process conducted throughout the decision-making process rather than a precursor to the moment of making the decision. In the complex environment decisions had multiple potential impacts and so the reaction to those decisions needs to be constantly monitored.

Decision-making

The study has provided evidence that decision-making in the MTS should be viewed as a joint and collaborative activity. As with sensemaking the joint nature of decision-making served to reinforce relationships, trust and offered a degree of emotional support to the decision-makers through a sense of shared responsibility. This study identified the broad descriptions of

[10] Common tools are contained in the Public Health Information Services Toolkit (WHO 2017c). This includes the 3/4 W's tool to map other responders the 4W are: Who, What, Where, When.

collaborative decision-making and enactment (joint and negotiated) however the quality of the joint decisions was not examined.

No set process for making decisions was recorded. Decision-making in the MTS should consider not only the facts of the situation but the interests and ways of working of other parties involved in the decision-making process. Decision-making in a complex, multi-sector response is therefore as much an exercise in maintaining networks and relationships as it is logic. Therefore decision-makers must gather and make use of a wide range of information sources and consider the relationship implications of decisions made.

It is unclear whether the joint decision-making processes identified in this study were more effective than decisions made by individuals described in many of the literature review studies. Further research around the mechanics of negotiated decision-making, and its impact in the MTS, would help to ascertain this as well as developing a model to help prepare staff for working in emergencies.

The data also called into question the use of RPD that was often quoted in the literature. In a public health response, decisions were enacted over a slower period than the acute events discussed in much of the literature. Also, the complex nature of the events involving multiple stakeholders and (potentially) multiple simultaneous problems meant that decisions were made as a series rather than as individual decisions. The evidence from this study indicates that RPD was only one element of a protracted decision-making process that relied on a combination of data analysis, RPD and consultation. Even where decisions were based on prior experience these were then negotiated with a group. Effective decision-making in the MTS may rely, to an extent, on experience but the role of effective advocacy to implement decisions must not be ignored. Public health decision makers should also seek to develop their advocacy and influencing skills.

Leadership

The evidence from this study indicates that leadership in the MTS context cannot be examined in the context of single teams. The evidence from the literature review examined established teams, with an established hierarchy and defined leadership position. In the MTS this hierarchy seemed to be largely absent and leadership a shared and negotiated construct. In the MTS lines of authority are not as well defined as they are in formal response structures. Activities are not conducted by established, formed teams for single organisations. Teams are *ad hoc* and built from members of networks. Recognising this fact will allow for responders to adapt their expectations of the exercise of their leadership from one of task delivery, to one that allows them to build the relationships and conditions that will allow them to collaborate effectively with other stakeholders. The emphasis becomes more about how to collaborate with and enable stakeholders instead of focussing solely on liaison between teams.

Leaders were called on to identify, bring together and empower the correct stakeholders to resolve issues by building and maintaining networks; identifying teams and individuals most relevant for the task in hand; and understanding the needs of those groups or individuals. Often they initiated decisions, but then advocated and managed the group to agree to and enact those decisions. This could mean that they needed to share - and on occasions relinquish – control for certain elements of a project to allow the relevant stakeholders to meet their own objectives. As with decision-making, leaders needed to keep in mind the interests and needs not only of the immediate project but of the long-term (distal) response goal.

The evidence from this study indicates that public health responders should examine and understand the broad response context as well as the roles, ways of working and interests of the other stakeholders involved. This work can be done as part of cross sector preparedness activities such as training and exercises. A focus for leadership development, for staff working at a senior level should be on identifying, building relationships with, and

enabling stakeholders to collaborate effectively. This could be assisted by research into the dynamics of shared leadership.

Collaboration and teamwork

In MTS responders work within *ad hoc* teams where authority is not predefined and was to a large extent negotiated. This indicates that a traditional view of a team as an established construct, is not suitable when considering how groups and individuals work together in a response. The role of specific liaison officers acting as links between established teams from different organisations may not be relevant in an MTS where *ad hoc* teams tended to be made up of staff from different specialisms and stakeholders.

The models of teamwork and leadership identified in the literature review focussed on the role of the team in setting and delivering tasks. However, the evidence from this study would suggest that collaboration is also required in the sensemaking and decision-making phases. Conducting these activities jointly helped build relationships between stakeholders who were then able to work more impactfully as joint teams.

In the traditional models of teamwork one of the roles of the leader was the allocation and monitoring of tasks to ensure optimum chances of completion. In an MTS the allocation of roles and responsibilities was tied up with stakeholders' interests and ways of working. Therefore, the emphasis in MTS was enabling the efforts of the individual stakeholder to contribute to, and not detract from the distal goal. For responders in MTS adopting a human-centric approach to teamwork and collaboration, focussing on the needs and interests of stakeholders instead of only the delivery of tasks will help with effective role allocation and collaboration in *ad hoc* teams.

This study has emphasised the existence of 'informal' channels of information and response stakeholders and activities working alongside the 'formal' established response systems. There is a tension in emergency

management literature between the role of systems such as the Incident Management and Cluster systems and a looser collaboration that allows for flexibility and adaptability. The data supports the argument, that a series of networks within the response environment, provide a means for the looser coordination that supports the formal support structures. These networks play a key role in building relations between individual responders, which in turn enhances sensemaking, decision-making, collaboration and provides a level of moral support that can help individuals cope with the stressors of working in the response environment. However, it is acknowledged that there was no mention of the formal response mechanisms of the Incident Management System and Cluster System which form the mainstay of international public health response. An examination of the NTS used explicitly within these systems is required.

Participants described how ‘informal’ structures can benefit the response. Further research is required into how these ‘informal’ networks develop and can be leveraged as part of the response effort. This should be done without bringing them into the ‘formal’ response system as doing so may undermine many of the advantages (the ability to speak freely for example) they provide.

Communication

The evidence from this study indicates that communication was used by the participants to build relationships, establish roles and advocate for decisions and action within *ad hoc* teams. Responders should recognise the role of communication in relationship building and be prepared to use verbal communication to effectively advocate for decisions and their role in the response environment.

Further research is required to better understand the interaction between ‘formal’ and ‘informal’ information and communication in the response and how both these sources can be used to develop a coherent situational picture. Such research should also include an examination of the role of

information technology in support the development of a holistic understanding of the response environment and events.

Relationship Building

This study has identified that within the MTS the ability to build and maintain relations is a key skill underpinning and supported by the other NTS. The ability to build and nurture the relationships, that underpin the networks within a MTS, relies on the development and maintenance of organisational and personal relationships. This requires responders to identify key stakeholders, and develop both personal and professional relationships, to build and maintain networks that could be leveraged to form *ad hoc* teams. The requirement to build and maintain relationships – in particular personal relationships – was not identified in the initial literature review or in the core NTS identified by Flin (Table 1 p.22 and Table 13 p.159). However, the crucial role of relationship building was identified in the second literature review which examined more specifically inter-organisational collaboration.

Relationship building was supported by actively sharing information during the response and can be supported by mapping networks and understanding the interests of the other stakeholders involved in the response. Emphasising the role of relationship building in effective collaboration can help public health responders define leadership and collaboration as a human-centric activity balancing these requirements against those of task completion.

Personal control

In the literature review the NTS covering personal control were limited to coping with fatigue and stress. This study identified that this category can be expanded, to consider the frustrations that can be created by the need to maintain effective relationships and distal response goals in mind, potentially at the expense of shorter term or personal goals. Exercising this kind of personal control required a cognitive effort, by identifying behavioural

standards to guide actions, provided by an individual's organisation or by their own values and beliefs. Staff preparing to work in response should consider their values and be certain of their mandate, to support and the distal goal of the response. This can support personal control and willingness to adapt one's way of working.

The participants in this study identified chronic stressors created by the response environment. Organisations can work to identify and acknowledge the chronic stressors created by the management systems they have in place and seek to minimise their impact on individual responders. Research into the management structures that can reduce these stressors could help to identify these factors and methods of mitigating them.

SECTION D - LIMITATIONS OF THE STUDY

The limitations of this thesis have been documented in Chapter 3 Research Design (p.69) and a self-reflection at Appendix D (p.235). A summary of these points is below:

The research questions

The data gathered was not sufficient to answer all the research questions due to limitations in sample size and absence of a comparison of the NTS used at a systematic level in the non-response environment and across different public health disciplines. Most of the participants were undertaking coordination roles so they used NTS at a systemic level rather than their technical functional level. However, the study does identify a common set of NTS used by responders at a systems level regardless of their technical background.

Critical Decision Method Interviews

The critical decision method (CDM) proved useful for this study even though the conduct of the interviews did not fit neatly with descriptions of the CDM methodology. It was difficult to find single, well-defined decision-points

rather, participants focused on a series of decision-points. Also, because CDM concentrates on challenges that tested participants beyond their routine tasks, NTS to conduct routine activities were missed. However, the emphasis on repetition in CDM helped individuals provide a high-level of detail about events.

Sampling

Whilst the sample size for both the interviews and the qualitative survey were small (10 and 46 respectively), they were drawn from a representative sample across public health disciplines and responses. The number of participants was comparable to other studies of its hard-to access type.

The requirement for participants to have been decision-makers meant that only senior public health professionals were included in the study. This methodology may not be suitable for identifying NTS that less experienced responders rely on.

This study only captured data from an individual standpoint; and events were usually reported favourably. To examine the effectiveness of actions taken and check the understanding of events it would be necessary to conduct studies of the same event with multiple individuals.

The qualitative survey

Although the sample number was relatively small, the data collected for this study was from real-time events (as opposed to simulation exercises) and was not restricted to a single event or team as was witnessed in the literature review.

The questionnaire developed for this study proved useful as an interview guide. One participant was interviewed over the phone using the questionnaire. A second participant reported that the questionnaire was a useful exercise in self-reflection and understanding the challenges of working in response.

The literature review

The study of NTS covers a wide range of theories and academic disciplines. The initial literature review provided a useful basis for understanding individual NTS and designing the study. However, it had to be supplemented by reading generated through a snowball technique and an additional literature review.

Explaining the concepts of NTS and decision-making

The interviews and questionnaire required detailed piloting and reviewing. The concepts of NTS and decision-making as a conscious process were difficult for the participants to understand. Both these elements had to be explained in detail.

Working in formal response structures.

The participants did not describe the NTS used in the IMS and the Cluster systems. In some cases, the data pre-dates the widespread adoption of the IMS. However, where it does not it would be useful to examine whether these systems were explicitly adopted and used.

SUMMARY - DISCUSSION

This research has examined a field of emergency response that has not previously been studied. The findings have shown that complex response environments can be viewed as MTS. In an MTS responders work in *ad hoc* groupings and through networks where an ‘informal’ system works alongside the ‘formal’ response system. In such an environment the traditional thinking around working in and leading established teams focussing on task delivery is replaced by one in which the development of relationships to build and maintain networks that can be called upon to deliver projects is key. The NTS identified in the course of the study all played a role in helping to develop trust that enabled collaboration between the disparate teams in the MTS. This reflects the evidence that there are a core set of NTS that can be applied across a range of professions and fields of work but that the context of environment and the nature of the work will define to what extent and how these NTS are used by individuals.

Fig 14 An overview of the findings from this study

Observations – what the data reveals / what was found	Interpretations – the researcher's understanding of the finding, what they mean	Literature - how do the findings relate to the existing literature?	Contribution - what is new, amended or reinforced? What was refuted, implications for practice?
Coding: Codes match the key NTS with the addition of Relationship Building and Collaboration.	A focus on collaboration rather than teamwork.	In the MTS there is more emphasis on inter-team collaboration than in the team environments.	Re-examining the concept of teamwork where multiple stakeholders are involved.
Environment: A complex environment with multiple teams.	A fluid environment with 'formal' and 'informal' systems.	MTS contain networks brought together to perform tasks.	Responders work in *ad hoc* teams formed of multiple stakeholders.
Sensemaking: Participants use multiple sources of information.	Sensemaking is a joint activity.	Joint Sensemaking builds trust and relationships between responders.	Responders should adopt a joint and holistic approach to sensemaking.
Decision-making (DM): Decisions are made in groups.	The group ratified or generated decisions.	DM followed no set process; it was a part of relationship building.	Joint DM is not purely logical it also helps relationship building.
Leadership: Leadership was exercised by different people and entities at different times.	Leadership focussed on the ability to influence and enable stakeholders to achieve tasks.	The Leadership model for the MTS differed from those of small well-defined teams.	Leadership in MTS is based on relationship building and enabling.
Collaboration and Teamwork: *Ad hoc* shared skills and work together.	Responders accessed people to build teams through networks.	There is an emphasis on joint working rather than teams.	Responders should understand stake-holder's operations and interests.
Communication: Individual contact outside formal meetings was key to information sharing	Communication was used to develop links and build trust between teams.	Communication was more than giving and receiving information it is used to build networks.	Communication training should focus on developing relationships, advocacy and building trust.
Relationship building: Responders created bonds to develop networks.	Personal relationships aided networking and collaboration.	In the initial literature review relationship building was not widely reported.	Relationship building underpins and facilitates collaboration.
Personal control: Personal control was required to remain objective and absorb setbacks	There was also the need to check frustration with self-control to collaborate effectively.	The management of frustration towards others was prevalent over personal stress management.	Examine and consider how inter-personal relationships can contribute to stress.

CHAPTER 7: CONCLUSION

This study was conducted over 4 years and achieved the aim to describe the use of NTS used by Public Health professionals working in an emergency or disaster environment by examining (a) which NTS they use (b) how they are used in the multiteam environment which characterises a response.

