CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Bio terrorism is a new dimension of man-made disaster. This is being taken up seriously by the countries which are more vulnerable to disasters. The case studies given in the Chapter 4 indicate that India is also vulnerable to such disasters. As India is a highly populated country any such disaster involving deliberate food adulteration can cause enormous mortality and morbidity. Hence, this can be considered as one of the most serious man-made disasters. In the following paragraphs some suggestions and recommendations have been made.

7.11 Awareness at all levels

Bio terrorism (and especially food bio terrorism) is not yet recognised as one of the disasters in India. It is part of the NBC (Nuclear-Biological-Chemical) disaster. There is a need to recognise it at the government levels (all concerned departments) and other stakeholders, mainly common public, who can be the victims in case of such disasters. The schools, colleges and large gatherings like the Kumbh mela and marriages, etc are highly vulnerable. Constant vigil and large scale sampling of water and edible items can be a good precautionary measure and part of the preparedness process.

Police and the medical staff should be exposed to this disaster as we do to the other types of disasters. There is a very thin line of difference between the awareness and creating panic. The local authorities need to take note of this and use appropriate methodology for the public awareness and education.

7.12 Steps to be taken and formulating plans

The initial response to such a deliberate release of infections or toxic agents against the civilian population is mainly a local responsibility, which has to be dealt with by the local authorities. The public health authorities are the first responders in these crises. For them also it raises a question of priorities, as these are very rare and intermittent instances hence other areas of public health take a front seat. The authorities need to do a proper threat assessment, analyse it and prepare accordingly. Any assessment of the threat has to be done keeping in view that there may be multiple strikes at far off places in on go. The facilities available at all these places need to be kept in readiness, if not alertness. Epidemiological studies done by agricultural specialists may be the indicator, identifying that a bio-terrorist attack has occurred. Identifying rapidly that an attack has occurred, identifying the biological agent used, isolating the contaminated area and containing the source will be critical to dealing with these events. These events can be a placed in continuum scale. On the one end is the scenario is that the attack has minimal consequences which can be handled at the local level with the available resources. This cannot be termed as a disaster. No external help is required as the scale is not large and can be contained with the local resources. The spin-offs of such attacks which may reflect in a couple of days also need to be kept in mind and local plans to handle such actions

formulated accordingly. At the other end of this continuum are the mass casualties and mass destruction/ impact due to such an event happening. For such a large scale attack, intervention of specialist agencies from within the country or outside may be needed. This may involve governmental and private agencies. The public health infrastructure may be stretched to the limit in such rare cases.

Adequate steps need to be taken to develop a micro level plan. These plans are based on-

- Prevention
- Detection
- Preparedness and Response mechanism

Operational risk management should include the following steps-[106]

- Identify the hazards
- Assess the risk
- Analyse risk control measures
- Make control decisions
- Implement risk controls
- Supervise the review

a) Identify the hazards and outbreak

Detailed information should be collected as soon as possible, which includes the following:

- Persons reporting the potential outbreak
- Number of persons affected
- Date and time of occurrence
- Event at which occurred
- Specific symptoms exhibited and first aid provided to them
- Samples of food and water consumed
- Multiple samples to be collected

- Any other relevant information to be collected

b) Assessing the risk

Based on the preliminary information obtained during the early stages of an outbreak investigation is to be conducted. This will give an idea as to the impact of attack and steps which need to be taken by the authorities, not only to treat the victims but also to protect the others. For most food-borne disease outbreaks, food and stool samples have to be collected from persons experiencing problems or exhibiting symptoms in order to identify or confirm the pathogen. Blood tests, stool tests and urine samples may also prove to be quite helpful.

c) Analyse and implement risk control measures

A successful investigation requires a teamwork approach and collaboration among the medical investigators, epidemiologists, food inspectors, microbiologists and healthcare providers, as the problem needs to be tackled as a team. Precautions and prevention are aimed at preventing future outbreaks. Appropriate control measures need to be established for-

- Removal of contaminated food
- Exclusion and restriction of persons who are at high risk of spreading illness, including food handlers, day care attendees and providers, and persons involved with direct patient care
- Emphasizing hand hygiene
- Closing the food establishment, if needed

d) Description of epidemiology and possible hypothesis

Tools that may be used to organize and depict the outbreak by time, place, and person include epidemic curves, maps and frequency tables. Develop a hypothesis as an educated guess about the cause of the outbreak and the factors that may have contributed to the illness and take ameliorative steps. Documentation is extremely important for future action and planning.

