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Towards Protecting Critical National Assets and Preparedness for Response to Hazardous Chemical, Biological and Radiological Attacks

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ABSTRACT

Hazardous chemical, biological and radiological (CBR) materials are catching attention of unscrupulous actors for creating terror and havoc. Threat perception for use of such materials by terrorists and non-state actors for malicious purposes, is not imaginative but real and imminent in today's context. World has witnessed a number of such incidences in the recent years, e.g., Mustard gas attack against Kurdish forces in Iraq; ricin laced letters sent to US President and others senators; use of Nerve gas agents in Syria; capturing of Uranium from University of al-Mousal, Iraq by IS, etc. National assets like critical buildings, legislative assemblies, historical building, hospitals are some of the likely targets for CBR attacks that attract quick coverage by media. Authorities entrusted with safeguarding of the facilities should take preventive measures and enhance their capabilities for an effective response. Essential CBR security should include measures to rapidly detect and effectively deter the CBR incidences and their deleterious consequences. In this review, protection of the critical facilities from CBR attacks, emergency planning and capacity development in terms of infrastructure, specialised training and mutual aid have been discussed.

Keywords: CBR hazard, National assets; Protection; Vulnerability; Mitigation; Preparedness; Capacity development

1. INTRODUCTION

TThe world is under persistent threat from a variety of toxic chemicals, micro-organisms and radioactive materials that can be used as weapon of mass destruction (WMD). Terrorists are continuously becoming sophisticated, particularly in aspects of their planning of terrorist operation with the adoption of newer modalities, techniques and strategies. They continue to adapt and exploit the developments in technology and improving the efficiency of existing methods[1]. Moreover, Non-state Actors and terrorists have ideological, financial, and logistical links with various like-minded individuals/organisations. Their force multiplier includes not only connections (good networking amongst themselves as well as with rogue nations/scientists) but also include swiftness and flexibility in all their operations. Furthermore, the basic information about chemical, biological and radiological (CBR) agents, knowledge on their means of delivery and Personal Protective Equipment (PPEs) etc., is nowadays easily available in open domain literature and on internet. Easy availability of dual use chemicals is another concern as some of the CBR materials are also used for a variety of legitimate purposes, e.g., chemical, pharmaceutical and biotechnology industries; nuclear medicine and radiotherapy facilities and in nuclear power generation. Security around stockpiles of decommissioned civil ormilitary CBR materials, is variable in different parts of the world and sometimes grossly inadequate. A reported increase in illicit trafficking of CBR agents globally and the role played by rogue countries in clandestinely propagating proliferation of CBR Technologies, further enhances this criticality. Terrorists misuse or sabotage of CBR materials may result in worst case scenarios[2-3]. Terrorist may choose a crowded place or a building of national importance for creation of utmost impact and disruption leading to mass casualty incidence (MCI).

Another fact is that virtually all CBR weapon states possess deep strike capability. North Korea is threatening to employ long range missiles for delivery of CBR materials against many nations. Test firing of OMAR-1 missile by Tahrik-e-Taliban, Pakistan in April 2015, added another dimension to the impending threats, as it would enable covert targeting of facilities from remote locations. This present challenges to secure critical structures from CBR threats emanating from well-known terrorist organisations like Aum-Shrinkiyo, Al-Qaeda and IS. Recent spurt in activities of Lone Wolf attackers, Home grown Terrorist outfits, and Suicide Terrorism also needs to be carefully watched from CBR standpoint.

CBR attacks/incidents are relatively uncommon due to high safeguard protective measures that are usually put in place. Nevertheless, in the past few years, there have been an increasing number of incidences or near misses with evidences that terrorist groups are plotting or seeking to create horror

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by using CBR agents. These attacks can cause exposure/ contamination of a large numbers of people to toxic CBR materials especially if carried out in confined spaces. CBR attacks should be taken as act of criminal significance targeted to inflict greatest damage. Such act calls for early identification of CBR agents and consequent decisive actions for their prevention and mitigation. Multi-agency response is aimed to ensure everybody sings off from the same hymn sheet, using the same language. This will lead to a well-organised, coordinated and effective response.

On the basis of the hazardous toxic nature of CBR agents, these can be broadly categorised into three groups, i.e., Chemical, Biological and Radiological.

1.1 Chemical Agents

Chemical warfare agents (CWAs) have become a familiar word in public domain after their release in World war -I, Japan (1994, 1995); Halabja, Iraq (1988); Damascus, Syria (2013); and Iraq (2015)[4-7]. Commercially available toxic industrial chemicals/ materials (TICs/TIMs) further widen the chemical threat spectra. As early as October 2006 Chlorine bombings in Iraq began and insurgents in Al-Anbar province used chlorine gas in conjunction with conventional vehicle-borne explosive devices. IS had managed to seize a former chemical weapons depot at al-Muthanna facility, located northwest of Baghdad, wherein around 2,500 chemical rockets filled with deadly nerve agent and their remnants, were stored along with other CWAs in Northern Iraq. Chemical weapons produced at al-Muthanna facility, are believed to include Mustard gas, Sarin, Tabun, and VX. Signs and symptoms of these chemical agents could range from 'stinking smell', difficulty in breathing or stinging of the eyes, experiencing nausea and vomiting, seizures, faintness, or ultimate death. The onset of the symptoms varies significantly according to time from instantaneous to several days depending on the agent used. The detection of various unknown chemicals with help of infrared devices traditionally relies on the matching of measured signals with library of signals included in the database. Mitigation of chemical attacks, require much more rapid medical attention to minimise their deleterious health effects[8-9]. CWAs are likely to be used by terrorist at critical national assets and adequate preparedness for response is required[6,9-13].