Although the research did not achieve all the objectives, it has provided new insight into the characteristics of the public health response environment and the ways in which teams and individuals operate within them (see Black et al 2022). It has shown that complex response environments involving multiple stakeholders can be examined as MTS.

The evidence from this study indicates that NTS come into play when people are working in high pressure, complex environments. People are not always operating in the objective and logical way that systems often presuppose. Whilst the advantages of response systems and processes are well documented, this study has shown that individuals also work outside of these systems in complex environments. Adopting a human-centric approach to better understand the way in which individuals work within response environments may enhance personal training and development of response systems.

In a MTS, relationship-building through joint working plays a key role. Shifting from a view of cooperation between teams to one of collaboration within *ad hoc* teams made up of disparate actors can help to better focus joint sensemaking, decision-making, leadership and working supported by effective communication and personal control. Such a way of working is enhanced by developing a detailed understanding of the interests, processes and cultures of the other stakeholders that make up the MTS.

Non-technical skills are used in all fields to support and enhance individuals' technical skills. The NTS identified during the study support the assertion that there exists a set of core NTS but that their application depends on the

profession and environment in which they are used. Developing a clear understanding of that environment is therefore key to ensuring staff working in response can be adequately prepared to undertake this work. It is hoped that this thesis, detailing the experiences of a small but dedicated group of public health professionals working tirelessly for the benefit of all our health, can contribute to this understanding.

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APPENDIX A

AN OVERVIEW OF INCIDENT MANAGEMENT AND CLUSTER SYSTEMS

This Annex provides an overview of two types of response system used in health emergency response. The participants who took part in this research were working in responses that were led by national governments with, in some cases, the support of the international humanitarian community. The response systems used by national governments varies depending on their resources and their approach to health emergency response. Where there are gaps in national capacity, or where the scale of the emergency outstrips capacity of the national government then the humanitarian community will assist and work alongside national governments.

The Incident Management System

The emergency response systems used in each country will vary however, the Incident Management System (IMS) provides an example of the type of response system in use by many national governments and responding organisations. The IMS has its foundations in military operations and was developed in the USA to fit the needs of civil response. The system is designed to bring together key functions (knowledge, skills and resources) under a command-and-control system that is outside of the structures that organisations use for day to day work. This ensures that resources can be concentrated on the response efforts. The IMS is used by the World Health Organization and advocated by the US Centers for Disease Control. The IMS provides a commonly recognised system based on best practices of emergency management and is increasingly used by emergency management systems globally, including within the health sector (Utunen, Gamhewage, Attias et al 2020). The functions and structure of the IMS are described in Figs A1 and A2

Fig A1. Extract from WHO Framework for a Public Health Emergency Operations Centre 2015 describing the IMS (WHO 2017b p.18)

The IMS provides a unified structure to bring together and coordinate key management functions required for any emergency response, regardless of the number of people available or involved in the operations. Within the IMS, five essential functions are typically established, with flexibility to adapt to different events, agencies, and jurisdictions. These are:

1. Management – responsible for overall operation of incidents or events (including coordinating risk communication and liaison with other agencies)

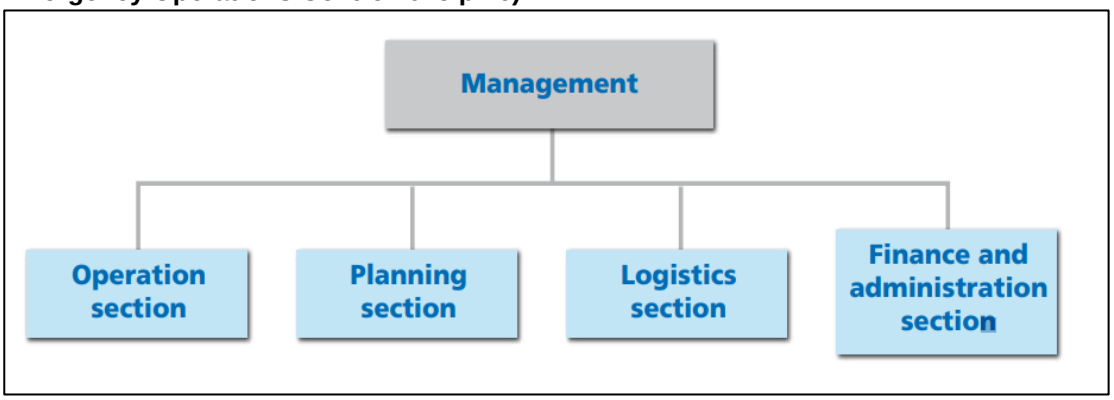
2. Operations – at the field level, this function provides direct response to the incident or event; at higher levels, it provides coordination and technical guidance

3. Planning – collection of data, analysis, and planning of future actions based on the likely course of the incident and the resources available for the response

4. Logistics – this function acquires, tracks, stores, stages, maintains, and disposes of material resources required for the response. It also provides services in support of the response, such as health services for responders

5. Finance and administration – cash flow management; tracking of material and human resource costs; budget preparation and monitoring; and production and maintenance of administrative records. These functions may be activated or deactivated as needed with the evolution of an event.

Fig A2: The Incident Management System Model (WHO Framework for a Public Health Emergency Operations Centre 2015 p.16)



The Cluster System

The Cluster system is a humanitarian response system advocated for and used by the international community in response to humanitarian crises. It is designed to work alongside and support existing national emergency response structures where they exist. The cluster system is described in Fig A3, its use in the context of health emergencies at a country level is described in Fig A4 and Fig A5.

Fig A3: Extract from the UNOCHA website describing the Cluster System

Clusters are groups of humanitarian organizations, both UN and non-UN, in each of the main sectors of humanitarian action, e.g., water, health and logistics. They are designated by the Inter-Agency Standing Committee (IASC) and have clear responsibilities for coordination. The aim of the cluster approach is to strengthen system-wide preparedness and technical capacity to respond to humanitarian emergencies and provide clear leadership and accountability in the main areas of humanitarian response. At country level, it aims to strengthen partnerships, and the predictability and accountability of international humanitarian action, by improving prioritization and clearly defining the roles and responsibilities of humanitarian organizations.

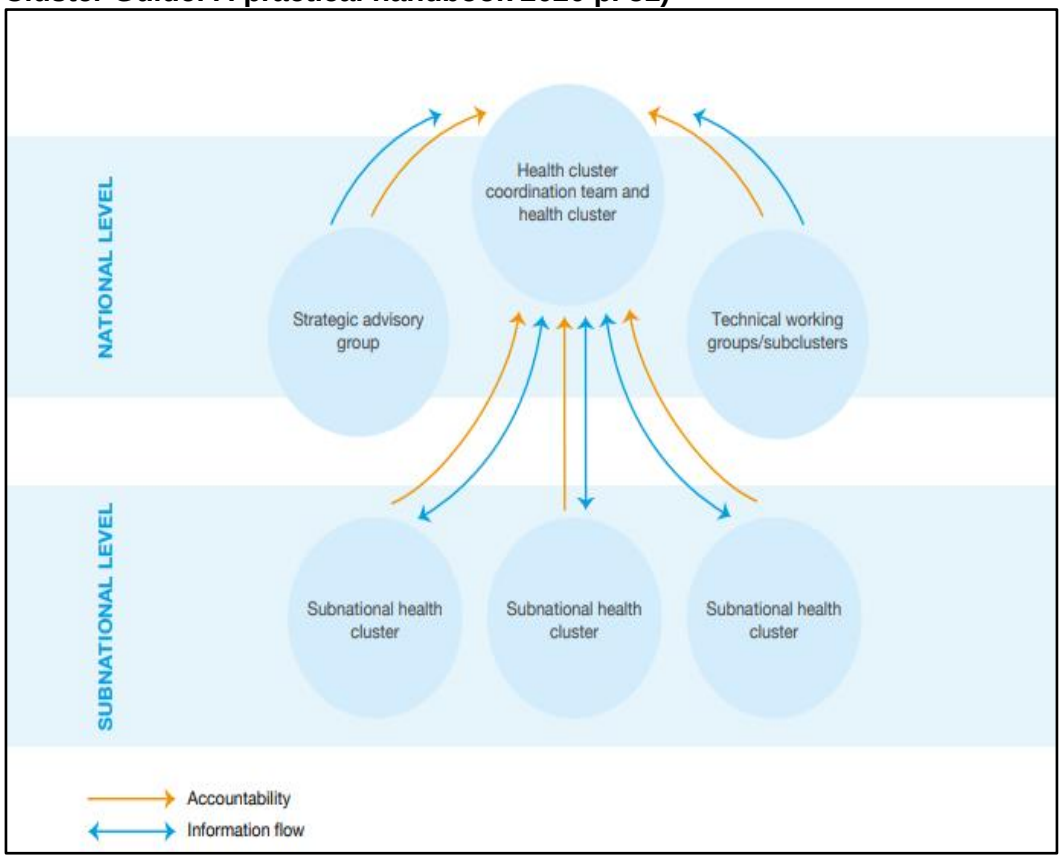
1. *Supporting service delivery by providing a platform for agreement on approaches and elimination of duplication*
2. *Informing strategic decision-making of the HC/HCT for the humanitarian response through coordination of needs assessment, gap analysis and prioritization*
3. *Planning and strategy development including sectoral plans, adherence to standards and funding needs*
4. *Advocacy to address identified concerns on behalf of cluster participants and the affected population*
5. *Monitoring and reporting on the cluster strategy and results; recommending corrective action where necessary*
6. *Contingency planning/preparedness/national capacity building where needed and where capacity exists within the cluster.*

WHO is the Lead Agency for the Health Cluster which will be used to augment national coordination capacity as required where gaps exist in national capacity or where the demands of the emergency exceed national capacity.

Within countries the purpose of the health cluster is to bring together responding organisations at a national and sub-national level to coordinate response planning and use of resources. These can include the national and

local health authorities, NGOs, community and faith-based organisations, the International and national Red Cross and Red Crescent, and United Nations agencies. The structure of the cluster will vary between countries but would typically comprise a strategic advisory group, technical working groups or sub clusters, and one or more subnational-level health clusters. An example of a national structure is shown in Fig A4 below.

Fig A4: Example of a typical country health cluster structure (WHO Health Cluster Guide: A practical handbook 2020 p. 51)



APPENDIX B

LITERATURE REVIEW SUPPORTING DOCUMENTS

This Appendix contains information developed during the literature review that was used to support and shape the research. It contains the following attachments:

1. Non-technical skills, Tools and Methodologies identified in the systematic and literature reviews.
2. Framework Analysis of the systematic and literature reviews
3. Framework Analysis of the primary studies identified
4. Sources identified in the literature review

NON-TECHNICAL SKILLS, TOOLS AND METHODOLOGIES IDENTIFIED IN THE SYSTEMATIC AND LITERATURE REVIEWS (INITIAL 12)

Literature Reviews	(Cotton & Morales, 2016)	(Mitchell et al., 2012)	(Rutherford et al., 2015)	(Yule et al 2006)	(Gordon et al., 2012)	(Cooper et al., 2010)	(Shields & Flin, 2013)	(Willems et al., 2013)	(Dearden et al., 2015)	(Daley et al., 2018)	(Reader et al 2006)	(Hitchens et al , 2017)
NTS identified	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Decision Making	X		X			X	X	X	X		X	X
Judgment										X		X
Clinical Judgement										X		
Situation awareness		X	X	X	X		X		X		X	X
Time Management									X			
Communication	X	X	X	X	X			X	X			X
Health advocacy												
Professionalism										X		
Interaction												
Team work	X	X	X	X	X	X	X	X		X	X	X
Collaboration												
Leadership	X		X	X	X	X	X	X		X		X
Teacher (Teaching)												
Coping with Stress and / or fatigue	X			X			X			X		X
Briefing and planning				X								
Preparation				X								
Resource management				X								
Seeking advice and feedback				X								
Mental readiness				X								
Assessing risk				X								
Anticipating problems and risk				X								
Adaptive strategies / flexibility				X								
Workload distribution				X								

Literature Reviews	(Cotton & Morales, 2016)	(Mitchell et al., 2012)	(Rutherford et al., 2015)	(Yule et al 2006)	(Gordon et al., 2012)	(Cooper et al., 2010)	(Shields & Flin, 2013)	(Willems et al., 2013)	(Dearden et al., 2015)	(Daley et al., 2018)	(Reader et al 2006)	(Hitchens et al , 2017)
Error awareness												
Personality / behaviour						X						
Clinical knowledge												X
Scope handling												X
Heuristics												X
Detection of abnormalities												X
Task Management											X	

	Tools for identifying NTS Identified in the course of the literature review (full titles listed at the base of the Table)	1. HFACS	2. Oxford NOTECHS II	3. NOTSS	4. ANTS	5. T-NOTECHS	6. Non-Technical Skills	7. WOCRM	8. Flight Crew Human Factors Handbook	9. TINSEL
	NTS identified	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	Decision Making		X	X	X	X	X	X	X	
2	Judgment	X								
3	Perception	X							X	
4	Cognitive factors[11]	X							X	
	Situation awareness		X	X	X	X	X	X	X	
5	Psycho behavioural factors[12]	X								
6	Inadequate supervision	X								
7	Planned inappropriate operations	X								
8	Failure to correct known problem	X								
9	Resource Management	X				X	X			
10	Organisational climate	X								
11	Organisational process	X								
12	Leadership and Management		X	X		X	X	X	X	
13	Teamwork and cooperation		X		X					
14	Problem solving		X							
15	Communication and Teamwork									
16	Task Management				X					
17	Communication			X			X	X	X	
18	Cooperation					X				
19	Assessment					X				
20	Coping with stress									
21	Teamwork					X			X	
22	Error management							X		
23	Workload								X	
24	Surprise and startle								X	
25	Fatigue								X	
26	Personality and cultural differences								X	