7.13 Precautions in planning

It is estimated by the WHO that food-borne diseases are notified in only 10% of cases in developed countries and 1% in developing countries.[107] The organisations involved in the whole process should take the following precautions in the planning process-

- Develop security plans after discussions with the local authorities
- Ensure safety of the raw materials till delivery at the factory premises
- Background check of the manpower involved in the process
- Restrict access
- Protect the logistics chain and storage points
- Use technology to identify the food supplies so that the contaminated products can be segregated and investigated if need be
- Immediately report to the authorities any suspicious behaviour and threats

7.14 Obstacles to effective response system

Inadequacy of the effective response systems is inbuilt in the whole process as for the food-borne illnesses, passive surveillance systems may not be adequate as it only represents the tip of the iceberg because:

(1) Most of the victims do not even realise the root cause of the problem

(2) Majority of the patients having mild symptoms of short duration do not seek medical care

(3) Many of those that do access clinical care will not have the laboratory tests performed to determine the etiology and

(4) Of those who seek medical care in whom an etiologic diagnosis is confirmed, not all will be reported to the surveillance system(s)[108]

Moreover, the establishment of a response system is not given due importance because of the following reasons-

- It is not given importance until a disaster strikes
- It lacks support from the ruling dispensation because preparedness does not get as much publicity as the recovery

- Regulation is always resisted and the governmental system suffers from inertia
- Lack of historical data impedes establishment of new agencies
- Inadequately trained and ill equipped personnel
- Co-ordination among various agencies
- Lack of finances
- Technical complexity
- Resistance to delegation of powers to lower levels
- There can never be proper assessment of risks. What is the level of preparedness may never be quantified as newer ways are being employed by the terrorist elements.

7.15 Specialised Response Assets for India

Different foods implicated in food borne outbreaks in India are milk and milk products such as dahi, khoa, butter milk, sweets, kheer; meat, poultry, fish, fowl, sea food such as prawns; cooked and uncooked rice; samosa, batata wada, tamarind and cooked as well as uncooked vegetables. A survey of eggshells, egg trays and egg contents in Coimbatore showed 7.7% eggs and 7.5% egg trays were contaminated with *Salmonella*. The most common serotype was *Salmonella enteritidis.*

The total count of bacteria per gram of food is an indicator of hygiene and temperature abuse in the preparation of food. The microbial population of different Indian foods varies from 0-400X10^6 organisms/ gm. The percentage of contamination of different food borne pathogens in Indian foods varies from 1-75%.[109]

Major food borne hazards along with their clinical symptoms have been detailed in the table given below.

Table-15

Pre dominant symptoms, associated organisms and various onset times [110]