1.2 Biological Agents

Biological Agents Natural outbreaks of a number of microbial diseases or intentional use of either natural or genetically modified micro-organisms/toxins leading to disability, diseases or death, is a matter of great concern. Distinction between a naturally occurring epidemic or endemic diseases and biological warfare attacks by terrorists is not always easy unless conclusively proved. Attacks employing toxic biological agents are more difficult to detect, and even cannot be suspected before the appearance of the disease symptoms after latent lag period. Unless the Toxic Biological Material (TBM) is in sufficient quantity to appear as a powder, it would most likely go unnoticed (as in case of the 2001 anthrax mails). The biological agents like agents like Bacillus anthracis, Yersinia pestis, Variola, tularensis, which causes anthrax, plague, smallpox, and tularaemia disease respectively, after their dispersal in the air, are mostly invisible. However, the consequential damage inflicted would be enormous. Acquisition or production of toxins such as botulinum and ricin by terrorists is not very difficult. Snail mail employing anthrax and ricin have been a preferred means of delivery for biological agents and toxins since beginning of 21st century to terrorize/harm political figures, and personnel employed in intelligence agencies & in print/electronic media. An umbrella designed to inject a toxic pellet of ricin, was used to assassinate Bulgarian dissident Georgi Markov, the then BBC World Service journalist, on September 7, 1978 in London, UK. For designing effective response strategies, there should be a clear understanding, whether these agents are contagious or not. Contagious diseases such as smallpox that can be transmitted from person-to-person (therefore, more difficult to manage) are worrisome. Whereas a non-contagious diseases such as anthrax would infect individuals who have been directly in contact with the anthrax spores. However, these spores might also lead to distressing impacts in view of their ease of spread-ability and steadiness[14].

1.3 Radiological Agents

At present, radiological terrorism is a real and imminent threat for the world[15-17]. For terrorists to lay their hands on toxic radiological material (TRMs) is a bit difficult, but not totally impossible. Security of these materials in agriculture, industry, nuclear medicine and oncology clinics, is mostly tentative in a large part of the world. Therefore, the likelihood for the terrorist to carry out a nuclear sabotage or radiological attacks can't be ruled out. Non-state actors or terrorists may spread radioactive materials anywhere using suitable dispersal devices (e.g., aerosols, explosives, and aerial spraying mechanisms). Radiological exposure device (RED) such as strapped / containerised TRMs may be used[17]. Improvised nuclear device (IND) is a low yield nuclear device whose use may cause harm to human life, critical infrastructures and environment[17-18]. Radiological dispersal device (RDD) or crude dirty bomb could cause small scale incident and may result in contamination of men and materials including substantial property damage. This may spur mass panic by provoking people's fear of radiation. Centre for Non-proliferation Studies (CNS) database, publicly reported 325 incidents (155 in 2013 and 170 in 2014) across 38 different countries where nuclear/radioactive materials was either lost, stolen, or otherwise went outside of regulatory control (orphaned sources)[21]. Thousands of potentially harmful radiation sources are annually reported as orphan sources all over the world." According to an IAEA Report, 'orphaned' sources have been reported 266 persons had been overexposed and 39 died in 60 severe radiological accidents[21]". Fortunately, just one of these incident involved less than a gram of highly enriched and directly weapons-usable Uranium, and only 5 per cent of these cases involved high risk radioactive sources. The need of the hour is to implement a more stringent regulatory policy for the safety/security and containment of these radiological materials.

2. CBR THREAT PERCEPTION

Important national assets such as metro trains, banks, parliament, defence head-quarters, airports, secretariat, chemical industries, biotech-industries, nuclear power plant, and major secondary or tertiary case hospital etc., could be soft targets for the terrorist. CBR threat perception pose series of challenges including fear of unknown (due to uncertain knowledge about the causative agent and associated health effects); potentiality to cause death, disability or disease including long-term health concerns; and exponential spread of exposed/contaminated victims etc. When it is at its worse, it can also cause public chaos, and may results in contaminated environment, wrong perception, and media scrutiny, collapse of civil order and essential services, and ultimately leading to almost complete disruption of the society. There are many indications that non-state actors and terrorists have already acquired CBR technologies and intended to use them for malicious purposes in covert attacks (including those in low-intensity conflicts). Even though CBR incidences involving CWAs, TICs, TIMs, TBM and TRMs etc., are considered as low frequency event, still the possibility of their happening and the overall impact they may create, remains very high. Experience shows that crowded and confined places like subway, sport venues and other critical national assets, etc., serve as an attractive and likely target for terrorists. Indian parliament attack in 2001 by Lashkar- e- taiba and Jaish-e -mohammed terrorists resulted in 12 deaths (5 terrorist, 6 police and 1 civilian)[22]. Thus, we can lose critical infrastructures, important persons or a crucial capability for longer period of time as a result of a CBR attack. Internationally important meetings or games that are organised regularly world-over provides a platform of high level threat and enhanced possibility for a CBR attack. These attacks could be deliberate, parallel/sequential incidences including follow-on attacks on Medical First Responders and hospitals[23]. Synchronised serial blast in Ahmadabad (India) Civil Hospital's Trauma Centre is one of the most disgraceful, inhumane, cruel and barbaric act against mankind that resulted in five mortalities and many more injuries.

