**APPENDIX 1.***Table showing the common themes of learning points from major incidents identified in the literature.*

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| Resource management/  Utilisation (27) | Lack of personnel to transport patients.  Disaster plan was accessed but not used by care providers.  Limited EMS resources and coordination were identified.  Use of an investigational new drug (vaccine) will be untenable to control a bioterror epidemic.  There was not enough time and personnel to stem spread of bioterror attack. Mass vaccination without regard to exposure probability was the resorted method.  Early resource mobilisation meant early patient transport.  Early dispatched HEMS was able to perform lifesaving airway procedures on inhalation injured casualties.  Need to coordinate with ED administrator or manager to call in off-duty staff.  Anticipate manpower needed for decontamination.  Prepare for cold weather decontamination such as utilising blankets.  Expect that antidote resources may fall short.  Prepare responders that MCE is not routine care.  Maintain transport access points.  Estimation of resources within organisation were poorly executed.  Abundant resources and supplies such as disaster plan manuals were not adequately utilised.  Issues with specific medical equipment/medication/electromechanical systems, specific reinforcement personnel were identified.  logistic challenges with increased demands for supplementary medical and mental health personnel, equipment, and clean food and water supplies due to suspected resource contamination are needed.  manpower shortages and delay in missions are expected.  Military epidemic management team to act as a distinct consulting body for the surgeon general is imperative for sustaining operations.  PPE and logistical equipment is required for burial after bioterror attack.  Resources took longer than expected to be made available.  Insufficient vaccination clinics due to large number of patients and needed documentation.  Absence of public health representative lead to members being asked difficult scientific questions.  Trauma system healthcare liaison should be updated frequently and be used to request resources.  Stretchers can be used as beds to create more resources.  The distance to burn centres is far and hence transport resources such as ambulance and HEMS and their early activation plays a key role. This was identified as a bottleneck.  Lack off efficient access of PICU Surge Plan by all employees. EMR was not consistently used by ED and PICU. |
| Communication (18) | Hospitals should be notified early with scene report.  Real time communication and radio devices were used however communications and intended recipients of the communications were not well deciphered due to noise. Improvements in communications and enhanced information sharing is needed.  In situ simulations can significantly increase knowledge and communication in MI simulations.  Communication difficulties led to triage area now being aware of arriving ambulances. This led to confusion over simulation patients and real patients in ED.  Lack of communication between emergency operations centres, the public and care providers.  Lack of communication between incident site and hospitals lead to unequal distribution of patients.  Radio communications at each hospital and for their staff to be trained is needed.  Communication between EOC and PICU and between EOC and ED were not timely.  Establish contact with incident officer at scene.  First information to media was poorly executed.  Breakdown in communications and skills performed led to compromise in victim triage, treatment and decontamination.  PPE hoods caused communication difficulties.  Incident command and ED communication problems led to disrupted timings of victim arrival.  Training staff to use communication systems is a limiting factor.  EOC did not effectively communicate with Greater Hospital Community.  Data smog present with social media etc. leading to incorrect or inaccurate information relay. Having a dashboard created on a secure internet link provided centralised accurate access to information.  Insufficient reporting and coordination between care providers can delay evacuation and result in higher death rates.  Lack of communication affected staff availability i.e. out of date contacts list. |
| Preparedness, learning and research (17) | Funding, standards and experience in disaster management are the improving factors for disaster preparedness.  Early epidemiological investigation is vital for preparedness and performance.  Further staff education on importance of hospital lockdown is needed in context of biochemical MCIs.  Exercise objectives and participants anticipated learning outcomes may differ. Therefore, self-report of satisfaction levels may not be a sign of “success”. Simulation planners must set out the outcomes and evaluation methods from the beginning and share the outcome with the participants of the simulation.  Lack of previous experience in MCE exercises may create risk of learning an incorrect procedure.  Lowest level of preparedness was seen of the Hospital Disaster Committee and the Emergency Operations Centre.  Data collection was more challenging in hospital than out of hospital. A distinct observer team stationed at the receiving hospital before drill initiation would allow more complete data collection.  Articulation of clear criteria for drill termination and establishment of detailed post drill procedures would facilitate more complete data collection.  