Time to onset	Predominant symptoms	Associated organism or	Samples from cases

of symptoms		toxin	(and food-handlers)
Upper gastrointestinal tract symptoms (nausea, vomiting) occur first or predominate			
<1 hour	Nausea, vomiting, unusual taste, burning of mouth.	Metallic salts	Vomit, urine, blood, stool
1–2 hours	Nausea, vomiting, cyanosis, headache, dizziness, dyspnoea, trembling, weakness, loss of consciousness	Nitrites	Blood
1–6 (mean 2–4) hours	Nausea, vomiting, retching, diarrhoea, abdominal pain, prostration	*Staphylococcus aureus and its enterotoxins*	Stool, vomit, (swabs from nostril, skin lesions)
8–16 hours (2–4 hours if Emesis predominant)	Vomiting, abdominal cramps, diarrhoea, Nausea	*Bacillus cereus*	Rectal swab, stool
6–24 hours	Nausea, vomiting, diarrhoea, thirst, dilation of pupils, collapse, coma	Mycotoxins (Amanita sp. Fungi)	Urine, blood (SGOT, SGPT), Vomit
12–48 (median 36 hours)	Nausea, vomiting, watery non-bloody diarrhoea, dehydration	Norovirus	Stool
2–36 (mean 6–12) hours	Abdominal cramps, diarrhoea (putrefactive diarrhoea - *Clostridium perfringens)*, sometimes nausea and vomiting	*Clostridium perfringens, Bacillus cereus*	Rectal swabs, stool
6–96 hours (usually 1–3 days)	Fever, abdominal cramps, diarrhoea, vomiting, headache	*Salmonella spp, Shigella, Aeromonas, Entero-Pathogenic E. coli*	Rectal swabs, stool
6 hours to 5 Days	Abdominal cramps, diarrhoea, vomiting, fever, malaise, nausea, headache, dehydration (sometimes bloody or mucoid diarrhoea, cutaneous lesions associated with *Vibrio vulnificus)*	*Vibrio cholerae (O1 and non-O1), V. vulnificus, V. fluvialis, V. parahaemolyticus*	Stool
1-10 (median 3-4) days	Diarrhoea (often bloody), abdominal pain, nausea, vomiting, malaise, fever (uncommon with *E. coli* O157)	*Entero-Haemorrhagic E. coli (including E. coli O157), Campylobacter*	Stool, rectal swabs
3-5 days	Fever, vomiting, watery non-inflammatory	*Rotavirus, astrovirus,*	Stool, vomit

	Diarrhoea	*enteric adenoviruses*	
3-7 days	Fever, diarrhoea, abdominal pain (can mimic acute appendicitis)	*Yersinia enterocolitica*	Stool
1-6 weeks	Mucoid diarrhoea (fatty stools) abdominal pain, flatulence, weight loss	*Giardia lamblia*	Stool
1 to several Weeks	Abdominal pain, diarrhoea, constipation, headache, drowsiness, ulcers, variable − often asymptomatic	*Entamoeba histolytica*	Stool
3-6 months	Nervousness, insomnia, hunger pains, anorexia, weight loss, abdominal pain, sometimes gastroenteritis	*Taenia saginata, T. solium*	Stool, rectal swab

Source-www.ncdc.gov.in

In order to manage the consequences of the likely destruction to be caused by the use of biological weapons, a specialised agency may be needed. It must be well equipped and manned by personnel who are well trained in prevention, detection and amelioration of the problem. Biological Emergency Response Teams should have the following capabilities-

1. As they will be first responders, they should have kits for detection
2. Technical advice to the local authorities
3. To carry out medical examination of the affected persons at the spot
4. Assist the hospital authorities in public health measures
5. Research facilities for checking the strain and acting upon it
6. Dedicate chain of command as any mistake may aggravate the issue instead of solving it
7. Ensuring co-ordination among the public and the private sector health centres

Food safety is most important in order to protect the consumers. For that a clear cut food policy will have to be framed and one nodal agency be identified and equipped well. Effective surveillance systems will supplement these. The National Institute of Communicable Diseases (NICD) can be nominated as the nodal agency

to handle these cases. It should have facilities for working as the nodal/ referral centre for such outbreaks in the whole of the country and be equipped accordingly.