Furthermore, such types of attacks highlight the need to ensure that the workers in such facilities/institutions/installation must be trained to recognise such attacks on the basis of common sense, followed by confirmation using different on-site/off-site detectors. Some incidents in general, tend to be more time critical, for substances especially that have a rapid onset of effect. CBR contaminants are often a matter of concern due to their late or delayed effects. The high probability of occurrence of CBR terrorism incidents has forced all governments and international organisations worldwide to review their existing safety, security, protection and response plans. They must develop new strategies and procedures, and up-to-date the protection and emergency plans. The CBR emergency response plan should be doable and quickly implementable[24].

The main deterrent to an overt CBR warfare is fear of International condemnation and estrangement of the attacking country that can cripple its economy. But a CBR attack through terrorist organisations and non-state actors duly supported by rogue nations is a clear possibility in the present context and pose a real danger to the entire world. The terrorist's organisations always crave for publicity and can go to any extent to achieve their sadistic motives. Attack by a terrorist organisation using a full-scale nuclear weapon is highly improbable. However, it could be a distinct possibility in the near future in the view of the alleged claims by IS that they will purchase ready-made nuclear weapons from international black market or rogue nations.

3. CBR ATTACKS: LIKELY SCENARIOS AND TARGET

CBR attack perception involves the assessment of vulnerabilities, prevention through physical security and mitigation. The CBR threat scenarios fall into four major categories, e.g., fast-acting, delayed-acting, contagious and non-contagious. Fast-acting chemical agents', e.g., Sarin, Hydrogen cyanide etc., shows symptoms in seconds to minutes. Delayed acting chemical agents and bio-toxins, e.g., mustard, arsine, botulinum toxin, ricin etc., toxic chemicals that cause no or very few detectable symptoms, may take from hours to days to show effects. Contagious and non-contagious biological agents biological agents causes no initial symptoms, or typically flu-like symptoms after a few days or weeks, and are problematic after the victims become symptomatic[25].

Dissemination techniques may include aerosol (i.e., liquid or solid particle), gas release, indoor/outdoor airborne attacks, and special release devices like pressurised vessels, and explosives in the public areas, and directed to the critical facilities/establishments. CBR attacks have the potential to show impact in large areas causing morbidity and mortality that may escalate to MCI. This may also result in large-scale contamination of the personnel, buildings, surrounding areas, materials present in the vicinity as well in downwind areas.

Important national assets and critical infrastructures that are likely targets and their vulnerability towards the CBR attacks is depicted in Fig. 1. CBR attacks act as a shock to the personnel involved in security and actual services as well as a challenge for government to counter them effectively. Buildings of national importance must be under high security vigilance by trained personnel to prevent happening of any CBR attack at the first instance. Target populations may include various employees as well as the transit population during working hours.

4. DESIRED AWARENESS LEVELS OF THE SECURITY PERSONNEL AND EMPLOYEES OF THE CRITICAL INFRASTRUCTURE FOR EFFECTIVE RESPONSE

Buildings harboring important activities could be soft targets for attackers. A centrally air conditioned building can be quickly contaminated with CBR agents by terrorist after introducing these agents into the heating ventilation and air-conditioning (HVAC) units system. Whether in the battlefield, urban settings or at the site of any confined space including national assets, the attack response needs immediate counter of the CBR agents in an accountable and responsive manner. Response to a typical CBR incidence including important aspects of an ideal response is presented in Fig. 2.

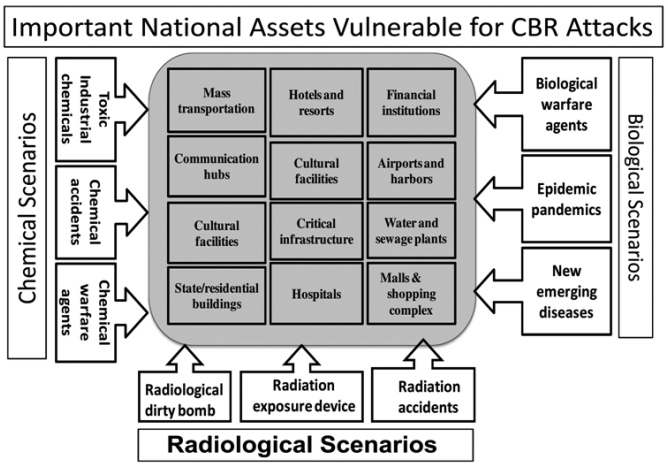

Figure 1. Important national assets vulnerable to CBR attacks.

Security/personnel/workers must be trained to act and to combat such situations. Regular table top exercises and rehearsal of on-site/off-site emergency plans by carrying out mock drills can help to protect the men and materials in case of actual CBR attacks. Emergency responders and building operators must be capable of dealing with the CBR release in the building. Buildings must be secure with the access open to only authorised personnel. In case of CBR emergency, cascades of instant operations are required such as evacuation assistance, shelter in place, communication with authorities, decontamination and medical management with countermeasures.

