Major Incident Communication

Cascade Evaluation

MMED Emergency Medicine

University of Cape Town

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CRSCHA004

Declaration

I confirm that the *Major Incident Communication Cascade Evaluation* is entirely my own work.

I confirm that I hold the degree MBChB from the University of Pretoria.

This dissertation is being submitted for the degree of Master of Medicine (Emergency Medicine).

I confirm that I have not submitted this dissertation for any other degree, diploma or professional qualification.

Full name: ....

Signature: ....

Date: ....

Acknowledgement

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Glossary

ACEP	American College of Emergency Physicians
ALSG	Advanced Life Support Group
EMS	Emergency Medical Services
EMSA	Emergency Medical Services Authority
FIFA	Federation of International Football Association
FIRESCOPE	Firefighting Resources of California Organized for Potential Emergencies
HEICS	Hospital Emergency Incident Command System
HMIMMS	Hospital Major Incident Medical Management and Support
ICS	Incident Command Structure
ISDR	International Strategy for Disaster Reduction
LDTT	Long Distance Table Top
MIMMS	Major Incident Medical Management and Support
NIMS	National Incident Management System
NYIAHP	New York Institute for All Hazard Preparedness
PHEC	Pre-hospital Emergency Care
PHPLS	Pre-hospital Paediatric Life Support
PHTLS	Pre-hospital Trauma Life Support
PNEO-STaR	Paediatric and neonatal Safe Transfer and Retrieval
STaR	Safe Transfer and Retrieval
SUNY	State University of New York

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Major Incident Communication Cascade Evaluation

Abstract

The development of an "all hazard" major incident response plan has unique challenges in a developing world setting. The judicious use of limited resources requires careful application during especially planning and training preparations. The initial development and training drills of a cascade system can be the effective bridge between preparation and response.

This study described the initial development of a communication cascade system at two private hospitals in the Cape Town metropolitan area. Comparisons between activation drills at different times of the day and each other highlighted the operational deficiencies experienced. Most (more than 80%) off the staff activated were in hospital within an estimated 30 minutes from activation during the day or night. The most significant delay was experienced during night activation with the estimated response time increased by more than 57%, staff activation time was 76% slower and on average 10 % less staff were contactable and available at night. Transport requirements for off site staff increased from 32.1% during the day to 37.7% with a nighttime activation.

The key development elements identified for a cascade template were: attention to the structure (critical roles activated first, specific standby and declared structures), up to date contact lists made freely available, back up communication equipment development and regular training drills at different times.

This study was limited due to the inherent lack of structured communication cascade systems in hospitals in both private and state hospitals in Cape Town. A lasting legacy of major incident planning preparation can only be achieved by enforcing the legislative Disaster Risk Management requirements.

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Signed by candidate

Date:

Chapter 1: Background

The world population is estimated to be 6.69 billion (20 November 2009) (World Bank, World Development Indicators 2009) and is predicted to reach 9 billion by 2050. The World Bank also estimates that 8 billion of the population in 2050 will be located in the developing world. The hazards of climate change, the massive population growth, worsening of poverty and conflict increases the risk of disasters (Schipper et al 2006).

Over the last 25 years natural disasters have claimed an estimated 3.5 million lives with enormous socio-economic consequences (Tintanelli et al 2004)(Thomalla et al 2006)(Schipper et al 2006). The indirect effects (food shortages, disease, civil unrest, etc) on the surviving vulnerable population compound the suffering.

Examples of recent disasters include the Indian Ocean tsunami in 2004 (250 000 estimated casualties) (Carley et al 2005), hurricane Katrina 2005 in the United States, cyclone Nagris in Myanmar 2008 (estimated 100 000 casualties) (Dara et al 2009) and the devastating 2010 earthquake in Haiti (estimated 200 000+ casualties). The worst natural disaster in recorded history was due to flooding caused by the Yellow River in China (1887), an estimated 900 000 people were killed. One million more lives were lost due to disease and food shortages that followed (Hodgetts et al 2002).

The effects of global warming over the next few decades are predicted to adversely affect weather conditions (Thompkins et al 2008)(Thomalla et al 2006). This will cause an increase in flooding especially in the more densely populated coastal and low laying areas (Costanza et al 2007).

In recent years the world has also seen an increase in unnatural or manmade disasters. These include acts of terrorism like the World Trade Centre 2001 New

York (2726 killed), Tokyo sarin gas attack 1995 (11 died and 5500 injured) and the Oklahoma City bombing 1995 (163 died)(Dara et al 2009). There is an ongoing threat of political instability in Pakistan, Afghanistan, Iraq, Africa and South East Asia. Major transport incidents like airplane accidents receive the most media coverage but are quite uncommon. Rail, road and sea transport incidents are more common (Hodgetts et al 2002). Other risks may lead to even greater loss of life, like the chemical disaster in Bhopal India 1984 (10 000 died) (Dara et al 2009) or industrial accidents like Chernobyl in Russia, a nuclear reactor overheated in 1986 (56 died immediately). Mass gathering incidents commonly involve sport stadia due to overfilling, crowd surges or structural collapse (Hodgetts et al 2002).

The emergency physician and emergency medicine worldwide are increasingly positioned in a central role in the planning, risk assessment and medical response to disasters (Dara et al 2009). The American College of Emergency Physicians (ACEP) has since 1976 (Tintanelli et al 2004) incorporated this in their training. Disaster planning is now part of the curriculum for their' and the Canadian (Alexander et al 2005) emergency physician residency programs.

Disaster medicine can possibly trace its origins to the plague pandemic in Europe during the Middle Ages (Dara et al 2005). In response to the "Black Death" health structures were established to monitor the disease and collect information. It has evolved into sophisticated systems like the National Incident Management System (NIMS) of the United States or the international Major Incident Medical Management and Support (MIMMS) systems.

Disaster medicine is taught as a subject at pre- and postgraduate level at most European universities (De Boer 1995). The European Master in Disaster Medicine is a one-year course offered at postgraduate level. It was launched in 1998 with the one founding university from Italy and one from Belgium. Six institutions from both Europe and the United States of America support this course.

The Major Incident Medical Management and Support- The practical approach at the scene (MIMMS) and the Major Incident Medical Management and Support- The practical approach in the hospital (HMIMMS) courses have become one of the international standards in the medical preparation and response to disasters. They are not part of formal training (Chapman et al 2008) but are widely taught in the United Kingdom, Europe, Middle East, Asia, Australia, Northern Africa and more recently in South Africa.

These training courses focus firstly on education then on exercises. It is these exercises especially between different governmental agencies where the operational flaws of disaster plans are identified (Hodgetts et al 2002). The operational lessons can then be incorporated in new, validated and revised disaster plans (Brady 2003). A real time exercise should be the effective bridge between training and responding to a disaster (Ingrassia et al 2009). These exercises are costly and involve complex organizational planning. A strong political will is essential to drive the preparation program (Marx et al 2002)(Burstein 2008). Further pre-hospital courses include the Pre-hospital Trauma Life Support (PHTLS), Pre-hospital Emergency Care (PHEC) and the Pre-hospital Paediatric Life Support (PHPLS)(Carley et al 2005). From an in hospital perspective other major incident preparation courses include the Safe Transfer and Retrieval (STaR) and the Paediatric and Neonatal Safe Transfer and Retrieval (PNEO-STaR)(Carley et al 2005).

The most significant advances in disaster preparation seem to occur only after disasters. The events of September 11 in 2001 was the catalyst for a major United States governmental policy shift to focus on disaster preparation and management (Tintanelli et al 2004)(Dara et al 2009)(Manley et al 2006). Similarly in South Africa the floods of June 1994 on the Cape Flats led to the formation of an Inter-ministerial Committee for Disaster Management and culminated in the 2002 Disaster Management Act (Wallis et al 2007).

This 2002 Act regulates the responsibilities of disaster management on a national, provincial and municipal level in South Africa. It focuses on disaster risk reduction, mitigation of a disaster's impact and the emergency preparation, response and recovery phases during a disaster (Wallis et al 2007).

The challenge for the developing world is effective disaster preparation with limited resources. Relying on international aid during a major incident is ineffective in mitigating the wider socio-economic impact or in prevention of future risks. The World Health Organization developed the Essential Trauma Care Program to help establish affordable preparation structures for disasters (Goosen et al 2005).

The biggest challenge facing the developed world is one of shifting from almost unlimited resources for each single patient to a situation of limited resources to do "the most for the most". Preparation needs planning, training and specific exercises to develop the skills needed to manage a disaster (Baker 2007). These plans should incorporate the shift from "standard of care" to "sufficiency of care" (Dara et al 2009).

International policy to reduce and mitigate the socio-economic impact of disasters has taken four distinct directions: reducing disaster risk, environment management, climate change adaptation and efforts at alleviating poverty (Thomalla et al 2006)(Schipper et al 2006). These are complex and possibly divergent directions. The challenge in future will be to coordinate these efforts globally.

The challenge South Africa currently faces in preparation for the 2010 Soccer World Cup is enormous. The first step in this planning process may require research to review the present status of hospital preparedness in dealing with major incidents, thereafter developing local and national strategies.

Chapter 2: Introduction

An understanding of the structure of the major incident response is essential in the development of a major incident plan. The Advanced Life Support Group (ALSG) with the MIMMS and HMIMMS courses established an international structured approach to pre-hospital and hospital major incident response. This system is the preferred structure utilized in South Africa's incident preparation of the 2010 FIFA Soccer World Cup. The biggest preparation challenge is incorporating this system into the national, provincial and local structures. Utilizing one system ensures effective communication with all responders using a common language, terminology and structure (Marx et al 2002).

The development of these new South African response structures requires these definitions and classifications to be incorporated with local adaptations. The opportunity exists whereby the MIMMS system remains the basic structure with the added local and international modifications and improvements.

This system is comparable in terms of definitions and classification to other international disaster systems.

1. Definitions

Disaster management and data collection requires clear definitions and classification of disasters. Unfortunately there seems to be no universal definition of a disaster (Below et al 2009). This limits the effective collection and comparison of global disaster data.

Internationally the different definitions range from describing a disaster as an event that overwhelms response capabilities (Marx et al 2002) or overwhelms local capacity, requiring external assistance (Below et al 2009). A more mathematical approach formulates it as a destructive event that claims so many casualties that a discrepancy arises between the numbers involved and their treatment capacity of the responding services (De Boer et al 2000).

From a hospital perspective a disaster can be where the patient surge at a point in time, prevent even minimal emergency care without added external resources (Tintanelli et al 2004).

In general terms disaster medicine can be defined as the study of the health care approach to the medical impact in the prevention, preparation, response and recovery phases of a disaster (Wallis et al 2007).

In an attempt to better clarify and standardize disaster definitions the term "major incident" has been proposed (Carley et al 2005). This may help standardizing the classification internationally and better assist future planning and incident research.

For the purposes of this study a major incident is defined according to the MIMMS and HMIMMS definitions. A major incident is then defined as an incident where the location, number, severity or type of casualties requires extraordinary resources (Hodgetts et al 2002) or more succinctly where an extraordinary response is required by the emergency services (Carley et al 2005).