[11] Listed in HFACs as: Inattention Channelized attention Cognitive task oversaturation Confusion Negative transfer Distraction Getting lost Checklist interference

[12] Listed in HFACs as: Pre existing Disorders Emotional state Personality style Over confidence Pressing Inadequate/misplaced motivation Over agressive Excessive motivation to suceed Get home / get there itis Response set Burn out

1. Department of Defense Human Factors Analysis and Classification SystemDoD HFACS
2. Oxford NOTECHS II (Theatre Team Non-Technical Skills Scoring System)
3. Non-Technical Skills for Surgeons (NOTSS)
4. Anaethetists Non-Technical Skills ANTS
5. Non-Technical Skills for Trauma (T-NOTECHS)
6. Non-Technical Skills
7. Well Operations Crew Resource Management (WOCRM)
8. Flight Crew Human Factors Handbook
9. TINSEL – checklist could not be found

METHODOLOGIES FOR IDENTIFYING NTS IDENTIFIED IN THE NTS LITERATURE REVIEWS

	Literature Reviews	(Cotton & Morales, 2016)	(Mitchell et al., 2012)	(Rutherford et al., 2015)	(Yule et al 2006)	(Gordon et al., 2012)	(Cooper et al., 2010)	(Shields & Flin, 2013)	(Willems et al., 2013)	(Dearden et al., 2015)	(Daley et al., 2018)	(Reader et al 2006)	(Hitchens et al , 2017)
	Methodologies Identified	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
1	Semi-structured interviews (Critical Incident Technique)									X			X
2	Semi-structured interviews									X			
3	Video analysis of behaviours in practice												X
4	Hierarchical Task Analysis												X
5	Verbal Protocol analysis												X
6	Literature Search												X
7	Delphi methodology												X
8	Focus Groups with thematic analysis												X
9	No method discernible / reported	X		X				X	X		X		
10	Questionnaire and interview				X								
11	Observation (in vivo, video, simulated)				X							X	
12	Surgical adverse events analysis				X								
13	Surgical education, training and competence assessment				X								
14	Assessment of training methods					X	X						
15	Cross sectional questionnaire									X		X	

	Literature Reviews	(Cotton & Morales, 2016)	(Mitchell et al., 2012)	(Rutherford et al., 2015)	(Yule et al 2006)	(Gordon et al., 2012)	(Cooper et al., 2010)	(Shields & Flin, 2013)	(Willems et al., 2013)	(Dearden et al., 2015)	(Daley et al., 2018)	(Reader et al 2006)	(Hitchens et al , 2017)
16	Free text questionnaires									x			
17	Incident reporting forms											x	

AN EXTRACT FROM THE FRAMEWORK ANALYSIS OF THE REVIEWS IDENTIFIED WITH FORMATTING ADJUSTED FROM THE ORIGINAL EXCEL SPREADSHEET (blank spaces indicate information not identified)

Author and year	ID CODE and Title	Date range	Sources	Search terms	Type of study	Basis for study	Quality Assess	Setting	N=	Protocol used and Data Analysis	Maj conclusions	Implications / Gaps	NTS ID or trained to
Jones, Fawker-Corbett, Groom, Morton, Lister and Mercer 2018	ID COMM and TEAMS Human Factors in preventing complications in anaesthesia: a systematic review	2000-2018	papers reporting on human factors and NTS in anaesthesia -	not listed	SYSTEMATIC	examines recent literature around human factors in anaesthesia. Highlights national reports and guidelines around teamwork, communication, SA and human error	not listed	Health - Anesthesia	74	not listed	recognition of human factors is firmly embedded into clinical anaesthetic practice	not listed	ANTS Task Management Team working SA DM National Audit Project 4 and 5(NAP4 NAP5)

Author and year	ID CODE and Title	Date range	Sources	Search terms	Type of study	Basis for study	Quality Assess	Setting	N=	Protocol used and Data Analysis	Maj conclusions	Implications / Gaps	NTS ID or trained to
Pang, Patel, Pilkington	EVAL NTS and TOOLS Lessons from surgery and anaesthesia: evaluation of NTS in interventional radiology				LITERATURE	a review of the literature to look at validated tools used to assess NTS in anaesthetics and surgery		Health Radiology					Communication (verbal and non-verbal) Organisation and planning / task management SA and DM Team working

AN EXTRACT FROM THE FRAMEWORK ANALYSIS OF PRIMARY STUDIES WITH FORMATTING ADJUSTED FROM THE ORIGINAL EXCEL SPREADSHEET (blank spaces indicate information not identified)

Author and year	Title	Purpose and Research question	Type of study	Setting	Sampling	Research Instrument and Tools	Data Analysis	Maj conclusions	Implications / Gaps	NTS ID or trained to
Irwin and Weidman 2015	A mixed methods investigation into the use of NTS by community and hospital pharmacists	ID NTS to examine attitudes towards and the use of NTS by pharmacy personnel	SUR-VEY (ATTITUDE) and INTER-VIEWS	health - pharmacists	62 community and hospital pharmacy staff	Timesteps (T-TPQ) quality of care process scale and Safety Attitudes Questionnaire (SAQ)	total score from T-TPQ, ANOVA used to compare construct across groups, total mean score for teamwork compared using t-test SAQs scored individually	identify team work, leadership, task management, SA and DM	development of terminology for pharma	team work, leadership task management DM SA
Flowerdew et al 2012	A multicentre observational study to evaluate a new tool to assess emergency physicians NTS	TRNG NTS to evaluate new tools to assess emergency physicians NTS	OBSER-VATIONAL paired observers	health - ED	43 senior trainees		intra-class coefficients spearman's for calculating test re-test reliability	the assessment tool is acceptable		Management and supervision Teamwork and Coop DM SA

Author and year	Title	Purpose and Research question	Type of study	Setting	Sampling	Research Instrument and Tools	Data Analysis	Maj conclusions	Implications / Gaps	NTS ID or trained to
Bogdanovic et al 2015	Adaptive coordination in surgical teams: an interview study	COORD explores the coordination behaviours and adaptive coord strategies employed by surgical teams	INTERVIEWS - semi structured	health - surgery	convenience 33 surgical team	interviews focusing on responsibilities and roles concerning clinical tasks and leadership	qualitative content analysis, coding using inductive and deductive approach	central role of coordination and need to behave adaptively	structured observation system needed	task management info management teaching leadership
Gillespie et al 2017	Correlates of NTS in surgery a prospective study	TRNG NTS identifying the contextual elements that impact NTS		health - surgery		NOTECHS - 2 trained observer teams made observations using a checklist from MOTECHS	regression models used to correlate operative time, team membership, miscommunications and interruptions	miscommunications and interruptions impact on NTS performance		(only abstract available)
Marquardt et al 2010	CRM within the automotive industry does it work?	TRNG NTS development, implementation and eval of CRM training	SELF REPORTING QUESTIONNAIRE	industry - automotive	80 staff	self-report Human Error Questionnaire (HEQ) the "dirty dozen"	repeated measures ANOVA, Bonferroni correction	CRM training can transferred to auto industry - decrease in error factors observed post training	lack of behavioural observations effects are limited	comms team work stress manage SA error identification

Author and year	Title	Purpose and Research question	Type of study	Setting	Sampling	Research Instrument and Tools	Data Analysis	Maj conclusions	Implications / Gaps	NTS ID or trained to
Blum et al 2004	CRM training for an anaesthesia faculty: a new approach to continuing education	TRNG NTS effect and utility of training	SURVEY pre and post SIMULATION TRAINING	USA health - anaesthetists	148 faculty	an immediate post course survey and then a follow up	Spearman's to correlate 4 course quality measures Mann Whitney U test for exploring differences in two sets of unpaired sets of ordinal data	all the faculty who experienced a difficult incident post course (about half of them) reported an improvement in CRM	indirect evidence that such training should be more widely promoted	Leadership Help Communication Debriefing Resources Tasks Stepping back Diagnosis Overall
Fackler et al 2009	Critical Care Physician CTA: an exploratory study	ID NTS the use of CTA to explore cognitive tasks in critical care	INTERVIEW CTA and OBSERVATION	USA health - critical care	20 staff	14 CTA interviews and ethnographic observation	thematic analysis of the interviews and full sets of observations	5 NTS identified - CTA as a useful tool to understand the critical care process	deeper analysis of each activity is required	pattern recognition uncertainty management pattern recognition strategic vs tactical thinking team coordination maintenance of common ground

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APPENDIX C

REFLECTION ON THE METHODOLOGY, ANALYSIS AND RESULTS

The reflection process described below is based on Gibbs (1998). In the first section of this review, I will describe some of the limitations identified for the methods of data collection and analysis I chose and their potential impact on the research findings. I will then describe some of the key challenges in the conduct of the research, my feelings relating to these challenges followed by a brief evaluation and analysis before presenting a summary and reflections of future actions.

Description

The interviews did not fit neatly with the descriptions of the critical decision-making methodology described by Crandall, Klein and Hoffman (2006). The participants and I initially struggled to find decision-points and were unable to find single decision points. What we got was more of a description of the environment in which the participants were working. The first half of an interview was spent trying to find suitable examples for analysis. In nine of the interviews this was achieved although the examples provided were not acute or centred around a single decision-point they tended to be more extended stories that centred around an achievement of the individual. For some people this was a result of having to think back a number of years and having to run over facts a number of times before they were able to create a narrative. On a number of occasions people would describe things that did not seem relevant or of interest, or they were simply unable to reflect on the reasons they had taken the actions they had. However, in all cases given enough time people were able to centre in on a decision-point. Once that happened it was easier to start to construct the interview.

All the participants had great difficulty explaining the process of how they had made a decision. In fact, the only person who had been able to centre in on a decision point and explain very clearly how it had been taken was one of the people in the pilot study. However, when analysed against the theory of group decision-making this difficulty was entirely understandable because decisions

were part of an ongoing process and an initial choice of strategy was often negotiated on with a group.

The qualitative survey met with similar challenges of participants not being entirely sure what was expected of them. Piloting the questionnaire took considerable time and re-wording to achieve a format that could be easily understood and correctly interpreted. The initial distribution of the qualitative survey did not achieve much success. It was sent a large network of over 900 people of which only four replied. When I asked another network if I could send the qualitative survey through them, they advised me that uptake would be low and that I would be better using a snowball technique. Along with this I also revised the initial covering letter which had reflected the potential benefits of the study and revised it to ask participants to support me in my Doctorate studies. After a month of receiving no answers the qualitative survey quickly began to receive input. I interviewed one of the participants over the phone using the questionnaire as an interview guide. This worked very well, and the participant was able to clearly understand what was needed and I gathered the information quickly. Following the issue of the questionnaire I also had a telephone conversation with a participant who had contacted me wanting to know more about the study. She reaffirmed that she had found the questionnaire a useful exercise in self-reflection and that she felt this study was of importance to understanding the challenges faced by her and colleagues working in response.

Feelings

The time taken to find suitable examples initially was frustrating and worrying. Out of three pilot interviews two had resulted in the realisation that the participants and I could not find suitable examples to analyse. However, as the interviews went on, I was more confident that we would find examples for people to talk about. The frustration about the inability to identify and explain decision-points was similar. Over time I realised that some of these elements were contained in the narrative that the participants were providing. I also learned to focus on what I was being told by the participants rather than trying to get them to hit a “check list” that I felt would mean that the interview was

successful. This was a shift towards more active listening that allowed the interviews to flow more freely whilst trying to keep the interview on track by steering people through the steps of the decision-making process. This was also part of a process of letting go of my own preconceptions and biases around what I had expected to hear in the interviews. This reflection gave me reassurance that the interview process and analysis was working because it was challenging my presuppositions directly.

Because the participants were so honest, I felt wary that I had to be careful with some of the information that they were providing me with. Striking a balance between “telling the story” because it was interesting and extracting the data from that story was sometimes difficult. However, I was able to include the rationale behind the decisions made in the study whilst omitting the details of some of the stories.

As with the interviews the initial development and roll-out of the qualitative survey was frustrating and disappointing. However, once the returns started to come in it was heartening to see the support that was provided by many people who at the time were working in the middle of a response. Similarly, the feedback from some of the participants who completed the study was encouraging as was the amount of detail provided and the time spent in completing the questionnaires (the average time was just under one hour). I felt disappointed that it was not practicable to issue the questionnaire to a wider audience and pleased at the high return rate and quality of the information contained in those returns.

In analysing the data, I found a great deal that countered the expectations of what I had thought the data would tell me. Based on my own professional experience and reading I had expected that far more emphasis would have been put on elements of teamwork by the respondents and more emphasis on a traditional decision-making methodology. The emergence of new information not reflected immediately in the literature was at once worrying and gratifying. In challenging my own assumptions, I felt that the analysis was more objective, but this could also have meant that there was something wrong with the study. The analysis forced me to go back to the literature and

uncover a theoretical background to explain the phenomena the data was revealing.

Evaluation

The methodology was apt for this descriptive study which required a good understanding of the context and environment in which individuals were working in order to be able to identify the non-technical skills used. Indeed, the study would have been of little value without an understanding of the environment in which it was taking place.

The piloting of both the interviews and the questionnaire reinforced the need to develop research methodologies and tools that would be suitable for the audience with whom you are dealing. It also showed the importance of using explicit language that is open to a minimum of interpretation.