USA has made the preparedness posture against CBRN threat agents as well as stockpiling 21 product for potential use for public health emergencies repertories of medical countermeasures. People with well-defined role clarities and responsibilities, should always be ready with backup. Some other important actions needed include: No permanent seal outdoor air intakes, No modification on HVAC system, Establish a security zone around outdoor air intakes to prevent access to these areas, Prevention of unauthorised public access to mechanical areas and building roofs, Security implementation measures such as guards, alarms and close circuit television (CCTV) to protect vulnerable areas and restriction to outside personnel to building operation, information and physical security upgrades. Some possible indicators for the chemical attacks would be explosion with little or no structural damage, mist or vapour, multiple casualties with similar symptoms, mass casualties with no apparent reason or trauma, report of unusual odours, liquids\spray devices or cylinders and dead birds/animals. Possible indicators for a biological attack would be inexplicable human illness, mysterious mortality of living organisms, and symptoms of diseases caused by the agents. In some situations like anthrax laden letters post 9/11, people may be pre-alerted to a potential exposure. USA has made significant progress in preparing for disasters and advancing public health infrastructure for bio-defence security. For a radiological attack, common indicators includes nausea, vomiting, skin irritation, blackening of finger nail and skin, hair fall and other peculiar effects depending on the type and extent of exposure/ radio-nuclides involved in the incidence.

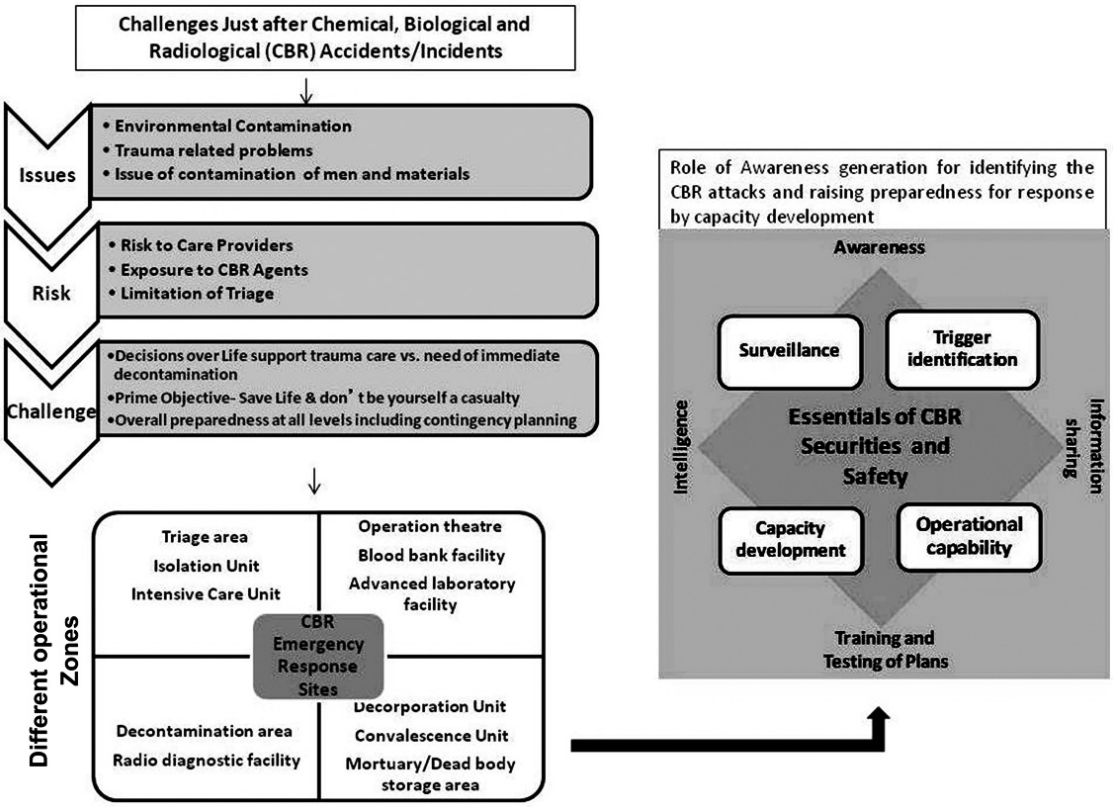

Figure 2. After a CBR accident/incident different challenges and issues like contamination of men, materials and environment could occur. CBR emergency sites must clearly be demarcated to different operational zones. For effective response capacity development and operational capability should be enhanced by regular training and testing of emergency plans.

5. PREPAREDNESS FOR THE CBR RESILIENCE OF NATIONAL ASSETS AND CRITICAL INFRASTRUCTURES

CBR agents may be disseminated in a specific confined structure by using air-burst bomb or by saboteurs employing various methods. Due to high impact nature of CBR agents, first responders and receivers of emergency victims must have adequate knowledge, skills, equipment and devices (e.g., prophylactic measures, decontamination agents and medical countermeasures) to manage these scenarios even at short notice. Preparedness for medical management of persons should be evolved as a part of the overall safety and security strategy. For effective prevention and emergency response, important points include vigilance, training, and application of common sense to recognise such hazardous incidents; Careful hazard response planning and regular exercising of capabilities and Possession of resources to mitigate the health effects of CBR materials. Corrective actions that should be taken immediately after incidents are evacuation of the victim from ground zero; resuscitation/stabilised; triage; decontamination at the incident site; evacuation to a safe holding area and transportation; hospital level decontamination and specific treatment.

