

National Disaster Management Guidelines

Management of Biological Disasters

National Disaster Management Guidelines—Management of Biological Disasters

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The National Guidelines are formulated under the chairmanship of Lt Gen (Dr.) J.R. Bhardwaj, PVSM, AVSM, VSM, PHS, (Retd.), Hon'ble Member, NDMA in consultation with various stakeholders, regulators, service providers and specialists in the subject field concerned from all across the country.

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Government of India

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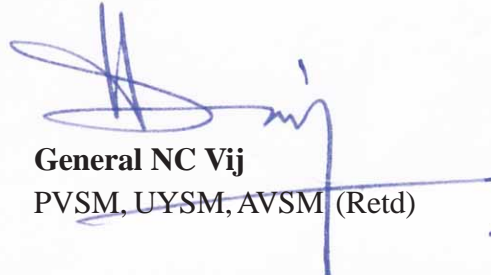
FOREWORD

The preparation of national guidelines for various types of disasters, both natural and man-made constitutes an important component of the mandate entrusted to the National Disaster Management Authority under the Disaster Management Act, 2005. In recent years, biological disasters including bioterrorism have assumed serious dimensions as they pose a greater threat to health, environment and national security. The risks and vulnerabilities of our food chain and agricultural sector to agroterrorism, which involves the deliberate introduction of plant or animal pathogens with the intent of undermining socio-economic stability, are increasingly being viewed as a potential economic threat. The spectre of pandemics engulfing our subcontinent and beyond poses new challenges to the skills and capacities of the government and society. Consequently, the formulation of the national guidelines on the entire gamut of biological disasters has been one of our key thrust areas with a view to build our resilience to respond effectively to such emerging threats.

The intent of these guidelines is to develop a holistic, coordinated, proactive and technology driven strategy for management of biological disasters through a culture of prevention, mitigation and preparedness to generate a prompt and effective response in the event of an emergency. The document contains comprehensive guidelines for preparedness activities, biosafety and biosecurity measures, capacity development, specialised health care and laboratory facilities, strengthening of the existing legislative/regulatory framework, mental health support, response, rehabilitation and recovery, etc. It specifically lays down the approach for implementation of the guidelines by the central ministries/departments, states, districts and other stakeholders, in a time bound manner.

The national guidelines have been formulated by members of the Core Group, Steering and Extended Groups constituted for this purpose, involving the active participation and consultation of over 243 experts from central ministries/departments, state governments, scientific, academic and technical institutions, government/private hospitals and laboratories, etc. I express my deep appreciations for their significant contribution in framing these guidelines. I also wish to express my sincere appreciation for Lt Gen (Dr.) J.R. Bhardwaj, PVSM, AVSM, VSM, PHS (Retd) for his guidance and coordination of the entire exercise.

New Delhi
July 2008


General NC Vij
PVSM, UYSM, AVSM (Retd)



Member
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I would like to express my sincere thanks to the representatives of the other central ministries and departments concerned, regulatory agencies, Defence Research and Development Organisation, professionals from scientific and technical institutes, eminent medical professionals from leading national institutions like the National Institute of Communicable Diseases, National Institute of Virology, Indian Veterinary Research Institute, Defence Research and Development Establishment, Sir Dorabji Tata Centre for Research in Tropical Diseases, National Bureau of Plant Genetic Resources, Indian Council of Agricultural Research, National Institute of Disaster Management and consortiums of the corporate sector for their valuable inputs that helped us in enhancing the contents and overall presentation of the Guidelines.

The efforts of Maj Gen J.K. Bansal, VSM, Dr. Rakesh Kumar Sharma, Dr. Raman Chawla, and Dr. Pankaj Kumar Singh in providing knowledge-based technical inputs to the core group and knowledge management studies of global best practices in Biological Disaster Management, are highly appreciated.

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New Delhi
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Abbreviations

The following abbreviations and acronyms used throughout this document are intended to mean the following:

AFMS	Armed Forces Medical Services
AICRP	All India Coordinated Research Project
AIDS	Acquired Immuno Deficiency Syndrome
AIG	Anthrax Immuno Globulin
AIIMS	All India Institute of Medical Sciences
ANM	Auxiliary Nurse Midwife
APHIS	Animal and Plant Health Inspection Service
APSV	Aventis Pasteur Smallpox Vaccine
AQCS	Animal Quarantine and Certification Services
ASCAD	Assistance to States for Control of Animal Diseases
ASF	African Swine Fever
ASHA	Accredited Social Health Activist
AVA	Anthrax Vaccine
BCG	Bacillus Calmette-Guérin
BDM	Biological Disaster Management
BSE	Bovine Spongiform Encephalopathy
BSF	Border Security Force
BSL	Biosafety Level
BT	Bioterrorism
BTWC	Biological and Toxin Weapons Convention
BW	Biological Warfare
C&C	Command and Control
CAC	Codex Alimentarius Commission
CAM	Crassulacean Acid Metabolism
CBD	Convention on Biological Diversity
CBPP	Contagious Bovine Pleuro-Pneumonia
CBRN	Chemical, Biological, Radiological and Nuclear
CDC	Center for Disease Control and Prevention
CGHS	Central Government Health Scheme
CHCs	Community Health Centres
CMO	Chief Medical Officer
CRF	Calamity Relief Fund
CRI	Central Research Institute
CrPC	Criminal Procedure Code
CSF	Classical Swine Fever
CSIR	Council for Scientific and Industrial Research
DADF	Department of Animal Husbandry, Dairying and Fisheries
DBT	Department of Biotechnology

DDMA	District Disaster Management Authority
DEBEL	Defence Bioengineering and Electromedical Laboratory
DFRL	Defence Food Research Laboratory
DGAFMS	Director General Armed Forces Medical Services
DGHS	Director General Health Services
DHO	District Health Officer
DIP	Destructive Insects and Pests
DM	Disaster Management
DM Act	Disaster Management Act
DMSRDE	Defence Materials and Stores Research and Development Establishment
DNA	Deoxyribonucleic Acid
DoD	Department of Defence
DPPQS	Directorate of Plant Protection, Quarantine and Storage
DPT	Diphtheria, Pertussis Tetanus
DRDE	Defence Research and Development Establishment
DRDO	Defence Research and Development Organisation
EEE	Eastern Equine Encephalitis
EMR	Emergency Medical Response
EOCs	Emergency Operations Centres
EPA	Environment Protection Act
ESIC	Employees' State Insurance Corporation
EWS	Early Warning System
FAO	Food and Agricultural Organization
FDA	Food and Drug Administration
FMD	Foot and Mouth Disease
FMD-CP	Foot and Mouth Disease-Control Programme
GDP	Gross Domestic Product
GF-TADS	Global Framework for Progressive Control of Transboundary Animal Diseases
GIS	Geographic Information System
GMOs	Genetically Modified Organisms
GOARN	Global Outbreak Alert and Response Network
Gol	Government of India
GPS	Global Positioning System
HEPA	High Efficiency Particulate Air
HIV	Human Immunodeficiency Virus
HPAI	Highly Pathogenic Avian Influenza
HRD	Human Resource Development
HSADL	High Security Animal Disease Laboratory
IAN	Integrated Ambulance Network
ICAR	Indian Council of Agricultural Research
ICMR	Indian Council of Medical Research
ICP	Incident Command Post
ICU	Intensive Care Unit
IDSP	Integrated Disease Surveillance Programme
IHR	International Health Regulations
IPC	Indian Penal Code

ABBREVIATIONS

IPPC	International Plant Protection Convention
IRCS	Indian Red Cross Society
ISO	International Standards Organisation
ITBP	Indo-Tibetan Border Police
IVC Act	Indian Veterinary Council Act, 1984
IVRI	Indian Veterinary Research Institute
JALMA	Japanese Leprosy Mission for Asia
KFD	Kyasanur Forests Disease
KIPM	King Institute of Preventive Medicine
KVKs	Krishi Vigyan Kendras
LBM	Laboratory Biosafety Manual
LMOs	Living Modified Organisms
MFRs	Medical First Responders
MHA	Ministry of Home Affairs
MoA	Ministry of Agriculture
MoD	Ministry of Defence
MOEF	Ministry of Environment and Forests
MoH&FW	Ministry of Health and Family Welfare
MoL&E	Ministry of Labour and Employment
MoR	Ministry of Railways
MPW	Multi-Purpose Worker
MRSA	Methicillin-Resistant <i>Staphylococcus aureus</i>
NADEC	National Animal Disease Emergency Committee
NADEPC	National Animal Disaster Emergency Planning Committee
NBC	Nuclear, Biological and Chemical
NBPGR	National Bureau of Plant Genetic Resources
NCCF	National Calamity Contingency Fund
NCMC	National Crisis Management Committee
NDDB	National Dairy Development Board
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NEC	National Executive Committee
NGOs	Non-Governmental Organisations
NIC	National Informatics Centre
NICD	National Institute of Communicable Diseases
NICED	National Institute of Cholera and Enteric Diseases
NIDM	National Institute of Disaster Management
NIV	National Institute of Virology
NPRE	National Project on Rinderpest Eradication
NRHM	National Rural Health Mission
OECD	Organisation for Economic Cooperation and Development
OIE	Office International des Épizooties (World Organisation for Animal Health)
PCR	Polymerase Chain Reaction
PED	Professional Efficiency Development
PFS	Plants, Fruits and Seeds
PGIMER	Post Graduate Institute of Medical Education and Research
PHCs	Primary Health Centres

PHEIC	Public Health Emergency of International Concern
PHFI	Public Health Foundation of India
PPE	Personal Protective Equipment
PPP	Public-Private Partnership
PPR	Peste des Petits Ruminants
PQ	Plant Quarantine
PRA	Pest Risk Analysis
PRIs	Panchayati Raj Institutions
PVOs	Private Voluntary Organisations
QRMTs	Quick Reaction Medical Teams
R&D	Research and Development
RRCs	Regional Response Centres
RMRC	Regional Medical Research Centre
RRTs	Rapid Response Teams
SARS	Severe Acute Respiratory Syndrome
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Force
SEB	Staphylococcus Enterotoxin B
SEC	State Executive Committee
SMX	Sulfomethoxazole
SOPs	Standard Operating Procedures
SPS	Sanitary and Phyto-Sanitary
SSB	Sashastra Seema Bal
TADs	Trans-Boundary Animal Diseases
TB	Tuberculosis
TMP	Trimethoprim
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
US	United States
USA	United States of America
USAMRIID	US Army Medical Research Institute of Infectious Diseases
USDA	United States Department of Agriculture
USSR	Union of Soviet Socialistic Republics
UTs	Union Territories
VAC	Veterinary Aid Centre
VATs	Veterinary Assistance Teams
VBMs	Valuable Biological Materials
VCI	Veterinary Council of India
VEE	Venezuelan Equine Encephalitis
VHFs	Viral Hemorrhagic Fevers
WEE	Western Equine Encephalitis
WHO	World Health Organization
WHO-SEARO	WHO-Regional Office for South-East Asia
WMD	Weapons of Mass Destruction
WTO	World Trade Organization
WW	World War

Glossary of Common Terms

The definitions of common terms used in this document are intended to mean the following:

Accountability

Accountability ensures that Valuable Biological Materials (VBM), are tracked and controlled, as per their intended usage by formally associating specified material with the individual under whom the material is being used, so that he is responsible for the said material.

Agroterrorism

Agroterrorism, is the malicious use of plant or animal pathogens to cause devastating disease in the agricultural sector.

Anti-microbial Susceptibilities

It aims to identify whether bacterial etiology of concern is capable of expressing resistance to the anti-microbial agent that is a potential choice to develop a therapeutic agent. It includes methods that directly measure the activity of the anti-microbial agent against a bacterial isolate and directly detect the presence of a specific resistance mechanism.

Bacterin

A suspension of killed or attenuated bacteria for use as a vaccine.

Biological Agents

They are microorganisms such as viruses, bacteria or fungi that infect humans, livestock or crops and cause an incapacitating or fatal disease. Symptoms of illness do not appear immediately but only after a delay, or 'incubation period', that may last for days or weeks.

Biological Disasters

Biological disasters are scenarios involving disease, disability or death on a large scale among humans, animals and plants due to toxins or disease caused by live organisms or their products. Such disasters may be natural in the form of epidemics or pandemics of existing, emerging or re-emerging diseases and pestilences or man-made by the intentional use of disease causing agents in Biological Warfare (BW) operations or incidents of Bioterrorism (BT).

Biological Diversity

The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological system.

Biological Laboratory

A facility within which microorganisms, their components or their derivatives are collected, handled and/or stored. Biological laboratories include clinical laboratories, diagnostic facilities, regional and national reference centres, public health laboratories, research centres (academic, pharmaceutical, environmental, etc.) and production facilities [manufacturers of vaccines, pharmaceuticals, large scale Genetically Modified Organisms (GMOs)] for human, veterinary and agricultural purposes.

Biomonitoring

It is the method of detection of biological agents based on properties like rapidity, reliability, sensitivity, and specificity so as to quickly diagnose the correct etiological agent from complex environmental samples before the spreading of illness on a large scale.

Biorisk

The probability or chance that a particular adverse event (in the context of this document: accidental infection or unauthorised access, loss, theft, misuse, diversion or intentional release), possibly leading to harm, will occur.

Biorisk Assessment

The process to identify acceptable and unacceptable risks [embracing biosafety risks (risks of accidental infection)] and laboratory biosecurity risks (risks of unauthorised access, loss, theft, misuse, diversion or intentional release) and their potential consequences.

Biorisk Management

The analysis of ways and development of strategies to minimise the likelihood of the occurrence of biorisks. The management of biorisk places responsibility on the facility and its manager to demonstrate that appropriate and valid biorisk reduction (minimisation) procedures have been established and implemented. A biorisk management committee should be established to assist the manager of the facility in identifying, developing and reaching biorisk management goals.

Biosafety

Laboratory biosafety describes the containment principles, technologies and practices that are implemented to prevent the unintentional exposure to pathogens and toxins, or their accidental release.

Biosecurity

The protection of high consequence microbial agents and toxins, or critical relevant information, against theft or diversion by those who intend to pursue intentional misuse.