A cascade may be defined as a succession of processes or actions that develop in incremental stages towards a cumulative effect (Mosby et al 2009). A communication cascade, in terms of this study, is defined as a series of successive steps ensuring rapid notification of key health personnel required in responding to a major incident.

2. Classification of major incidents

The South African Disaster Management Act, Number 57 of 2002 (Government Gazette 2003), classifies a disaster into local, provincial or national according to the impact on the governmental structures. It stipulates that a local disaster is contained to only one district, provincial when more than one district is affected in the same province and national if more than one province is affected.

The MIMMS course classifies a major incident according to the type, location, number of casualties, effect on the emergency services and the affected population (De Boer et al 2000)(Hodgetts et al 2002). These classifications are primarily used in the research and data collection in major incident planning. This adds a more scientific or mathematical approach to disaster medicine (De Boer 1999). From a practical and communication point of view, responders will consist of multiple agencies and need to use a common language and terminology (Marx et al 2002). It is important to note the limitation of each classification.

2.1 Type of major incident

The incident can be classified into natural on the one hand and manmade, unnatural or technological on the other. The limitation of this is that most "natural" disasters are complex and are due to human factors. An example is overcrowding in coastal and low laying areas in a flood contribute directly to the loss of live.

Manmade/ unnatural or technological include transport incidents, industrial incidents, mass gathering events (crowds of 1000 and more) and civil disorder incidents (including terrorism) (Carley et al 2005).

In a framework policy on Disaster Risk Management it was proposed that South Africa utilize the International Strategy for Disaster Reduction (ISDR) hazard classification (National Disaster Management Centre 2010). This classifies hazards into natural (geological, biological and hydrometeorological), technological and environmental hazards.

This ISDR classification is based on the international EM-DAT database used by the Centre on the Epidemiology of Disasters. Combining two of the largest international natural disaster databases (EM-DAT and NatCatService), a more complete classification was proposed. This may in future create an even more standardized classification for research of natural disasters globally (Below et al 2009).

2.2 Effect on the community

This classification focuses on the effect on the hospital, road or communication networks. A simple incident is where the infrastructure stay intact and a compound incident is where the infrastructure is destroyed (Carley et al 2005).

2.3 Effect on the health services

The major incident will affect the health services' ability to respond (Hodgetts et al 2002). The extent of the effect will determine if it may be considered compensated, where the extra health resources mobilized to cope with the extraordinary circumstances are adequate to respond. An uncompensated incident therefore will be when these extra resources are inadequate to cope with the massive workload required.

According to this classification a disaster can be classified as a compound and uncompensated major incident.

2.4 Location

From the hospital perspective the incident will be either internal if the incident occurred within the hospital grounds or external if it occurred in the surrounding area or community (Marx et al 2002).

The limitation of this classification is where the hospital is part of the incident for example in a flood or earthquake.

2.5 Size

The exact number of casualties does not necessarily determine if a major incident occurred. For instance ten patients from one incident can cripple a small community health centre. A large trauma unit might be able to handle up to twenty patients from one incident without requiring external support. The capability and surge capacity of each hospital will determine the exact number that determines if a major incident has occurred. Quantifying these numbers for each hospital is crucial in the planning stage of a major incident plan.

De Boer et al in 2000 proposed a classification into minor, moderate or severe according to purely the number of casualties. They considered the total number of casualties (alive or dead) and the number presenting to hospital. The largest limitation with this classification is that it does not take into account local surge capacity neither the local capabilities.

3. Incident Response Structure development

The response structure to a major incident may be divided into pre-hospital and hospital phases. It is imperative that emergency physicians be well versed with the plans in both pre-hospital and hospital incidents (Doyle 1990). The integration of these plans will ensure a coordinated response (O'Neill 2005). This coordination is especially important in a hospital's incident response activation. This may also enable efficient and smoother transition from treatment in the field to definitive care in hospital.

3.1 Pre-hospital phases

The MIMMS system divides the pre-hospital phase into preparation, response and recovery phases (Hodgetts et al 2002).

3.1.1 Pre-hospital: Preparation phase

In terms of medical preparation it is during the planning stages that mitigation of the disastrous effect of a major incident is effected. Each sphere of the response needs an organizational incident response plan. This ranges through all governmental levels, emergency medical services (EMS), non-governmental organizations (NGO's), military and both state and private receiving hospitals. It is the integration between these structures that are complex and challenging.

The most important part of preparation is adequate training (Baker 2007). All responders need to be familiar with the major incident plan and be able to utilize the equipment properly. The training drills can range from tabletop exercises (testing communication and incident structures) (Shover 2007) (Marx et al 2002) to a community and multiagency exercise with volunteer victims (Keeny 2004). Exercising the components of the plan (like exercising radio procedures and specific triage exercises) regularly would ensure that the live exercises run more effectively (Hodgetts et al 2002)(Tintanelli et al 2004). Specific evidence to support major incident training to improve skills and knowledge is still lacking at this stage (Williams et al 2008)(Kaji 2007). A systematic review on the effectiveness of training from Williams et al in 2008, showed mixed results, but computer and lecture training may be effective training for pre-hospital providers. The review pointed to numerous study limitations and inadequacies that prevented firm conclusions to be made from them.

3.1.2 Pre-hospital: Response phase

The response at the scene should have an “all hazard” (Hodgets et al 2002)(Born et al 2007)(Carley et al 2005) and structured approach. The United States (US) adopted an Incident Command System (ICS) structure. It was developed in the 1970’s by the Firefighting Resources of California Organized for Potential Emergencies (FIRESCOPE) taskforce to respond to wildfires (Skivington et al 2006). This management system standardized the organization of a response in the US into an incident command, operations, planning, logistics and finance sections (Marx et al 2002)(Tintanelli et al 2004). Internationally a similar structure is used with the MIMMS system. Both these systems provide a flexible structure for pre-hospital response; these can either expand or contract as required at the scene.

Major Incident Medical Management and Support pre-hospital system has a seven-tiered structure consisting of a command, safety, communication, assessment, triage, treatment and transport sections (CSCATTT)(Hodgets et al 2002).

The first priority of command, infers a vertical structure with the emphasis on a “collapsible hierarchy” (Hodgetts et al 2002) concept. This structure provides the ability for a small number of responders occupying many roles initially and expanding or contracting as the incident develops. Role assignment ensures no single individual’s absence causes disruption of the organizational structure.

It is imperative that each responder be familiar with the chain of command to effectively utilize resources and healthcare providers at the scene (Shover 2007).

The most common failing in major incident management is poor communication (Hodgetts et al 2002)(Tintanelli et al 2004)(Martchenke et al 1994)(Milsten 2000)(Roccaforte 2001). This includes failures between multiple agencies (Martchenke et al 1995), in hospital and equipment failures. Alternative and back up modalities need to be incorporated into the plan. Specific communication training and daily equipment checks should be routine.

A rapid assessment at the scene determines the requirements there and at the receiving hospitals. Frequently the initial information will be inaccurate but with adequate communication this will improve as the incident progresses (Hodgetts et al 2002). It is the lack of information flow to the hospitals that prevented adequate preparation during the Loma Prieta earthquake in the San Francisco Bay area in 1989 (Martchenke et al 1995).

3.1.3 Pre-hospital: Recovery phase

In the aftermath of a major incident the recovery phase will include both the structural repair of infrastructure and rehabilitation of the affected population (Wallis et al 2007). This includes the survivors as well as the emergency responders.

3.2 Hospital phases

The United States utilizes the Incident Command System (ICS) and specifically the Hospital Emergency Incident Command System (HEICS) as the preferred organizational response tool to major incidents in hospital (Tintanelli et al 2004)(O'Neill 2005)(Born et al 2007).

The Major Incident Medical Management and Support: The Practical Approach in the Hospital proposes another international system of incident response from a hospital perspective. This incorporates the same CSCATTT structure as the MIMMS model (Carley et al 2005). It is divided into pre-hospital, reception, definitive care and recovery phases (Carley et al 2005).

3.2.1 Hospital: Pre-hospital phase

South Africa has, like most developing countries, severe hospital staff shortages. This limits the medical response at the scene to mostly EMS medical responders. Ideally hospital personnel should be deployed in hospital and not at the scene unless organized in specific pre-hospital response teams (Carley et al 2005). These are specialized roles that need training and regular updates to seamlessly integrate into the pre-hospital incident structures.

Medical personnel should be familiar and be involved in regional preparation plan development (Marx et al 2004). Specifically the emergency physicians need the knowledge of both the pre-hospital and hospital plans to ensure the seamless response from the scene to hospital care (Doyle 1990). Local hospitals need to be aware of all regional hospital capabilities. Agreements on mutual aid during a major incident have to be in place as part of the plan.

3.2.2 Hospital: Reception phase

The reception phase starts when the first casualties arrive at the hospital. This is the busiest time, with patients' arrival by any transport means. It is crucial that the major incident plan be seamlessly and effectively activated to handle this chaotic stage. At this stage personnel should ideally be activated quickly and efficiently using a structured activation system. The HMIMMS course proposes a communication cascade activation system (Carley et al 2005).

The primary objective during reception is preparation of clinical priority areas like the emergency room, theater and intensive care unit. Secondary objectives are support services consisting of clinical, non-clinical and management services (Carley et al 2005).

The application of the HMIMMS system in South African hospitals will require specific local adaptations. Some (both state and private) emergency units in the

Cape Town metropolitan area utilize a pre-prepared major incident filing system. The implementation of this system nationally may possibly be an important step in standardizing national incident preparation.

Pre-prepared notes with a unique identifying number will ensure each patient is logged and movements accurately tracked. Documentation at every step is essential but should not cause delays. The allocation of numbers for unidentified patients should preferably only be allocated in one area and tied to the patient (Lavery et al 2005).

In a South African context it is especially the porter and security services that present a challenge. The lack of training and high staff turnover may severely limit the ability to control an incident response. The porter service is central to all patient and equipment movement.

The security service and possibly with the help of the porter service should be directing patient and vehicle flow from very early on. Command and control will be lost if the security service is not able to control the traffic routes on site and in hospital. The training to execute these unfamiliar tasks is especially important where some hospitals in Cape Town use sub-contractors to provide security services.

3.2.3 Hospital: Definitive Care phase

This phase starts once the patients have moved from the receiving areas. This definitive treatment entails both surgical and non-surgical responses.

A structured surgical team response is required to lead the response during both the reception and definitive phases (Carley et al 2005). In South Africa the private health system relies on specialist that cover more than one hospital on any given on call day. The true surgical cover will be limited in a major incident to one specialist for possibly two or three hospitals.

The initial focus during a major incident should only be life saving or critical surgeries. Resources may allow more time later in the response but services should be restricted to only the minimum that is safe (Carley et al 2005). This ensures “the most for the most”.

Similarly a structured physician team response is needed for the non-surgical or medical response (Carley et al 2005). The same limitation for private hospital physician cover exists than for the surgical service. This limitation in the true specialist cover will require the development of a specific backup call roster for off duty specialist.