5.1 CBR Protection

CBR Protection requires building a safer and resilient infrastructure and associated resources by nurturing a culture of prevention, mitigation and preparedness for prompt response. The entire process will provide momentum and sustenance through the collective efforts of all concerned government agencies, private player and stakeholders. CBR Resilience can be augmented by improving proactive strengthening of security and response so as to reduce overall vulnerability. A comprehensive list of critical infrastructure assets including various hazardous sites (chemical, biological and nuclear facilities) should be available to security agencies and response organisations. Security agencies should be able to prevent access of hazardous substances by terrorist and to prioritise protective security measures according to risk perception and maximum loss scenario. Hazardous sites of chemical, explosive stores, pathogen and toxin laboratories and radiological sources like nuclear medicine units and tele-therapy units in hospitals are potential areas to be critically watched. For effective proactive response, risk management plan must be revisited and updated at regular intervals.

Level of the protection and planning should be primarily derived from vulnerability assessment. Government should take appropriate steps to increase the CBR resilience of the critical infrastructure and security for crowded places. Owners and operators of critical infrastructures must be adequately equipped and have trained responder forces for handling CBR emergencies. Infrastructure can be categorised according to its value or 'criticality', which can be determined on the basis of the impact of its loss on business continuity. This could be analysed by using the criticality scale which depends on three different dimensions such as impact on life, economy, and essential services.

Pre-event planning and decision making (considerations in identifying the key, critical information and decision criteria) for facilitation of post-attack management activities are also important preparedness aspects to deter any such eventuality. In case of confined space, various employees as well as transit passengers may be the likely targets. The important aspects includes developments on CBRN protective clothing, the importance of forecasting models of protection and improving the comfort and physiological stress, development and modification of membranes and construction models, development of pronunciation and validated models for consequence of impact assessment, including cascading events to all the way up to societal impact joined to the application as well as exploitation of such models to major CBR scenarios. To protect critical national assets, the measures that should be implemented includes: reduce vulnerability through measures that are proportionate to the risk, raise physical security (e.g., perimeter security and multi-parametric security systems), augment personnel security (e.g., pre-employment screening and creation of security culture) and enhance cyber security (e.g., technical control, policies and procedures).

After implementing of these tight regulations and self assessment tool, a noticeable reduction in vulnerability of higher risk sites can be achieved. Countering terrorism, protect (restricted site access), prepare (model response), and pursue forensic capability, are other essential for competence development. Enhancing capability to detect CBR agents; denying terrorist access to knowledge and materials; and improving the effectiveness of response to recover after incident, are additional suggested measures. Intelligence agencies should augment co-operation and working relationships with critical industry and wider government/private sector, who own most of the infrastructure sites. Post-event remediation and restoration activities are necessary to attain reusable or normalised facilities.

5.2 Development of Systems to Quickly Detect and Thwart Covert CBR Attacks

Security should specifically address the policies and procedures associated with the physical security staff and transportation security along with material control and information secrecy. It should also include emergency response plan that address specific issue like general protocols that could be used at the incident site because the likelihood of a specific building targeted is difficult to predict. The building operator must take their own decisions about how to reduce their building's risk to a CBR attack. Building operators can reduce threat of CBR agents to a great extent by increasing the security at all the entry points. Protection from the other types of attacks such as building collapse, explosions and water supply contamination require different sets of measures. The building management authorities would implement CBR retro-fittings without undue delay to enhance occupant protection measures from CBR attacks. Higher risk facilities such as national assets, seats of political and financial powers, industrial and military facilities, subway systems, important medical facilities well as law enforcement facilities require to take special considerations. Besides preparatory recommendations, specific recommendations must be chalked out and followed for every facility for safety and security of the occupants.

5.3 Pre-screening and Surveillance

Screening refers to all the techniques and methods used in protecting staff and critical resources from accidental/malicious harm, crime, attack or other threats. Large numbers of public and very important persons may be visiting these facilities every day. This represents potential targets for terrorism because of the number of people located at a particular site in a specified time frame. Similarly, crowded locations present the high potential of death rate with attacks on national assets, and ability of the terrorist for creation of hostage crisis. Screening attempts may prevent any threats or potentially dangerous situations from arising. If security succeeds in this, the chances of any dangerous situations, threats or illegal items entering into building may be greatly reduced. Access controls should allow to the facilities and restricted areas, e.g., certain days of the week or shifts. In addition to controlling passage in and out of facilities or areas, determining who belongs and does not, and the ability to observe and track movement in and out of controlled areas has advantage. Agencies may permit access for various combinations of persons as well as assets, depending on the requirements and restrictions.

Basic principle for pre-screening may includes limited number of entry points; secured areas identification and dedicating; providing transition areas for secure and non-secure areas; minimising interference with the movement of passengers as well as system operations; layering (multiple layers) of security systems; using protective measures addressing all attack detection, mitigation, phases-deterrence, defence, response and recovery; providing an audit trail and transaction reporting capability. The ability to know intrusion detection is when someone has entered in a secured area, may include the ability to determine and identifying of intruder. This tracking of movement may include both authorised and unauthorised activity, and serves as both a staff management and a security tool.