Biotechnology

The integration of natural and engineering sciences in order to achieve the useful application of organisms, cells, parts thereof and molecular analogues for products and services. It includes any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use. Biotechnology products include pharmaceutical compounds and research materials.

Bioterrorism (BT)

The intentional use of microorganisms, or toxins, derived from living organisms, to produce death or disease in humans, animals or plants.

Bioweapon

Biological weapons include any organism or toxin found in nature that can be used to incapacitate, kill, or cause physical or economic harm. Biological weapons are characterised by low visibility, high potency, substantial accessibility and relatively easy delivery methods.

BSL— Biosafety Level

A method for rating laboratory safety. Laboratories are designated BSL 1, 2, 3, or 4 based on the practices, safety equipment, and standards they employ to protect their workers from infection by the agents they handle. BSL-1 laboratories are suitable for handling low-risk agents; BSL-2 laboratories are suitable for processing moderate risk agents; and BSL-3 laboratories can safely handle high-risk agents. BSL-4 laboratories are designated to hold WHO Risk group-IV organisms that pose the maximum risk as well as unknown emergent epidemic pathogens (WHO Risk Group-V).

Chemoprophylaxis

The administration of a chemical, including antibiotics, to prevent the development of an infection or the progression of an infection to active manifest disease, or to eliminate the carriage of a specific infectious agent to prevent transmission and disease in others.

Communicable Disease

An infectious condition that can be transmitted from one living person or animal to another through a variety of routes, according to the nature of the disease.

Disinfectants

Disinfectants are anti-microbial agents that are applied to non-living objects to destroy microorganisms.

Droplet Infections

Pathogens resistant to drying may remain viable in the dust and act as a source of infection. Small droplets under 0.1 mm in diameter, evaporate immediately to become minute particles or droplet nuclei which remain suspended in air for long periods acting as a source of infection.

Epidemics

The outbreak of a disease affecting or tending to affect a disproportionately large number of individuals within a population, community, or region at the same time.

Epidemiology

The branch of medicine concerned with the incidence and distribution of diseases and other factors relating to health.

Eukaryotic

Organisms whose cells are organised into complex structures enclosed within their respective membranes and have a defined nucleus, e.g., animals, plants, fungi, and protists.

Genetic Engineering

A process of inserting new genetic information into existing cells through modern molecular biology techniques in order to modify a specific organism for the purpose of changing one of its characteristics. This technology is used to alter the genetic material of living cells in order to make them capable of producing new substances or performing new functions.

Genetically Modified Organisms (GMOs)

Organisms whose genetic material has been altered using techniques generally known as recombinant Deoxyribonucleic Acid (DNA) technology. Recombinant DNA technology is the ability to combine DNA molecules from different sources into one molecule in a test tube. GMOs are often not reproducible in nature, and the term generally does not cover organisms whose genetic composition has been altered by conventional cross-breeding or by 'mutagenesis' breeding, as these methods predate the discovery (in 1973) of recombinant DNA techniques.

Hybridoma

Hybridoma are fused cells with continuous growth potential that have been engineered to produce as a single antibody.

Immunisation

The process of inducing immunity against an infectious organism or agent in an individual or animal through vaccination.

Incubation Period

The interval between infection and appearance of symptoms.

Infectious Diseases

Diseases caused by microbes such as viruses, bacteria, and parasites in any organ of the body that can be passed to or among humans, animals and plants by several methods. Examples include viral illnesses, Human Immunodeficiency Virus (HIV)/Acquired Immuno Deficiency Syndrome (AIDS), meningitis, whooping cough, pneumonia, Tuberculosis (TB), and histoplasmosis, etc.

Insecticides

An insecticide is a pesticide used against insects in all its developmental forms. They include ovicides and larvicides used against the eggs and larvae of insects. Insecticides are used for domestic household purposes, and commercially in agriculture and industry.

Laboratory Biosecurity

It describes the protection, control and accountability for VBM within laboratories, in order to prevent their unauthorised access, loss, theft, misuse, diversion or intentional release.

Livestock

Domestic animals kept or raised on a farm for use, sale or profit.

Molecular Biology

A branch of biological science that studies the biology of a cell at the molecular level. Molecular biological studies are directed at studying the structure and function of biological macromolecules and the relationship of their functioning to the structure of a cell and its internal components. This includes the study of genetic components.

Pandemics

A pandemic is an epidemic (an outbreak of an infectious disease) that spreads across a large region (for example, a continent), or even worldwide.

Pathogens

Microorganisms that can cause disease in other organisms or in humans, animals and plants. They may be bacteria, viruses or parasites.

Personal Protective Equipment (PPE)

Equipment worn or used by workers to protect themselves from exposure to hazardous materials or conditions. The major types of PPE include respirators, eye and ear protection gear, gloves, hard hats, protective suits, etc.

Phyto-sanitary Measures

The measures to achieve an appropriate level of sanitation and phyto-sanitary protection to safeguard human, animal or plant life or health as per the laid down standards are called phyto-sanitary measures.

Polymerase Chain Reaction (PCR)

A technique for copying and amplifying the complementary strands of a target DNA molecule. It is an *in vitro* method that greatly amplifies, or makes millions of copies of DNA sequences that otherwise could not be detected or studied.

Prokaryotic

The group of microorganisms that do not have a cell nucleus or any other membrane bound organelles. They are divided into two domains—bacteria and archaea. They are mostly unicellular, except for a few which are multicellular.

Quarantine

Any isolation or restriction on travel or passage imposed to keep contagious diseases, insects, pests, etc., from spreading.

Recombinant DNA Technology

Recombinant DNA is a form of artificial DNA that is engineered through the combination or insertion of one or more DNA strands, thereby combining DNA sequences that would not normally occur

together. This is an exclusively engineered technological process of genetic modification using the enzymes restriction endonucleases.

Sentinel Surveillance

Surveillance based on selected population samples chosen to represent the relevant experience of particular groups. It is a monitoring method that employs a surrogate indicator for a public health problem, allowing estimation of the magnitude of the problem in the general population.

Stockpile

A place or storehouse where material, medicines and other supplies needed in a disaster are kept for emergency relief.

Surveillance

Continuous observation, measurement, and evaluation of the progress of a process or phenomenon with the view to taking corrective measures.

Terrestrial Animals

Terrestrial animals are those which live predominantly or entirely on land.

Toxoid

A toxoid is a bacterial toxin whose toxicity has been weakened or suppressed while other properties—typically immunogenicity, are maintained. Toxoids are used in vaccines as they induce an immune response to the original toxin or increase the response to another antigen.

Training

The act or process of teaching or learning a skill or discipline.

Triage

Triage comes from the French verb *trier* which means literally to sort. In the current sense it is from the military system used from the 1930s, of assessing the wounded on the battlefield. The meaning in our context is—one is able to do the most good for the highest number of people in the light of limited resources, especially during a mass casualty event. This concept prioritises those patients who have an urgent medical condition but are most likely to survive if given medical attention as soon as possible.

Tropism

The involuntary movement of an organism activated by an external stimulus wherein the organism is either attracted to or repelled from the outside stimulating influence. An example is heliotropism, the movement of plants, where they turn towards the sun.

Vaccine

The term is derived from the Latin word *vacca* which means cow, as the first vaccine against smallpox was derived from a cowpox lesion. It is a suspension of attenuated live or killed microorganisms (bacteria, viruses or rickettsiae), or fractions thereof, administered to induce immunity and thereby prevent infectious diseases.

Valuable Biological Materials

Biological materials that require administrative control, accountability and specific protective and monitoring measures in laboratories to protect their economic and historical (archival) value, and/or the population from their potential to cause harm. VBM may include pathogens and toxins, as well as non-pathogenic organisms, vaccine strains, foods, GMOs, cell components, genetic elements and extraterrestrial samples.

Vector

A carrier, especially the animal or host, that carries the pathogen from one host to another, e.g., mosquito spreading malaria using a human as host.

Vector control

Measures taken to decrease the number of disease carrying organisms and to diminish the risk of their spreading infectious diseases.

Veterinary Practitioner

A graduate of veterinary science registered with the Veterinary Council of India (VCI)/State Veterinary Councils.

Virulence

Virulence refers to the degree of pathogenicity of a microbe, or in other words the relative ability of a microbe to cause disease. The word virulent, which is the adjective for virulence, is derived from the Latin word *virulentus*, which means 'full of poison'.

Virus

A minute infectious agent, smaller than bacteria, which is capable of passing through filters that can block bacteria. They multiply only within a susceptible host cell.

Zoonoses

Diseases that can be transmitted to people by animals and vice-versa.

Executive Summary

Background

Biological disasters might be caused by epidemics, accidental release of virulent microorganism(s) or Bioterrorism (BT) with the use of biological agents such as anthrax, smallpox, etc. The existence of infectious diseases have been known among human communities and civilisations since the dawn of history. The classical literature of nearly all civilisations record the ability of major infections to decimate populations, thwart military campaigns and unsettle nations. Social upheavals caused by epidemics have contributed in shaping history over the ages. The mutual association of war, pestilence and famine was acknowledged and often attributed to divine influences, though a few keen observers realised that some infections were contagious. The development of bacteriology and epidemiology later, established the chain of infection. Along with nuclear and chemical agents, which are derived from technology, biological agents have been accepted as agents of mass destruction capable of generating comparable disasters.

The growth of human society has rested largely on the cultivation of crops and domestication of animals. As crops and animals became necessary to sustain a divergent social structure, the depletion of these resources had far reaching consequences. Along with the growth of societies, crop and animal diseases acquired more and more importance.

Epidemics can result in heavy mortalities in the short term leading to a depletion of population with a corresponding drop in economic activity, e.g., the plague epidemics in Europe during the middle ages or the Spanish influenza between 1917–18. Infections like Tuberculosis (TB) might

not kill in the short term but thrust nations towards socio-economic disasters. Another example is the Human Immunodeficiency Virus (HIV)/Acquired Immuno Deficiency Syndrome (AIDS) epidemic in Sub-Saharan Africa, that has wiped out the benefits of improved health care and decimated the productive segments of society leading to economic stagnation and recession.

Recently, some events experienced in India have highlighted such issues. The outbreak of plague in Surat which was relatively small, disrupted urban activity in the city, generated an exodus and lead to a massive economic fallout. The ongoing human immunodeficiency virus/ acquired immuno deficiency syndrome epidemic in different parts of the country is leading to the diversion of substantial resources. The spread of the invasive weed *Parthenium hysterophorus* after its accidental introduction into India has had wide repercussions on human and animal health, apart from depleting the fodder output.

Infectious agents are constantly evolving, often acquiring enhanced virulence or epidemic potential. This results in normally mild infections becoming serious. The outbreak of Chikungunya that started in 2005 is one such example.

In recent times travelling has become easier. More and more people are travelling all over the world which exposes the whole world to epidemics. As our society is in a state of flux, novel pathogens emerge to pose challenges not only at the point of primary contact but in far removed locations. The Marburg virus illustrates this. The increased interaction between humans and animals has increased the possibilities of zoonotic diseases emerging in epidemic form.

Biological Warfare (BW) and Bioterrorism (BT)

The historical association between military action and outbreaks of infections suggest a strategic role for biological agents. The non-discriminatory nature of biological agents limited their use till specific, protective measures could be devised for the 'home' troops. The advances in bacteriology, virology and immunology in the late 19th century and early 20th century enabled nations to develop biological weapons. The relative ease of production, low cost and low level of delivery technology prompted the efforts of many countries after World War (WW) I, which peaked during the cold war. The collective conscience of the world, however, resulted in the Biological and Toxin Weapons Convention which resolved to eliminate these weapons of mass destruction. Despite considerable enthusiasm, the convention has been a non-starter.

While biological warfare does not appear to be a global threat, the use of some agents such as anthrax by terrorist groups pose a serious threat. The ease of production, packaging and delivery using existing non-military facilities are major factors in threat perception. These artificially induced infections would behave similar to natural infections (albeit exotic) and would be difficult to detect except by an effective disease surveillance mechanism. The threat posed by bioterrorism is nearly as great as that by natural epidemic causing agents.

Mitigation

The essential protection against natural and artificial outbreaks of disease (bioterrorism) will include the development of mechanisms for prompt detection of incipient outbreaks, isolation of the infected persons and the people they have been in contact with and mobilisation of investigational

and therapeutic countermeasures. In the case of deliberately generated outbreaks (bioterrorism) the spectrum of possible pathogens is narrow, while natural outbreaks can have a wide range of organisms. The mechanism required however, to face both can be similar if the service providers are adequately sensitised.

The response to these challenges will be coordinated by the nodal ministry—Ministry of Health and Family Welfare (MoH&FW) with inputs from the Ministry of Agriculture (MoA) for agents affecting animals and crops. The support and input of other ministries like Ministry of Home Affairs (MHA), Ministry of Defence (MoD), Ministry of Railways (MoR) and Ministry of Labour and Employment (MoL&E), who have their own medical care infrastructure with capability of casualty evacuation and treatment, have an important role to play. With a proper surveillance mechanism and response system in place, epidemics can be detected at the beginning stage of their outbreak and controlled. Slowly evolving epidemics do not cause upheavals in society and will not come under the crisis management scenario usually. They will be tackled by ongoing national programmes like the Revised National Tuberculosis Control Programme and National Air Quality Monitoring Programme. There may, however, be specific situations when the disaster response mechanism may be evoked, e.g., an outbreak of *Plasmodium falciparum* malaria erupting after an exceptionally wet season in a previously non-endemic region and epidemics occurring as a consequence of an attack of bioterrorism.

Epidemics do not respect national borders. As international travel is easy, biological agents need to be tracked so that they do not enter new regions across the boundaries. This aspect has made international collaboration crucial for epidemic control. International organisations like the World Health Organization (WHO), Food and Agricultural Organization (FAO), Office International des

Épizooties (OIE) as well as some national agencies with global reach, e.g., Center for Disease Control and Prevention (CDC), United States of America (USA) have an important role to play and cooperation with them is necessary.

Structure of the Guidelines

These Guidelines are designed to acquaint the reader with the basics of Biological Disaster Management (BDM). They deal with the subject in a balanced and thorough manner and give the information required by organisations to formulate Standard Operating Procedures (SOPs) at various levels. It is also envisaged that these Guidelines will be used for the preparation of national, state and district biological disaster management plans as a part of 'all hazard' Disaster Management (DM) plans.