In most hospitals intensive care beds are limited and only a small number of extra beds can be utilized. It was previously noted in the United Kingdom that most Intensive Care Units are usually 90% full on normal occupancy rates (Morrow et al 1996). This limitation is very similar or possibly worse in a South African context. Critical care will still be restricted and patients should be identified for possible transfer (Carley et al 2005).

3.2.4 Hospital: Recovery phase

HMIMMS divide this phase into resolution, reflection and audit parts (Carley et al 2005).

It is during the resolution phase where a specific business continuation plan will need to be activated. Rescheduling elective surgery cases according to priority will ensure an ordered resumption of clinical duties. Previous major incidents have shown the surgical services were still overloaded from five (Lavery et al 2005) to seven days (Stevens et al 1990) after the incident.

The reflection phase will entail debriefing, both operational and emotional (Carley et al 2005). The operational debrief should highlight all the positive aspects of the response and areas of improvement in the execution of the current major incident plan.

A formal audit of the major incident will strengthen future plans. It is preferable that the audit be presented to those involved in the incident. The emphasis must remain on improving the service and it should not blame individuals (Carley et al 2005). It would be beneficial at this stage in liaising with other agencies like EMS, police and traffic on improving inter-agency cooperation.

4. Communication Cascade (Call Down) System

An integral part of a major incident plan is the communication cascade system, which is a structured approach utilized to mobilize key personnel.

4.1 Major Incident declaration

The major incident plan should include preparation for both an internal or external major incident. An internal major incident may be defined as any event that disrupts a hospital's ability to perform its regular services (Marx et al 2002). It can range from a fire, bomb threat, severe water damage, overcrowding, failure of services or equipment. This preparation should include clear definitions of when an internal plan may be activated, who may activate the plan and which personnel are activated first. This should also include clear plans for each type of incident and define a specific evacuation plan.

An external major incident, as previously noted, may be defined as any incident that occurred outside the hospital premises. The hospital's major incident plan must also define both the personnel able to activate the plan as well as the criteria when to declare an external major incident (Tintanelli et al 2004).

A major incident can be declared after receiving information from the Emergency Medical Services (EMS) or by the hospital themselves (Carley et al 2005).

The HMIMMS proposes two levels of activation and one cancelling the activation (Carley et al 2005). The first level is "Major incident – Standby". This is a limited or partial activation of only specific personnel in preparation of a possible incident. It would entail activation of senior staff only that will assess the current status of the hospital.

The next level of activation after receiving confirmation is "Major Incident – Declared". This is the complete or full activation of the plan from staff notification, the preparation of receiving areas to the establishment of the major incident command structure (Carley et al 2005).

"Major Incident – Canceled" will cancel any previous activation, either Standby or at the end of full activation. This will notify all personnel previously activated to stand down (Carley et al 2005). The activation plan needs to be robust enough to be activated at any time and to notify additional personnel quickly.

The person (usually the switchboard operator) receiving the major incident declaration will need to verify the authenticity of the call. Most hospitals utilize a specific document as a reminder of what information to obtain (Tintanelli et al 2005). Returning the call and re-confirming the details will add to information accuracy. This person then only activates key personnel with a short message. This should be brief and include a summary of the estimated number of patients, the type of incident, where it took place, at what time the incident occurred (Carley et al 2005) and the possible estimated time of arrival of the first casualties.

4.2 Cascade activation

One of the most efficient manners to activate a large number of staff in the shortest time is possibly by using a cascade (or call down) system (Carley et al 2005).

The switchboard operator activates the first tier: Hospital Coordination Team (Figure 1); they in turn activate staff under them and on to the next level. If a staff member is not contactable it is important to contact them again after completion of the list.

The crucial aspect of this system is deciding in the planning stage what structure the cascade will take and the allocation of specific roles. This cascade structure should tier according to clinical need with the most important staff activated first (Goldman et al 2007).

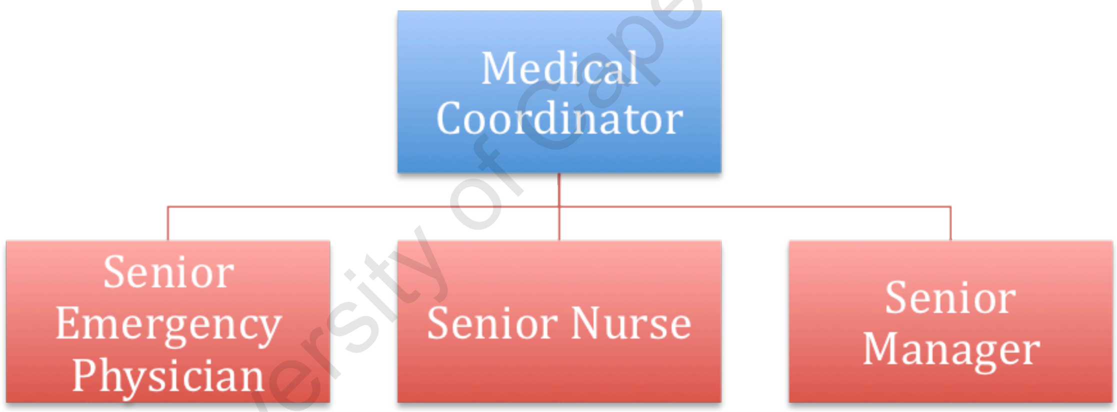

Figure 1. Hospital Coordinating Team (Carley et al 2005).

This structure forms part of the collapsible hierarchy of the HMIMMS major incident command structure. The Medical Coordinator is in overall command and the hospital coordinating team control the incident response (Carley et al 2005). The initial activation will only be essential roles first.

An example and local adaptation of the clinical hierarchy activation structure see Figure 2.

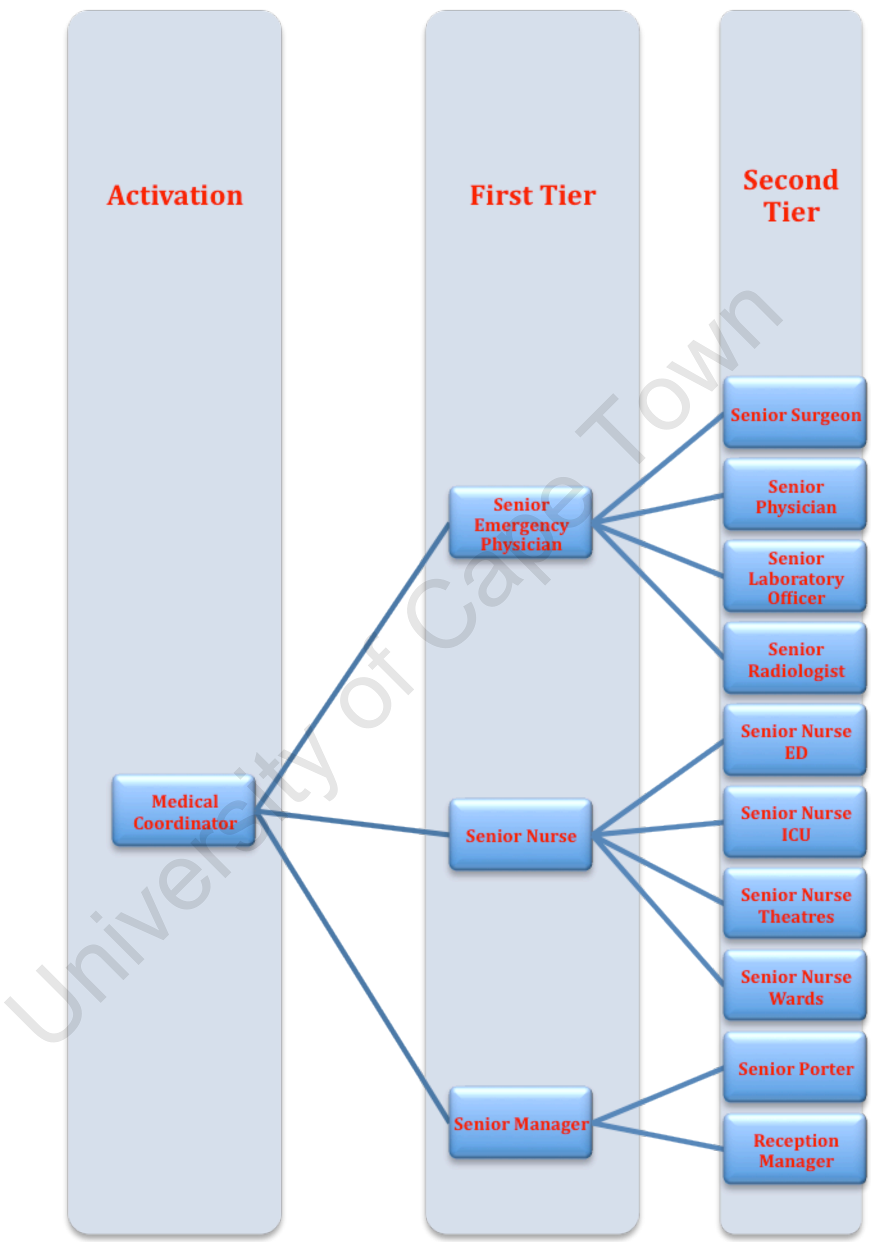

Figure 2. Example of a communication cascade structure (Adapted from Carley et al 2005).

The Senior Emergency Physician (first tier) will activate the clinical second tier. The Senior Nurse (first tier) will activate the nursing second tier. The Senior Manager (first tier) will activate the Senior Porter and the Reception Manager initially.

It is crucial to have a cascade contact system set up and in place. This should provide accurate up to date contact details of each team member and be easily accessible to the on-call team leader (Carley et al 2005).

The cascade is a time sensitive process and is structured in this way to contact and mobilize a large group of staff in the shortest time possible. Limitations would include outdated contact details, restricted access to the list after hours (Carley et al 2005) and whether staff members would require transport and/ or child care services.

The best way to ensure optimal use of a call down system requires regular update of contact details (preferably monthly) and wide dissemination of the lists. The ideal place to keep a list may be in specific clinical departments with the person on duty then able to initiate the cascade. Non-clinical personnel will need access to these lists even after hours, as would clinical staff in certain instances (Carley et al 2005). This requires planning and local adaptations. Up to date copies can be kept at the security office and where the command post will be situated. Backup communication systems need to be in place to contact off duty staff. Commonly used modalities include pagers, cellular phones, e-mails, personal device applications (PDA's) and even the media.

Some hospitals assign one person to call all the staff on the call down list. This communications officer or designee will call a predetermined call down list using either a paging system or a telephonic system. The biggest limitation of this system is the time taken for one individual to call a large number of personnel while relaying a short message. A paging system might compensate for this by relaying the message and requiring a call back to the officer for confirmation. It might leave the system activation vulnerable if the person or designee is not available. A further common limitation is the fact that personnel not regularly carry their pagers when off duty (Goldman et al 2007).

4.3 Communication Cascade Testing

Poor communication appears to be the most common failing in incident response and is a significant concern (Kaji et al 2003) (Alexander et al 2005) (Auf der Heide 1996) (Klein et al 1991). Testing the hospital communication systems is a vital part of evaluating how effective the incident plan activation is (Goldman et al 2007). These tests will highlight flaws and deficiencies of the cascade structure.