7.2 Recommendations

7.21 Use of Technology and strong systems

Technology is widely being used a worldwide in order to track the food chain. This will assist in identifying and proper monitoring of the food chain in case of any disaster or undue interference. Blockchain technology which has a lot of advantages can be used in the food industry. This technology ensures that the transactions are bundled into batches called blocks. These blocks are inter-connected with each other. Each block is cryptographically linked to the previous one showing the sequence of transactions. The information is in public domain. It will be extremely difficult for the adulterers to mix and make any alteration in food chain and if anyone wants to interfere in the process, they can easily be identified. From fake rice and shrimps to synthetic eggs, food fraud is turning into a serious global issue. Chinese food companies rapidly becoming part of the global food supply chain are looking to invest in blockchain (bitcoin) technology to tackle food fraud. This has been initiated due to the scandals in China over the past decade- from melamine laced baby food that killed 6 infants, to rat meat dressed as lamb- have seen the country become a hotbed of corrupted, counterfeit and contaminated food. Retail giants in China are turning to the blockchain technology to combat this. Walmart, the world's largest retailer has completed a trial to track pork in China, where it has more than 400 stores. The time taken to track the meat's supply chain was cut from 26 hours to seconds using blockchain.

Pesticide use and management in India is largely unregulated and food contaminated with pesticide residues is freely used by unsuspecting consumers. These strongly need to be regulated. Pesticides are linked to long-term health effects such as endocrine disruption, birth defects and cancer. These have been found in packaged food products, soft drinks, bottled water and also in human tissues in India.

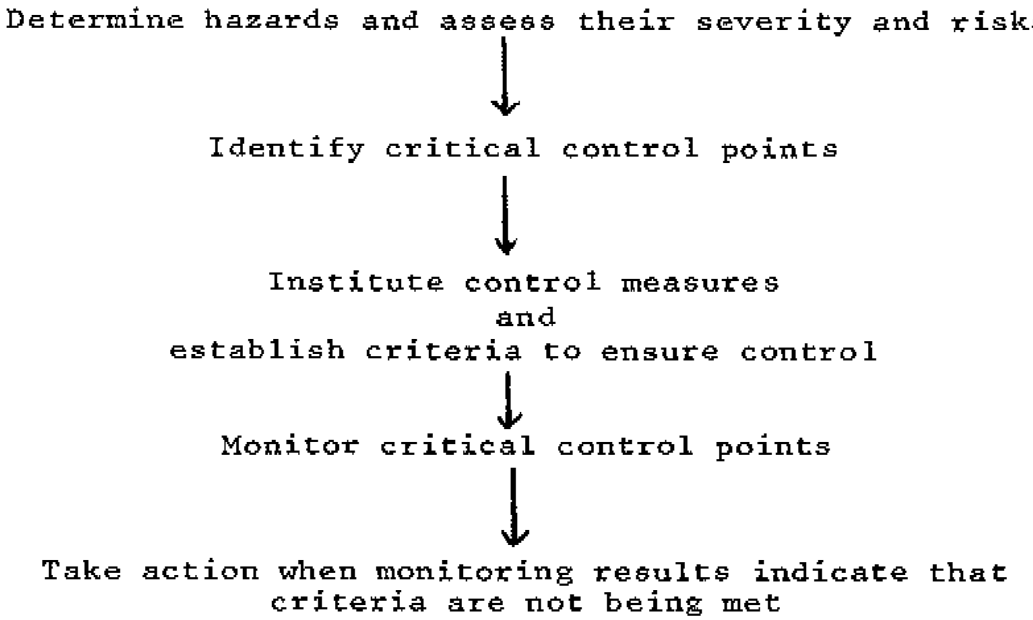
Food Safety and Standards (FSS) Act should be strengthened and financial & legal penalties imposed on the delinquents. FSSAI should simplify regulations and

standards for Food Processing Organisations at all levels. Standards must be unambiguous and clear. FSSAI should also place greater emphasis on training food handlers.

An effective monitoring mechanism is the 'key' to the success of Indian food safety regulatory framework while limited capacity of enforcement authorities should not be a hindrance and should be augmented. Opportunities for deliberate contamination of food can be minimized by increasing the security of people and premises. All segments of the food industry could develop security and response plans for their establishments, proportional to the threat and their resources. Sources of raw materials and storage facilities and transport systems have to be safeguarded. Access to all critical areas in production, processing, transport and storage be controlled and documented to minimize opportunities for contamination.