Chapter 1—Introduces the subject and provides the background to these Guidelines. The characteristics of naturally triggered outbreaks are described and the potential for the use of pathogenic organisms in strategic and tactical modes as well as the potential of bioterrorism are presented. The mass destruction capability of biological agents in the context of disaster potential is outlined. The characteristics of biological agents used or developed as weapons have been listed in Annexure-A. The section on threat perception has been written in the Indian context. The chapter deals with modern concepts on zoonoses in a broad fashion and also indicates the impact of the advances in molecular biology on this field. The chapter touches on biosafety and biosecurity and the evolution of epidemics. In practice, though the course of action to deal with natural and artificial outbreaks is similar as far as the infected individuals are concerned, subsequent action depends on the genesis. Clues to distinguish the two modes have been included, along with an illustrative collation. The economic aspects of epidemics, which have

been well quantified in the context of deliberate action, illustrate the impact of biological agents.

Chapter 2—Deals with the resources available to prepare for and face the threat of biological disasters. The current laws and Acts that deal with methods for the control of epidemics have been enumerated. The Biological and Toxin Weapons Convention has been discussed. The international agencies concerned with biological disasters and the related activities of these agencies have been given. A note by the World Trade Organization (WTO) on the regulation of world trade has been included. The concerns voiced at the Earth Summit held in Brazil on the disruption of natural ecosystems that could result in biological disasters, the role of Interpol in enforcing the concerned regulations and the role of Non-Governmental Organisations (NGOs) have been mentioned. An account of the importance of the integrated disease surveillance project in biological disaster management is given. The chapter mentions the role of the Armed Forces and Railways who have a countrywide infrastructure that can be used in such disaster situations.

Chapter 3—It is a reality check of the present capability to tackle biological disasters. The areas that have to be addressed during the preparatory phase are discussed. It also gives a short description of the response to challenges that the country has faced in recent times, e.g., the Plague in 1994 (Beed and Surat) and 2002 (Himachal Pradesh) and the H5N1 outbreaks in poultry. The performance of the responding agencies has been adequate in the epidemics but could be improved upon to meet bigger challenges.

Chapter 4—Provides guidelines for individual stakeholders to prepare their respective DM plans. The chapter indicates the legislation that can be used, mechanics of disaster management and major modalities for preventing an epidemic situation and recovering from it.

The chapter also deals with the community aspect and preparation that is necessary for the satisfactory control of an epidemic threat.

Chapter 5—Deals with guidelines for the safety and security of microbial agents. The activities of various countries for developing biological weapons have had one benefit—a clearer understanding of the hazards of handling virulent organisms. The erstwhile method of bench top style working is now considered unsafe and is not likely to be used in the 21st century. Natural pathogens from new areas or those that have demonstrated epidemic potential have to be handled in appropriately designed laboratories. This chapter deals with the levels of pathogens and the corresponding safe handling areas. The security protocol for valuable biological materials has been presented. Training requirements and resource materials are given in this chapter. The basic information necessary for preparing biosafety manuals is also given.

Chapter 6—Deals with the effects of disasters on animal husbandry. It discusses the present state of animal husbandry in India, its vulnerability to disasters, the economic consequences of disasters and proposes a plan for dealing with such situations. The statutory and legal framework available in the country and internationally is also mentioned. Global veterinary issues and the need to interact with various international agencies and neighbouring countries have been elucidated. The intersection of public health and veterinary issues also finds a place in this chapter.

Chapter 7—Deals with the issue of crop diseases that have economic ramifications. The genesis of this issue and instances of inadvertent/illicit entry of some plant species and exotic pests have been discussed. The national and international regulatory mechanisms have also been described. The recent effort by the government to provide the infrastructure for plant quarantine and regulation of imported agricultural products has been

elaborated. Increased transnational traffic following the World Trade Organization agreements poses a challenge that the nation has to address. The steps being taken have been discussed in this chapter.

Chapter 8—Rounds off the Guidelines to provide a broad perspective on biological disasters. The components for a system necessary to prepare for and respond to the threats have been set out.

The time lines proposed for the implementation of various activities in the Guidelines are considered both important and desirable, especially in the case of non-structural measures for which no clearances are required from central or other agencies. Precise schedules for structural measures will, however, be evolved in the biological disaster management plans that will follow at the central ministries/state level, duly taking into account the availability of financial, technical and managerial resources. In case of compelling circumstances warranting a change, consultation with the National Disaster Management Authority (NDMA) will be undertaken, well in advance, for adjustment on a case-to-case basis.

The Milestones for Implementation of the Guidelines are as Follows:

A) Short-term Plan (0–3 Years)

- i) Regulatory framework.
 - a. Dovetail existing Acts, Rules and Regulations with the Disaster Management Act (DM Act), 2005.
 - b. Enactment/amendment of any Act, Rule or Regulation, if necessary for better implementation of health programmes across the country for effective management of disasters.
- ii) Prevention.
 - a. Strengthening of integrated surveillance systems based on epidemiological surveys; detection

- and investigation of any disease outbreak.
- b. Establishment of Early Warning System (EWS).
 - c. Coordination between public health, medical care and intelligence agencies to prevent bioterrorism.
 - d. Rapid health assessment, and provision of laboratory support.
 - e. Institution of public health measures to deal with secondary emergencies as an outcome of biological disasters.
 - f. Immunisation of first responders and adequate stockpiling of necessary vaccines.
- iii) Preparedness.
- a. Identifying infrastructure needs for formulating mitigation plans.
 - b. Equipping Medical First Responders (MFRs)/Quick Reaction Medical Teams (QRMTs) with all material logistics and backup support.
 - c. Upgradation of earmarked hospitals for Chemical, Biological, Radiological and Nuclear (CBRN) management.
 - d. Communication and networking system with appropriate intra-hospital and inter-linkages with state ambulance/transport services, state police departments and other emergency services.
 - e. Mobile tele-health services.
 - f. Laying down minimum standards for water, food, shelter, sanitation and hygiene.
 - g. Capacity development.
 - 1) Knowledge management.
 - Defining the role of public, private and corporate sector for their active participation and their sensitisation thereof.
- 2) Human Resource Development (HRD).
 - Strengthening of National Disaster Response Force (NDRF), medical first responders, medical professionals, paramedics and other emergency responders.
 - Development of human resources for monitoring and management of the delayed effects of biological disasters in the areas of mental health and psychosocial care.
 - 3) Education and training.
 - Imparting basic knowledge of biological disaster management through the educational curricula at various levels.
 - Knowledge management.
 - Proper education and training of personnel, with the aid of information networking systems and conducting continuing medical education programmes and workshops at regular intervals.
 - h. Community preparedness.
 - 1) Community awareness programme for first aid.
 - 2) Dos and Don'ts to mitigate the effects of medical emergencies caused by biological agents.
 - 3) Defining the role of the community as a part of the community disaster management plan.

- 4) Organising community awareness programmes for first aid and general triage.
- j. Hospital preparedness.
 - 1) Preparation of hospital disaster management plans by all the hospitals including those in the private sector.
 - 2) Developing a mechanism to augment surge capacities to respond to any mass casualty event following a biological disaster.
 - 3) Identifying, stockpiling, supply chain and inventory management of drugs, equipment and consumables including vaccines and other agents for protection, detection, and medical management.
- k. Specialised health care and laboratory facilities.
 - 1) Upgradation of existing biosafety laboratories and establishing new ones.
- l. Scientific and technical institutions for applied research and training.
 - 1) Post-disaster phase medical documentation procedures and epidemiological surveys.
 - 2) Regular updation by adopting activities in Research and Development (R&D) mode, initially by pilot studies.
- early warning systems at regional levels.
- b. Incorporation of disaster specific risk reduction measures.
- ii) Preparedness.
 - a. Institutionalisation of advanced Emergency Medical Response (EMR) system (networking ambulance services with hospitals).
- iii) Capacity development.
 - a. Strengthening of scientific and technical institutions for knowledge management and applied research and training in management of chemical, biological, radiological and nuclear disasters.
 - b. Continuation and updation of human resource development activities.
 - c. Developing community resilience.
- iv) Hospital preparedness.
 - a. Testing of various elements of the emergency plan through table top exercises, and mock drills.
- v) Specialised health care and laboratory facilities.
- vi) Implementing a financial strategy for allocation of funds for different national and state/district-level mitigation projects.
- vii) Ensuring stockpiling of essential medical supplies such as vaccines and antibiotics, etc.

C) Long-term Plan (0–8 Years)

The long term action plan will address the following important issues:

- i) Prevention.
 - a. Strengthening of Integrated Disease Surveillance Programme (IDSP) and
 - i) Knowledge of biological disaster management should be included in the

- present curriculum of science and medical undergraduate and postgraduate courses.
- ii) Establishment of a national stockpile of vaccines, antibiotics and other critical medical supplies.
 - iii) Initiation of relevant postgraduate courses in biological disaster management.
 - iv) Training programmes in the areas of emergency medicine and biological disaster management shall be conducted for hospital administrators, specialists, medical officers, nurses and other health care workers.
 - v) Public health emergencies with the potential of mass casualties due to covert attacks of biological agents will be addressed in the plan through setting up of integrated surveillance systems, rapid health assessment systems, prompt investigation of outbreaks, providing laboratory support and instituting public health measures.
 - vi) Quality medical care.
 - vii) Strengthening of the existing institutional framework and its integration with the activities of the National Disaster Management Authority, state government/ State Disaster Management Authority (SDMA), district administration/District Disaster Management Authority (DDMA) and other stakeholders for effective implementation.
 - viii) Establishing an information networking system with appropriate linkages with state ambulance/transport services, state police departments and other emergency services.
 - ix) Strengthening of the National Disaster Response Force, medical first responders, paramedics and other emergency responders. Identification and recognition of training institutions for training of medical professionals, paramedics and medical first responders.
 - x) Development of post-disaster medical documentation procedures and epidemiological surveys.

These guidelines provide a framework for action at all levels. The nodal ministry—Ministry of Health and Family Welfare will prepare an action plan to enable all sections of the government and administration machinery at various levels to prepare and respond effectively to biological disasters. The sporadic occurrence of low gravity biological disasters will be managed primarily by the existing mechanism of response for medical, veterinary and agricultural services. In the current scenario, the private sector is well entrenched in the primary and tertiary health care sector and is growing at a rapid rate. It would be mutually beneficial for both the private sector and government if this infrastructure can be used for biological disaster management in a Public-Private Partnership (PPP) module. Also unlike the other two agents of mass destruction (nuclear and chemical), biological threats can be controlled to an extent—if protective systems are in place the influx of infective agents would not have any disastrous consequences. The implementation of these Guidelines through an action plan will lead to a state of preparedness, which should be able to prevent biological disasters and if any such situation does occur, then will be managed properly.

Sickness and disease are important subjects that have exercised human thought since the dawn of civilisation. It was realised that certain diseases came in crops and spread from the afflicted to the healthy. The concept of 'contagion' developed and the earliest societies devised methods and systems that could contain the spread of such diseases to ensure a reasonable level of health for the populace. The spread of agriculture and domestication of animals led to economic development and the realisation that diseases affecting crops and livestock could also affect the well-being of human societies as they became more complex, and populations increased. The increase of population also resulted in the congregation of a large number of susceptible people in limited spaces. The larger communities became vulnerable to food supply and trans-species migration of infectious agents. Infectious agents with innate or acquired ability to spread from person to person caused extensive morbidity or mortality. Medical and literary texts of ancient civilisations describe such epidemics. Diseases that caused the largest disruption were plague (bubonic and pneumonic), louse-borne typhus, and smallpox, because of their high mortality. Infections like malaria, dengue, and yellow fever that debilitated populations, led to economic disasters. Similar large-scale loss of livestock or crops also resulted in destruction of the social fabric.

During WW I, commanders tried to use the knowledge of infectious diseases to influence their military tactics. Until the development of bacteriology and vaccinology, it was not possible for infectious agents to be used in situations where the combating armies were in contact, as, 'own'

and 'enemy' troops were equally susceptible to the disease usually. There were, however, circumstances when this was not the case and the use of biological agents in combat conditions was feasible. Thus, there could be a natural or artificial spread of infections leading to the emergence of the definition of BW put forward by Prof. Joshua Lederberg as 'use of agents of disease for hostile purposes'. This essentially simple definition is good enough for dealing with the subject.

1.1 History

Biological disasters of natural origin are largely the result of the entry of a virulent organism into a congregation of susceptible people living in a manner suited to the spread of the infection. In crowded areas, anthrax spreads by spore dispersal in the air, small pox spreads by aerosols, typhus and plague spread through lice, fleas, rodents, etc. The average epidemic spreads locally and dies down if the contagion is localised, but there have been instances where diseases have spread widely, even across national boundaries. Disasters have occurred when environmental factors were conducive, e.g., Black Death occurred when conditions were favourable for increase in the number of rats, and cholera attained a pandemic form when the causative agent entered urban areas which had inadequate sanitation facilities. Similarly, post WW I, the movement of population led to the rapid spread of the Spanish influenza virus.

Short-duration infections with high mortality rates harm societies by depleting their numbers. The longer duration infections, with varying

immediate mortality, nevertheless, become important when they cause large-scale morbidity affecting the productive capacity of the population. Malaria and tuberculosis are examples of such infections which, in the long run, are as important as the more visible florid epidemics.

The extension of human activity and its contact with a hitherto localised microbial environment introduces novel pathogens. The spread of Nipah, Hendra, Ebola, Marburg and Lassa fever viruses are examples of this phenomenon. In the case of HIV, a sporadically occurring phenomenon—that of transmission of the virus from chimpanzee to man—became a pandemic when it began to be sexually transmitted, and has since become the largest epidemic in history.

Human conflict resulting in large-scale population movement, breakdown of social structures and contact with alien groups has always generated a large number of infections. Until very recently, the number of casualties due to infections far exceeded losses due to arms.