One of the very few published examples of a call down drill was published in a letter to the editor of the Disaster Management & Response journal (Goldman et al 2007). This test involved 72 staff in total (4 residency directors and 68 residents). The residency director initiated the drill by calling the assistant directors and the four chief residents (first tier). The second tier divided into 8 branches with 8 residents down each branch. Each resident called the name under theirs' until the last one who phoned the residency directors again. The directors phoned the drill modulator to complete the activation of each branch. Each resident was instructed before the drill on the procedures and contact numbers and pager numbers were distributed to all. They were made aware to phone a resident back if one was not contactable. The results showed only half of the branches completed their drill within an hour and the longest took 3 hours and 45 minutes. Reasons for the delays ranged from leaving a message and not returning the call, not carrying pagers to sleeping post call. The authors concluded the call down was effective but only repetition would improve response times.

4.4 Preparation Drills

It is the repetition of these drills that will ensure personnel become familiar and comfortable with incident procedures (Marx et al 2002) (Tinanelli et al 2005).

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires that United States compliant hospitals have two drills a year (Marx et al 2002) (Tintanelli et al 2005). This would be difficult to achieve even in a developed world environment (Carley et al 2005) but the emphasis should remain on regular exercises. These training drills need not take the shape of a full-scale community wide and multiagency exercise for hospital personnel (Carley et al 2005). Regular drills can be developed using tabletop scenarios between different staff groups. Furthermore dynamic paper triage exercises can update the specific triage skills needed (Carley et al 2005). It may take the shape of a basic test of the communication capabilities by telephone. An example is a telephone audit that helped ascertain whether the West Midlands hospitals in the United Kingdom were prepared to respond to a chemical incident (Pooransingh et al 2003). Another example is a survey questionnaire followed by a telephone survey to study hospital preparations for a biological terrorist attack (Phillips 2004). These audits may be repeated annually and comparisons used to improve awareness.

Tests involving communication are especially important in familiarizing personnel with equipment, procedures and back up or redundant systems (Shover 2007) (Marx et al 2002). Communication equipment like hospital telephone lines and power supply are particularly vulnerable during an incident (Milsten 2000). Observations from a hospital during the World Trade Centre attack noted that both internal and external lines were down and pagers and mobile phones only intermittently available (Roccaforte 2001). Similarly after the Omagh bombing in 1998 all the fixed line telephone lines were down and cellular phone networks overloaded for a number of hours after the incident (Lavery et al 2005). This made communication with off duty staff almost impossible. This negated any communication cascade activation plan with no other backup. In this instance most staff was notified via the local media or word of mouth.

Two-way radios are a common and useful back up modality on site and between Emergency Medical Services and the hospital (Lavery et al 2005) (Marx et al 2002). The use of two-way radios will require specific training and knowledge of the equipment, radio network and radio voice procedures (Hodgetts et al 2002). Further options include pagers, cellular phones, mobile devices, broadband Internet access, fax lines and the media (Marx et al 2002). The press may even be used in requesting specific specialist volunteers, instead of the general non-specific help offered by the public (Laverly et al 2005) (Martchenke et al 1995).

In some countries the facility exists whereby the overloaded cellular network can suspend normal network services and enable emergency telephone access. This backup system may be utilized by the incident command structures when needed (Lavery et al 2005). In the United Kingdom the police may activate this "access overload control for cellular radio telephones" (ACCOLC). This activation was considered during the Omagh bombing but the pre-hospital incident management used radio communications and furthermore the receiving hospitals lacked these specific enabled cellar phones (Lavery et al 2005). Emergency Medical Services used only a limited activation of one square kilometer around the Aldgate incident during the London bombing of 2005 (McCue 2006). This limited use was again attributed to EMS personnel not carrying the specific phones.

The last resort would be the use of staff or specific volunteers to act as runners. The Bellevue Hospital utilized medical students as runners during New York's

World Trade Centre attacks (Roccaforte 2001). They were familiar with the staff, hospital premises and the equipment.

If the components of the incident plan were exercised more regularly like testing the staff communication cascade activation (Gebbie et al 2007), exercising radio procedures, triage exercises and mini drills, it would ensure more effective real time exercises (Hodgetts et al 2002) (Tintanelli et al 2004).

A real time exercise is possibly more important for pre-hospital personnel than for their' in hospital counterparts. Hospital responders need to be aware of the pre-hospital response structure (Doyle 1990), but wouldn't benefit as much from these exercise. This is from a practical point of view and operational interruptions would be too costly (Carley et al 2005). Legislation and a strong political will is needed to drive a sustainable preparation program (Marx et al 2002)(Burstein 2008).

4.5 Future Research

Preparation priorities are firstly planning then adequate training (Baker 2007). The only way to improve disaster response is ensuring that the planning and training are evidence based (Auf der Heide 2006) (Burstein 2006). There have been repeated calls for standardization of evaluation tools specifically in order to evaluate major incident training.

There have been attempts to standardize the criteria used in evaluating an emergency service's medical response to a major incident (Green et al 2003). Utilizing these objective tools to identify limitations especially in a developing country setting may optimize future organizational responses. These tools have not found wide acceptance yet.

The evidence to support specific major incident training that improve skills and knowledge is still lacking (Williams et al 2008) (Hideko 2007). One study from

Israel in 2008 showed a correlation between the best drill performances of hospitals with the best quality of standard operating procedures (Adini et al 2008). This may suggest that if these generic plans are realistic they will help train clinicians to manage even the most challenging medical incidents (Burstein 2008).

Williams et al reported on their systematic review of the major incident preparation literature in 2008. They found that most research regarding major incident preparation and training are subjective reports and in the form of "lessons learned" (Auf der Heide 2006). The review evaluated the disaster training effectiveness and included both pre-hospital and hospital responders. They acknowledged that there were studies showing an improvement in the knowledge of pre-hospital responders after both computer and lecture training. These studies had various limitations though including selection bias by lacking control groups. The review could not accurately show effectiveness for in-hospital personnel training. Most studies lacked the scientific robustness to enable firm conclusions to be drawn. An example was one study that did find a slight improvement in knowledge in Emergency Department personnel after a computer-based intervention (Chun et al 2004). The improvement was not statistically significant and the study was found to be underpowered. This means that almost all training exercises are done without the proper evidence to support their effectiveness. Furthermore that major incident planners making assumptions to develop an incident plan, do so without research to back these assumptions (Auf der Heide 2006). These possible false assumptions may cause responders to repeat mistakes from past incidents. The review called for disaster research based on more sound scientific grounds and that standardized evaluation tools are to be used to ascertain training effectiveness.

Chapter 3: Aim

The aim of this study is to evaluate the staff activation process when a hospital's Major Incident Plan is activated and specifically in terms of activation of the hospital's communication cascade.

To achieve this goal the following parameters were investigated:

- Total number of management and staff activated
- Average time to activation
- Percentage able to be contacted
- Percentage of staff available
- Transport requirements
- Child care requirements

These parameters were utilized to compare the activation process at different test times and at different hospitals. The two hospitals were both from the private sector in the Cape Town metropolitan area.

This may add to the limited research available on communication cascade drills and may also help in the development of a local generic activation protocol.

Chapter 4: Literature Review

The literature regarding communication cascade drills is still lacking. The literature review included relevant training course documentation: The Advanced Life Support Group (ALSG) MIMMS and HMIMMS courses; The Universities of Cape Town and Stellenbosch Disaster Medicine Course; The Emergency Medical Services Authority (EMSA) of California Hospital Incident Command System Guidebook.

The following databases were reviewed:

- Science Direct
- OVID Medline (R) 1950-Present
- Sabinet Online
- CSA Illumina Databases
- MD Consult
- Google Scholar
- PubMed

The following search terms were entered: disaster, disaster + preparation, disaster + test, major + incident + test, communication + test, communication + cascade + test and call +down+ drill + test.

All relevant articles were reviewed by abstract and relevant article's reference lists were reviewed for further relevant articles and extracted.

Chapter 5: Methods

This was a descriptive study of the communication cascade activation of the hospitals in Cape Town that are designated as 2010 FIFA Soccer World Cup receiving hospitals. Six of these hospitals identified are from the private sector and three are from the public sector.

One hospital (Private Hospital 1) agreed to be included in the study the other eight hospitals did not respond and could not be included initially. It was possible to complete the test at the proposed different times and expand it to one further event at Private Hospital 1. The first drill was initiated at 10:10 on a Thursday; the second on a Tuesday night at 20:14 and the third was done retrospectively by each line manager after a major incident on a Friday at 12:45.

Further recruitment of additional hospitals was attempted by including the communication cascade test submitted by each of the nine hospitals for the Western CAPE-abilities Long Distance Table-Top (LDTT) drill. This was a provincial led computer simulation test for the Cape Town metropolitan area. It consisted of twelve weekly drills between May and September 2009. This online disaster drill simulation was under the supervision of the New York Institute for All Hazard Preparedness (NYIAHP) of the State University of New York State (SUNY). One additional hospital (Private Hospital 2) could be included in the study and consent was obtained to use the data. Private Hospital 2 utilized a partial activation system. This limited activation was similar to Private Hospital 1's activation but limited the data comparisons.

A further three hospitals submitted data but access to two of these submitted databases' was restricted due to corrupt files. Neither the researcher nor researchers at SUNY was able to obtain access to this data. One further submission was a vague summary of an activation test and could not be included due to the data not being comparable to the other two hospitals data sets.

This study was conducted between April and October 2009 at two private hospitals in Cape Town: Private Hospital 1 (PH1) and Private Hospital 2 (PH2).

The study was initiated with a detailed email orientation to all relevant hospital managers. This was followed up by meeting and further instructions given by utilizing an instruction sheet (Appendix 1). This included details on the initiation sequence, how to collect data, how the cascade should be structured and where the extra data sheets could be obtained (main reception desk or email). They were reminded to complete the call down and re-contact the staff not initially contactable. Each line manager was given a data collection sheet (Appendix 2) at least two weeks before the test but not told when the test would be activated.

The proposed sequence was- A Major Incident call test was initiated with a call made to the hospital's main reception or Emergency Unit at time 0 minutes. The reception staff activated the key staff members on their action card, giving them the following instructions: This is a Major Incident call test- please phone all the team members on your action card, for each call note the time the call is answered, ask an estimation how long it would take them to get to hospital and if transport or childcare is required.

Each department activated would call all the people on their respective action cards. Then each department was to document what time each individual's call was answered. Staff members were asked to estimate how long it would take them to get to the hospital and if special services were required like child care or transport.

It was noted how many staff members were unable to be mobilized e.g. out of town, ill, night duty, etc and what percentage of staff were not contactable. The test was run at different times, to enable comparisons between day and night staff activations. These results were summarized on a different sheet (Appendix 3) and compared.

Data analysis

Completed data collection sheets (Appendix 2) were reviewed and summarized (Appendix 3).

Data variables reviewed:

- Hospital
- Number of line managers
- Average time to activate line managers
- Number of staff activated in total
- Average time to activate staff
- Percentage of staff contactable
- Percentage of staff available
- Percentage of staff requiring transport to hospital
- Percentage of staff requiring child care
- Percentage of all staff in hospital within the estimated 30 minutes
- Estimated average travel time to hospital

The 2-D clustered bar and the 2-D clustered column charts were chosen to represent the differences between the data sets visually.