Surveillance is the ability to monitor a specified area and may occur through on-site personnel or via remote technologies, using CCTV, unmanned aerial vehicles as well as other platforms attached with sophisticated CBR detectors etc.. In the premise or buildings, provision for adequate lightening should be there so to clearly see the entry and exit point as well other parts of the buildings. Surveillance systems vary in terms of detecting and recording capabilities. Policies and procedures must be clear for entry-point screening along with prompt communications and information processing systems. Recommendation of security personnel should be quick and implementable.

5.4 Evacuation during CBR Emergency

Evacuation an immediate and urgent step to take people away from the site of incident. Emergency evacuation plans are developed to ensure the safest, speedy and most efficient evacuation of all expected occupants of a building. benchmark ‘evacuation time’ for different hazards and conditions must be established during pre-event planning and execution phase. These established benchmarks can be set by using best practices, regulations, or employing simulation procedure (such as modelling the flow of people from building) or to determine doing the actual mock drill with prompt response. The use of multiple exits from proper planning structure, contra-flow lanes, and special technologies would lead to ensure full, fast and complete evacuation. Personal consideration may affect an individuals ability to evacuate and shall be taken into account. Evacuation Alerts, including visual alerts, audio and alarm signals may be used. The codes on buildings can be used to reduce the possibility of panic by allowing individuals to process the need to self-evacuate without causing alarm. Planning in a proper way would implement an all-hazards approach so that plans can be reused for multiple hazards that could exist.

The evacuation sequence can be divided into the different phases like detection, decision making, protection and alarm for people, shifting of those to shelters or an assembly station, and transportation. For important national buildings, adequate collective protection shelters must be planned in advance.

5.5 Multi-agency Response for Mitigation of CBR Attacks

To effectively mitigate or reduce the CBR risk, emergency preparedness must be the primary priority. It could enable the response team to combat a variety of such hazards efficiently. Awareness of the people for hazard mitigation and emergency preparedness will go a long way to protect themselves from released CBR agents. Threat detection should be faster to timely classify the category of hazards. Emergency preparedness models in government organisations/agencies suffer from many regulatory limitations. Hazard mitigation management must compete with routine demands as well as for space on the organisation agenda. Emergency preparedness management programs are difficult to implement because they tends to be viewed as an intractable problem. Due to policies that lack clear measurable performance objectives, jurisdiction with insufficient resources and minimal official support, Government on higher levels may fail to provide sufficient emergency management guidance with local jurisdictions. Only a very few organisationsare specifically evaluated periodically on the preparedness to continued business operations.

Since CBR attacks come without warning, emergency preparedness plan and precautions including preventive vigilance against terrorists are needed. An emergency contingency plan should be designed and tested periodically during regular trainings table tops and mock exercises. An internal room for sheltering in place, preferably on the top/middle level and windowless to restrict air-flow must be earmarked. No single agency is fully capable to response to such attacks. The essence of a well-structured and coordinated multi-agency response is assessment of capabilities and limitations of various stakeholders and responders. Mutual-aid agreements among various responding and stake holding agencies and other techno-legal documents should be drafted as a part of pre-event planning.

5.6 Development of Capabilities and Procedures

First step for any accidental CBR release in confined space is to identify the agent employed. Biological agents

never cause immediate symptoms while chemical agents may do so. If there is any biological agent suspected, goal must be to first detect and reduce the total number of people exposed while for chemical release, one should aim to minimise the concentrations to which people shall be exposed. Evacuation of the buildings should be done safely in such a manner so that the meeting point is in upwind air direction. For 'shelter-in-place' the responsibilities is of keeping the place identified and ready. Sequence of critical steps includes: Main decision-making: evacuation from the building following immediate turning off the HVAC systems, contacting authorities (fire and emergency department, police), building occupants to be provided instructions and proper coordination with the first aid providers and medical first responders and HVAC operators.

For chemical release area: It is very important to leave the system operating without alteration, unless a knowledgeable operator has to handle and perform HVAC manipulation. The HVAC system will provide some outdoor air and will exhaust some indoor air, so it will help to dilute the chemical and exhaust it from the building under normal operation.

For biological release: HVAC system to shut off and close outdoor air dampers. Local exhausts to serve bathrooms and kitchens, must be shut off. These immediate actions would prevent the building from becoming a source of contamination for people outside. The outdoor air to provide for an evacuation route including stairways should be pressurised. Segregate people known to be exposed, to avoid cross contamination, and tag or mark these people for further follow up. Risk based approach, threat dynamics, false alarm screening deterrent and risk model approach, are of utmost importance for effective response. Realistic vulnerability assessment, attack prevention and passive protection need proper attention. A schematic depiction of the CBR threats, vulnerabilities and preparedness in terms of capacity development, is as given in Fig. 3..