As a tactical manoeuvre, the introduction of a communicable disease in the enemy camp has been exercised by military commanders from the earliest times. Apart from prayers to gods to shower pestilence on the enemy, active measures were also adopted. These were based on the observed link between filth, foul odour, decay and disease/contagion. Filth, cadavers and animal carcasses have been used to contaminate wells, reservoirs and other water sources up to the 20th century. In the Middle Ages, military leaders recognised the strategic value of bubonic plague and used it by catapulting infected bodies into besieged forts. Two such episodes, that of Kaffa (1346) and Carolstein (1422), have been identified as events that probably initiated and perpetuated the infamous Black Death which killed a third to half of Europe's population. There is documentation of the use of biological weapons during the French and Indian wars in North America (1754–1767).

In the 20th century, the use of bioweapons became more scientific as technology for the cultivation of pathogens and vaccinology developed. During WW I, Germany developed a biowarfare programme to use bacteria to infect or contaminate livestock and feed. There are also accusations of German bioattacks on Italy (cholera) and Russia (plague). After WW I, many nations undertook the development of bioweapons. Significant research efforts were also made by both sides in WW II. Human pathogens like *Bacillus anthracis*, *Botulinum* toxin, *Francisella tularensis*, *Brucella suis*, etc., and crop pathogens like Rice Blast, Rye Stem Rust, etc., were developed into bioweapons.

Post-WW II, the Cold War saw the serious development of bioweapon programmes. Major state-sponsored research was carried out at establishments like the US Army Medical Research Institute for Infectious Diseases (USAMRIID) at Fort Detrick, the British complex at Porton Down and Biopreparat in the Soviet Union. United States (US) President Nixon's executive orders of 1969 and 1970 terminated the US programme but it continued to maintain 'defensive' research. The Soviet programme started around the 1920s and is believed to have continued unabated till the breakup of the Soviet Union. The number of countries currently working on biological weapons is estimated to be between 11 and 17 and include sponsors of terrorist activities. Even smaller groups have now acquired bioterrorist capabilities.

1.2 Biological Agents as Causes of Mass Destruction

Whether naturally acquired or artificially introduced, highly virulent agents have the potential of infecting large numbers of susceptible individuals and in some cases establishing infectious chains. The potential of some infectious agents is nearly as great as that of nuclear weapons and, are therefore, included in the triad of Weapons of Mass Destruction (WMD): Nuclear, Biological

and Chemical (NBC). The low cost and widespread availability of dual technology (of low sophistication) makes BW attractive to even less developed countries. BW agents, in fact, are more efficient in terms of coverage per kilogram of payload than any other weapons system. In addition, advances in biotechnology have made their production simpler and also enhanced the ability to produce more diverse, tailor-made agents. Biological weapons are different from other WMD as their effects manifest after an incubation period, thus allowing the infected (and infectors) to move away from the site of attack. The agents used in BW are largely natural pathogens and the illnesses caused by them simulate existing diseases. The diagnosis and treatment of BW victims should be carried out by the medical care system rather than by any specialised agency as in the case of the other two types of WMD. Another characteristic of some of these attacks, e.g., smallpox, is their proclivity to set up chains of infection.

The production and use of biological agents is simple enough to be handled by individuals or groups aiming to target civilians. Thus, BT is defined by CDC as, 'the intentional release of bacteria, viruses or toxin for the purpose of harming or killing civilians'.

1.3 Sources of Biological Agents

Theoretically, any human, animal or plant pathogen can cause an epidemic or be used as a biological weapon. The deliberate intention/action to cause harm defines a biological attack. A well-known example is the incident in the USA where members of a religious cult caused gastroenteritis by the use of *Salmonella typhimurium*. The organism causing the illness was such a common natural pathogen, that, only the confessional statements of the perpetrators (when the cult broke up) revealed the facts. However, certain characteristics need to be present for an organism to be used as a potential biological agent for

warfare or terrorist attack. Of these, anthrax, smallpox, plague, tularemia, brucellosis and botulinism toxin can be considered as leaders in the field. It is the causative agents that have to be catered for in the context of BT at all times. As already mentioned, the use of agents that target livestock and crops could be as devastating as human pathogens, in terms of their probable economic impact on the community.

1.4 Threat Perception

The general perception that the actual threat of BT is minimal was belied by the anthrax attacks through the postal system in 2001 which followed the tragic 9/11 events. BT, rather than BW, has now been perceived to be more relevant. Likewise, in agriculture, the inadvertent introductions of exotic species have had far-reaching consequences. Nevertheless, deliberate actions have not yet been recorded. Rapid advances in biotechnology and aggressive deliberate designs could open up opportunities for the hostile use of biological resources.

Anthrax, smallpox, plague and botulism are considered agents of choice for use against humans. Similarly, crop and livestock pathogens have been identified in their respective fields. However, the perceptions change as public health, veterinary and crop practices evolve. A disease that has been eliminated from a community automatically becomes a BW weapon as herd immunity wanes. This is the case with smallpox, which was once an endemic infection. In the veterinary field, the elimination of rinderpest in India, without parallel eradication in neighbouring countries, makes it a potential agent. The characteristics of various BW agents is given in Annexure-A.

In the case of India it is generally believed that:

- i) BW agents are unsuitable for attacking military formations as troops would, most

likely, be protected, while the attacking forces would need to be immunised; hence the surprise element would be lost. Should the defending troops be dispersed in mountainous or desert regions, a BW attack will not be effective in such terrain and atmospheric conditions. Theoretically, of course, a bioattack can be launched against discrete targets like naval bases, island territories or isolated military facilities with a greater probability of success.

- ii) Bioweapons such as anthrax are more likely to be used by terrorists, possibly encouraged by state or non-state actors, against vulnerable populations or industrial centres. Terrorists are capable of manufacturing bioweapons of lower military efficiency that will be adequate against civilian targets, especially to cause panic. In this context BW agents have gained the status of bioweapons rather than WMD.
- iii) Consciousness is increasing about the fact that apart from human targets, bioweapons could be used to attack agricultural crops and livestock. Recently in India, an infection of avian flu in a limited area, required the mass culling of birds, causing massive losses to commercial poultry enterprises, thus highlighting their vulnerability to attack and the potential of natural epidemics to cause economic losses.
- iv) An overloaded urban infrastructure consequent to rapid urbanisation, along with population movement, is the largest hazard the country faces. Natural outbreaks can occur easily, as also selectively introduced pathogens. The social disruption that can occur was clearly evident during the Surat plague epidemic in 1994.

Biological research is rapidly changing the epidemiology of infectious diseases, thereby altering the threat perceptions which have to be reviewed periodically in the long and short term. International organisations (e.g., WHO, FAO, etc.) have a major role to play. National surveillance mechanisms should be upgraded to be able to provide useful inputs. Intelligence reports based on epidemiological information, intent to harm, and technological developments can give an idea of the threat. Based on these inputs, threat perceptions can be qualified.

1.5 Zoonoses

WHO defines zoonoses as 'diseases and infections naturally transmitted between non-human vertebrate animals and human beings'. Emerging zoonotic diseases are 'zoonosis that is newly recognised or newly evolved or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range'. A catalogue of 1,415 known human infections revealed that 62% were of zoonotic origin. An analysis of emerging infectious diseases revealed 75% of them to be of zoonotic origin. Bacteria, viruses and parasites can spread from a wildlife reservoir. Fungi do not normally adopt this route.

Historically, plague, rabies and possibly some viral diseases like the West Nile virus, have been described as zoonoses. The transmission of zoonotic infections may be by the following means:

- i) By direct transmission as in tularemia (by inhalation) or bites as in rabies (inoculation) or contact with infected material as in HIV transmission through mucosal breaches.
- ii) Ingestion of infected animal products used for food e.g., milk (brucellosis), pork (trichinosis, tapeworms), lamb and goat (anthrax), etc.

- iii) Through the bites of insect vectors e.g., plague, West Nile virus, Lyme borreliosis, etc.

Changes in the epidemiology of zoonoses occur constantly, either due to natural causes when the distribution of the animal reservoir or vector varies, or due to anthropogenic causes when human activity changes the environment. Thus, in the case of Lyme borreliosis, reforestation increased the vector population (ticks). Similarly, deforestation and monkey migration increased human–tick interaction to precipitate the Kyasanur Forests Disease (KFD) outbreaks in South India. National or international wildlife trade for food or pets bring together different species from varied sources into the human environment permitting re-assortment of genes and the emergence of novel pathogens. It is this type of interaction that is believed to have triggered the Severe Acute Respiratory Syndrome (SARS) outbreak in South China and thereby caused the evolution of a new influenza strain with the potential of causing an epidemic.

Arthropod vectors play an important role in the transmission of zoonoses as well as some non-zoonotic infections. Viral infections such as West Nile, dengue, etc., and bacterial infections such as filarial, dracunculosis, etc., are transmitted by vectors. Vectors transmit the infection by amplifying the pathogen, e.g., malaria, dengue, etc., and by introducing it in a bite, or by direct implantation as in louse-borne typhus, or ingestion of the infected vector as in dracunculosis.

Zoonotic infections are not easy to control unless the epidemiology is well-established and specific activities favouring the transmission are identified and addressed. Thus, the discovery of the involvement of the trombiculid mite in the transmission of scrub typhus permitted a specific method of control to be adopted. However, such success is unusual. Prevention of human contact with the source of infection will be the true remedy, though not often feasible.

1.6 Molecular Biology and Genetic Engineering

The discovery of the Polymerase Chain Reaction (PCR) in 1983 by Kary Mullis has been a major advancement in biotechnology. The resultant technologies have stimulated the development of diagnostics, enhanced the understanding of the genetic configuration of living beings and enabled the construction of the complete genomes of a large number of living forms. Thus, the genetic configuration of several viruses, bacteria (including more than 100 pathogens), protozoa and higher plants and animals are now known and have been published. We are now in a position to follow gene activities in different situations; e.g., we now have the complete genomes of the three components of the falciparum malaria cycle: man (*Homo sapiens*), the vector (*Anopheles gambiae*) and the pathogen (*Plasmodium falciparum*). The implications of this in the field of infectious diseases are immense—elucidation of the processes of infection, defining vaccine targets and identifying sites for therapeutic processes can now be attempted proactively. These advances have been assessed to be comparable to the discovery of antibiotics as far as their impact on infectious disease control is concerned. Only the earliest impacts are currently being felt.

It is now possible to diminish (or enhance) the virulence of pathogens, change their anti-microbial susceptibilities or even their tropism. Simple viral molecular structures can be modified even *in silico*. The results are largely predictable, though some surprises may arise during experimentation. The experiment to devise an immuno-contraceptive in mice using the ectromelia virus (with added interleukin-4), which resulted in an unexpected enhanced virulence, is a case in point. The polio virus has now been synthesised and the product proved to be viable. Other viruses are also on the synthetic path, i.e., intentional synthesis of wild strains. Another achievement has been the

reconstitution of the Spanish influenza virus of 1918 from laboratory preserved tissue and infected cadavers frozen in permafrost.

As has happened in the case of other major technological advancements particularly in nuclear and chemical technology, there is considerable scope for 'dual use' in molecular and genetic technology and the benefits may be overshadowed by the perverted uses that may accrue. In this respect, the areas of concern are briefly summarised below:

- i) Modifying organisms to change their antigenic profile to render existing vaccines ineffective. Examples could be changing the surface antigens of the smallpox virus to make it resistant to standard vaccination. Likewise, the introduction of plasmids into *Salmonellae* may change their antigenic profile.
- ii) Change of the antibiotic susceptibility pattern of the pathogen. The introduction of R-factor plasmids or chromosomal determinants may result in phenotypic modification that renders the organisms resistant to useful antibiotics. This can be achieved in *Yersinia pestis*, *Bacillus anthracis* or *Brucellae* by transformation or transduction. If virulence remains intact, the resultant outbreaks can be disastrous.
- iii) The identification of virulent genes and islands in bacteria defines Deoxyribonucleic Acid (DNA) segments that can be transferred to marginally virulent or avirulent organisms and render them strongly virulent. In essence, this is a laboratory duplication of natural processes.
- iv) The initiation of infection is strongly dependent upon the pathogen being able to adhere to the susceptible host tissue. The specificity of the process determines the infectivity range and is usually dictated by the configuration of the surface

glycoproteins antigens. The host range may be amplified or modified by changing the genes determining surface attachment motifs.

- v) Enhancing the release of a virus or addition of newer characteristic can result in a simultaneous change in the transmission characteristics of the organism.
- vi) *In vitro* processing of pathogens may alter their surface characteristics enabling them to avoid detection or even change their survival profile; e.g., introduction of a novel gene into *Bacillus anthracis* could result in a robust pathogen if the introduced genes remain active in spores.
- vii) Some experiments designed to use viral genomes to introduce biologically effective infectious genetic material in a dormant state may result in changing the profile of populations in a manner suitable for molecular manipulation. While such clandestine genetic attacks are fictional at present, biotechnology has advanced adequately to make it feasible. A mycoplasma genome (*Mycoplasma genitalis*) has been synthesised. This is the first free living microorganism to be created *in vitro*.

The spread of biotechnology and genetic engineering has added novel dimensions to both BW and BT. This technology is largely available legitimately and is being actively researched to sharpen its thrust. Its potential for good can easily be distorted by unethical manipulation.

1.7 Biosafety and Biosecurity

The threat posed to laboratory and other investigators studying pathogenic organisms has become evident after cultivation of these agents became possible. The history of infectious diseases is studded with accounts of workers who

succumbed to the diseases they studied. The latest example is that of Carlos Urbani who died of SARS. Organised BW programmes laid the foundation of biosafety. The different biosafety classes have been defined as Biosafety Level (BSL) 1–4 and the necessary standards for the corresponding laboratory and other precautions have been laid down. Thus, laboratory designs to study the various levels have been defined to safeguard the interests of the laboratory worker, the treatment facility and the community at large. This aspect has been a beneficial spin-off from BW activities. These are dealt with in greater detail in Chapter 4.