The change in approach for the second phase of the study, moving to a qualitative survey and approaching participants directly delivered richer data than would have been achieved using a survey that relied upon multiple choice selections alone.

Acknowledging and challenging my own biases was a key step in the analysis of the data and provided a rich source of learning.

Summary

The use of the critical decision method identified in the process of the literature review provided a suitable methodology for this study. Whilst the sample size for both the interviews and the qualitative survey were small, they were drawn from a representative sample across a range of professions within public health and for a range of different types of response. This will allow for the results to be applied across a variety of settings and gives credence that they may indicate descriptions of working environments and the non-technical skills used by public health responders that can be applied to a variety of different situations.

APPENDIX D

KEY INFORMANT INTERVIEWS

Interviews were conducted with a purposive sample of 10 individuals with at least 10 years' experience in public health and representing the most deployed roles as defined by the Global Outbreak Alert and Response Network (GOARN) (MacKenzie et al. 2014). These roles are also included as part of the WHO Incident Management System (WHO 2017a) and were selected as a means of obtaining a cross-section of the possible roles fulfilled by public health responders. The participants had a range of professional backgrounds: two were medical doctors, two were communications experts, two were virologists, two were nurses, two were epidemiologists. During the events they described in the interviews they had been working for a range of organisations: UN Agency (8), International NGO (1) and National NGO (1).

The interviews were based on a Critical Decision-Making methodology which is a Cognitive Task Analysis tool (Klein and Militello 2001). Critical Decision Making is a retrospective interview strategy using probe questions to gather information and analyse non-routine events. They were designed to try and capture information around the seven core non-technical skills identified during the literature review.

The interviews took place between October and December 2019. Each interview lasted between 45 and 90 minutes.

- Appendix 1 contains the Interview Schedule
- Appendix 2 contains the Interview Information Sheet
- Appendix 3 contains the Interview Script

INTERVIEW SCHEDULE

STEP ONE CONFIRM DETAILS

1. Participants are asked when approached to identify a response or event during a response in which they were involved. The type of incident or experience that will be relevant to the study is described in the Interview Information and Consent Form (at **Attachment 2**) the Interview Script is at **Attachment 3**. Before proceeding with the interview:

   a) Check that the subject has read the brief sent to them and understands the requirements of the interview
   b) Check that you have the correct equipment (see below)
   c) Ensure that you are in a private room and will not be disturbed
   d) Conduct a sound check on the recording equipment
   e) Confirm name and allocate identity number

STEP TWO SELECTION OF RELEVANT INCIDENTS

2. Select the deployment. Subjects may have been deployed on a number of occasions in different roles. The first stage of the interview requires selection of an appropriate deployment and ensuring that the role that will be described will meet the needs of the study.

a) The role should be of the following:

   i. Coordination in a headquarters setting
   ii. Laboratory
   iii. Social Mobilisation and Communications
   iv. Case Management
   v. Epidemiologist

b) The deployment should be one that meets the following:

   i. An emergency meeting the Red Cross definition where the host nation will have needed international assistance
   ii. Where the subject was working independently or leading a team that was part of a response in which other types of organization were involved and where their work interacted with other teams and organizations
   iii. Where the subject was in a position which required them to make decisions that were beyond their routine or technical knowledge

3. Select incidents. Having selected a deployment the interviewer should then guide the subject in selecting relevant incidents in the course of that deployment. The participant recounts examples of events that may be suitable for further discussion. The interviewer should select events when the subject felt particularly challenged or where their knowledge and influence was counted upon and had an impact on the result of the incident. To select the incident the following criteria should be met.

a) The subject was the “doer or decision maker”
b) The decision maker directly influenced the situation i.e not just observe it
c) The subject felt challenged by the situation
d) The decision the subject made beyond the scope of background or procedural knowledge

4. Once a suitable incident is identified the interviewer allocates a row on the interview sheet to that incident and proceeds to identify further incidents with the subject by repeating the process. The interview sheet is shown as **Attachment 4**.

STEP 3 SELECTION OF DECISION POINT

5. Once the incidents have been selected the interviewer should select that which best meets the criteria set out in step one.

6. The subject is then asked to tell the story of the incident and the interviewer identifies decision points. A decision point will be one that involved

a) Situational Awareness. Gathering information in order to obtain a picture of the situation.
b) Decision Making. Having assessed the situation, the selection of a course of action that altered the situation.
c) Enacting the decision. That the decision was followed by action (although the process for how it was enacted is not a required part of the interview process).

STEP 4 QUESTIONING ABOUT THE NON-TECHNICAL SKILLS USED

7. The decision point is then marked on the timeline using a triangle and examined in detail.

a) The participant repeats the narrative around the decision point and the interviewer at this point must clarify their understanding of the incident and the decisions made. This may mean for example getting the subject to explain jargon or more routine processes.
b) Once the situation and the decision is clear the interviewer inserts probe questions to identify the non-technical skills used to make the decision. The probe questions are based on the core NTS identified by Flin and the behavioural indicators in the NOTSS tool. These are listed at **Attachment 4**.
c) The interviewer is not limited to the probe questions, where the subject describes an issue relating to situational-awareness or decision making that is not covered by the probe questions the interviewer should clarify.
d) Around each decision point the interviewer makes notes creating a mind map describing the details of the incident.
e) These notes can be used to inform questions about the other decisions discussed as part of the interview.

PAPERWORK and EQUIPMENT REQUIRED

8. The interviewer should prepare the following material

   a) Consent Form (Attachment 2)
   b) Information Note (Attachment 3)
   c) Interview Script (Attachment 4)
   d) Number to issue to interviewee
   e) Digital Audio Recorder.
   f) A3 paper to construct the interview mind map (see Attachment 5).
   g) A notebook for additional notes

ON COMPLETION OF THE INTERVIEW

9. In line with the data management plan the interviewer should:

   a) Save interview with file name “YYYYMMDD-Interview-IDNumber”
   b) Transfer the file to Hard Drive for synching with University Server and transfer as soon as possible
   c) Delete audio file from recording device
   d) Enter details onto encrypted excel spreadsheet held on University database and destroy written notes
   e) Check notes for any personally identifiable information, anonymize people and place names
   f) Scan notes and consent sheets destroy original and save pdf copies to University Server
   g) Make a note of any questions to check with subject
   h) Arrange for transcription of audio file
   i) Once transcription complete destroy the audio file

INTERVIEW INFORMATION SHEET

To identify the non-technical skills used by Public Health professionals working in a Disaster environment.

Name of Researcher: Andrew Black
Contact details of Researcher: E:a*******@bath.ac.uk
T: +44 (0) [tel. no deleted]

Name of Supervisor: Alan Buckingham
Contact details of Supervisor: E **********@bath.ac.uk
M +44 (0) [tel no. deleted]

This information sheet forms part of the process of informed consent. It should give you an idea of what the research is about and what your participation will involve. Please read this information sheet carefully and ask one of the researchers named above if you are not clear about any details of the project.

1. What is the purpose of the project:

Public Health staff perform essential roles in emergency and disaster response and are rightly proud of the work that they do. This study aims to identify the personal qualities and skills (called non-technical skills) that public health workers draw upon to help them to work in the challenging emergency environment. This important study will provide an insight to the way in which public health staff are able to work within a response environment and could be used to inform future training.

2. Why have I been selected to take part?

You have been approached to take part in this study because you are a public health professional who has deployed as part of a disaster response. To be eligible for the study you should:

- Have taken part in a deployment where the definition of a "disaster" is met. Disasters are events that "disrupt the functioning of a community or society and causes … losses that exceed the community's or society's ability to cope using its own resources" (International Committee of the Red Cross).
- Should be confident that to recall these events will not cause you upset or anxiety

If you fulfill these criteria and are over 18 you are eligible to take part in the study.

3. Do I have to take part?

No. This study is entirely voluntary. It is up to you to decide whether you would like to participate. Taking part will have no bearing on your employment. If you decide to take part, you will still be free to withdraw your data within two weeks of completing the interview / questionnaire without giving a reason. If the study harms you in any way, you can contact the researcher, using the details below for further advice and information.

4. What will I have to do?

You are being asked to take part in an interview concerning non-technical skills (NTS) and the way in which you used them during your deployment to a disaster or emergency environment in a public health role. The following section explains what NTS are and the definition that we are using for a disaster environment.

The interview will last between 1 and 2 hours and is divided into three phases. You will be asked to describe an experience of working in a disaster or emergency response environment during which you had to make decisions.

You should select a deployment that meets the following:

- Where you were deployed to an emergency where the host nation required international assistance
- Where you were working independently or leading a team that was part of a response in which other types of organization were involved and where your work interacted with other teams and organizations
- Where you were completing a task or were in a position which required you to make decisions that were beyond their routine or technical knowledge

5. Outline of interview process

The interview comprises the following:

a) You will be asked to identify a decision you made during a deployment which meets the criteria above.
b) You will be asked to recount the event. While you are speaking the interviewer will work with you to identify points at which you made decisions
c) You will be asked to repeat the narrative and with the interviewer build a timeline of decision points
d) The interviewer will then ask you questions about the NTS used at each of the decision points.

6. What are the exclusion criteria?

Public Health staff with no deployment experience or have not taken part in a deployment where the definition of a “disaster” is not met.

7. Are there any reasons why I should not take part?

You should not take part in the study if you have no deployment experience or have not taken part in a deployment where the definition of a “disaster” is not met.

You should not take part in the study if you feel that to recall these events might cause upset or anxiety.

8. What are the possible benefits of taking part?

There are no obvious direct benefits of taking part in the research. However, the information that you and other participants provide will help us to understand better the challenges faced by deployed Public Health staff.

9. What are the possible disadvantages and risks of taking part?

There are no obvious disadvantages to you taking part in the research. If you do not want to answer any questions for any reason you can choose not to answer.

10. Will my participation involve any discomfort or embarrassment?

We do not expect you to feel any discomfort or embarrassment if you take part in the project. If however you do feel uncomfortable or appear upset at any time the researcher will stop the interview straight away and may direct you to approach an

appropriate support service. If you feel that this interview may cause you to remember events that you find distressing you should decline to take part.

11. Who will have access to the information that I provide?

Only the research team will have access to the information that you provide. All records will be treated as confidential.

12. What will happen to the data collected and results of the project?

All data collected, including personal, identifiable data will be treated as confidential and kept in a locked cabinet or on a password protected file on the University of Bath's secure server. Data will be handled in accordance with the General Data Protection Regulation. You will be able to access data about your results up to two weeks after participation. Recorded data will not be kept longer than 5 years. Your name or other identifying information will not be disclosed in any presentation or publication of the research.

After the project has finished, we will also provide participants with a summary of the findings if they would like that. The summary will not include any identifiable information and will show the overall findings of the project.

Once the project is completed other researchers at the University of Bath may conduct related research which would benefit from the data that you have provided. Further use of the data will only occur with your consent and the University of Bath's approval, where data will continue to be stored in accordance with the General Data Protection Regulation. So again your name or other identifying information will not be disclosed in any presentation or publication of the research.

13. Who has reviewed the project?

This project has been given a favourable opinion by the University of Bath, Research Ethics Approval Committee for Health (REACH) [reference: 17/18 236].

14. How can I withdraw from the project?

If you wish to stop participating before completing all parts of the project, you can inform the identified researcher in person or by email, telephone or in person. You can withdraw from the project at any point without providing reasons for doing so and without consequence for yourself.

If, for any reason you wish to withdraw your data please contact an identified researcher within two weeks of your participation. After this date it may not be possible to withdraw your data as some results may have already been published. Your individual results however will not be identifiable in any way after presentation or publication.

15. What happens if there is a problem?

If you have concerns about any aspect of this work speak to the researcher who will do their best to answer any questions. If they are unable to resolve your concern, or you wish to make a complaint regarding the project please contact the Chair of the Research Ethics Approval Committee for Health.

Name and email and telephone provided

16. If I require further information who should I contact and how?

The contact details are at the top of this information sheet.

INFORMATION ABOUT NON-TECHNICAL SKILLS (NTS)

Non-Technical Skills (NTS) are cognitive, social and personal skills which augment an individual's technical skills (Flin 2008). They have been widely studied and applied in the aviation industry, the emergency services, surgery and emergency medicine where they are primarily used to improve safety by training staff to increase awareness of their surroundings and improve their decision making, teamwork, leadership and communication skills whilst under pressure.

Although Public Health professionals and other Humanitarian staff working in emergency environments are subjected to similar pressures as domestic emergency responders, the NTS used by Public Health staff and the impact of the emergency environment upon their use has not been studied.

There is no single definition of disasters and emergencies however the commonality is that they both are events that "disrupt the functioning of a community or society and causes … losses that exceed the community's or society's ability to cope using its own resources" (International Committee of the Red Cross).Working in disaster environments challenges staff to: work with more groups than usual, many of which will be unfamiliar to them; (CARE 2005, Global Public Policy Institute 2010, UNDP 2016) have a different level of autonomy; operate to different standards (Owen and Hayes 2014); and work under stress (McLennan et al 2014) in rapidly changing environments to which they must adapt (Comfort and Kapacu 2006, Red Cross 2012).

Much of the research and training around NTS have concentrated on individuals working within small, well defined teams such as surgical teams, fire-fighting crews or military units. However, there is an increasing need to examine these skills in the context of emergency response which will require them to be examined in the context of multiple teams (Comfort and Kapacu 2006, Farazmand 2007).