Ethical approval

Ethical approval for this study was obtained from University of Cape Town Research Ethics Committee REC REF: 121/2009. Ethical approval was obtained from the relevant hospitals Academic Advisory Boards to conduct research at their hospitals.

Outcome

The outcome was to evaluate the communication cascade drill for each hospital. These drills were compared being activated at different times of the day and at different hospitals.

The following end points were compared:

- Average time to activate: managers and staff.
- Estimated response time for off site staff.
- Availability of staff: contactable, available, required childcare or transport.
- Percentage of staff in hospital within a 30 minutes cutoff period.
- Comparison between different activation times.
- Comparison of the test times with an estimated actual response times.
- Comparing different hospitals activation, response times and availability.

These data sets can be repeated regularly as part of a planned major incident training drill. It may help in the development of a generic communication cascade test for the Cape Town Metropolitan area.

Chapter 6: Results

Outcomes

The first drill at Private Hospital 1 was run at 10:10 on Thursday 02/04/2009.

A total of 75 staff was activated which included 9 line managers (Table 1). Over 90% of staff was contactable and 85% were available to respond in case of a major incident. Average time to activate managers was 15.4 minutes and staff was activated in 8.3 minutes.

Of the off site staff contacted, 32.1% required transport. Only 14.3% of them required childcare. The average estimated response time to hospital was 10.1 minutes. More than 80% of staff was available within 30 minutes from being activated.

<u>Test 1. Date 02/04/09 Thursday 10:10</u>

Hospital:	PH1
Number of line managers:	9
Number of staff in Total:	75
Average time to activate line managers:	15.4 minutes
Average time to activate staff:	8.3 minutes
Percentage contactable:	90.9%
Percentage available:	85%
Percentage needing transport:	32.1%
Percentage needing child care:	14.3%
Percentage in hosp < 30 min:	80.9%
Estimated response time to hospital:	10.1 minutes

Table 1

The second drill at Private Hospital 1 (night time activation) was run at 20:14 on Tuesday 30/06/2009.

A total of 101 staff was activated which included 9 line managers (Table 2). Over 80% of staff was contactable and 74.3% were available to respond in case of activation. Average time to activate managers was 21.4 minutes and staff 34.6 minutes.

The percentage of staff requiring transport increased to 37.7% but only 13% requested childcare. The estimated response time to hospital was 17.7 minutes. After hours more than 80% of staff were estimated to be available within 30 minutes from being activated.

<u>Test 2. Date 30/06/09 Tuesday 20:14</u>

Hospital:	PH1
Number of line managers:	9
Number of staff in Total:	101
Average time to activate line managers:	21.4 minutes
Average time to activate staff:	34.6 minutes
Percentage contactable:	81.3%
Percentage available:	74.3%
Percentage transport needed:	37.7%
Percentage child care needed:	13%
Percentage in hosp < 30 min:	80.5%
Estimated response time to hospital:	17.7 minutes

Table 2

On 11/09/2009 a car collided with a bus on the R27 road just north of Cape Town. The female driver died on the scene and the bus rolled over injuring 67 of the 72 occupants. The Metro Emergency Medical Services contacted Private

Hospital 1 at 12:40. At 12:45 the hospital's Major Incident Plan was activated. The communication cascade was activated and staff mobilized. From 13:30 a total of 26 patients were received: 7 Priority 2 (Yellow) and 19 Priority 3 (Green) patients. The following week all line managers on duty for the incident were requested to fill the communication cascade data collection sheets retrospectively. This formed part of the audit following the major incident.

The third data set (Test 3) was included to compare the estimated response with the training drills. The total staff activated was 60 and included 7 line managers- Maternity and Paediatrics were not activated initially (Table 3). Over 96% of staff was contactable and 85.5% were available to respond.

Average time to activate managers was 15.3 minutes and staff 11.3 minutes. No staff required transport or childcare. The estimated response time to hospital was 10.7 minutes. There was more than 87% of staff available within 30 minutes after being activated.

Test 3. Date 11/09/09 Friday 12:45

Hospital:	PH1
Number of line managers:	7
Number of staff in Total:	60
Average time to activate line managers:	15.3 minutes
Average time to activate staff:	11.3 minutes
Percentage contactable:	96.8%
Percentage available:	85.5%
Percentage needing transport:	0%
Percentage needing child care:	0%
Percentage in hosp < 30 min:	87.1%
Estimated response time to hospital:	10.7 minutes

Table 3

Private Hospital 2 submitted the fourth test on 18/10/2009 as part of the electronic simulation test- Western CAPE-abilities LDTT. This was a real time simulation of crush major incident at the Green Point Stadium in Cape Town, South Africa. The major incident for this was declared during office hours. This was a partial activation (Standby activation) with only the managers and selected staff directly affected by a major incident declaration contacted.

The total staff activated was 24 and included 11 line managers (Table 4). All the managers and staff were contactable and available to respond.

Average time to activate managers was 2.3 minutes and staff 2.6 minutes. None of the staff required transport or childcare. All the staff members contacted was already in hospital. This meant that all the staff was available within 30 minutes after being activated.

<u>Test 4. Date 18/10/09</u>

Hospital:	PH2
Number of line managers:	11
Number of staff in Total:	24
Average time to activate line managers:	2.3 minutes
Average time to activate staff:	2.6 minutes
Percentage contactable:	100%
Percentage available:	100%
Percentage needing transport:	0%
Percentage needing child care:	0%
Percentage in hosp < 30 min:	100%
Estimated response time to hospital:	Not applicable

Table 4

Comparisons

1. Staff activation times: day versus night

Firstly the cascade activation was compared at Private Hospital 1 at different times of the day. Test 1 (PH1 Test AM) was activated in morning and Test 2 (PH2 Test PM) at nighttime.

Activation during normal office hours for the managers was 28% faster than at night (15.4 minutes compared with 21.4 minutes; n= 9 for both). Staff members were activated 76% slower during the nighttime activation, but 26 % more staff were activated (8.3 minutes versus 34.6 minutes; n= 66 daytime and n= 92 at night) (Figure 3).

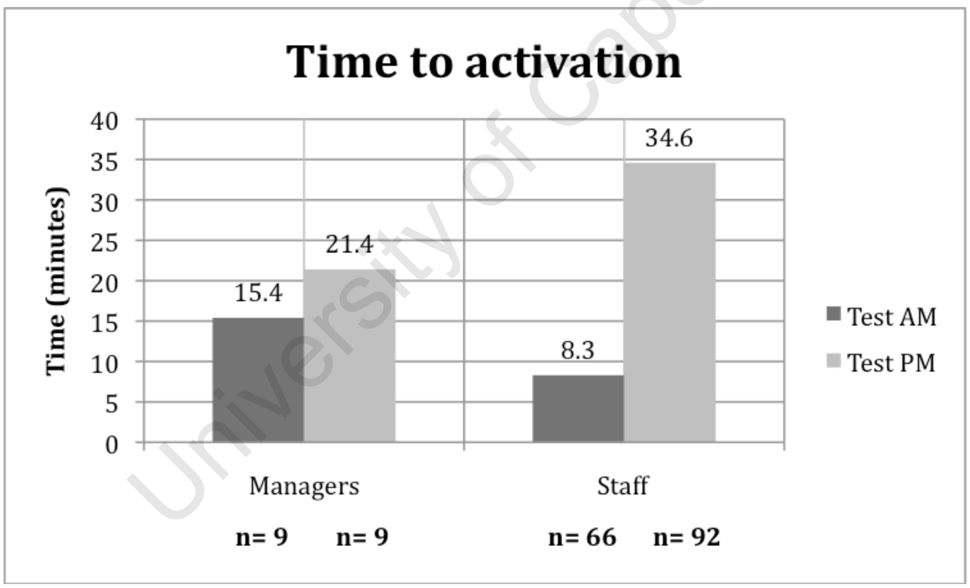

Figure 3. Activation times of Managers and Staff: day versus night

2. Staff availability: day versus night

The time of the day resulted in almost 10% more staff being contactable during the day (90.9% versus 81.3%) and 10.7% less available at night (85% versus 74.3%) (Figure 4).

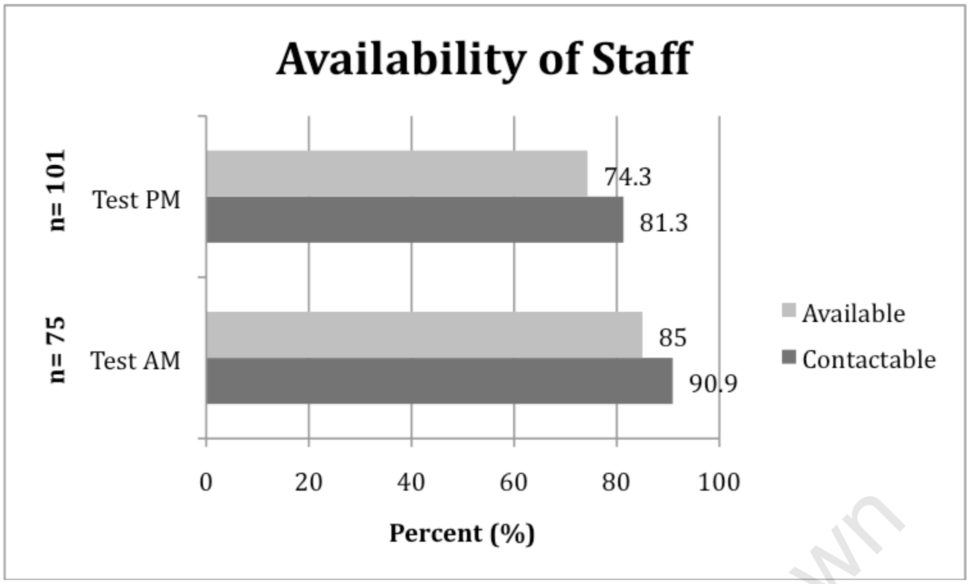

Figure 4. Staff - availability and contact ability at different times

3. Transport and Childcare requirements

The number of off site staff's transport requirements increased by 5.6% during the nighttime activation (32.1% versus 37.7%). Childcare needed was very similar for both. During the daytime activation 14.3% might need care and at night 13% indicated that they also might require childcare (Figure 5).