1.8 Epidemics

The introduction of a pathogen capable of establishing a transmission chain into a susceptible population will result in an epidemic. In nature, the initial primary infection(s) are followed by rounds of secondary and tertiary infections and so on. A natural epidemic starts to wane when the number of susceptibles decreases or the transmission chain is interrupted. In classical viral exanthemata (e.g., measles), epidemics peter out when the population becomes totally (or at least 90%) immune. In the case of arthropod-borne epidemics (e.g., dengue or Japanese encephalitis), the onset of cooler weather (decreased mosquito breeding) interrupts the outbreaks. In some cases, essentially individualistic infections may adapt to human activity or ecological changes. The ongoing HIV/AIDS epidemic is an example of such a phenomenon. Deliberate introduction of pathogens can largely mimic natural outbreaks. However, a close examination of the characteristics may offer a clue to the artificiality. These clues are enumerated below:

(A) Epidemiologic Clues

- i) Greater case load than expected, of a specific disease.
- ii) Unusual clustering of disease for a geographic area.

- iii) Disease occurrence outside the normal transmission season.
- iv) Simultaneous outbreaks of different infectious diseases.
- v) Disease outbreak in humans after recognition of the disease in animals.
- vi) Unexplained number of dead animals or birds.
- vii) Disease requiring an alien vector.
- viii) Rapid emergence of genetically identical pathogens from different geographic areas.

(B) Medical Clues

- i) Unusual route of infection.
- ii) Unusual age distribution or clinical presentation of a common disease.
- iii) More severe disease symptoms and higher fatality rate than expected.
- iv) Unusual variants of organisms.
- v) Unusual anti-microbial susceptibility patterns.
- vi) Single case of an uncommon disease.

(C) Miscellaneous Clues

- i) Intelligence reports.
- ii) Claims of the release of an infectious agent by an individual or group.
- iii) Discovery of munitions or tampering.
- iv) Increased numbers of pharmacy orders for antibiotics and symptomatic relief drugs.
- v) Increased number of emergency calls.
- vi) Increased number of patients with similar symptoms to emergency departments and ambulatory health care facilities.

Experience with the highly pathogenic avian influenza virus (H5N1) in West Bengal in January 2008 is a good example of the economic and health issues, and actions needed to control epidemics

and epizootics. The death of a large number of free range poultry in eastern India activated surveillance. The cause of the epizootic was identified and preventive action was initiated. There was initial reservation and lack of cooperation by the community which depended heavily on poultry for nutrition and income, as well as the inertia of other stakeholders (including medical professionals). However, once the gravity was realised, action was initiated and community participation was forthcoming. The outbreak was probably triggered by trans-border illegal poultry trade. The reporting of outbreaks in all the countries bordering India has made the establishment of regional surveillance networks a high priority issue. These will be coordinated by the international agencies FAO and WHO. The potential of such outbreaks to initiate a new influenza strain with pandemic potential would challenge the medical infrastructure of all the nations.

1.9 Biological Disasters (BT)

Events in the recent past have shown that the threat of BT is real. 'The arguments advanced to defer consideration of the issues related to bioterrorism have been "without validity" and we cannot delay the development and implementation of strategic plans for coping with civilian bioterrorism'. Reconstructed scenarios in the case of attacks by the more likely BT agents reveal two patterns. In the case of anthrax and botulinum toxin which have high initial effect but no secondary cases, the scenario is similar to chemical attacks. However, when the pathogen used has the ability to set up secondary cases, and probably an epidemic, the scenario is far more complex. The preparation and action have to be tailored appropriately.

Bioweapons are particularly attractive to terrorist groups because of the ease of their production and also their low cost. They have been termed 'the poor man's nuclear bomb' since it is

estimated that a large-scale operation, against a civilian population with casualties, may cost about \$ 2,000 per sq. km with conventional weapons, \$ 800 with nuclear weapons, \$ 600 with nerve gas weapons and \$ 1 with biological weapons. There have been numerous documented attempts at BT. Biological agents are more efficient in terms of coverage per kilogram of payload than any other weapons system. Terrorism by means of weaponised biological agents such as anthrax is no longer a theoretical concept. Anthrax spores can be milled to an unexpectedly fine degree—100 times smaller than the human strain in size and easily inhaled deep into the lungs. Even the delivery system for weaponised anthrax need not be sophisticated. Accidental release of anthrax bacilli from a bioweapons unit at Sverdlovsk [in the former Union of Soviet Socialist Republics, (USSR)] and an outbreak of salmonellosis in Dallas, Oregon, in 1984 are well known incidents. The postal dissemination of anthrax spores (after 9/11) caused 22 cases, including 5 deaths, and 'ushered in the transition from table top bioterrorism exercises to real world investigation and response'. The crucial role of well trained, alert health care providers like Larry Bush, the infectious diseases physician from Florida, USA, who diagnosed the first case promptly, is underlined by this outbreak.

1.10 Impact of Biological Disasters

Dispersal experiments have been attempted using non-pathogenic *Bacillus globigii*, which has physical characteristics similar to *Bacillus anthracis*. The variables in dissemination have been worked out and the impact of bioterrorist attacks estimated. The dispersal experiments showed that an attack on the New York subway system would kill at least 10,000 people. WHO studies show that a 50 kg dispersal on a population of 500,000 would result in up to 95,000 fatalities and over 125,000 people being incapacitated. Other experiments have also shown similar disastrous outcomes.

In the case of smallpox, the emergence of secondary cases at the rate of 10 times the number of primarily infected subjects, would add to the burden. There would also be a demand for large-scale vaccination from meagre stocks and no ongoing production. Inevitably, epidemics would break out and social chaos would ensue.

The economic impact of BT would be a major burden that could transcend the medical consequences. It has been estimated that the use of a lethal agent like *Bacillus anthracis* would cause losses of \$26.2 billion per 100,000 persons exposed, while a less lethal pathogen, e.g., *Brucella suis* would cause \$477.7 million. The study also shows that a post-attack prophylaxis programme will be cost-effective, thereby justifying expenditure on preparedness measures. The major economic losses that occurred due to the fallout of the 1994 Surat plague epidemic of natural origin is an example of the larger ramifications of BT/BW. A BT attack on agriculture can cause as much economic loss as an attack on human beings. The spread of the *Parthenium hysterophorus* weed, which entered India in the late 1950s along with imported wheat, affected the yield of fodder crops and became a crop pest. This is an excellent case study on how an inadvertent entry of exotic pests can occur and lead to adverse consequences in the long term. With properly equipped emergency crews, designated meteorological experts to track the movement of airborne particles, stockpiling of prophylactic and therapeutic antibiotics, and a mechanism for going rapidly to emergency mode, the estimated casualties can be reduced to just 5–10% of the normal casualty rates. This analysis succinctly expresses the need for, and value of, a proper response to BT.

1.11 Regulatory Institution

There is need for an agency that can incorporate stakeholders and experts to oversee this aspect on a continuing basis. The National

Science Advisory Board for Biosecurity set up by the US Department of Health and Human Sciences could be emulated in our country. A model plan will be prepared by the nodal ministry with the help of an advisory committee, which will be updated periodically. The perceived threat would be the basis for anticipating and executing action. The advisory committee would have strong links with NDMA.

1.12 Aims and Objectives of the Guidelines

Under Section 6 of the DM Act, 2005, NDMA is inter alia mandated to issue guidelines for preparing action plans for holistic and coordinated management of all disasters. The Guidelines on management of biological disasters will focus on all aspects of BDM, including BT, with a focus on prevention, mitigation, preparedness, medical response, and relief.

The Guidelines will form the basis for central ministries/departments concerned and states to evolve programmes and measures to be included in their action plans. MoH&FW is the nodal ministry for the said issue. The health services of other important line ministries with important roles to play are MoD, MoR and Employees' State Insurance Corporation (ESIC) of the MoL&E. The private sector is also encouraged to participate in BDM by adoption of the PPP model. The approach to be followed will emphasise a preventive approach such as immunisation of first responders and stockpiles of medical countermeasures based upon risk reduction measures by developing a rigorous medical management framework to reduce the number of deaths during biological disasters, both intentional and accidental. This is to be achieved through strict conformity with existing and new policies and proactive involvement of all stakeholders. It will include the development of specialised measures pertaining to the management of biological disasters.

The important underlying objectives would be to educate the persons concerned, whether in actual contact in the field or not, in the diagnosis, treatment and organisation of relief measures; to lay down the procedures to successfully combat epidemics; to provide a ready source of basic information on the subject to influence preparedness and execution of relief measures at all levels; and to provide the basis for preparation of BDM protocols at various levels.

In addition, the Guidelines will be utilised by the following responders and service providers:

- i) District administrators in coordination with Chief Medical Officers (CMOs) and other health care providers will use these

Guidelines for the development of BDM in the 'all hazard' district DM plans.

- ii) All hospitals (government, local bodies, NGOs, private and others) will develop BDM as part of their hospital DM plans using these Guidelines.
- iii) State medical management plans covering macro issues of capacity development and micro issues pertaining to more vulnerable districts will be developed based on these Guidelines.
- iv) All stakeholders connected directly or indirectly with BDM will make use of these Guidelines to mitigate the effects of such disasters.

2

Present Status and Context

After Independence, India accorded significant priority to the control and elimination of diseases posing a major public health burden. Successful eradication, elimination, and control of major killer diseases also contributed in sustaining socio-economic growth, reflecting the improvement of health in its people. This led to an epidemiological and demographic transition. The notable success stories are eradication of smallpox in 1975, a highly contagious endemic disease that accounted for a third of all deaths in the 18th and 19th centuries. Malaria is another major public health problem which had caused absenteeism leading to a fall in economic production with over 75 million cases annually in the early 1950s, which has now been successfully brought down to a load of about two million cases annually; and plague, which had assumed epidemic proportions in the early to mid 19th and 20th centuries, has nearly been eliminated.

The outbreak of plague in Surat (1994) after a gap of 28 years, with over 1,000 suspected cases and 52 deaths, caused widespread panic and mass exodus of people from the affected areas. This outbreak badly affected commerce, trade and tourism. The SARS outbreak in 2003 caught the attention of the world, establishing how laxity in infection control practices could result in the spread of a disease from a single hospital case to a global pandemic in less than three months. Though India reported only three probable (that too imported cases), the panic created by the media was unprecedented. Similarly, the outbreak of avian influenza among poultry in small pockets of Nandurbar and Jalgaon districts of Maharashtra and adjoining districts of Gujarat and Madhya

Pradesh (2006) saw the poultry industry plummet. A still greater threat is the possibility of avian influenza (H5N1) or the circulating seasonal influenza virus undergoing a major antigenic shift to become a pandemic virus that may kill millions. The 1918 influenza pandemic killed an estimated 7 million people in India.

Slow, evolving epidemics such as HIV/AIDS (5.1 million estimated cases in the year 2004) also have the potential to cause socio-economic disruption as has been witnessed in some African countries. Emerging and reemerging diseases, notably SARS, avian influenza, Nipah virus, leptospirosis, dengue, Chikungunya and Rickettsial, are also posing serious threats. So are the spread of drug-resistant TB, drug-resistant malaria and other drug-resistant diseases that may emerge in the future. Environmental changes and their effects can impact the ecological system with potential for new emerging causative agents, notably higher incidences of zoonotic diseases.

Another facet of biological disasters in the Indian context is the emerging threat of BT and BW. Though biological agents have been used since ancient times for inflicting damage on the enemy, there is no direct evidence that such agents have been used in the wars involving India. However, the threat remains as our adversaries and terrorist outfits are capable of adopting advanced technologies to cause damage.

In this context, the subsequent sections review the existing policies, and the legal, institutional, and operational framework for managing biological disasters in India and identifying the critical gaps.

2.1 Legal Framework

According to the constitution, health is a state subject. The primary responsibility of dealing with biological disasters rests with the state government. There are a number of legislations that control and govern the nation's health policies. The government can enforce these legislations to contain the spread of diseases. Some of the commonly used legal instruments are discussed below.

2.1.1 Legislation that Supports Health Action at Grass-root Level

The 73rd Constitutional Amendment on Panchayati Raj Institutions (PRIs) provides for setting up of a three-tiered structure of local governance at district, block and village level. Health is a subject matter that can be acted upon by PRIs. The amendment mandates setting up of health and sanitation committees in each village, the most peripheral body at the grass-root level, to take decisions on health matters for the community.

The municipal Acts are civic Acts that govern the civic responsibilities of local bodies such as municipalities and municipal corporations. The Acts provide for the provision of safe drinking water, hygiene and sanitation, food safety, notification and control of diseases, and public health concerns, including containment of outbreaks.

2.1.2 State and District Level

The Epidemic Diseases Act (Act 111 of 1897) provides for 'better prevention and spread of dangerous epidemic diseases'. This Act, still in force, provides the states the authority to designate any of its officers or agencies to take measures for the prevention and control of epidemics.

Relevant provisions under the Indian Penal Code (IPC) and Criminal Procedure Code (CrPC) can be invoked to detain and question persons

involved in criminal acts, which includes BT in its ambit. Other provisions under this Act can be applied for establishing law and order, enforcing quarantine, etc.

2.1.3 National Level

The Water (Prevention and Control of Pollution) Act, 1974, provides for the prevention and control of water pollution and the maintenance or restoration of the wholesomeness of water. It provides for the creation of central, state, or joint boards for the prevention and control of water pollution, and for such purposes empowers them to obtain information, inspect any site, take samples for analysis and take punitive action against the polluter. For this, the rules were laid down in the Water (Prevention and Control of Pollution) Rules, 1975.

The Air (Prevention and Control of Pollution) Act, 1981, and the Rules (1983) provide for the prevention, control and abatement of air pollution and establishing boards for such purpose and assigning powers and functions to them relating to air pollution.

The Environmental (Protection) Act, 1986, and the Rules (1986) provide for protection of the environment and empowers the government to take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution. This Act also provides for the Biomedical Waste (Management and Handling) Rules, 1998 with a view to controlling the indiscriminate disposal of hospital/biomedical wastes. These rules apply to hospitals, nursing homes, veterinary hospitals, animal houses, pathological laboratories, and blood banks generating biomedical waste.