This research seeks to address gaps in the current research in NTS by identifying the NTS used by Public Health staff working in an emergency in an international or humanitarian context and how working alongside multiple teams can impact on the use of those NTS. It is hoped that the findings from this research will be of value when training the Public Health staff who intend to work as part of a Humanitarian or emergency response.

The table overleaf shows describes the NTS that we will speak about in this interview.

Table 1: Core non-technical skills with a brief explanation (adapted from Flin 2008)

Skill	Elements
Situation Awareness	Gathering and interpreting information, anticipating future states. Situational awareness is the ability to picture and assess a situation. It plays a major part in decision-making. A lack of situational awareness can lead to staff fixating on relatively minor problems and failing to acknowledge larger dangers or failing to identify the most important problems to be addressed.
Decision-making	Defining a problem, considering and selecting options: In the context of emergencies decision-making requires reaching a judgement about the situation, choosing a course of action (often rapidly and with limited information) and then reviewing that decision as part of an on-going process
Communication	Sending, receiving and contextualising information. Poor communication has often been cited as a cause of accidents. It can be shaped by policy (for example the use of jargon) but also requires staff to not only send but to receive information appropriately.
Team working	Supporting and coordinating. A key factor is about making individuals more effective in the teams in which they are working. This focusses on how team members define tasks and roles in order to work more effectively
Leadership	Planning, use of authority, maintenance of standards and discipline. Effective planning and coordination within a team and with other teams is a key element of the response.
Managing Stress	Identifying causes of both chronic and acute stress, recognising the symptoms and effects and implementing coping strategies
Coping with fatigue	Identifying the causes of fatigue, recognising the effects of fatigue and implementing coping mechanisms

INTERVIEW SCRIPT

Read aloud the script in italics

INTRODUCTION

Thank you for agreeing to take part in the interview to identify and examine the use of non-technical skills in a disaster response environment.

Collect consent form and issue number

You will be allocated a number as part of the study so that you cannot be identified. Your number will be [insert number] should you require information about the interview you can use this number.

During the interview I will be asking you to recall events from your deployment. If this may cause you any distress, please let me know and we will stop the interview. Remember, that it is absolutely fine to withdraw from the interview at any time.

Before we proceed do you have any questions?

I am going to start recording. I will do a quick test for sound and then proceed with the interview.

Explanation of interview process

We are going to conduct an interview based on a technique called Cognitive Task Analysis. I will ask you to describe decisions that you found challenging to make and which went beyond routine decisions. We will be discussing how you assessed the situation, how you identified that a decision needed to be made, and then factors that influenced that decision.

This interview concerns non-technical skills and the way in which you used them during your deployment to a disaster environment in a public health role. I have provided you with an information sheet explaining what non-technical skills are and the definition that we are using for a disaster environment. I am particularly interested in the organizational factors that may have impacted your use of non-technical skills.

The interview will last between 1 and 2 hours and is divided into three phases.

In Phase One we will select an appropriate deployment and an incident or incident(s) during that deployment. I am going to ask you to describe a challenging decision or decisions that you had to make whilst you were deployed as part of an emergency response.

In Phase Two I will ask you to repeat your account of each decision and will ask questions related to the non-technical skills you used. During this phase we will plot the decisions on the A3 paper and draw a mind-map of the decisions and non-technical skills used.

In Phase Three we will revisit the decisions and I will ask you to confirm any details and also to consider what you might have done differently.

So, we first need to consider which deployment that we are going to talk about:

PHASE ONE – SELECT INCIDENT

Select deployment. *The deployment should be one that meets the following:*

a) *An emergency meeting the Red Cross definition where the host nation will have needed international assistance*
b) *Where you worked independently or where in a team that was part of a response in which other types of organization were involved and where your work interacted with other teams and organizations*
c) *Where you were in a position which required you to make decisions that were beyond your routine or technical knowledge*

Please select a deployment which was an emergency in which the usual resources of the national government had been over stretched and so they needed support from other organizations. It is best if you can identify a response in which you had interaction even informally with organizations and teams other than your own. It also needs to be a response during which you were required to take a decision which you found challenging to make.

Select incidents. Once a deployment is selected ask the participant to identify an incident. Select events when the subject felt particularly challenged or where their knowledge and influence was counted upon and had an impact on the result of the incident.

Thank you I would now like you to think about an incident which you found challenging and where you had to use knowledge beyond your routine or technical knowledge to make a decision and respond to that situation. I need you to think of an incident where:

a) *You were the "doer or decision maker"*
b) *Your decision directly influenced the situation i.e., you didn't just observe it*
c) *You felt challenged by the situation*
d) *The decision you made was the scope of background or procedural knowledge*

Confirm details of the deployment

Once a suitable deployment and incident have been selected confirm the following with the subject and make a note.

1. Name and contact details (email and telephone)
2. The length of time that they have worked in Public Health
3. The response which they are referring to?
4. The dates of that deployment?
5. Their role during the deployment?

PHASE ONE - DESCRIBE DECISIONS

The aim of this part of the interview is to get you to talk freely about your experience. I will use some open-ended questions to help me understand better what you are talking about. I may prompt the conversation to keep you to time or to help you shape your story.

The interviewer can prompt conversation. Take notes and listen particularly for examples around the core non-technical skills of situational awareness, decision-making, communication, leadership and teamwork. You may identify other non-technical skills during this element of the interview in this case you should ask follow on questions which will explore the multiteam aspects of the response.

PHASE TWO – IDENTIFY AND DISCUSS DECISION POINTS WITH REFERENCE TO NTS

In this part of the interview, I am going to try and learn a bit more about the non-technical skills that you used and how you used them. You may remember from the information sheet that I sent you that the most common non-technical skills used are: situational awareness, decision-making, communication, leadership and teamwork. During your description of the event, you referred to a number of items which I would now like to explore in the context of non-technical skills.

Situation Awareness – follow on questions that may be used to prompt discussion

Situation awareness is about developing and maintaining an awareness of what is happening around you and building up a picture on which to base your decisions. Can you tell me:

- *Had you encountered a similar situation before?*
- *How did you gather information about the incident that led to your decision?*
- *Did you use these information sources routinely?*
- *Were they formal or informal information sources?*
- *Describe the formal and informal information sources*
- *What did other organizations or people understand of the situation?*
- *How did other organizations or people influence your view of the situation?*
- *If you gathered information from informal sources how did you tally this with routine and formal information that you were receiving?*
- *Did you discuss the situation with anyone else to help you make sense of it?*
- *How did you predict what was likely to happen next given the information available to you?*
- *On what did you base your prediction? (for example, prior experience of a similar situation)*

Decision-making - follow on questions that may be used to prompt discussion

Decision Making is about selecting an appropriate course of action based on the information that you have available. Please remember I am not interested in whether the decision was the right or the wrong decision, rather I am interested in how you came to take the decision that you did.

- *In reaching a decision did you consult with other people?*
- *If you did consult with other people how and why did you select them?*
- *Explain your decision-making process did you consider a number of options or only one? Why?*

- *What were the criteria you used to narrow down your options or justify your choice of only one option?*
- *Did you consult any published guidelines, or other kind of direction from colleagues or other organizations (for example did you take into account directions from superiors)?*
- *Who did you inform about your decision?*
- *How did you inform others about the decision?*
- *Did you have a Plan B?*
- *How did you consider any risks that would result from your decision?*
- *Did you have to change your plan?*

Leadership – follow on questions that may be used to prompt discussion

- *(How) did you tell people about your decision before enacting it?*
- *(How) did you consult with colleagues about how best to enact my decision?*
- *In taking the decision what consideration did you give to the welfare of colleagues?*
- *(How) did you balance the welfare of colleagues against enacting the decision?*
- *(How) did you assign tasks?*
- *Did your decision favour any group or individual above others?*
- *Describe how you coordinated the team*

Communication – follow on questions that may be used to prompt discussion

- (*How) did you inform people about the decision you had made?*
- *(How) did you listen to the opinions of colleagues and other stakeholders?*
- *Did you brief people about your plan?*
- *How was the briefing done, formally and centrally or informally on a one-to-one basis?*
- *(How) did you ensure that members of your team and other teams, were comfortable with the decision you had made?*

Teamwork – follow on questions that may be used to prompt discussion

- *(How) did you involve other members of your team, or of other teams, in your decision-making process?*
- *If others were involved in enacting your decision how did you involve them?*
- *(How) did you prioritise and allocate tasks?*
- *If others disagreed with your decision or your mechanism for implementing it how did you deal with that?*

Stress and fatigue – follow on questions

- *Do you consider that you may have been stressed or fatigued at the time?*
- *If so, what impact do you think this had on your decision?*
- *If you found the situation stressful how did you deal with this?*
- *Do you think that the situation caused stress and / or fatigue for your team or other stakeholders?*
- *If so (how) did you address this?*
- *Did you debrief yourself, your team and other stakeholders?*

PHASE THREE – CHECK UNDERSTANDING

Go back through the interview and check your understanding of the events and the NTS used. Clarify the use of acronyms and agree with the interviewee how people and organisations can be anonymised. Thank the interviewee and ask them if they have any questions. Remind them of your contact number and that they have two weeks to withdraw from the study if they so wish.

Remind them of the contact details for the Occupational Health Departments [numbers have been removed]

APPENDIX E – QUESTIONNAIRE DESIGN

Table 9: Table used to help design the questionnaire indicating questions, rationale, expected answers and references

<table>
<tr><th>Question</th><th>Rationale</th><th>Expected answer</th><th>Reference</th></tr>
<tr><td>SECTION A ABOUT YOU
Your gender M/F/Prefer not to say</td><td>To get a sense of who is answering the questionnaire different genders may give different types of answers</td><td>M or F</td><td></td></tr>
<tr><td>How many years have you worked in public health emergencies?</td><td>To picture those with over 10 years' experience who thus fall into the expert camp</td><td>5-25 years</td><td>Klein et al 2010</td></tr>
<tr><td>Which country are you from?</td><td>As with gender the approach to NTS especially leadership and comms is shaped by culture</td><td>Country name</td><td>Livingstone et al. 2014</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>6. Thinking about the team in which you worked please answer the following

<table><tr><td></td><td>LIKERT SCALE</td></tr><tr><td>A</td><td>I was working mainly with a single set team from the same organization</td></tr><tr><td>B</td><td>I was in a team comprising people from multiple organizations</td></tr><tr><td>C</td><td>I worked with a variety of teams from various organizations or disciplines</td></tr><tr><td>D</td><td>I was coordinating a number of different teams</td></tr></table></td><td>This set of `questions is designed to do 2 things

a) To help the individual remember the incident by asking when the incident was, where and what was the working environment. This kind of prompt can be useful especially because for some of the participants the incident may have been sometime in the past (the last large deployments were Ebola west Africa)
b) Help the researcher understand the context in which the participant was working at the time of the incident. Working in an international HQ may cause people to use very different set of skills than out on the ground for example</td><td>Majority answers will be B and C as this is the common deployment, multi-sector or team working is common. Fewer people will answer D as there are fewer coordination roles. Answer A will be for those working in lab roles</td><td>These descriptions of teams match those of the descriptions provided by the participants in the interviews

The lab information from the lab experts interviewed both key informants and the pilot

The structure of teams can have an impact on situation awareness (Sorensen and Stanton 2013, Klein Wiggins and Dominguez 2010,</td></tr>
</table>

7. What best describes the specialism you were working in during the response (select one): (a) Emergency Management and or planning (b) Epidemiology and/or information collection and analysis (c) Clinical or Health operations (d) Risk Communications and Community Engagement (e) Laboratory (f) Logistics (g) Administration (h) Other please write (free text)	This is to help answer one of the research questions about whether public health staff working in different technical functions use different NTS.	Most respondents will be epis as this makes the up the bulk of deployments – however there should also be a sizeable clinical and lab component … because lab is a special environment in that it is very local and small team based it is separated out here	The list is from the list used for the interview selections which based on GOARN and the WHO ERF which outlines the key roles for a public health response As above information about lab working is from participants' descriptions of lab deployments. Also reflects the networks that can be approached to complete the questionnaire
8. Please give a brief description of the response or incident on which you wish to report and why you found it challenging (100 words)	This is included for 2 reasons a) It will help the participant to remember the incident and b) It will help the researcher understand the context and overall story of the incident By encouraging them to think about a single incident it focusses their mind other than the possibility of getting rather general answers concentrating on the description of particular incidents rather than decisions	Mixed answers –	In the interviews people either found this very easy to answer or very difficult. They had trouble identifying individual incidents. Even in the interviews the shortest incidents lasted a few hours they were not quick … In interviews participants found it easier to examine incidents rather than decisions, one incident often covered a multiple of decisions