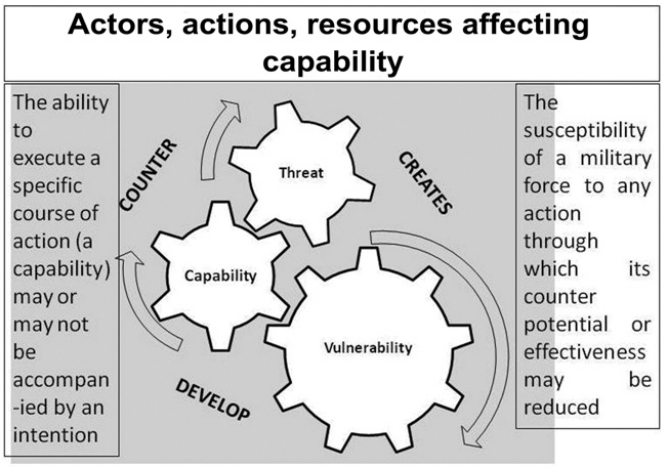

Figure 3. doctrine for the assessment of CBR attack threat and vulnerability mechanism to develop capabilities to successfully counter such malicious activities.

5.7 Decontamination Strategies for Toxic CBR Agents

The recent turmoil situations in many parts of Middle East and the increased risk of perceived CBR attack have raised alarm bells for CBR defence management. In situations involving CBR exposure and possible contamination, evacuees shall be decontaminated prior to being moved into clean areas to reduce body burden of hazardous CBR substances. CBR Emergencies requires technology smart multifunctional/ self-usable devices for personnel/mass decontamination. Decontamination is a complex process involving the conversion of toxic chemicals into harmless end products. Physical decontamination (scrubbing, brushing, dislodging, displacement, rinsing, evaporation, scraping, and wiping with wet clay and Fuller's earth) is easy to implement. Wet decontamination involves flushing with water or applying the chemical decontaminants. It possess some challenges like cross contamination; hypothermia; and needs trained personnel. It also results in large amount of hazardous waste generation and may be dangerous due to corrosive nature of decontamination agent.

Responder forces, operating in a potential or actual CBR attack zone should formulate active counter terrorism functions that are doable without prejudicing operational tempo and combat effectiveness. Chemical warfare agents could kill immediately or incapacitate the affected individuals even when they are present with low concentration. These toxic agents should be removed immediately to minimise their deleterious health effects. Similarly, radiological materials are also to be removed as soon as possible to reduce the risk of exposure as well as internalisation of contamination. Since, decontamination is both a science as well as an art, it require extensive training to develop required skills. In addition, decontamination team should preferably be cross trained in various tasks because they must be capable of changing roles as per situation's demand. Employees need to be trained in performance of simple task to multiple tasks, learn how to function after wearing individual protection equipment (IPE), and to work as a team for CBR emergency response continuum. Rehearsal can produce effective teams. Physicians, paramedics, and nurses designated to provide treatment to CBR contaminated casualties needs specific training in medical management of CBR attacks. In CBR MCI, the responder to take account of chemical agents and also the dispersal route, this can modify operations including PPE, the method of decontamination and expectation to the number of possible victims. The various dispersal routes are through aerosol, thermal detonation, addition in to water and food supply chain and even human contact. Standard operating procedures for decontamination

- Reduce contact with hazardous waste that has the potential for contamination
- Stress on practices that could minimises hazardous material contact
- Collect remote sampling, handling, and container-opening techniques and protection of monitoring/sampling instruments by bagging in appropriate packages
- Wear or use disposable outer garments/equipment
- Cover equipment/tools with strippable coatings, removable during decontamination
- Encase the source of contaminant with protective materials to prevent cross contamination and exposure.

  Place clothing into black plastic bags and spectacles,

wallets ornaments mobiles etc., in a transparent zipped pack for further decontaminating and/or disposal. The most important and most effective decontamination should be done within few minutes after exposure/contamination. Self-decontamination, by the victims will make a significant impact on the difference between survival (minimal injury) and death (severe injury).

5.8 CBR Training Exercises for the Occupants of the Facilities

Training of all emergency functionaries including district authorities and specialised first responders is an important prerequisite for the efficient management of CBR emergency. Medical preparedness is the weakest link in all CBR plans and the gap need to be filled with technical expertise and personal experience using training and mock exercises. Specific training modules need to be prepared, tested and implemented at different levels for emergency management. Normally occupants lack knowledge of CBR agents and their effect on health, recommended treatment profile and antidotes. Skill and competence are two pillars of resilience that one achieved through training. Exercising is the toughest part of learning, while training is the soul of transformation. Regular training of the establishment employees can help to protect, prevent, deter and respond to act of terrorism involving hazardous or toxic CBR agents. Imparting basic level of knowledge and understanding through training courses can help in framing proper instructions, advanced competencies, technology and tactics, focused to the CBR threats. Figure 4 represent different CBR skill enhancement modules that can be used to strengthen CBR response and cope up capacity based on the future needs.

Mock exercises should be conducted to allow occupants and responders to check their preparedness for locating and identifying the toxic substances and practice co-ordination with other responders and emergency functionaries to reinforce their skills and knowledge in a realistic training environment. The military, paramilitary and elite forces have stood the test of time in providing prompt, efficient, and highest degrees of mitigation and relief measures to not only its dependent clientele but also to civil authorities during CBR emergencies. Multi-agency integration and interoperability are the two biggest challenges to the participants in co-ordinating an effective CBR response. Goal of training is to avoid the failure to CBR events (Fig. 5).