The Disaster Management Act (DM Act), 2005, provides for the effective management of disasters and for all matters connected therewith or incidental

thereto. It provides for an institutional and operational framework at all levels for disaster prevention, mitigation, preparedness, response, recovery, and rehabilitation. This includes setting up of NDMA, SDMA, DDMA, National Executive Committee (NEC), NDRF, and National Institute of Disaster Management (NIDM). It also clearly spells out the role of central ministries. It empowers the district authorities to requisition by order any officer or any department at the district level or any local authority, to take such measures for the prevention or mitigation of disaster, or to effectively respond to it, as may be necessary, and such officer or department shall be bound to carry out such orders. For the purpose of assisting, protecting or providing relief to the community in response to any threatening disaster situation or disaster, the district authority is also empowered to (a) give directions for the release and use of resources available with any department of the government and the local authority in the district; (b) control and restrict vehicular traffic to, from and within, the vulnerable or affected area; (c) control and restrict the entry of any person into, his movement within and departure from, a vulnerable or affected area; and (d) procure exclusive or preferential use of amenities from any authority or person. These provisions imply that for biological disasters, necessary quarantine measures will be legally instituted using private sector health facilities also for comprehensive patient care.

The Public Health Emergencies Bill being drafted by MoH&FW is intended to replace the Epidemic Diseases Act, 1897 and provides for effective management of public health emergencies, including BT. The draft is presently being modified after seeking comments from the states.

2.1.4 International

International Health Regulations [IHR (2005)]

IHR (2005) adopted by the World Health Assembly on 23 May 2005 came into force on 15

June 2007. The purpose and scope of IHR (2005) is to prevent, protect against, control and provide a public health response to the international spread of disease and to avoid unnecessary interference with international traffic and trade. A legally binding international agreement, it seeks to protect against, control and provide a mechanism to initiate a public health response to the threat or spread of disease causing a Public Health Emergency of International Concern (PHEIC), including that of biological, chemical or radio-nuclear origin.

Under IHR (2005), Member States are required to strengthen their core capacity to detect, report and respond rapidly to public health events and to notify WHO, within 24 hours, of all events that may constitute a PHEIC. It also provides for routine inspection and control activities at international airports, seaports, and certain ground crossings. WHO will provide clear guidelines on the outbreak verification process, technical and logistical support upon request, and Member States will also be eligible for support from the Global Outbreak Alert and Response Network (GOARN), which will be mandated to conduct global surveillance and intelligence gathering to detect significant public health risks. WHO will also assist in settling international public health differences by negotiation, mediation, conciliation and arbitration.

Biological and Toxin Weapons Convention (BTWC)

The Biological and Toxin Weapons Convention, which came into force on 26 March 1975, provides for prohibition of the development, production and stockpiling of bacteriological (biological) and toxin weapons and for their destruction. BTWC now has 146 States Parties, including the five permanent members of the United Nations (UN) Security Council but not including 48 WHO Member States. India is signatory to the BTWC. Each signatory of the BTWC undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:

- i) Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes.
- ii) Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

If any signatory feels threatened, it may lodge a complaint with the Security Council of the UN. Such a complaint should include all possible evidence confirming its validity, as well as a request for its consideration by the Security Council. Each State Party to this Convention also undertakes to provide or support assistance, in accordance with the UN Charter, to any Party to the Convention which so requests, if the Security Council decides that such Party has been exposed to danger as a result of any violation of the Convention.

2.2 Institutional and Policy Framework

2.2.1 National Disaster Management Authority

With the objective of providing for effective management of disasters, the DM Act, 2005 was enacted on 26 December 2005. The Act seeks to institutionalise mechanisms at the national, state and district levels, to plan, prepare and ensure a rapid response to both natural calamities and man-made disasters/accidents. The Act mandates: (a) the formation of a national apex body, the NDMA, with the Prime Minister of India as the Chairperson, (b) creation of SDMAs, and (c) coordination and monitoring of DM activities at district and local levels through the creation of district and local level DM authorities.

The NDMA is responsible to (a) lay down policies on DM; (b) approve the National Plan; (c) approve plans prepared by the ministries or departments of the Government of India (GoI) in accordance with the National Plan; (d) lay down

guidelines to be followed by state authorities in drawing up the state plan; (e) lay down guidelines to be followed by the different ministries or departments of GoI for the purpose of integrating measures for the prevention of disaster and the mitigation of its effects in their development plans and projects; (f) coordinate the enforcement and implementation of the policy and plans for DM; (g) recommend provision of funds for the purpose of mitigation; (h) provide such support to other countries affected by major disasters as may be determined by the central government; (i) take such other measures for the prevention of disaster, or the mitigation, or preparedness and capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary; and (j) lay down broad policies and guidelines for the functioning of NIDM. NDMA is assisted by the NEC, consisting of secretaries of 14 ministries and Chief of the Integrated Defence Staff of Chiefs of the staff committee, *ex officio* as provided under the DM Act, 2005.

NDMA is, *inter alia*, responsible for coordinating/mandating the government's policies for disaster reduction/mitigation and ensuring adequate preparedness at all levels. Coordination of response to a disaster when it strikes and post-disaster relief and rehabilitation will be carried out by NEC on behalf of NDMA.

NDMA has been supporting various initiatives of the central and state governments to strengthen DM capacities. NDMA proposes to accelerate capacity building in disaster reduction and recovery activities at the national level in some of the most-vulnerable regions of the country. The thematic focus is on awareness generation and education, training and capacity development for mitigation, and better preparedness in terms of disaster risk management and recovery at community, district and state levels. Strengthening of state and district DM information centres for accurate and timely dissemination of warning is also in progress.

2.2.2 National Crisis Management Committee (NCMC)

The NCMC, under the Cabinet Secretary, is mandated to coordinate and monitor response to crisis situations, which include disasters. The NCMC consists of 14 union secretaries of the concerned ministries including the Chairman, Railway Board. NCMC provides effective coordination and implementation of response and relief measures in the wake of disasters.

2.2.3 National Disaster Response Force

The DM Act, 2005 has mandated the constitution of the NDRF for the purpose of specialised response to a threatening disaster situation or disaster. The general superintendence, direction and control of the force is vested in and exercised by the NDMA and the command and supervision of this force is vested in the Director General of NDRF. Presently, NDRF comprises of eight battalions with further expansion to be considered in due course. These battalions have been positioned at eight different locations in the country based on the vulnerability profile. This force is being trained and equipped as a multi-disciplinary, multi-skilled force with state-of-the-art equipment. Each of the eight NDRF battalions will have three to four states/Union Territories (UTs) as their area of responsibility, to ensure prompt response during any disaster. Each of these battalions will have three to four Regional Response Centres (RRCs) at high vulnerability locations where trained personnel with equipment will be pre-positioned. NDRF units will maintain close liaison with the state administration and be available to them proactively, thus avoiding long procedural delays in deployment in the event of any serious threatening disaster situation. Besides, NDRF will also have a pivotal role in community capacity building and public awareness. NDRF is also enjoined with the responsibility of conducting the basic training of personnel from the State Disaster Response Forces (SDRFs), police, civil defence,

home guards and other stakeholders in disaster response.

2.2.4 Ministry of Health and Family Welfare

MoH&FW is the nodal ministry for handling epidemics. The decision-making body is the Crisis Management Group under the Secretary (MoH&FW), which is advised by the Technical Advisory Committee under Director General Health Services (DGHS). The Emergency Medical Relief Division of the Directorate General of Health Services is the focal point for coordination and monitoring. The National Institute of Communicable Diseases (NICD) is the nodal agency for implementing IHR (2005) and for investigating outbreaks. The NICD/Indian Council of Medical Research (ICMR) provide teaching/training, research and laboratory support. Most states have a regional office for health and family welfare and the regional director liaises with the state government for effective management of biological disasters.

MoH&FW is vested with the responsibility of framing the national health sector guidelines, providing guidance and technical support for capacity development in surveillance, early detection of any outbreak and supporting the states during outbreaks in terms of outbreak investigations, deployment of Rapid Response Teams (RRTs), manpower and logistic support for case management, etc.

The National Health Policy, 2002, while observing that the decentralised public health outlets have become practically dysfunctional, had advocated developing the public health capacity within the states up to the grass-root level to provide quality public health services.

There are various national health programmes run by the DGHS, MoH&FW, either as a central sector scheme or in partnership with the state government. Some of these programmes, such as

the National TB Programme, National Vector Borne Disease Control Programme, National Programme for Control of Iodine Deficiency Disorders and National AIDS Control Programme which have their networks throughout the country, run as vertical programmes, merging horizontally with service delivery at the grass-root level and have focused strategic approach with inbuilt components for surveillance and monitoring. Many of these programmes were successful in achieving their objective to control/prevent major biological disasters—malaria, smallpox and AIDS are prime examples. These programmes often dwell on renewed strategies for emerging threats such as drug-resistant TB, HIV-TB co-infection, drug-resistant malaria, etc. The experience gained from the controlling of malaria came handy in preventing the dengue and Chikungunya outbreaks. In fact, the rich experience gained in managing national programmes will remain the backbone of managing future public health threats.

The National Rural Health Mission (NRHM) 2005–12 strives to strengthen health delivery at the grass-root level by placing a village health worker—Accredited Social Health Activist (ASHA), in each village, supported by the Village Health and Sanitation Committee. The Primary Health Centres (PHCs), the Community Health Centres (CHCs), and the district hospitals are being strengthened for ensuring minimum public health standards for health care delivery. Once strengthened, the primary health care system will be in a position to assess vulnerabilities, detect early warning signs, feed information into the national surveillance system and help the district health officials in case management.

The Central Government Health Scheme (CGHS) and central government run hospitals provide general and specialised medical professionals for clinical management of cases.

2.2.5 Ministry of Home Affairs

MHA is the nodal ministry for BT and partners with MoH&FW in its management. MHA is responsible for assessing threat perceptions, setting up of deterrent mechanisms and providing intelligence inputs. MoH&FW will also provide the required technical support.

2.2.6 Ministry of Defence

The Armed Forces have a hospital network across the country which can support clinical case management. Further, they have the capacity to evacuate casualties by ambulance, ship, and aircraft. MoD is the nodal ministry for coordinating war related matters and they have also the capacity for managing the aftermath of BW. MoD provides transportation for RRTs and supports supply chain management. The Armed Forces Medical Services (AFMS) have mobile field hospitals which can be moved to the affected areas for treatment at the site. Well-equipped ambulances are available for evacuation of patients to hospitals. The hospitals under AFMS are spread out across the entire length and breadth of the country. Medical and paramedical staff are well trained to handle patients who are victims of any disaster. Training is imparted at the time of induction and refresher courses are conducted regularly. The role of the Armed Forces is discussed below:

- i) The Armed Forces by their inherent organisation, infrastructure, training, leadership, communications, etc., are suitable as first responders in any national-level calamity or disaster.
- ii) Response to a bioterrorist attack will be no different from the response to any other situation, except for a few peculiarities, which must be identified and suitably catered for.

iii) Since this type of disaster will be more towards the management of providing immediate medical assistance, the MoD will coordinate and provide assistance as first responders that will be orchestrated by the Director General Armed Forces Medical Services (DGAFMS). These will be in the form of earmarking command-wise responses, relating to assigned areas of responsibilities. Basically, the following may be included:

- a. Upgrade necessary infrastructure and develop capacity to respond adequately.
- b. Training of earmarked medical personnel in the management of casualties occurring on account of any biological attack, as these will be different in nature to war casualties or casualties on account of any other disaster.
- c. Earmarking of command-wise first responders from all medical resources of the Army, Navy and Air Force.
- d. Create adequate stockpile of necessary vaccines such as anthrax vaccine under various commands with a mechanism to turn over the stocks held.
- e. Conduct periodic exercises to ensure efficacy of response plans.
- f. Immunise adequate number of first responders in each command.
- g. 25 hospitals have been earmarked for treating casualties caused by biological agents.

Defence Research and Development Organisation (DRDO): Many establishments of DRDO are deeply involved in developing facilities for management of biological disasters. Research

is being carried out in the field of vector control, biomarkers and vaccine development. DRDO is also imparting training to trainers for the management of biological disasters.

2.2.7 Ministry of Agriculture

MoA is the nodal ministry for all actions to be taken for biological disasters related to animals, livestock, fisheries and crops. Under MoA, the Department of Animal Husbandry, Dairying and Fisheries (DADF) deals with diseases of animals and livestock, including their quarantine, and the Department of Agriculture and Cooperation in MoA deals with crop diseases and the Directorate of Plant Protection, Quarantine and Storage (DPPQS) deals with pests. Besides, there is a Department of Agricultural Research and Education under which the Indian Council of Agricultural Research (ICAR) functions as an apex body for research on agriculture and allied sciences. ICAR has Krishi Vigyan Kendras (KVKs) in many districts of the country, which work closely with the local community on all agriculture related issues. MoA will attend to biological disasters involving agricultural crops, poultry and cattle. It will send teams of experts, collect samples and get them diagnosed. It will mobilise the local machinery on operational aspects.

2.2.8 Other Supporting Ministries

In the context of biological disasters, the Department of Drinking Water Supply (Rajiv Gandhi Drinking Water Mission), and the Urban Development Ministry/Rural Development Ministry (National Sanitation Campaign) play a key role in the provision of potable water, hygiene and sanitation. The Indian Railways have their own independent medical capabilities, including tertiary care hospitals, across the nation. A wide network of trained manpower is an asset available with this organisation. It also has the potential for

conducting mass evacuation of the affected community. ESIC (MoL&E) caters to 4% of the population and has secondary and tertiary care hospitals in major industrial townships.

2.2.9 Institutions supporting Management of Biological Disasters

NICD, under the administrative control of the Directorate General of Health Services, MoH&FW, has various technical divisions and many specialised laboratories. The institute has three technical centres, viz., Centre for Epidemiology and Parasitic Diseases, Advanced Centre for HIV/AIDS and Related Diseases, and Centre for Medical Entomology and Vector Management; and four technical divisions—Biochemistry and Biotechnology, Microbiology, Training and Malariology, and Zoonosis. Each centre/division has several sections and laboratories (molecular diagnosis, cholera, hepatitis, polio, TB, HIV/AIDS, rabies, plague, leptospirosis, kala-azar, malaria, filaria, intestinal parasite, mycology, etc.) dealing with a wide range of communicable and a few non-communicable diseases. The functions of the Institute broadly cover three areas—trained health manpower development, outbreak investigations, specialised services and operational/applied research. It provides teacher training in field epidemiology. Advanced laboratory work is supported by a BSL-3 laboratory. NICD is also the national focal point for IHR (2005).