			It also will act as a memory cue in the same way as the original question did in the CTA interviews
SECTION C: **We are interested in how you gathered information about the response whilst you were working in it. Think about both the meetings and briefings you attended but also about conversations and interactions you had with colleagues, officials and others outside of these meetings. Please think carefully about all the different sources of information and interactions you had and then answer the following**	The process of decision-making is divided into the three sub-sets for the purpose of this questionnaire. This is a shortening of other decision-making models. The rationale for shortening it is to make the questionnaire more manageable and also to use layman's terms that the participants can easily relate to. The decision-making process is broken into steps as this will aid memory and analysis … it's an easy question to warm the participant up Prompts are provided in the text to encourage people to think outside of the formal information they would get around the COP and `epi data and think also about times when they were using their NTS rather than technical skills	No answer questions below	Information gathering was something that the participants were able to remember in the interviews It forms the first stage of decision-making (Crandall and Klein 1985, JESIP, Alison et al 2015) and is key to the performance of teams Endsley and Robertson (2000) The use of prompts is balanced by the need to put the participants into the right ballpark
LIKERT SCALE A I RELIED MOST ON information from formal sources such as briefings or situation reports B I RELIED MOST ON information only from informal sources such as discussions outside of formal settings (for example outside of	This will help the participants to remember the incident by refreshing their memory about the different sources of information	Expecting to see an even balance between formal and informal people based in HQ esp. at international level will emphasise formal sources – based on interviews it may be also that lower ranking staff do	These prompts are based on the information given by the participants during the interview phase where they described the use of the informal and formal information sources – this is also backed by the literature

meetings, after work or in social settings) C I RELIED MOST ON discussions with members of my immediate team or organization to help me understand the situation D I RELIED MOST on information people from other teams or organizations to help me to understand the situation		also (this was the experience of the pilot)	Kapacu (2011), Stephenson (2005) and Lipsom (2005) have argued that the only way of generating meaningful coordination in such environments is through informal networks.
Thinking about the incident again please describe how you gathered information about the situation and looking back what (if anything) would you do differently if you faced this situation again?	As above	As above	As above
***SECTION D*: Thinking about HOW you made a decision can be difficult. It doesn't matter whether you feel the decision you made was right or wrong we are interested in the process you followed to choose a particular course of action.**	The second part of the decision-making process is choosing an option (making a decision). We are inter in how the decision is made in order to help people think that there is no judgement about the decision selected (no right wrong)	No answer required	The definition of the NDM from Klein 1985 The need to make people feel at ease and that they are not being judged
LIKERT SCALE A I carefully considered several courses of action and judged each	The prompts are designed to refresh the memory of the participants	I expect that information on this topic will be sparse or it will generally of the type that indicates	4A decision-making tool 4B this what seemed to be the model reported in the interviews

	on its merits. I chose the best option B I made the decision myself and then discussed with colleagues about how to proceed C I had a discussion with colleagues, and we decided jointly what we should do D I felt that it was important to have advice from others in taking this decision E I discussed the pros and cons of the decision with colleagues and stakeholders from other organizations F I made my decision based on my experience; I did not need to consult with others G I referred to published guidelines or other formal documentation in order to make my decision	It also helps with the analysis as we can identify what the majority thinking was when the participant made the decision The models are taken from the description of classic decision making that is reflected in decision-making tools and information from the interview	that the participant discussed the information with colleagues and that they jointly decided …	4C this can be described as a joint decision-making model (JESIP) 4D joint decision-making (JESIP) 4E is also joint decision-making but going outside of the immediate circle into the MTS 4F this is an example of Recognition Primes Decision Making 4G published guidelines exist and protocols exist for response designed to aide decision-making
This question is designed to think about how you worked with colleagues to form your own and other organizations to get things done		The third element of taking a decision is the enactment of that decision … this also links closely to the leadership functions	No answer	Based on the interviews where people described having to work across teams and from MTS literature
	LIKERT SCALE A I took charge and assigned tasks to other people and teams	In the interviews participants described how taking action between multiple teams worked more organically than a traditional project management style of team leadership. These choices are designed to give an indication of	I expect the predominant answers to be C and E certainly among the more senior staff … among the more junior staff A and B will be the most popular	These questions are based on the responses provided by the participants during the interview and the leadership taxonomy of immediate actions for a

B	I took charge but worked with other people and groups to decide who should do what	which model of taking action was favoured in practice. These questions reflect a balance of the traditional leadership functions and the information gathered during the interviews These questions also serve to help participants think about the actions that they took	answers because they are dealing with smaller teams where direct control is easier	Leader from (Yukl et al 2002) which is Plan short term activities, clarify tasks, monitor operations and the functions listed by Adair (2009): plan, define purpose-aim-objective, communicate, control, monitor.
C	We worked as a group to identify who had the technical knowledge and resources to perform particular tasks			
D	All the teams worked separately to achieve their own goals			
E	We all agreed a common goal, but all worked in our own teams to achieve it			
F	All teams worked together we even used mixed teams of people from different organisation to make best use of skill and resources s			
SECTION E **Working in emergencies means working in difficult conditions often under pressure and sometimes in danger. Working in these conditions requires a particular set of skills and qualities. Thinking about your own skills and qualities and those of colleagues you have worked with over the years in emergencies. What do you think is the most important quality you need to work in emergencies? Why is**		This was an element brought up for each of the interviews brought to the attention a range of elements that could not be easily coded but seemed to sit within the realm of having the ability to manage emotion and remain objective … it was a behaviour that allowed people to remain calm under pressure and underpinned their ability to make decisions and manage the relationships they needed to in order to progress with their mission	A range of answers are expected here but I am expecting that they will broadly reflect the information given in the interviews	This is based on the issue of resilience raised by the interviewees

this quality so important? What would your advice be to someone who was starting out working in emergencies?			

QUESTIONNAIRE MATERIALS

Introduction

This survey was used as a way of validating the coding developed during the interview phase with a larger and more diverse audience and for checking the validity of the importance of the creation of networks and the role of joint working in the multiteam system. The survey was delivered using Microsoft Forms and ran between January and May 2021.

Participants

Forty-six questionnaires were completed with public health staff from a range of professional backgrounds.

Overview of the categories

The questionnaire was divided into sections reflecting different parts of the decision-making process. These were: gathering information and sensemaking; decision-making and enacting the decision. To cover the personal control elements the participants were asked to identify the skill they felt was most essential for working in emergencies and what advice they would give to someone who was considering a career in emergencies.

Each of the decision-making sections was preceded by a series of tick-box Likert scale questions. These were designed as memory prompts for the participants but also provide an overview of the way in which they approached each of these tasks.

- Appendix 1 to this Annex contains the email that was sent to participants.
- Appendix 2 to this Annex is a copy of the Questionnaire that was issued on Microsoft Forms.

EMAIL TEXT FOR QUESTIONNAIRE

Dear [insert name]

I hope this finds you well.

I realise that you are very busy at the moment but wanted to ask for a little help. I am currently in the final stages of Doctorate studies at the University of Bath in UK.

I would be very grateful if you could find time to complete this survey for the final part of my studies and also advise me on other people I might approach to get it completed (I am happy to write to them direct)?

The link to the survey is here *Public Health Teamwork survey*

The survey is relevant to all staff working in public health response but input from experienced personnel with your breadth and depth of experience would be particularly welcome.

The survey looks at how public health staff work together during emergencies and will help to develop training for health emergency preparedness and response.

Thank you very much

Andrew

Aim of the research

The doctorate examines the non-technical skills used by Public Health professionals working in emergency response.

Non-Technical Skills is a term used to describe behaviours that help people to work with others, communicate effectively, make decisions and lead groups to carry-out work and manage stress and fatigue. Research has shown that people and teams with high levels of non-technical skills work more effectively.

The findings from this research will help to develop training and ways of working for staff working in emergencies.

I would be grateful if you would be able to spend some time to share your experience of working in emergencies to help shape learning for the public health professionals of the future by completing this survey.

The survey is anonymous, and all names and names of organisations will be anonymised.

The survey takes between 40-60 minutes to complete.

QUESTIONNAIRE TEXT ONLINE

Non-technical skills used by public health experts working in emergency response

Thank you for taking part in this survey to examine the use of non-technical skills in an emergency response environment. Non-Technical Skills (or transversal skills) is a term used to describe behaviours such as leadership, understanding our environment, decision-making, communication, teamwork and managing stress.

WHY IS THIS QUESTIONNAIRE BEING ADMINISTERED?
Working in public health emergency preparedness and response requires a unique combination of non-technical skills alongside strong technical skills. There is no clear consensus on which of these skills are most relevant. This questionnaire is part of a Doctorate that aims to bring clarity to this area. When published, it will contribute to the growing body of evidence to support institutions such as national governments and WHO that are investing in developing leadership skills in anyone who works in health emergencies. The information that you provide will help us understand the challenges faced by public health staff working in emergencies and how they overcome these challenges. The results will be used to help develop training for public health responders and leaders.

HOW TO COMPLETE THIS QUESTIONNAIRE
Please read the following information carefully as it will help you to answer the questionnaire. It will take between 40-60 minutes to complete.

Where asked to please provide as much information in your answer as possible. Your answers will be subjected to a qualitative analysis that will rely on the detail you provide.

In this questionnaire you will be asked to reflect on an event that was a challenging situation you faced where you were forced to make a decision whilst working in emergency response. The event should be one which meets all the following criteria.

a. More than one team and / or sector was involved in the response
b. You were the "doer or decision maker" (or part of the decision-making team)
c. The decision directly influenced the outcome of the situation i.e., you didn't just observe it
d. You felt challenged by the situation
e. The decision you made was beyond the scope of background or procedural knowledge – i.e., it was not a routine decision but one that forced you to adapt your usual ways of working.
You will be asked to describe in detail

- a challenge that you faced whilst working in an emergency
- how you made sense of the situation
- how you took a decision
- how you enacted the decision

You should reflect on these questions before you start the questionnaire.

All information will be anonymized: no names of individuals, organizations or other identifiable information will be used or published in the thesis.

This project has been given a favourable opinion by the University of Bath, Research Ethics Approval Committee for Health (REACH) [reference: 17/18 236].

If you have concerns about any aspect of this work contact the researcher who will do their best to answer any questions. If they are unable to resolve your concern, or you wish to make

a complaint regarding this project please contact the Chair of the Research Ethics Approval Committee for Health.

Researcher: Andrew Black adb53@bath.ac.uk (mailto:axxxx@bath.ac.uk) Tel: +44 (0) 7812994454
Chair of the Ethics Committee Dr James Betts J.Betts@bath.ac.uk Tel: +44 (0) 1225 383448

Please read the following information and provide your consent to the participate in the survey.

a. Are there any reasons why I should not take part?
You should not take part in the study if you have no experience of working as part of a public health emergency response or if you feel that to recall events about your work in response might cause upset or anxiety.

b. What are the possible benefits of taking part?
Participation will help you to reflect in a structured way on a past challenge and thereby contribute to you own learning as a current or future leader. The information that you and other respondents provide will help us to understand better the challenges faced by Public Health staff working in emergencies and the non-technical skills that are most important in those situations. Your voice will be heard, and you will feel the satisfaction of contributing to moving the area of leadership in emergencies forward.

c. What are the possible disadvantages and risks of taking part?
There are no obvious disadvantages to you taking part in the research. If you do not want to answer any questions for any reason you can choose not to answer.

d. Will my participation involve any discomfort or embarrassment?
We do not expect you to feel any discomfort or embarrassment if you take part in the project. If, however you do feel uncomfortable or upset at any time please stop the questionnaire. If you feel that this survey may cause you to remember events that you find distressing you should decline to take part.

e. Who will have access to the information that I provide?
Only the research team will have access to the information that you provide. Information collected in this survey and all records will be treated as confidential.

f. What will happen to the data collected and results of the project?
All data collected, including personal, identifiable data will be treated as confidential and kept in a locked cabinet or on a password protected file on the University of Bath's secure server. Data will be handled in accordance with the General Data Protection Regulation. You will be able to access data about your results up to two weeks after participation. Recorded data will not be kept longer than 5 years. Your name or other identifying information will not be disclosed in any presentation or publication of the research. Once the project is completed other researchers at the University of Bath may conduct related research which would benefit from the data that you have provided. Further use of the data will only occur with your consent and the University of Bath's approval, where data will continue to be stored in accordance with the General Data Protection Regulation. So again, your name or other identifying information will not be disclosed in any presentation or publication of the research.

g. How will the data be used?
The data will be analysed in accordance with strict ethical and research standards and will be published as a Doctorate in Health Thesis supervised by the University of Bath. Once published, the findings will be openly accessible and available to other researchers, national governments or international agencies such as WHO that are investing in strengthening leadership in health emergency response.

h. How can I withdraw from the project?
If you wish to stop participating before completing all parts of the project, you can inform the identified researcher by email, telephone or in person. You can withdraw from the project at any point without providing reasons for doing so and without consequence to yourself. If, for any reason, you wish to withdraw your data please contact the researcher within 2 weeks of your participation. After this date it may not be possible to withdraw your data as some results may have been published. Your individual results will not be identifiable in any way after presentation or publication.

1a. I consent to participate in the research study. I understand the purpose and nature of this study and I am participating voluntarily. I understand that I can withdraw from the study at any time without penalty or consequences

[tick box if selected proceeds to q.2]]

1b. I do not consent to take part in this study

[tick box if selected exits survey]

2. I grant permission for the data generated from this survey to be used as described above *

Yes
[tick box if selected proceeds to q. 3]

No
[tick box if selected exits survey]

SECTION A - ABOUT YOU
This section aims to find out about you and your experience working in public health

3.What is your gender
Female
Male
Prefer not to say
Other [free text]

4.How many years have you worked in Public Health?

Insert free text

5.How many years' experience do you have of working in public health emergencies?

Insert free text

6.Which country are you from?

Insert free text

SECTION B - Select an Incident
In order to answer this questionnaire, we will need you to reflect on a challenging situation you faced where you were forced to make a decision whilst working in emergency response.

The event should be one which meets all the following criteria
a. More than one team and / or sector was involved in the response
b. You were the "doer or decision maker"
c. Your decision directly influenced the outcome of the situation i.e., you didn't just observe it
d. You felt challenged by the situation
e. The decision you made was beyond the scope of background or procedural knowledge – i.e., it was not a routine decision but one that forced you to adapt your usual ways of working

Take a few minutes to think carefully about the incident and then answer the following:

7. In which country were you working at the time of the event?

Insert free text

8.What was the response you were working in?