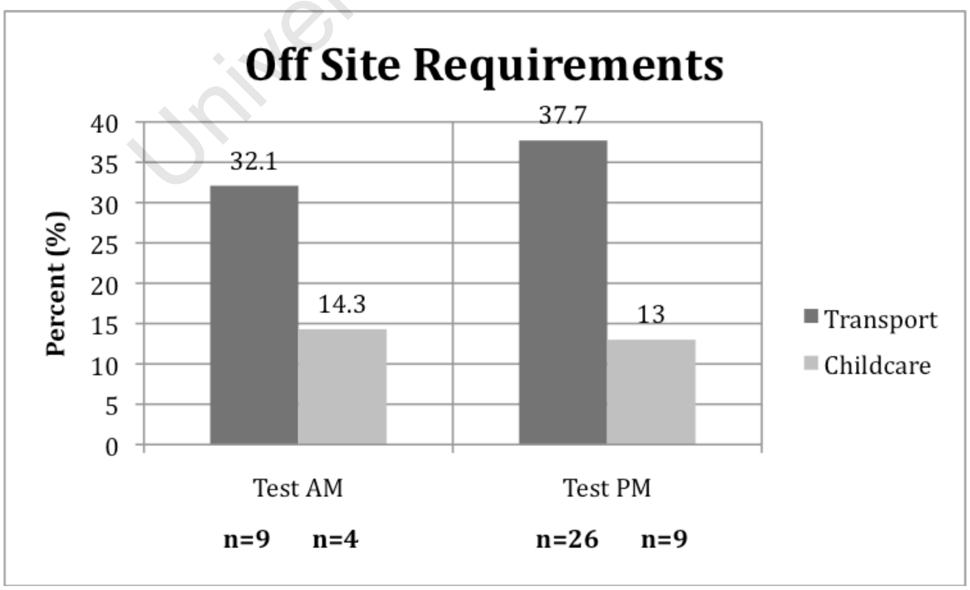

Figure 5. Transport and childcare requirements- off site staff

4. **Estimated response time: day versus night**

Estimated off site staff response time to the hospital was 10.1 minutes during the day and 17.7 minutes at night. This was with almost 2.5 times more staff off site at night (n=28 for daytime and n=69 at night) (Figure 9).

5. **Arrival under 30 minutes: day versus night**

Around 80% of the total on and off site staff members were able to arrive at the hospital within 30 minutes during either the day or nighttime (80.9% and 80.5%) (Figure 8).

6. **Staff activation: two daytime activations**

Comparing the daytime (Test 1) activation to the major incident activation (Test 3) showed very similar results. The managers were activated in 15.4 minutes and 15.3 minutes respectively. Staff members were activated in 8.3 minutes in Test 1 and 11.3 minutes in Test 3 (Figure 6).

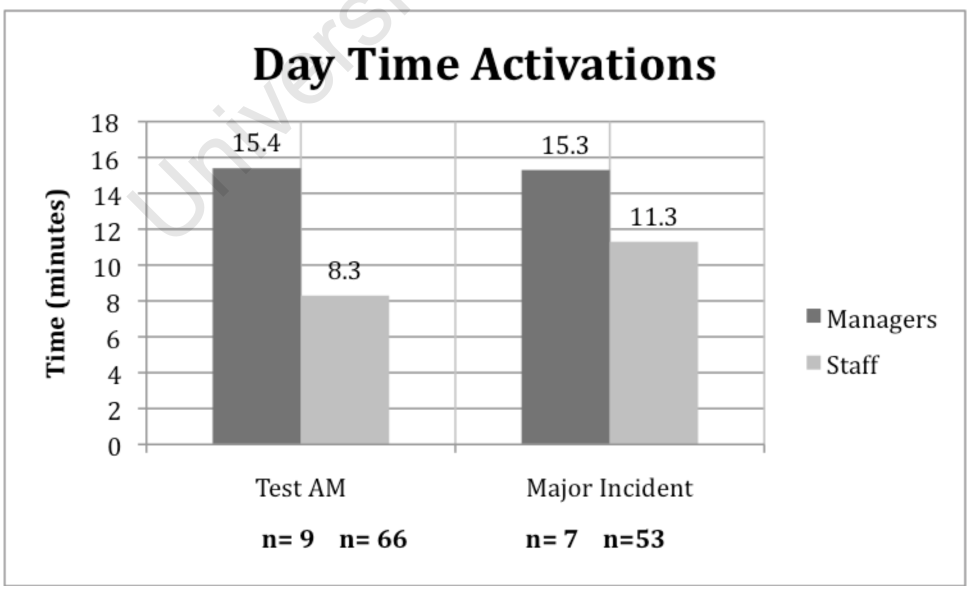

Figure 6. Activation time comparison of the daytime drill and the incident

7. **Staff availability: two daytime activations**

Staff availability showed the same trends during the two daytime activations. This showed that 85% of staff was available for Test 1 and 85.5% for the major incident activation. There was 96.8% of staff contactable during the real activation and 90.9% during the daytime drill (Figure 7).

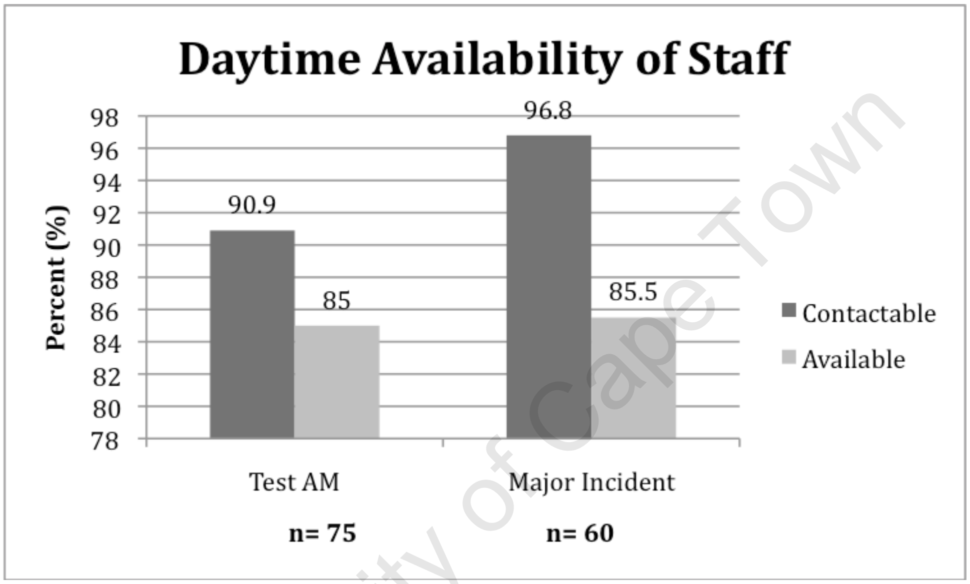

Figure 7. Staff availability daytime

8. **Arrival under 30 minutes**

A comparison of data using both tests and the incident showed that more than 80% of the total staff number (both on and off site) estimated that they would be at the hospital within the 30 minutes cut off time (Figure 8).

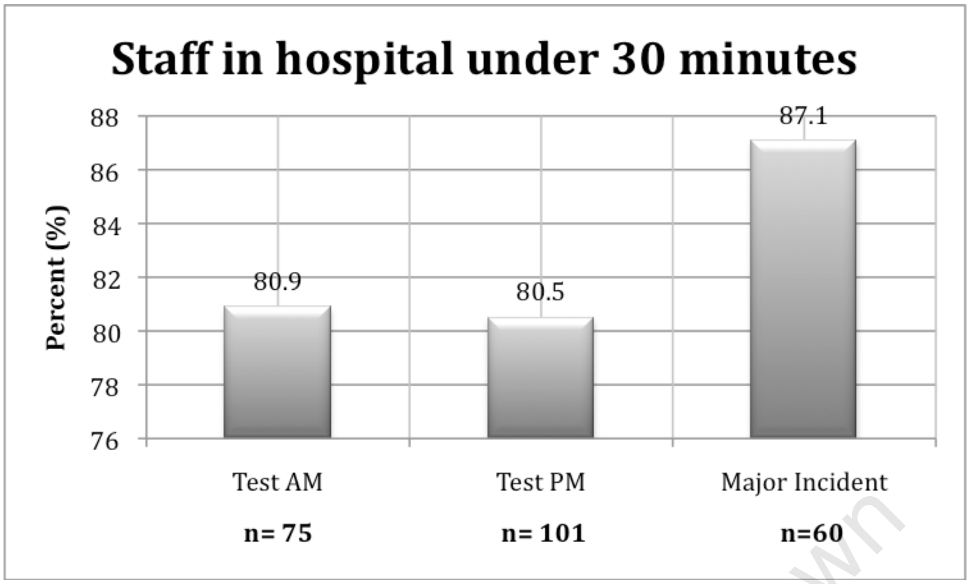

Figure 8. Estimated arrival of all staff under the 30 minutes cutt off.

9. Estimated Response Time

The response time to the hospital was estimated to be almost 10 minutes during both the daytime activations but almost 8 minutes longer at night (17.7 minutes) (Figure 9). At nighttime there were significantly more staff off site (n=69) than either the day test (n=28) or major incident (n=7).

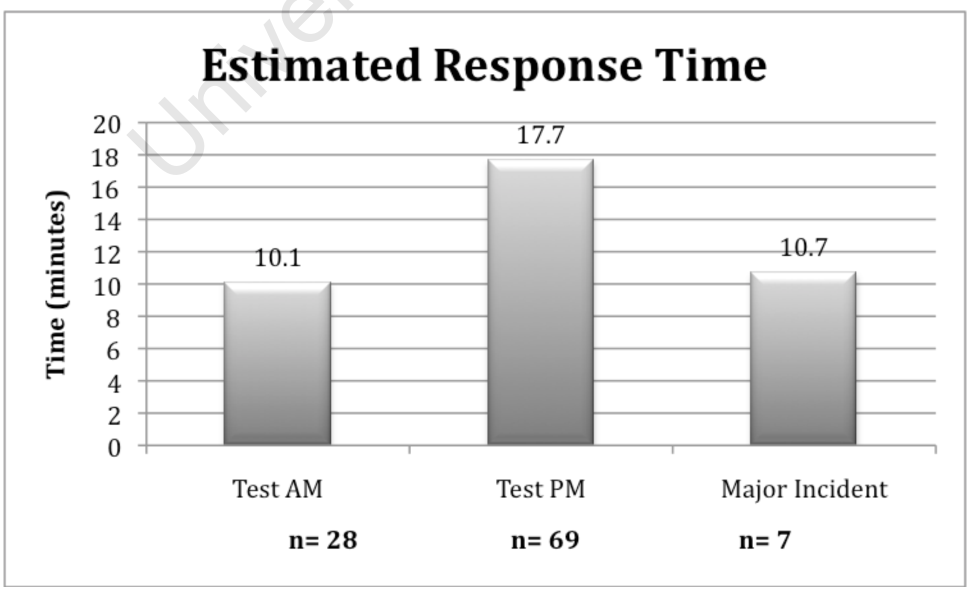

Figure 9. Estimated response times for off site staff

10. Management Activation: two hospitals

Comparing the two hospitals' management activation showed that Private Hospital 2 activation time was 6 times faster than Private Hospital 1 (2.3 minutes versus 15.4 minutes) (Figure 10). This even though 11 managers were activated at Private Hospital 2 and only 9 at Private Hospital 1.