Indian Council of Medical Research (ICMR), New Delhi: It is the apex body in India for the formulation, coordination and promotion of biomedical research. Among others, the Council's research priorities include control and management of communicable diseases, and drug and vaccine research (including traditional remedies). It has a network of organisations spread across the country. The National Institute of Virology (NIV), Pune, is an apex laboratory of international standards capable of viral genomic characterisation, monitoring of viral

strains, production of diagnostic kits, and vaccine research.

National Institute of Cholera and Enteric Diseases (NICED), Kolkata: It is an ICMR institution specialising in diarrhoeal diseases and provides expertise in tackling national emergencies caused by epidemics of cholera and other diarrhoeal diseases.

National Institute of Epidemiology, Chennai: It is another ICMR institution with the vision of becoming a centre of excellence in the field of epidemiology concentrating on goal-oriented programmes of national relevance, operational research, health systems research, teaching and field epidemiology training.

Vector Control Research Centre: This ICMR institution is involved in developing methods for rapid response and disaster management with reference to vector-borne disease outbreaks.

All India Institute of Hygiene and Public Health, Kolkata: It is among the oldest public health institutions in India involved in public health teaching, training and research. It runs regular postgraduate training programmes in public health, environmental health, public health engineering, etc.

Indian Council of Agricultural Research (ICAR): This is a premium research institution in the fields of Agriculture, Animal Science and Fisheries. For details, refer to Chapter 7 of the document.

Defence Research and Development Organisation (DRDO): It has an extensive network of laboratories in the various disciplines of biological science. These laboratories have developed expertise in various aspects relevant to this subject. These are:

Defence Research and Development Establishment (DRDE): DRDE (under MoD) is

engaged in research on hazardous chemicals and biological agents as well as associated toxicological problems. It has developed diagnostic kits for certain biological agents. It also imparts training in the medical management of chemical warfare/terrorism and BW/BT. The Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, is another DRDO institution that specialises in the manufacture of protective suits, gloves and boots. The Defence Bioengineering and Electromedical Laboratory (DEBEL), Bangalore, manufactures face masks, canisters, NBC filter fitted casualty evacuation bags, etc., based on the technology provided by DRDE. The Defence Food Research Laboratory (DFRL) specialises in all aspects of food preparation, security and quality.

Council for Scientific and Industrial Research (CSIR): It is one of the world's largest R&D organisations having linkages to academia, R&D organisations and industry. CSIR's 38 laboratories form a giant network that embraces areas as diverse as aerospace, biotechnology, drugs and toxicology.

Department of Biotechnology (DBT): DBT has significant achievements in the growth and application of biotechnology in the broad areas of agriculture, health care, animal sciences, environment, and industry. DBT also has a laboratory network throughout the country.

The Public Health Foundation of India (PHFI): It is an autonomous institution set up in 2005 to redress the limited institutional capacity in India for strengthening training, research, and policy development in the area of public health. It is a PPP venture and its mission is to benchmark quality standards for public health education, establish public health institutes of excellence, undertake public health research and advocate public policy linked to broader public health goals.

Vaccine Production Centres

The public health load in the country including that of vaccine-preventable diseases, gives high priority to vaccine manufacturing both in the public and private sectors. The country is not only self-reliant in this sector but also supplies vaccines to other countries and international organisations such as WHO and United Nations Children's Fund (UNICEF). Notable among them are the oral polio; Diphtheria, Pertussis and Tetanus (DPT); measles; Bacillus Calmette-Guérin (BCG); yellow fever vaccine; anti-rabies; meningococcal; and smallpox vaccines. It also manufactures immunoglobulins and antiserums for tetanus, rabies and snake bite. India has the R&D facility coupled with latest technology to manufacture second- and third-generation cell culture vaccines. It is one among the six countries in the world, identified by WHO for manufacturing avian influenza vaccine that can be scaled up for manufacture of pandemic influenza vaccine. Notable vaccine manufacturers are the Central Research Institute, Kasauli; Haffkine Institute, Mumbai; Pasteur Institute, Coonoor; BCG Laboratory, (Guindy) Chennai, and NIV, Pune, all in the government sector and the Serum Institute of India, Shanta Biotech, Biological Evans and Bharat Biotech in the private sector.

Drug Manufacturing Units

The Indian pharmaceutical sector is a leading industry and a major player in the global market. The products range from basic essential drugs to third-generation antibiotics, anti-retroviral drugs, immuno-modulators and anti-cancer drugs. The Drug Controller General of India and drug controllers in the states ensure good manufacturing practices under the ambit of the Drugs and Cosmetics Act. These drug manufacturing units are both in the government and private sectors.

2.2.10 State Level

The SDMA is vested with the powers for planning, preparedness, mitigation, and response

to disaster events, including biological disasters, in the concerned states. SDMA is assisted by the State Executive Committee (SEC). The state plan is prepared by SEC based on the guidelines issued by NDMA and SDMA. The latter will also assist the districts in preparing and executing the district plan.

Health being a state subject, there is wide inter- and intra-state differential in terms of public health assets, functioning of the public health departments, teaching and training institutions, and public health research. Tamil Nadu, Andhra Pradesh, Maharashtra and Gujarat are creating their own public health institutions. In addition, the medical colleges are an important resource both for public health and medical services. The preventive and social medicine (community health) departments have regular outreach services into the community. The laboratory services of medical colleges augment the laboratory surveillance under IDSP. Apart from providing clinical services, the medical colleges also act as sentinel sites for surveillance.

Many states have established SDMAs. Gujarat, Maharashtra, Andhra Pradesh, etc., have prepared DM plans. Other states are in the process of establishing SDMAs and preparing their DM plans which will be in accordance with the DM Act, 2005. State health management plans will form an important component of state DM plans. States such as Gujarat have developed epidemic control programmes as well.

2.2.11 District Level

DDMA will be the focal point of planning for disasters in the respective districts. The District Health Officer (DHO)/CMO of the district is a member of the DDMA. Under the CMO/DHO, there are programme officers for immunisation, TB and malaria. Under the IDSP, a surveillance/IDSP officer at the district level is envisaged. The peripheral units that provide preventive and promotive health

care are the PHCs and sub-centres spread across the districts, established on the norms of one PHC for 30,000 population and one sub-centre for 5,000 population (3,000 in hilly areas). These are the basic units from where public health information is generated and public health service is delivered.

2.2.12 Local Level

At the local level, the local DM committee (village DM committee) is expected to be trained and empowered as first responders. Anganwadi workers/ASHA/Auxiliary Nurse Midwife (ANM) of the village/sub-centre will be the peripheral health service delivery point, keeping a watch on disease outbreaks and notifying the village health and sanitation committee and the PHC.

Urban municipal corporations and councils look after public health, hospital services, drinking water, sanitation, disposal of dead bodies, and other civic functions related to health.

2.2.13 Non-governmental Organisations

NGOs perform a variety of services and humanitarian functions, bring citizens' concerns to the attention of the government, monitor policies, and encourage political participation at the community level. They provide analysis and expertise, serve as early warning signals and help monitor and implement international agreements. Some are organised around specific issues, such as human rights, the environment, or health. Their involvement, as of now, in the prevention and control of the health consequences of biological disasters is very limited and would depend on government seeking partnership and offering a fair playing field.

The Indian Red Cross Society (IRCS) has 655 branches at the state/district/divisional/sub-district/taluka levels spread throughout the country, together with its national headquarters at New Delhi. It has 90 blood banks and promotes blood

donation camps. Red Cross volunteers are motivated and if given adequate training, can complement the primary health care facilities for case management in home settings during major biological disasters.

2.2.14 Role of International Organisations

(A) World Health Organisation (WHO)

WHO provides advocacy, guidelines, training and technical support in health related matters. WHO India Office, WHO-Regional Office for South-East Asia (WHO-SEARO), FAO and World Organisation for Animal Health (OIE) provide assistance if the biological disaster involves agriculture or animal health.

WHO contributes to global health security in the specific field of outbreak alert and response by: (i) strengthening national surveillance programmes, particularly in the field of epidemiology and laboratory techniques; (ii) disseminating verified information on outbreaks of diseases, and whenever needed, following up by providing technical support for response; and (iii) collecting, analysing and disseminating information on diseases likely to cause epidemics of global importance. Several BW related diseases fall under WHO surveillance. Guidelines on specific epidemic diseases, as well as on the management of surveillance programmes, are available in printed and electronic form.

(B) World Trade Organisation (WTO)

Refer to Chapter 7 of the document

(C) Interpol

- i) Interpol has an environmental laboratory with multi-disciplinary staff consisting of engineers, chemists, scientists and technicians. Member States are provided with a full range of environmental testing services including field monitoring, ambient

air quality, chemistry, stationary sources testing, etc. They maintain state-of-the-art equipment, employ professionals and implement a comprehensive quality control plan.

- ii) At the request of Member States, the Command and Coordination Centre based at Lyon (France), is mobilised to facilitate the coordination of any large-scale disaster management. The Centre gives priority to such events, provides services round the clock, and circulates information to all concerned anywhere in the world. It also has direct access to all Interpol facilities, e.g., DNA finger printing, etc. Interpol also releases specific resources for disasters such as staff, equipment and premises.
- iii) The coordinating agency for Interpol in India is the Central Bureau of Investigation through which all the above facilities can be obtained.

2.3 Operational Framework

2.3.1 Central Level

At the national level, NDMA is the authority for providing National Guidelines on management of biological disasters, including biowarfare and BT. Being the nodal ministry for epidemics, MoH&FW advocates on policy issues and lays down a national plan. It supports the states in terms of advocacy, capacity building, manpower and logistics. IDSP, which is described in detail in the foregoing paragraphs will be the backbone for disease surveillance and detection of early warning signs.

In a crisis situation, the Crisis Management Group of MoH&FW takes decisions for controlling the outbreak. If the crisis has the potential for socio-economic disruption or involvement of a number of states/districts and central ministries, the NCMC coordinates the response. The technical inputs are

provided by the Technical Committee under DGHS. Within MoH&FW, the Emergency Medical Relief division coordinates all such actions that require interface between MoH&FW, other central ministries, the state(s) and other institutions both in the public and private sectors. The control room functions from the Emergency Medical Relief division and from NICD. Multi-disciplinary RRTs from NICD and institutions under ICMR, manage public health problems and provide necessary laboratory support. Major central government hospitals and institutions such as CGHS provide a large pool of medical manpower for case management. The Central Medical Stores Depots and some of the Public Sector Undertakings have expertise in handling material logistics and support the states with drugs, disinfectants and insecticides. The vaccine production centres supply vaccines as required.

For epidemics which threaten to spread across the states and tend to be endemic, or from an endemic situation to an epidemic outbreak, MoH&FW decides on the strategic approach for their control/elimination. They draw up various programmes in consultation with WHO on various relevant issues. Diseases of international public health concern are required to be notified to WHO as per the requirement under IHR (2005). The disease trend is monitored on a day-to-day basis till it ceases to be a public health problem.

The agriculture ministry would attend to biological disasters involving the agriculture/poultry/cattle segment.

In the context of biological disasters, the Department of Drinking Water Supply and the Rural Development Ministry play key roles in the provision of potable water, chlorination of water and water quality monitoring. MHA/MoD/Ministry of Civil Aviation would support airlift of RRTs/clinical samples and logistics. The Armed Forces also have the capacity for managing the aftermath of BW and provide technical inputs for managing BT.

In case of surge capacity for clinical case management, the hospital facilities of the Armed Forces, Railways and ESIC can be used. The Indian Railways has mass evacuation potential as well.

2.3.2 State Level

Under the provisions of the DM Act, 2005, SDMAs will advise the state on biological disasters and approve the plan of the state government and provide guidelines to act upon. In states which are yet to establish the SDMA, the state health department is the nodal agency responsible for planning and to be in a state of preparedness. This includes capacity development in terms of surveillance, early detection, and rapid response and containment of any outbreak. In case of a bioterrorist attack, epidemiological clues have to be delineated to establish the nature of the attack. The state health department is to prepare SOPs in instituting the public health response. In crisis situations, the state health department has to depute the RRTs, conduct clinical and epidemiological investigations, and institute public health measures to contain the outbreak.

2.3.3 District and Sub-district Level

DDMA is the authority to plan and execute the DM programme at the district level. In districts where DDMA is yet to be constituted, the district collector assumes the prime responsibility. He is vested with powers under IPC and various other enactments to direct and mobilise resources for containment of the outbreak. He also decides on the help required from outside agencies and communicates the requirement to state authorities. The preparedness measures, of which surveillance is the major functional component, is being supported under IDSP. The district level RRTs are also trained, and the communication hub at the district level uses terrestrial and satellite linkages. Under IDSP, it is envisaged that by 2009 all the districts would acquire such capabilities.

All major outbreaks, man-made or natural, if not detected early and contained, spread and soon go beyond the coping ability of the district administration, requiring support from the state/centre. The primary health care system has to play a crucial role in detecting the early warning signs. The village health functionaries [ASHA/Anganwadi worker/ANM/Multi-Purpose Worker (MPW)] interface with the community and are advantageously placed to report public health events to the peripheral public health services outlets such as sub-centres and PHCs. The functioning of the public health system at the grass-root level is of paramount importance in picking up early signals and acting rapidly, as is the presence of a communication network for bi-directional flow of information.

The district health setup includes hospital facilities such as district hospitals, sub-district hospitals, CHCs and PHCs. Public health support is provided by the DHO and other officers related to public health work such as the immunisation officer and district officers for TB and malaria. The network of PHCs and the network of sub-centres is the backbone of the public health system through which the public health measures are instituted—be it event-based, house-to-house surveillance, provision of safe drinking water through chlorination, vector control measures, mass chemoprophylaxis, sanitation measures, home care or referral of critical patients. The DHO/CMO mobilises medical officers from the PHCs supported by health workers from the sub-centres for field work. The teams are constituted usually on population norms, covering the entire affected area. Reinforcements, if required, are arranged by the state governments from other districts, medical colleges and from central government institutions.

2.3.4 NGOs/Private Sector

NGOs play a major role in all disasters but are largely conspicuous by their absence in biological disasters. At the district level, the district collector would coordinate all the activities of NGOs.