Insert free text

9.What year did you start working in the response? *

Insert free text

10. If you deployed what year did you deploy?

Insert free text

11. What type of organization were you based in for your response role? (select all that apply) *
Ministry of Health
Other Ministry
UN Agency
NGO

Other [free text]

12. Please select the best description of your main or primary work base during the event you want to describe

In an International Headquarters
In a National Headquarters or Government Ministry
At a sub-national (state or province) level in a country
At a local level or community level

Other [free text]

13. Thinking about the team in which you worked at the time of the event select the option(s) that best describe the way in which you were working *

I was working mainly in one team with colleagues from the same organization
I was working mainly in one team with colleagues from multiple organizations
I was working across a variety of teams from various organizations or disciplines
I was leading or coordinating a number of different teams

Other free text

14.What was your role at the time of the event? *

Insert free text

15. In as much detail as possible. Please describe the challenging situation you faced and the decision you made. Your answer will be subjected to a qualitative analysis so please be as descriptive and detailed as possible. You may find it useful to use the questions above and the following questions useful as a guide: What were the circumstances leading up to the event? who else was involved? Where did the event happen? how did you feel at the time? What was the decision that you made and why did you make that decision? What was the result? (There is no word limit for this answer although most people normally write 200-300 words) *

Insert free text

SECTION C – GATHERING INFORMATION

Gathering information and understanding the situation you are in is the first step in making a decision. Think about the meetings and briefings you attended and also about conversations and interactions you had with colleagues, officials and others outside of these meetings. Please think carefully about all the different sources of information and interactions you had and then answer the following. [select options on Likert scale]

16. Think about how you got the information you used to make your decision. Which information did you feel you relied on? (please put an answer for each option) *

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
I relied on information from formal sources such as technical briefings or situation reports					
I relied on information from informal discussions outside of meetings, after work or in social settings					

17. Which people did you get information from? Which sources of information did you use to help inform your decision? (Please put an answer for each option) *

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
I used information from members of my immediate team or organization					
I used information from people and colleagues from other teams and organizations involved in the response					
I used information from members of the public that I met					
I read people's body language					

18. Thinking about the situation again please describe how you gathered information about the situation. Your answer will be subjected to a qualitative analysis so please be as descriptive and detailed as possible.You may find it useful to use the questions in this section and the following information as a guide. We would like to understand who you spoke to, in what setting you spoke to them, how you knew them and how you gathered the information. Did you speak to more than one person? Where did you meet with them? If you used printed sources which ones did you use? Did you trust the information you were provided with? If not how did you check your information was correct? (There is no word limit for this answer although most people normally write 200-300 words) *

insert free text

SECTION D – MAKING A DECISION

Thinking about HOW you made a decision can be difficult. Some decisions are easier to make than others and some can be almost automatic. So, please take your time answering these questions and remember we are interested in the process you used to make your decision, not whether the decision was right or wrong.

19. Think carefully about HOW you made your decision and answer the following questions. (Please put an answer for each option) *

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
I carefully considered different courses of action, assessed each one and chose the best option possible					
I made the decision myself based on my previous experience					
I had a discussion with colleagues, and we decided jointly what we should do					
I followed standard operating procedures or guidelines to make my decision					

20. Thinking about the event again please describe how you made your decision. You may find it useful to use the questions in this section and the following questions as a guide. Can you describe the moment you made your decision? Or did your decision just seem to grow out of events? Did you make the decision alone or in a group? It may help you to describe when you thought you had made the right decision and why you felt it was the right thing to do. (There is no word limit for this answer although most people normally write 200-300 words) *

Insert free text

SECTION E – TAKING ACTION

Taking action is the third step in decision making. It's about HOW you made positive steps to implement the decision you had made. We can either do this on our own or with others.

21. Thinking about how you allocated roles and tasks to implement the decision answer the following (please put an answer for each option) *

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
I took charge and assigned tasks to other people					
I took charge but consulted with other people and groups about who should do what					
We worked as a group to identify who had the technical knowledge and resources to perform particular tasks					
There were no other people involved I acted on my own					

22. Thinking about how teams or individuals worked to carry out their tasks answer the following (please put an answer for each option). *

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
All teams worked separately to achieve their own goals					
We all agreed a common goal but worked separately in our own teams to achieve it					
All teams worked together, we used mixed teams from different organizations to make best use of skills and resources					
There were no other teams involved, I acted on my own					

23. Thinking about the event again please describe how you took action to implement your decision. You may find it useful to use the questions in this section and the following as a guide. What action did you take to enact the decision? Were you in a group when the decision was made? Would you describe yourself as being in charge, directing people to fulfil tasks or did people take responsibility for their own actions? How did you know when the decision had been carried out? (There is no word limit for this answer although most people normally write 200-300 words) *

insert free text

SECTION F – WHAT ADVICE WOULD YOU GIVE?

Working in emergencies means working in difficult conditions often under pressure and sometimes in danger. Working in these conditions requires a particular set of skills and qualities. Think about your own skills and qualities and those of colleagues you have worked with over the years in emergencies and answer the following.

24. What do you think is the most important personal quality you need to work in emergencies and why? (There is no word limit for this answer although most people normally write 200-300 words) *

insert free text

25. What advice would you give to someone who wanted to start a career working public health emergencies? (There is no word limit for this answer although most people normally write 100 words)*

insert free text

Thank you for taking part in this survey
When you have completed the questionnaire please click submit below.

APPENDIX F - A SUMMARY OF THE NTS USED BY PARTICIPANTS IN THE RESPONSE ENVIRONMENT

Sensemaking:

Sensemaking was identified as a key element across all the NTS. It covers information gathering, analysis of the information and predicting future states to develop a coherent picture of what is happening in the response at a given point in time. NTS that supported sensemaking were:

- Aware of capacity and capability. Being aware of the resources and skills available in your team or organization and in other teams and organisations and how these contribute to the achievement of the mission and distal goal.
- Maintain Awareness of the distal goal. Being aware of and shaping efforts to meet the overall response goal. Looking to future states that need to be achieved or may occur.
- Combining information. Gathering, combining, prioritising and analysing information from a range of formal and informal sources to develop situation awareness.
- Information sharing Proactively giving and receiving information with other parties.
- Understanding context. Having knowledge of the different responding organisations and the socio-cultural factors and immediate environment that impact on populations or the roles of organisations.
- Information reviewing. Verifying that information and decisions are still relevant as decisions and their enact take place over a period during which the situation can change

Decision-making

Decision-making describes the point at which a decision is made (i.e.: when a strategy is selected). The selection of a strategy or course of action in the MTS. NTS needed to support effective decision-making were:

- Individual decision-making. An individual identifies and enacts a strategy or course of action without consulting others, through processes RPD or analysis of factors or a combination. It also applied to decisions made following standard operating procedures or guidance.
- Joint decision-making. Two or more people arrive at a decision that is to the satisfaction of the group. Often, the solution to a problem or a proposed action was provided by an individual who had made the decision alone and then debated by the group. There are examples where joint decision-making was arrived at by brainstorming a joint solution.
- Setting priorities. This skill is linked to both personal control, managing information and risk. It involved the ability to decide on a course of action and balancing immediate gain with longer term maintenance of the response. This also includes balancing the priorities of the mission over personal beliefs.

Leadership
Leadership required a variety of NTS which overlap with other categories. The following were the NTS which most closely related to supporting collaboration between groups in the MTS. - Adaptability. The ability to change or alter decisions and priorities based on an unforeseen situation. It also included the capacity to identify learning from experience and act on it. - Empowering stakeholders. Providing teams and individuals with the ability to act collaboratively by managing group dynamics: identifying and mitigating potential differences between groups or individuals or balancing the needs of groups and the needs of the mission. - Using Initiative. Taking the lead in planning and decision-making to proactively address situations or problems. This could be done as an individual or by bringing together and empowering a group. Being able to judge when to act beyond one's mandate. - Identifying and using resources. Identifying and procuring assistance either from technical colleagues and also about seeking out moral or psychological support. Factoring in availability of resources or funding affects the into the decision-making process or way of working; appropriate tasking of teams and individuals. - Risk management. Assessing and managing risk; including maintaining staff safety. - Personal management. Distinct from personal control this required participants to be able work in in accordance with an established procedure or guidance and manage tasks and timetables. - Providing support. Providing physical support such as working with other teams to achieve an outcome or psychological support by providing advice or encouragement or thanks
Collaboration and teamwork:
Collaboration and teamwork have been combined because there were few examples of distinct teams. Behaviours used to support effective collaboration were: - Shared leadership and responsibility. Shared leadership and responsibility by groups and individuals within the response working towards a common goal. Recognising the need for multiple skill sets or functions and teams to build situation awareness and enact decisions. - Understanding the roles, responsibilities and capacities of stakeholders. Collaboration required knowledge of the other partner's needs, capability and capacity and the ability to fulfil agreed ways of working This helped to set the conditions for the different teams to work together. - Adapting ways of working. Adapt ways of working to preserve relations and deliver the distal response aim. It has links with negotiation and communication as ultimately it is about understanding the needs of other parties and compromising individually held opinions for the greater good
Communication
Communication is more than a means of sharing information. It is also a key element to creating networks, teams and building trust between different responders. Individuals and teams needed to persuade others about the value of their work to the response for advocacy or to influence joint decision-making. NTS used to support effective communication were:

- Briefing. The ability to deliver verbal or written information concisely and accurately.
- Persuade and argue. Facilitate joint decision-making and advocacy participants needed to be able to formulate an argument to make a case for a particular course of action that resulted in a change or is intended to result in a change of direction.
- Negotiate. Negotiation was required to overcome barriers to cooperation and in the joint decision-making process to bring parties towards agreement on a common strategy.
- Provide technical information. Communicating technical information in clear language orally or by creating written technical guidance and advice or using body language.

The skills listed above were supported by communication used as a means of developing and maintaining relationships and trust.

- Conduct Informal conversation. Informal conversations were used to gather and exchange information and build relationships and trust. These conversations could be ad hoc or planned but were deliberately informal. This included conversations with colleagues, responders and members of the public.
- Listening. Listening is a key skill in relationship building and sensemaking. It refers to deliberately receiving, assessing and acting on (or choosing not to act on) information from other individuals or teams. It was key to ensuring awareness of the other parties' interests and sensitivities ensuring collaboration. It is key to developing trust and conducting negotiations.
- Identifying when to speak out. Having the moral courage and the nerve to speak up at events and the ability to realise when it may better not to speak. This links to personal control.
- Interpreting non-verbal cues and communicating using them. This was used by participants to anticipate potentially hostile situations but was also described as being used during a negotiation process to gauge the receptiveness of another party.
- Operate across different languages. The ability to operate in the language of the audience was identified as key to building trust with stakeholders.

Relationship building: Creating personal, professional and organisational links that foster trust, communication and collaboration

Identifying, building and maintaining networks within the MTS was a key consideration for participants who used ad hoc or established networks to deliver response objectives. NTS that supported relationship building were.

- Creating organisational relationships. Relationships that are created based on organizational capability and the delivery of work objectives. working together in multi-sector teams helped people to bond, teams came together to share resources, including people and having access to resources seemed in some cases to be a way to shape these relationships
- Developing and maintaining Trust. Developing a personal bond that creates trust between individuals – this extends professional relationships into ones of inter-personal trust Showing appreciation for people's efforts maintain trust between parties to be able to work effectively together.
- Developing Networks. Identifying and gaining access to people and organizations can help participants complete their task. Creating opportunities to speak across boundaries and hierarchies, this can include organizations or individuals, a network would be with multiple people a channel with an individual perhaps an influencer.
-

Personal control
The ability to control emotions and demonstrate resilience to negative experience and the symptoms of stress was reported throughout the data. NTS that supported personal control were. - Developing behavioural handrails. Identifying protocols or core beliefs to guide personal decisions and behaviour even when fearful. This seems to be aided by risk assessment (understanding the risk), knowing your own capability and trusting equipment. This included addressing psychological force exerted by external parties but was also self-induced by participants not wanting to fail for reasons of reputation. - Resilience. Resilience can be mental and physical. It was described as the ability to detach oneself from emotions and physical difficulty (tiredness for example) to focus objectively on current tasks and persevere to complete these tasks. It required participants to balance their own needs and beliefs against those of the wider response. This resilience is perhaps at the centre of the concept of self-control - Self-awareness. Knowing and being able to describe your own limits and capabilities both emotional and technical. Being able to describe your own skills, experience and technical knowledge that might build into self-confidence and be part of self-awareness. Accepting a level of risk and uncertainty. - Humility. To be able to listen without judgement to the needs and opinions of others and include these into your own reasoning and decision-making Being honest about shortcomings or issues with actions that you have taken

APPENDIX G - CODEBOOK USED FOR THE ANALYSIS OF DATA FROM INTERVIEWS AND QUESTIONNAIRE.

This codebook was developed during the analysis of the interviews and used to analyse the data from the interviews and questionnaires. It was refined during the writing of the analysis chapter to provide a final list of non-technical skills and environmental factors which are shown as tables in the analysis chapter of this thesis.