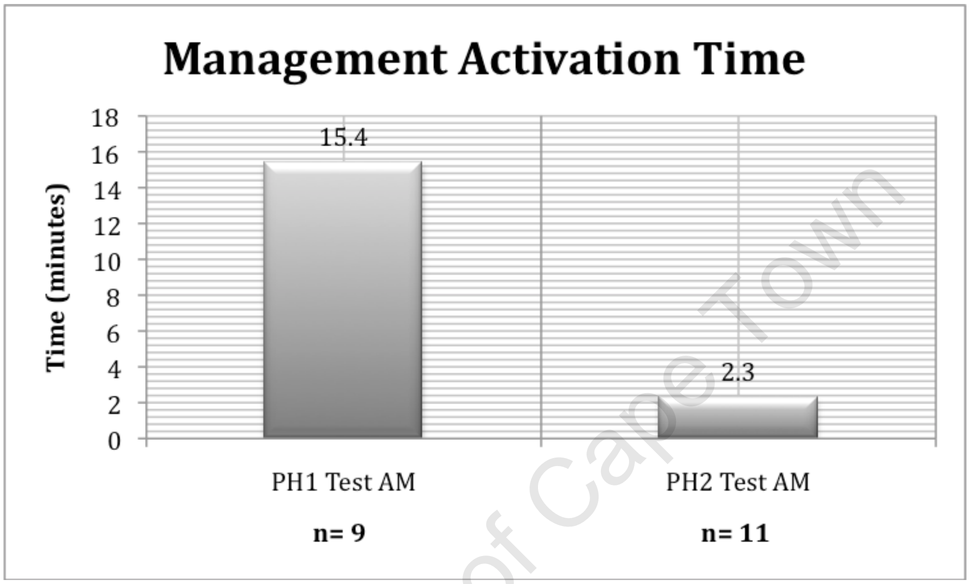

Figure 10. Management activation time at different hospitals.

11. Staff Activation: two hospitals

The staff activation times' were also 3 times faster at Private Hospital 2 (2.6 minutes versus 8.3 minutes) (Figure 11). There was significantly more staff members activated at Private Hospital 1 though at 69, compared to the 13 at Private Hospital 2.

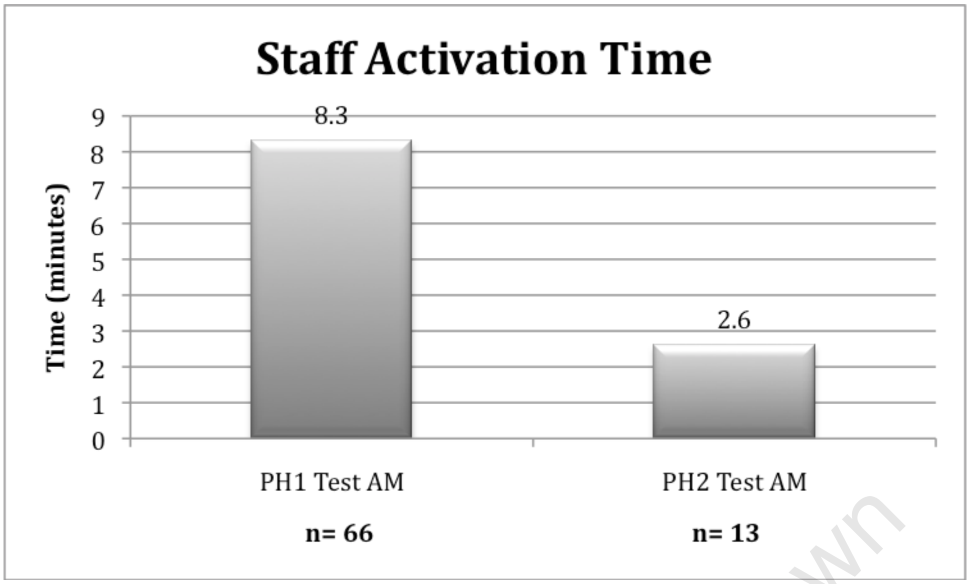

Figure 11. Staff activation at different hospitals

12. Staff Availability: two hospitals

The limited activation of Private Hospital 2 showed that all staff members activated (24 in total) was contactable, available and on site in less than 30 minutes. At the Private Hospital 1 a total of 75 personnel were activated, of which 90.9% were contactable, 85% available to respond and 80% on site within 30 minutes after activation (Figure 12).

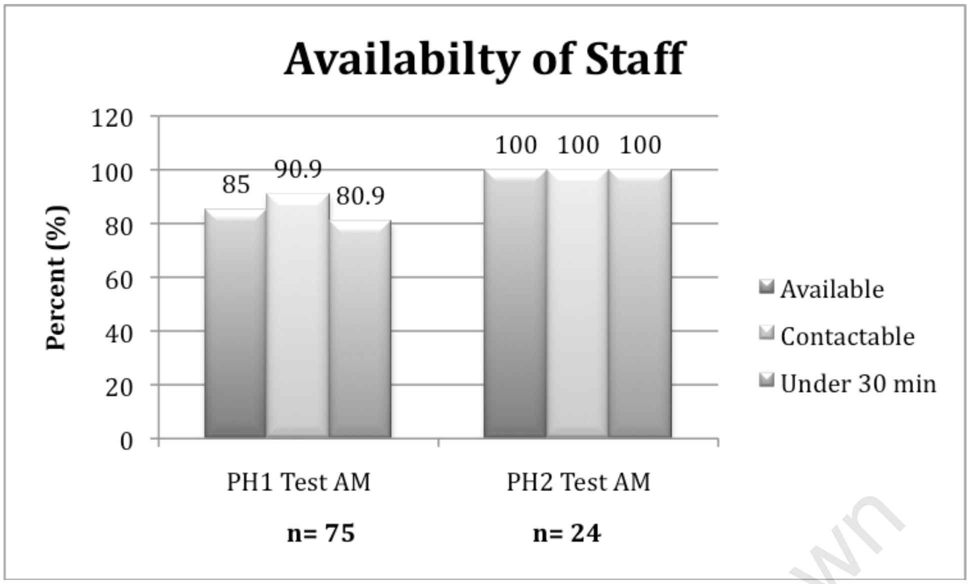

Figure 12. Comparison between staff availability at two hospitals.

Chapter 7: Discussion

The development of a major incident plan should incorporate generic requirements with local practicalities. A crucial part of the plan entails a formalized communication cascade or call down procedure. Incorporating the data from regular incident exercises will enable the development of revised and validated plans (Brady 2003).

7.1 Study Limitations

An argument may be made that the instructions to the managers and data sheets would cause bias and neither was there a control to compare the data to. This was unavoidable as there was no formal structure in place before the study.

The development of major incident plans for hospitals in South Africa may not have received adequate attention in the past. The reasons for this may range from inadequate funding, lack of resources, political will, motivation and to limited research. The lack of funding is not unique to South Africa but even in developed countries like the United States the private sector more frequently developed an incident plan compared to the non-private hospitals (Phillips 2004). A strong political will is essential to drive the formal legislative and organizational requirements to establish major incident preparation plans (Marx et al 2002)(Burstein 2008).

Most likely very few of the hospitals in the Cape Town metropolitan area had a formal communication cascade structure in place previously. The activation of a major incident without this is less structured and will take on an ad hoc approach. Development of the structured approach was recently stimulated by the introduction of the MIMMS and HMIMMS systems as the preferred response structure for South Africa in preparation for the 2010 FIFA Soccer World Cup.

A limitation of this study is that very few hospitals were motivated enough to develop a communication cascade even as part of the international long distance tabletop exercise. The more hospitals included, even only from the private institutions, would have enabled better comparisons.

A further limitation comparing the data is the different format all the hospitals utilized to collect the data, the style also varied widely and lacked consistency. One hospital submitted a very poorly formulated data set to represent the activation of one of the biggest state hospitals in the province. This submission could not be utilized due to the limited data it contained.

The Private Hospital 2 used a limited activation system (similar to a Standby activation) even though they had the study template at their disposal. This only included personnel from management, a few hospital services and emergency medicine practitioners.

The Private Hospital 1 utilized the study format and activated all personnel: all the managers and line managers, hospital services, wards, theatre, Intensive Care Unit, emergency unit, specialists and all nursing staff. Each hospital will have different requirements and expectations for incident exercises. This will lead to different drill tests and data sets. A standard generic template would help to standardize the call down with specific local adaptations.

A further limitation is utilizing data captured retrospectively after a major incident. It is neither ethical nor practical to complete the data sheets during a major incident. The data can only be considered a good estimation, but the information was useful from an audit point of view.

7.2 Study Strengths

The benefit of the cascade activation at a different time of day while using the same activation system resulted in useful data comparisons. Similarly useful was utilizing a daytime activation test as a control and comparing it to real time major incident cascade activation.

The two hospitals included are both from the private sector (similar staffing and management structures) and the data comparable in most regards.

7.3 Outcome discussion

Private Hospital 1 is a community or Level 2 Hospital (according to the Department of National Health). On call services include a General Surgeon, Neurosurgeon, Cardio-Thoracic Surgeon, Physician, Paediatrician, Radiologist, Emergency Medicine Physician among others.

Private Hospital 2 is a referral hospital but also a Level 2 Hospital (according to the Department of National Health), with the similar on call services. It does additionally have a cardiac catheter laboratory. These two hospitals have similar management structures, patient profiles and staffing levels.

These hospitals are in the private sector but have specific limitations in major incident response which include: a high turnover of medical and nursing staff, large percentage of part-time (locum) employees and on call specialist covering more than one hospital per call day. The high turnover of staff and utilization of agency staff may negate any training if not part of a standard orientation program or not repeated regularly. The true specialist cover will be limited in a major incidence response affecting more than one private hospital.

The major incident plan has to take into consideration these limitations. This may include regular training days and have agreements in place for the off duty specialist to be available if needed.

The first test at Private Hospital 1 showed that during the day, out of the 75 personnel activated it took almost twice as long to activate managers than staff (15.4 minutes versus 8.3 minutes). This was in spite of the fact that 69 staff members were activated compared to the 9 managers during the daytime drill. A large proportion of the staff (n=47) was on site and in the department so that their activation time would be quicker once initiated. Most of the staff were contactable (90.9%), available (85%) and at the hospital within the required 30 minutes if activated (80.9%).

The second test at Private Hospital 1 revealed that at night it took almost twice as long to activate the staff than the managers (34.6 minutes versus 21.4 minutes). Furthermore less staff was contactable (81.3%) and available (74.3%) at night. This limitation not withstanding, most (80.5%) estimated they would be on site within the 30 minutes cutoff.

The major incident data from Private Hospital 1 showed more similar activation times for managers (15.3 minutes) and staff (11.3 minutes). The majority of the personnel was contactable (96.8%), available (85.5%) and could be on the premises within the required 30 minutes (87.1%).

The cascade test submitted by Private Hospital 2 showed a very rapid response time for both managers (2.3 minutes) and staff (2.6 minutes). It was a limited cascade activation and where all personnel were contactable, available and on site within the 30 minutes post activation.

7.4 Data comparisons

7.4.1 Activation Time: day versus night

Cascade activation at Private Hospital 1 during the day shift was compared to the activation of a night shift. The day shift managers were activated 28% faster than their night colleagues (15.4 minutes compared with 21.4 minutes). Most managers would be on site during the day even though 9 managers were contacted in each test.