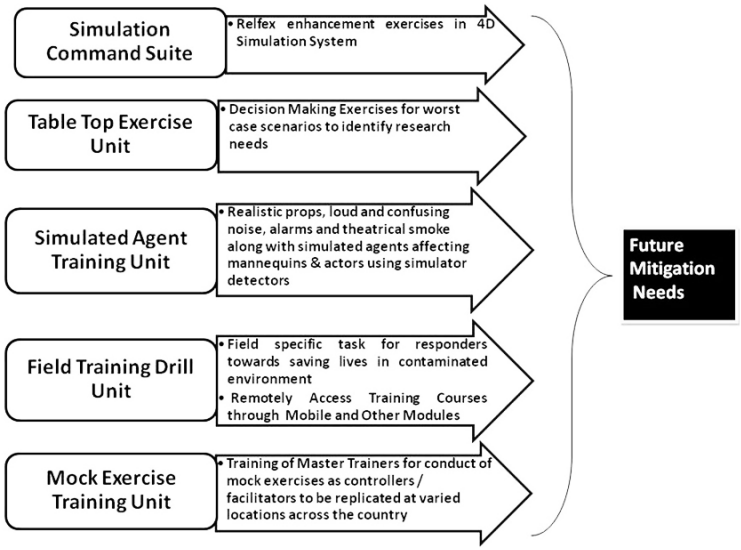

Figure 4. Advanced skill enhancement training facilities required to cope up with the emerging cBr threats. this will enhance capability and overall preparedness to efficiently combat cBr terrorism. Inclusion of e-Learning and use of mobile platforms will be a step towards moving from class room training to technology centric training.

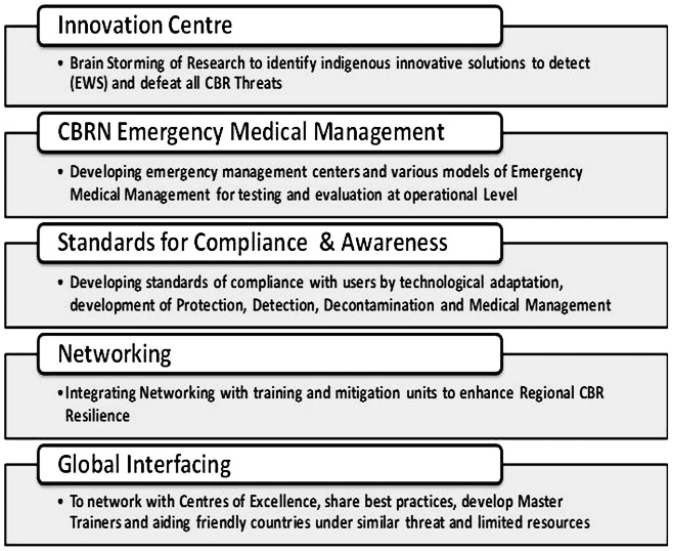

Figure 5. road map for cBr mitigation and towards enhancing resilience to identify needs of novel technologies. Awareness generation, technology- focus training and CBR Forensics lab should be developed as capacity development measure for crisis management.

6. CBR RESILIENCE CHALLENGES

Critical infrastructures and national assets belong to different stakeholders. Planning for their protection and response in the event of CBR attacks is not easy. Deployment of on-site and off-site CBR detectors is an important limiting factor. Training is critical to the success of broad spectrum response operations executed by multiple agencies. Most of the current training methodologies and technologies are not well-suited for addressing emergent training requirements for critical structures protection and response. Co-ordination between different response agencies, academia and industry to optimally utilise global technologies and maintaining a self-sustenance process for CBR defence is an important challenge. Global training and education needs of today's demographics should be met by using innovative instructional medium. The ability to train and communicate due to the vast nature of the scope with limited connectivity and infrastructure needed to be developed. Inadequate training infrastructure and trainers for training is another limiting factor. Non-standardised training equipment, systems and methodologies, lack of facilities for field/simulation based trainings and inadequate enhancement of capabilities of trainers at regular intervals, are some of the impediments for CBR resilience.

7. CONCLUSIONS

A national code of practice for security needs to be designed and promulgated. There should be pro-active integration of CBR intelligence into military doctrine and civil emergency planning. Furthermore, its implementation by occupants/managers of facilities and other related structures is to be ensured. Immediate alert and early warning system can help to reduce level of severity of any CBR incident. Airborne warning and control system system could help to reduce vulnerabilities to a great extent. For the confined buildings, HVAC should be equipped with rapid CBR detectors so that the air could be quickly redirected through scrubbers to remove these agents. Universal full time basic protection, preparedness and capacity development includes mitigation measures, medical management, augmenting equipment, skills and strategies to protect both personnel and national assets. Training (not a one-time event) should also provide guidance on the implementation of codes of conduct, development of communication skills among different agencies, improvement of productive collaboration and endorsement of confidentiality. Mobile and ready-to-task field laboratories, mobile hospitals, mobile specialist teams and units for immediate response of the attacks should always be in provisioned. A network of reach- back experts should be available to provide prompt and continuous scientific CBR mitigation support and advice to control chaos. Security plan need to be revisited at regular intervals to make sure that there are no flaws in it. Last, but not the least, improved co-ordination between intelligence agencies, military, civilian responders, other security agencies, as well as emergency functionaries, is absolutely essential to keep a preventive vigilance and develop strong response mechanisms.

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