Category (in bold) and sub-category.	**Description of the code**
Communication	**Communication (deductive) involves the ability to give and receive information by speaking, listening, reading or writing and including body language.**
Briefing	Concise and accurate verbal or written passing of information - briefing is one-way information sharing (from the briefer to the audience)
chatting	Informal conversation with the intention of gathering and exchanging information - they can be ad hoc or planned but are intentionally or deliberately informal -- an outcome (intended or unintended) of chatting can be relationship building but they were also chatting with people with whom they had no prior or subsequent relationship (e.g. taxi driver)
Communicate technical issues clearly	The ability to share technical information. This includes orally or by creating technical guidance and advice in the form or using body language
Develop guidelines	Develop practice and guidelines these are formal agreement of actions that are written down - they cross from the informal into the formal realm
Listening	Refers to deliberately receiving, assessing and acting on (or choosing not to act on) information from others - individuals or teams. In one case listening is described as the basis for building interpersonal relationships
Local Language	The ability to operate across different languages - in the examples given it was mainly French - the inability to speak a language can become a barrier to getting things done and building relationships
Persuasion	Individuals and teams needed to persuade others about the value of their work to the response - in some cases they shape the environment - they need to sway people by working across sectors and using past experience to bring together the actors who will help their argument
Argument	Being able to formulate an argument to make a case for a particular course of action. The result should be that it results in a change or is intended to result in a change of direction
Diplomacy	Aware of the other parties' interests and sensitivities including their position and ensuring that you do not undermine that position by words of actions
Negotiation	Discussion between two or more parties to achieve a common goal - negotiation was required to overcome barriers to cooperation. This was normally described in relation to the decision-making process.

Speak out or up	Having the moral courage and the nerve to speak up at events and the ability to realise when it may better not to speak ... this links to personal control and relationship building ... the way in which communication can contribute to it
Use of body language	Interpreting non-verbal cues and communicating using them. This was used by participants to anticipate potentially hostile situations but was also described as being used during a negotiation process to gauge the receptiveness of another party.
Coordination	**Coordination across and within networks and teams. This is most strongly related to sensemaking (building situation awareness) and the enactment of decisions. It was mostly described in relations to management of networks of different stakeholders.**
Collaborate	Recognising the need for multiple skill sets/functions and teams to build situation awareness and enact decisions - the recognition of needing to work together and the ability to identify which teams can deliver which function. Collaboration requires knowledge of the other partner's needs, capability and capacity and the needs of the response and the ability to agree and fulfil agreed ways of working
Criticism	Facing criticism from individuals or teams criticising the work or methods of others this can be both ways from and to the participant or participants org
Interdisciplinary coordination	Setting the conditions for the different teams to work together
Resolving different paradigms	Resolving the application of scientific methods and technical expertise to particular problems. Where different technical experts have disagreed over the methodology to be used. It has links with negotiation and communication as ultimately it may be about compromising individually held opinions for the greater good
Role definition	Understanding the role of the other team(s) in the response and what they contribute
Sharing resources	The acts of sharing physical resources including logistics and funding - this seems to follow from improved relations between individuals and organizations and was instigated and implemented at the operational and tactical levels of the response without recourse to the headquarters level
Trust in equipment and the processes in place	Having faith that the equipment and the processes you are using is adequate to perform a task.
Decision-making	**Decision-making describes the point at which a decision is made (i.e.: when a strategy or course of action is decided upon). It does not include the steps of sensemaking, enacting or reviewing the decision.**
Individual decision-making	Where an individual identifies and enacts a strategy or course of action without consulting others. There were a number of ways in which the decision was made but there was no consultation with others about the course of action to be followed.
Joint decision making	This is when two or more people arrive at a decision that is to the satisfaction of the group. The solution to a problem or a proposed action was provided by the participant and then debated by the group who either agreed wholeheartedly or found a middle way between viewpoints to arrive at a suitable decision. Linked to

	negotiation there are some instances where joint decision-making was arrived at by brainstorming a joint solution and where following brainstorming the decision-maker overturned the decision of the group
Following standard operating procedures or guidance	Existing standard operating procedures of guidance were followed in response to a problem.
No choice	This is taking the only option they perceived at the time "we had no choice" although the choice in these instances was between a delay or failure of the mission and breaking the rules - the fear of failure does not seem to have been a driver in many other situations where the stakes were arguably higher
Recognition Primed decision-making	Where prior experience is used as the basis for selecting a course of action. prior experience can extend to moral views
Setting priorities	The ability to decide on a course of action and balancing immediate gain with longer term maintenance of the response. This also includes balancing the priorities of the mission over personal beliefs and the rules of the mission
Environment	**Descriptions of the environment in which people were working and challenges they faced that were generated either by the environment itself or by stakeholders working in the environment and may have impact on the skills they use**
Community	Relating the host communities within the member state - not for e.g. professional communities. The communities may have been directly or indirectly impacted by the emergency and response
Disparate Teams	Teams made up of individuals from different stakeholders, organisations and / or professional and cultural backgrounds. Disparate teams could exist within organisations where they represented different technical functions
Feeling intimidated	Feeling threatened either physically or mentally by the environment or people within the environment and their actions or words
Frustration	Feelings of anger towards other parties or situations when the participant was not able to act in the way that they believed was most appropriate for the response
Hierarchy	Where systemic hierarchies have blocked or enhanced the ability of participants or other stakeholders to act
Host Government	Situations where interactions with host government entities including local authorities took place
Inter-team antagonism	An indication that there are deliberate or unconscious elements (such as competition or organisational identifies) that cause induvial, or teams not work wholeheartedly with each other - and increase silo working
Incomplete info - working	Where participants were acting with an identified lack of situation awareness
Lack of clear procedure	Where no procedure or guidance for dealing with a challenge or establishing roles and responsibilities existed
Managing meetings	The ability to manage and guide a group of people (including ad hoc groups and teams) towards a stated goal

Organisational culture	The organisational culture that may have an influence on how individuals and teams within a particular organisation or group may act
Partner agencies	Concerning organisations external to those of the participant
Rapid staff turnover	Staff were placed in roles for short periods of time and ten replaced
Security	When security considerations impacted on the environment and decisions made
Silo working	When teams or individuals deliberately or unwittingly fail to share information block or work round another group
Uncertainty	This can be lack of information or uncertainty on a personal level about personal role or ability to carry out a task
Leadership	**Leadership concentrated primarily on skills needed to be the main decision-maker and demonstrating initiative in the coordination or enactment phase of decision-making**
Adapting	The ability to change or alter decisions and priorities based on an unforeseen situation. The common factor throughout these examples is a lack of information. this could be because the participants had a lack of information about the situation they were going into or because the situation changed and therefore the information they had was no longer as relevant or correct
Empower	Providing teams and individuals with the ability to act collaboratively based on their own experience and knowledge
Identify options	Present different approaches to doing things and being able to identify when a different approach is required using the information available.
Initiative	Taking the lead in decision-making or enacting a decision without consulting others the action is pro-active as opposed to reactive
Learning from experience	Using past or immediate experience as a way of learning and adapting ways of working
Managing relationships	Identifying and mitigating potential differences between groups or individuals or balancing the needs of groups and the needs of the mission
Planning	Identifying the actions that need to be taken to address situations or problems. Most of the time this was done as a group, you can follow formal or informal procedure to achieve planning
Procedure – following	Acting in accordance with an established procedure or guidance
Regime	Timetabled activities that occur regularly
Resources and funding	Factoring the availability of resources or funding affects the into the decision-making process or way of working
Responsibility - taking	Taking charge of the situation. this could be because of a sense of duty to the affected people, other teams, because no one else was able or willing to, because you were the person with the correct knowledge or because the participant had a mandate to take that role.
Risk assessment	Assessing and managing risk; risk was assessed against viable options, prior and technical experience and knowledge, reputation, what was considered "normally done' especially when established processes were not followed.

Staff safety	The need to balance staff safety into actions and decisions and maintain awareness of this factor
Supporting	Providing physical support such as working with other teams to achieve an outcome (for example by regular sharing of information and resources) or psychological support by providing advice or encouragement or thanks
Tasking	Identifying and allocating roles to achieve outcomes. in the examples this is done by pre-allocated roles or specialisms (as opposed to asking people to take on a task that they would not normally do)
Using support	Identifying and procuring assistance either from technical colleagues; seeking out the person or team with the correct technical expertise to advise or carry out a task (this includes senior staff or managers giving the benefit of their experience) and about seeking out moral or psychological support for a well done or the knowledge that the senior leadership had your back
Working beyond mandate	A mandate equates to formal permission to act either using the mandate as a reason or excuse not to do something or about deciding actively to go beyond what you know you have permission to be doing
Personal control	**Controlling emotions and resilience to negative experience and the symptoms of stress**
Behaviour handrails	Use of protocol or guidance to guide personal decisions and behaviour
Courage	Physical and moral bravery - doing what is right despite being fearful. This seems to be aided by risk assessment (understanding the risk) having the behavioural handrails to hold onto, knowing your own capability and even trusting equipment
Lack of sleep	Dealing with long working hours
Pressure to succeed	A sense of psychological force to complete a task. This psychological force can be exerted by external parties (for example government asking for results) but was also self-induced by participants not wanting to fail for reasons of reputation (personal and organisational) in one case because it may impact the opportunity for future deployments
Resilience	This can be mental and physical. It is demonstrated in the way people react to the environment. It is the ability to detach oneself from emotions and physical difficulty (tiredness for example) to focus objectively on current tasks. This category links to many under self-control which seem to comprise coping mechanisms - the sense of resilience is perhaps at the centre of the concept of self-control
Perseverance	The ability to focus on or return to a task time and again until completed
Pragmatism	Balancing one's own beliefs and principles with the practicalities of achieving objectives
Remain calm	The ability to remain objective despite what is going on around you - this relates to robustness and self and situational awareness
Setting an example	Putting the needs of the mission before your own needs and showing this to others through actions
Responsibility - feeling	Feeling responsible for the failings or success of the mission

Risk acceptance	Accepting a level of risk and uncertainty - although this is accepted after a risk assessment of some kind (mini-dynamic) and seems related to the level of responsibility people are willing to take and accept
Self-awareness	Knowing and being able to describe your own limits and capabilities both emotional and technical. Being able to describe your own skills, experience and technical knowledge that might build into self-confidence and be part of self-awareness
Honest about failings	Being honest about shortcomings or issues with actions that you have taken
Humility	To be able to listen without judgement to the needs and opinions of others and include these into your own reasoning and decision-making
Self-confidence	Trust in one's own abilities and knowledge
Selflessness	The ability to put the needs of other people or the mission before your own comfort
Stress	Dealing with or encountering stress
Relationship building	**Creating personal, professional and organisational links that foster trust, communication and collaboration**
Appreciation	Showing appreciation for people's efforts
Attachment to cases	People get attached to the cases they are overseeing this can be something that creates a bond and link between responder organizations and individuals
Create organizational relations	Relationships that are created based on organizational capability and the delivery of work objectives. Working together in multi-sector teams helped people to bond, teams came together to share resources, including people and having access to resources seemed in some cases to be a way to shape these relationships
Create personal relationship or bond	Developing a personal bond that creates trust between individuals – this extends professional relationships into ones of inter-personal trust
Networking	Identifying and gaining access to people and organizations can help participants complete their task
Senior support	Advice or reassurance from people higher in the organization. This comes from outside of the immediate networks of teams and provides support and guidance when required
Technical ability skills - trust in	Trust in the processes procedures and knowledge which helps build relationships with other teams
Trust	Building and maintain trust between parties to be able to work effectively together
Creating communication networks and channels	Creating opportunities to speak across boundaries and hierarchies, this can include organizations or individuals, a network would be with multiple people a channel with an individual perhaps an influencer
Situation Awareness	**Covers information gathering, analysis of the information and predicting future states to develop a coherent picture of what is happening in the response at a given point in time**
Aware of capacity - others	Being aware of the resources and skills available in your team or organization and in other teams and organisations and how these contribute to the achievement of the mission and distal goal

Awareness of the distal goal	Refers to people being aware of and shaping their efforts to meet the overall response goal (distal goal is that that links all the organisations and bodies responding)
Combining information	Putting together, prioritising and analysing information from a range of sources to develop situation awareness
Identify gaps	The ability to analyse information, response systems, networks and teams and see where they are gaps which should be addressed
Triangulate information	Checking and comparing information from different sources to be able to develop a detailed situation awareness
Formal information	Information that is fed through formal organizational processes such as regular meetings, briefings or situation reports
Granular information	Detailed information about low level activity - including rumour or opinion which is gathered from individuals within communities or the response system. This can be both formal and informal and often helps to develop an understanding of context
Informal information	Information not gathered through formal routes, but which is gathered from individuals within communities or the response system or members of the public. This often helps to develop an understanding of context
Information Gathering	The act of collecting information from sources
Information sharing	Proactively giving and receiving information with other parties
Looking ahead	Looking to future states that need to be achieved or may occur
Observing surroundings	Examining the physical surroundings to build up a sense of the context and situation
Empathy	Picking up on signals from people that reflect their position or requirements
Reading the environment	Picking up signs from the environment visual and audio clues that are not communicated expressly. This can be in the physical environment for example damage to buildings or posters or in the body language of people
Understanding context	Knowledge of the different responding organisations and the socio-cultural factors in the country that impact on populations or the roles of organisations - learned before deployment
Information reviewing	Verifying that information and decisions are still relevant as decisions and their enact take place over a period of time during which the situation can change
Teamwork	**Creating teams (groups of two or more people to perform a specific task) making individuals more effective in the teams in which they are working. This focusses on how team members define tasks and roles in order to work more effectively**
Integrated teams	Working in joint teams formed to carry-out a specific task. The team would include personnel from more than one agency
Integrating people into teams	Bringing together individuals to ensure that feel part of the team.
Joint working	Working with people or teams from the same or different disciplines
Reaching out	Approaching colleagues proactively to include them in teams or networks

Shaping a team	Considering the abilities and roles of individuals to identify and bring together the different elements of a team to think about how they might best work