A proper HACCP system with appropriate command structure needs to be established like the example given below.

FIGURE 1. THE HACCP SYSTEM



Source: http://apps.who.int/iris/bitstream/10665/61692/1/WHO_EHE_FOS_88.7.pdf

Setting up of a National level disease surveillance and public alert system is essential as it is important to record all acute and long-term food-borne cases and their reasons.

Monitoring of antibiotic resistance trends in live animals, retail meat and humans would help tackle the antimicrobial resistance. Veterinary Council of India needs to be involved in this.

Strengthening of food testing laboratory infrastructure and skills as the existing facilities are inadequate. Food safety is a cross cutting issue with prominent stakeholders in non-health areas such as the food industry, agriculture, standardization/regulation authorities, food distributors and the general public.

Banning of chemical additives, various colours used in the food items, ultra-processed junk foods are known to be high in salt, sugar and fats including trans-fats. Controlling adulteration is a big challenge in this sphere.

Preparedness planning should include facilitation of unhampered criminal investigation, which may require adequate legislation, a signed chain of custody for any specimens and effective interaction between emergency response and law enforcement components. Appropriate diagnostic training and veterinarian capabilities need to be enhanced. Food Inspectors and Sanitary Inspectors can be exposed to this threat so that they are alert and learn to use Spot testing of food materials. Preparedness planning and response systems for food terrorism need to be developed to a level corresponding to the magnitude of the threat assessed.

Assessing the vulnerabilities and strengthening the surveillance systems is essential at all levels.

Cooperating with industry to strengthen the security of processes, people and products; providing industry with information on known or possible biological, chemical and radio-nuclear agents is extremely important.

The globalization of the food trade means that an inability to respond to a food emergency incident such as food terrorism would have severe consequences on

health and trade in many countries. Hence, involvement of other countries has also become imperative in establishing a good plan. Similarly, experiences from some of the most well prepared countries can also be useful for us. The IHR adopted by WHO in 1969, represent the only regulatory framework for global public health security. IHR can prevent the international spread of infectious diseases by requiring national public health measures that are applicable to travellers and products at the point of entry. WHO has issued detailed guidelines, which needs to be strictly followed.[111]

A free society will always have exposures to terrorist activities but vigilance and surveillance are essential to minimize food terrorism events. Any lapse could prove costly in economic, psychological and life-threatening ways. Strengthening of the FSS Act 2006 and FSSAI has paved the way for easier access to and utility of food safety regulations by the food and agricultural industry as well as health officials. Further strengthening of food safety policies and its effective enforcement is needed along with educating the public. Additional efforts to enhance inter-sectoral public health approaches will be essential to further strengthen food safety in India.

7.22 Role of NDMA and guidelines

The Disaster management Act (2005) has widened the definition of 'Disaster'. Now each and every natural and man-made disasters are being dealt with by the NDMA. The Authority may organise a national level discussion, inviting some of the most vulnerable states to know the status and suggest preparedness, mitigation and response systems.

An integrated Command Structure under the NDMA with representatives of the concerned ministries and officials from State Administration, State Police, State Fire Services, FSSAI and some Eminent Experts, representatives from the various State governments of Maharashtra, Tamil Nadu, Telangana, Haryana, Rajasthan and Uttar Pradesh, etc needs to be set up to cater to such emergencies. NDMA has prepared more than 26 guidelines for various disasters. Similar guidelines can be

prepared by this potential man-made disaster. Each State Authority should have clear cut delineated roles to perform to remove any ambiguity. Training plans and mock drills should be conducted to increase awareness among the agencies and the common man. This integrated structure will go a long way to provide prompt response and quality medical care to the affected victims. It will also ensure that the impact is restricted and does not spread to other parts of the country. This will definitely have a positive impact on the society.

BIBLIOGRAPHY