Post-exercise debrief was found to be extremely valuable for further discussion and critique.  Observer-based performance evaluation provided more complete and accurate data set.  Lower performance was seen as a consequence of lacking comprehensive hospital disaster planning and a hospital command centre.  All agencies involved should continue to receive disaster response training.  Lack of knowledge over response plans was identified.  Disaster preparedness is ongoing and requires never-ceasing vigilance.  The decontamination tent was set up by fire crew who felt it would have been more appropriate to put PPE on before setting off for the mission instead of putting PPE on at the entrance of A&E department.  Regular updates of staffs’ contact information is needed.  Training for using walkie-talkie is needed. |
| Medical care (11) | Discharge instructions in the emergency department were not clear.  Ocular medical management was suboptimal.  If there is a risk of contaminated patient influx, all arriving people should be directed to decontamination area.  Anticipate reluctancy to remove clothes.  Continue to monitor and re-assess.  Anticipate that victims may return to site.  Burial locations need demarcating.  Challenging to identify the deceased with highly contagious organism.  Knowledge gaps were present in the management of those with immunocompromise.  Vaccinating all staff and not just care provider is important.  Human remains and disposal was an overwhelming problem as well as the legal aspects of who had the power to dispose of them. |
| Role identification (11) | Lack of understanding of own role.  Staff should be made aware of simulation, check in at incident command, have a clear assigned role. Physician and pharmacy leaders should be identified who can act as advocates.  Role identification was challenging with nonuniformed supervisory personnel unexpectedly appearing on scene.  Challenges in ability to identify personnel was seen.  Organisations need to plan for the emergency roles of medical staff.  Responsibility for roles need to be clearly outlined.  Challenges over who had authority.  Need to inform chiefs and personnel about job action sheets.  Identification of incident commanders in the PICU and ED were delayed.  One task to one person.  “Dual hatting” lead to staff shortage. |
| Patient flow (10) | Acute life-threatening emergencies should be stabilised in the emergency department and moved to appropriate destination as soon as possible.  Bottlenecks can occur and can be overcome by care providers’ modifications.  Using a computerised simulation system freed the care providers from constant calculations of casualty flow. As a result, they were able to anticipate problems and bottlenecks.  CT scanner was identified as a bottleneck.  Anticipate walk-in patients as well as EMS arrival.  Central patient tracking is key. A designated contact person at each hospital site is recommended for better equal distribution of patients. Volunteers can be mutually beneficial.  Establishment of incident complexes at each site led to unequal patient distribution.  More hands-on training is needed for state patient tracking system.  A variety of novel approaches helped with patient flow such as opening an ambulatory care area and transferring patients with minor injuries directly to the ambulatory areas, bypassing the emergency department.  Have at least 1 staff assigned to track paediatric patients and minors. |
| Triage (5) | Walking wounded triage status can deteriorate and create a second are of incident.  Ambulatory patients should be sent to ambulatory/ outpatient department when possible.  Allocate triage officer early.  Correlate triage with decontamination.  Remind triage officer to use triage tool appropriate to age. |
| Know the environment (4) | Live exercises identify gaps that can be missed in table-top exercises. i.e. knowing where the key to the kit cupboard is or how to turn on the water for decontamination tent.  Decontamination process was inadequate due to water drainage and kit utilisation.  Access to provided resources can be a limitation i.e. access to computers and software.  Insufficient gurneys were available which led to delays in patient flow. |
| Performance Evaluation (4) | A standardised, centralised core training and knowledge testing evaluation system to allow running exercises to feed back and assist for future training is needed.  Using standardised evaluation tools simultaneously to assess relationship between preparedness elements and response performance was not feasible.  Institutionalised system of process improvement based on continuous cycles of drills with targeted system modification and training is recommended.  Measurable indicators as standards of care could support decision making and be utilised as a quality control tool. |
| Friends and family (3) | Lack of grief counselling expertise.  Re-unification of friends and family is a demanding area and needs a large number of people to be effective.  Co-ordinating information from hospitals to relatives were also challenging from an information governance perspective and needs better organisation and clear protocol as this varies from hospital to hospital. Having an airline representative at each hospital helped with this issue. |
| Crowd control (2) | Simple tapes can be used to control crowd and prevent department contamination.  Crowds within hospital such as relatives, curious people and volunteers brought about issues of crowd control and security. |