Staff members were activated 76% faster during the day than at night (8.3 minutes versus 34.6 minutes). This is a significant delay but most (75%) of the staff contacted was off site after hours. It may also be that the night staff was more unfamiliar with the activation process than their daytime counterparts. Delayed access to the contact lists may also have added to the long activation time. One of the managers noted that she could not access the list while at home. This is an important point to note and the night staff may need extra training to become more familiar with the system.

7.4.2 Staff availability: day versus night

The availability comparison between the time differences showed that almost 10% more staff was available and contactable during the day (85% versus 74.3% were available and 90.9% versus 81.3% were contactable). This may indicate a reluctance of staff to respond after hours. There may be quite valid security concerns, transport requirements also increased at night and maybe a lack of motivation. Although this compares well with the previous published study that achieved only a 50% contactable test time after 1 hour (Goldman et al 2007). The ability and usefulness by comparing these two tests are lessened by the different methods used.

7.4.3 Transport and childcare requirements

The transport requirements expressed by activated off site staff increased from 32.1% during the day to 37.7% at night. The childcare requirements seemed to affect only a small percentage of the staff (14.3% during the day and 13% at night). These requirements may have contributed to the drop in available staff members at night (from 85% down to 74.3%).

7.4.4 Activation time: daytime only

Utilizing (with the limitations accepted) the first daytime activation as a control and comparing it with the major incident activation data showed a few similarities. The activation of the managers took 15.4 minutes in the test and 15.3 minutes during the major incident. The staff on the other hand took almost one and a half times longer to be activated during the real activation even though 20% less staff were activated (8.3 minutes compared with 11.3 minutes).

7.4.4 Staff availability: daytime only

Similarities were also shown with staff availability; during the test it was 85% and 85.5% for the incident. Almost all the personnel were contactable for the incident activation (96.8%) and slightly less so for the test (90.9%). The similarities of the real daytime activation with the test in some way might validate the data gathered from the first drill.

7.4.5 Arrival under 30 minutes

The incident plan may very likely require that most of the activated staff be on the hospital premises within 30 minutes from the time of activation. Both the on site and off site personnel from the tests and incident estimated that more than 80% of them would be on the hospital premises in this time.

7.4.6 Estimated response time

The daytime activations showed the estimated response time to hospital to be approximately 10 minutes. This may indicate that most of the staff resides in close proximity to the hospital. At night the response time was 7.6 minutes longer at 17.7 minutes. An extrapolation taking into account the estimated response time of the off site staff together with the average time to activate off site staff at night, may mean most staff arriving on average 52.3 minutes after activation (34.6 + 17.7 = 52.3 minutes). This is a significant delay and especially with the lower after hours staffing levels (off site n=69 at night) compared to the daytime (off site n=28). The activation time at night needs to be sped up significantly through training and/ or extra staffing contingencies incorporated into the plan to cover possible night activation. This highlights some of the difficulties and limitations that nighttime incident plan activation may need to incorporate (Carley et al 2005).

7.4.7 Activation time: two hospitals

The next comparison was done between the two private hospitals' daytime activations. The management activation at Private Hospital 2 showed a significant faster activation time at six times faster (2.3 minutes compared to 15.4 minutes). This was with 11 managers activated at Private Hospital 2 and 9 at Private Hospital 1. This may indicate that the managers should review their activation protocol at Private Hospital 1 to identify this significant activation delay. One might have to consider bias in terms of personnel being primed or expecting the activation call from Private Hospital 2. The staff was also more rapidly activated at Private Hospital 2 at three times faster than their counterparts (2.6 and 8.3 minutes respectively). This may be attributed to the limited activation of PH2 staff of 13 compared to the 66 activated at PH1.

7.4.8 Availability: two hospitals

The limited activation also likely explains the discrepancies of the staff availability between the two hospitals. All the personnel at Private Hospital 2 were contactable, available and had response times under 30 minutes. The 75 PH1 personnel showed that 90.9% were contactable, 85% were available and 80.9% would be able to make the required thirty minutes on site time.

7.5 Communication Cascade Tests

The structured approach to a major incident plan requires a structured communication cascade system. It is through careful planning, consideration of system limitations and adhering to key elements that a robust structure is developed.

7.5.1 Preparation

The preparation will include educating all staff and familiarizing them with the structure. Regular training drills should follow and be incorporated in the incident plan preparation and development. The annual review of the plan should include the results of the cascade audit. The phone tree should be widely distributed together with the audit sheets to enable the drill activation at any time. This may improve the bias encountered with staff anticipating the test.

7.5.2 Common problems encountered with a cascade system

- The most common limitation is outdated or inaccurate contact information.
- Restricted access to the contact lists at night.
- Personnel are less contactable and less available when activated after hours.

- Response times may be affected by the time of day (traffic peak hours or night time).

7.5.3 Key elements to develop a cascade structure

- Careful consideration of the cascade structure: defining who may activate the cascade, type of activation (Standby or Declared) and most critical staff activated first by defining each tier's structure (first tier hospital coordination team, second tier managers, third tier line managers, etc).
- Contact list or phone tree need to be updated regularly (preferably monthly or quarterly). This should specifically include a back up list of all on and off duty specialist available.
- Up to date contact lists need wide distribution and be freely available at any time (copies may be kept in the departments, security office and at the hospital coordinating team's meeting point).
- Back up communication systems development – may be pagers, cellular phones or email.
- Regular drills at different times of the day.
- The communication cascade as part of the major incident plan annual audit.
- Two specifically structured cascade systems one for a standby (partial) activation and for a declared (full) activation.

7.5.4 Declaration Structures

7.5.4.1 Standby (Partial) Activation

- Definition – Situation develops that threatens to possibly compromise the hospital's service delivery ability. This includes Emergency Unit overcrowding, Very Important Person patient, partial failure of hospital services or equipment and Emergency Medical Services notifies the hospital of possible major incident in the area.
- Activated by the Medical Coordinator (or stand in) in consultation with Hospital Coordinating Team.
- Only key personnel notified after verification that were identified previously in standby activation cascade plan.
- Example of cascade activation - Call taker phones the Medical Coordinator.
  - Medical Coordinator phones the first tier, consisting of the Hospital Coordinating Team.
- These senior staff members will review the current staffing and bed levels.
- Staff will review their action cards.

7.5.4.2 Declared (Full) Activation

- Definition – Major Incident developed that will affect the hospital's ability to deliver a service so that extra resources need to be mobilized to respond.
- Activated by Emergency Medical Services or Medical Coordinator in consultation with the Hospital Coordinating Team.

- Call taker to verify the call and ascertain location of the incident, type of incident, estimated number of patients, time of incident and expected time of arrival.
- Cascade activation - Call taker phones the Medical Coordinator

  - Medical Coordinator phones the first tier (Hospital Coordinating Team).

  - First Tier activate the second tier, etc
- Full activation – Staff to review action cards and preparation of receiving areas.
- Real time staffing counts and bed status.
- Ensure that the major incident plan is activated in each department.

Chapter 8: Conclusion

This study described the initial development of a communication cascade system at two private hospitals in the Cape Town metropolitan area. Comparisons between activation drills at different times of the day highlighted the operational deficiencies experienced. The most notable problems were encountered during the after hours activation.

Most (more than 80%) off the staff activated were in hospital within an estimated 30 minutes from activation during the day or night. The most significant delay was experienced during night activation with the estimated response time increased by more than 57%, staff activation time was 76% slower and on average 10 % less staff were contactable and available at night. Transport requirements for off site staff increased from 32.1% during the day to 37.7% with a nighttime activation. It is only through regular drills that organizational limitations can be identified and incorporated into revised plans. These drills ensure a seamless integration from planning and training to responding to a major incident.

This study was limited due to the inherent lack of structured communication cascade systems in hospitals in both private and state hospitals in Cape Town. The lack of motivation and political will has limited the ability to expand on the initial stimulation created by the preparation for the FIFA 2010 Soccer World Cup.

It is the responsibility of the National Department of Health, in accordance to Section 25 of the Disaster Management Act 57 of 2002, to ensure adequate health structures relating to Disaster Risk Management with "an integrated monitoring and evaluation system".

A lasting legacy of major incident planning preparation can only be achieved by enforcing the legislative Disaster Risk Management requirements.

Chapter 9: Recommendations

The following recommendations can be made in the development of a generic communication cascade system for the Cape Town Metropolitan area:

- As proposed by HMIMMS, specific drills rather than full-scale multi-agency exercises will be more beneficial and cost effective for in-hospital staff compared to pre-hospital staff (Carley et al 2005). It is this researchers opinion that this is especially applicable in a developing world setting.
- Key elements identified: attention to the cascade structure detail (partial and full activation), updated contact lists made freely available, backup communication systems development and regular standardized training drills.
- Local adaptations to a generic communication cascade system may ensure acceptance and familiarity with activation procedures.
- A strong political will is required to achieve the Disaster Management Act requirements.

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Appendix 1

Instructions: Communication Cascade Test

1. **Preparation:**

- **Management meeting**
  - **Process walk through**
  - **Phone tree with numbers**
  - **Data sheets**

2. Algorithm

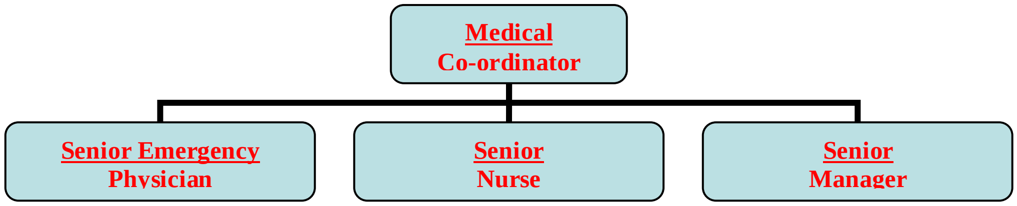
i) Phone switchboard to activate test- Time= 0 min

ii) Switchboard activates Hospital Co-ordinating Team (HCT)

iii) Each member of HCT phones every person on their phone tree- Note time contacted

- Available Y/N
- Transport needed Y/N
- Childcare Y/N
- Estimated time to hosp

-If unable to contact reattempt at end of list


Medical
Co-ordinator
Senior Emergency
Physician
Senior
Nurse
Senior
Manager

Appendix 2

Data sheet:

DEPARTMENT: ____________________________

Line Manager: ______________________________

Time activated: _____________________________

Total number of staff in Department: _____________

On duty: _____________

Off duty: _____________

Time taken to activate staff	Min
Percentage of staff contactable	
Percentage of staff available to work	
Percentage of staff requiring transport	
Percentage of staff requiring Childcare	
Percentage of activated staff in Hospital within 30 minutes	
Average time to hospital	Min

Comments:

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	Staff Initial	**Time Contacted**	**Available Y/N**	**Transport Y/N**	**Child Care Y/N**	**Est. Time To Hosp**
1)						
2)						
3)						
4)						
5)						
6)						
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Appendix 3

<u>Summary Sheet</u>

Hospital:

Number of line managers:

Average time to activate line managers:

Number of staff in Total:

Average time to activate staff:

Percentage contactable:

Percentage available:

Percentage transport needed:

Percentage childcare needed:

Percentage in hosp < 30 min:

Average time to hospital:

Comments:

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