However, there is poor networking and it needs to be improved. 70% of health services are provided by the private sector but their presence is mainly in urban areas. Private hospitals are better organised and equipped. However, in mass casualty incidents, their utilisation leaves much to be desired. The DM Act, 2005 provides enough powers for the DDMA to call for the services of organisations which can contribute to effective management of any disaster.

2.4 Important Functional Areas

2.4.1 Human Health Surveillance

In biological disasters, surveillance is the key strategy to detect early warning signals and has to have components to include human, animal and plant surveillance. Till 1999, when the National Communicable Disease Surveillance programme was launched, there was no organised system for disease surveillance. It was expanded to cover about 100 districts in three states. The lessons learned were reviewed and MoH&FW initiated the IDSP with World Bank support.

(A) Integrated Disease Surveillance Programme

Launched in 2004, the IDSP intends to detect early warning signals of impending outbreaks and help initiate an effective response in a timely manner. It is also expected to provide essential data to monitor the progress of ongoing disease control programmes and help allocate health resources more efficiently. It is a decentralised, state-based surveillance programme, using an integrated approach with rational use of resources for disease control and prevention. Data collected under the IDSP also provides a rational basis for decision-making and implementing public health interventions.

Specific objectives of the IDSP:

- i) To establish a decentralised state-based system of surveillance for communicable

and non-communicable diseases so that timely and effective public health action can be initiated in response to health challenges in the country at the state and national levels.

- ii) To improve the efficiency of the existing surveillance activities of disease control programmes and facilitate sharing of relevant information with the health administration, community and other stakeholders so as to detect disease trends over time and evaluate control strategies.

The project is intended for surveillance of a limited number of health conditions and risk factors keeping in view the local vulnerabilities; integrate disease surveillance at the state and district levels; improve laboratory support; strengthen data quality; and, analyse and link them to action. The project envisages a transnational training programme, to involve communities and other stakeholders, particularly the private sector. Integral to the IDSP is an IT network which aids the national electronic disease surveillance system. The strengthening of the laboratory network with standard biosafety practices would mean that selected district and state level laboratories would have specific culture facilities.

All the states/UTs are to be covered in a phased manner by 2009. For project implementation, surveillance units have been set up at the central, state and district levels. Surveillance committees at the national, state and district levels would monitor the project. Nine training institutes were identified to conduct training of the state and district surveillance teams. Training modules have been developed for this purpose. Training of state/district surveillance teams has been completed for nine states in Phase-I. A total of 605 master trainers have been trained in 13 of the 14 Phase-II states. States are organising training programmes for medical officers, health workers, and laboratory technicians at the district and CHC/PHC levels.

Training manuals for medical officers, health workers and district level laboratory technicians have been dispatched to the states. The financial and administrative component is also being strengthened by training of accountants in financial management and training of data entry operators in data management.

Once fully implemented, syndromic reporting would have the advantage of detecting possible unusual events. The call centre concept being implemented by the IDSP would help any medical professional or general public to inform the IDSP about any unusual event through a toll free number. The RRT in each district would investigate the suspected situation. Till such time the information management system becomes fully operational, authentic baseline data may not be available and epidemic threshold levels cannot be determined.

2.4.2 Epidemiological Assessment

One of the major inputs for successful management of biological disasters is acquiring the capability of rapid epidemiological assessment, identifying assessment tools such as mapping, use of Geographic Information System (GIS) and Global Positioning System (GPS), vulnerability assessment, risk analysis, and use of mathematical models. This would help in strategic decision-making for public health interventions. ICMR is using such tools in a limited way. GIS has also been used to some extent in leprosy, immunisation, TB, and malaria programmes.

2.4.3 Environmental Assessment

Environmental assessment and strategic interventions are increasingly becoming a priority issue. Climate change is creating an enabling environment conducive for vector-borne and zoonotic diseases. This is also due to the destruction of habitats of wild animals which increasingly interface with the human population. Areas which

require attention are water quality monitoring, food safety and security, vector control, animal health surveillance, sanitation and solid waste management, and safe disposal of hazardous materials, including biomedical waste, etc.

2.4.4 Laboratory Support

Prior to the appearance of avian influenza, the health sector had only one BSL-3 laboratory at NIV, Pune. Now in addition, NICD, Delhi; Japanese Leprosy Mission for Asia (JALMA), Agra; and NICED, Kolkata (both ICMR institutions), have BSL-3 laboratories. Additional BSL-3 laboratories are being set up at the Regional Medical Research Centre (RMRC), Dibrugarh (Assam); and King Institute of Preventive Medicine (KIPM), Chennai, Tamil Nadu, to complement the NICD/ICMR avian influenza network. BSL-3 laboratories are under consideration for Central Research Institute (CRI), Kasauli; Haffkine Institute, Mumbai; and DRDE, Gwalior. The existing BSL-3 lab at NIV, Pune, has been upgraded to BSL-3+ and another BSL-4 laboratory is being established by ICMR at Pune. The MoA has one BSL-4 laboratory at the High Security Animal Disease Laboratory (HSADL) at Bhopal. The DADF is planning to instal four BSL-3 laboratories for avian influenza and other emerging diseases. The Centre for Molecular Biology has four BSL-3 laboratories and a BSL-4 laboratory is also under consideration. A portable laboratory has been developed by DRDO in collaboration with WHO and is available with NICD, Delhi, for such disaster situations.

Under IDSP, the laboratories within PHCs, CHCs, district hospitals and medical colleges are being upgraded to establish a national network of laboratories. The National Laboratory Accreditation Board sets the minimum standards to be followed by laboratories across the nation. Major issues remain regarding biosecurity, indigenous capability of preparing diagnostic reagents and quality assurance.

2.4.5 Immunisation

Vaccination if available against a biological agent, can offer good protection to the 'at-risk' population. As a strategic measure, anthrax vaccine can also be given to personnel who are at high risk of exposure, e.g., hospital functionaries, Armed Forces personnel, first responders of NDRF, veterinarians and laboratory workers. These practices are factored into preparedness measures. Prime examples are the vaccine preparedness for pandemic influenza and stockpiling anthrax and smallpox vaccines for a potential threat of bioterrorist attack with the smallpox virus. Anthrax vaccine can also be administered post exposure in combination with appropriate antibiotics such as ciprofloxacin.

2.4.6 Chemoprophylaxis

Use of medication as a public health strategy to prevent disease has been in practice. Stockpiling of doxycycline for an attack of plague (natural or terror strike), oseltamivir (Tamilflu) for avian flu and rifampicin/ciprofloxacin for meningococcal meningitis are essential. With a strong pharmaceutical manufacturing base, mobilisation of millions of doses of chemoprophylactic agents is possible in the Indian context at short notice.

2.4.7 Nutrition

A factor accentuating the spread of disease in India is the poor nutritional standard of the population, especially children. Nutrition for preschool children is supported by the Integrated Child Development Scheme, and for school going children under the midday meal programmes.

2.4.8 Medical and Public Health Services

The network of PHCs and sub-centres is the backbone of the public health system through which public health measures are instituted. The

primary health care systems interface with the community and are advantageously placed to detect early warning signs and report public health events. There are 23,109 PHCs providing preventive, promotive and limited curative services. The rural network of PHCs and sub-centres provides substantial help in biological disasters when field interventions are required.

The CHC (1/100,000 Population) is the grass-root level functional hospital with 30 beds where basic specialties are envisaged. But a substantial number of CHCs do not have a full complement of basic specialties and the services are highly skewed towards reproductive health. The district hospitals, planned to provide secondary level care, have on an average 200–250 beds but show wide inter- and intra-state variation. In some states, they are suitable even for medical teaching/training.

In poorly performing states, 30–50% of the hospital beds are in rural hospitals, and are poorly maintained. Even 60 years after independence, the country cannot meet the standards set by the Mudaliar Committee in the 1950s—that of one bed per 1,000 population. Infectious diseases hospitals and isolation facilities in the district hospitals, even if existing, are the most neglected. Emergency support systems (including critical care support) and specialised capabilities for CBRN management in these hospitals are grossly inadequate/non-existent. Most district level hospitals, taluka hospitals and CHCs are not equipped to handle mass casualty incidents. Emergency support systems (including critical care support) in these hospitals are grossly inadequate. Another critical area in mass casualty events is the disposal of dead bodies. Even in the best of the urban settings, these facilities are lacking.

State-run hospitals have limited medical supplies. Even in a normal situation, the patient has to buy medicines. There is no stockpile of drugs, vaccines, PPE, and diagnostics for surge

capacity. In a crisis situation, there is further incapacitation due to tedious procurement procedures. Inventory management/supply chain management concepts are not followed. However, the Indian pharmaceutical sector is capable of meeting enhanced requirements at times of such disasters.

After the sporadic outbreak of avian influenza, a central stockpile of PPE, ventilators, automatic analysers and oseltamivir has been maintained.

NRHM (2005–12) strives to strengthen health delivery at the grass-root level by placing a village health worker, i.e., ASHA, in each village, supported by the village health and sanitation committee. The PHC would have a medical officer and 24x7 services provided by nurses. The CHC would provide basic specialities, including 24x7 emergency services. The district hospitals are being strengthened for health care delivery. Under the health system projects funded by the World Bank, the hospital systems at district and sub-district levels are being strengthened in terms of infrastructure. Under the Pradhan Mantri's Swasthya Suraksha Yojna, tertiary care institutions are being strengthened.

2.4.9 Information Technology

IDSP is establishing linkages with all district and state headquarters, and all government medical colleges on a Satellite Broadband Hybrid Network. 84 sites have already been made active by the Indian Space Research Organisation and the requisite equipment has been installed at all these sites. The network, on completion, will enable 800 sites on a broadband network, 400 sites (out of these 800) will have dual connectivity with satellite and broadband. The National Informatics Centre (NIC) has been entrusted the task of setting up and managing of the information technology network. NIC is also establishing a 'disease outbreak monitoring call centre' that would receive

disease outbreak related calls from across the country on a toll free number. The network is intended for distance learning, data transmission and video-conferencing as a part of tele-medicine initiatives.

The reach of mobile telephony has changed the face of telecommunication in India. Most previously inaccessible areas are now covered by one or the other network. It is essential that there be an efficient communication system, including provision of satellite telephones, especially in inaccessible areas to support outbreak investigations and response. Establishment of Emergency Operations Centres (EOCs) at all state headquarters is under consideration by the MoH&FW.

2.4.10 Risk Communication and Creating Community Awareness

The community will be greatly empowered if the risk is communicated to the community. Our country has vast experience in the health sector for instituting behavioural change through effective communication. Given the level of literacy in some states, communication strategies, to be successful, need planning, trained manpower, an understanding of communications protocols, messaging and the media, as also the ability to manage the flow of information. The reach of visual and print media to a substantial section of the population ensures that messages in the context of biological disasters can be delivered to them instantaneously and further sustained through the audio/print media. Activities at the local level could include street plays, dramas, folk theatres, poster competitions, distribution of reading material, school exhibitions, etc. It has been seen that creating awareness in the community not only empowers them to act accordingly, but also alleviates fear and lessens the psychological impact.

2.4.11 Community Participation

Presently, community participation is inadequate in biological disasters due to the intrinsic fear of community members of contracting the disease. However, communicating the risk, strict following of infection control protocols and encouragement from the government to NGOs and self-help groups, especially for instituting preventive measures, would ensure community participation. Containment of avian influenza in Maharashtra, Gujarat and Madhya Pradesh saw substantial involvement of the PRIs. This culture has to be taken forward to involve other NGOs, self-help groups, resident welfare associations, *vyapar mandals*, etc. Areas where the district authorities partner with these organisations can include health education, chlorination and water quality monitoring, sanitation, vector control, drug distribution, documentation and data management during mass casualty incidences, disposal of dead bodies, and provision of psycho-social care.

2.4.12 Mental Health Services and Psycho-social Care

Disease outbreaks instil fear, cause anxiety and affect a large population, and usually leave a trail of human agony that requires psycho-social interventions. The country possesses rich experience and adequate expertise in providing mental health services and psycho-social care, including training of manpower and service delivery. The National Mental Health Programme has a community based approach delivering services through the District Mental Health Programme. Successful community based innovative micro models at the grass-root level, incorporating contextual realities and cultural practices were adopted during major disasters such as the Orissa cyclone, Gujarat earthquake and more recently during the Indian Ocean tsunami recovery and rehabilitation process.

2.4.13 Research and Development

ICMR is the apex body for medical research in India. DRDO also contributes to basic and applied research in the biomedical field. ICMR and DRDO have established the capacity for basic and applied research in the area of molecular biology, genomic studies, epidemiological, and health system research. Private establishments are excelling in the area of drugs and vaccines and have established their global presence.

Areas requiring attention are—operational research in forecasting, using trend analysis, mathematical modelling, GIS based modelling for molecular research on potential genetically engineered BT agents, genomic studies, specific biomarkers, new treatment modalities and advanced robotic tools.

2.5 Genesis of National Disaster Management Guidelines—Management of Biological Disasters

One of the important roles of NDMA is to issue guidelines to ministries/departments and states to evolve programmes and measures in their DM Plan for holistic and coordinated management of disasters as identified in the DM Act, 2005.

In this direction, a National Workshop on Biological and Chemical Disasters was convened by NDMA at its headquarters in New Delhi between 22–23 February 2007 as part of a nine-step participatory and consultative process to evolve the National Disaster Management Guidelines—Management of Biological Disasters. Stakeholders from various ministries/departments of Gol (Health, Home Affairs, Defence, and Agriculture), Interpol, R&D organisations/Institutes [ICMR, ICAR, CSIR, Bhabha Atomic Research Centre, NICD, DRDO, NIDM, All India Institute of Medical Sciences (AIIMS), Sir Dorabji Tata Centre for Research in

Tropical Diseases, Indian Veterinary Research Institute (IVRI), etc.], professional institutions and a large number of professionals, NGOs, regulatory bodies, experts, and stakeholders in the field of BDM participated in the deliberations.

During the workshop, the present status of the management of biological disasters, including BT, in the country was discussed and important gaps were identified. The workshop also identified priority areas for prevention, mitigation and preparedness of biological disasters and provided an outline of comprehensive guidelines to be formulated as a guide for the preparation of action plans by ministries/departments/states.

A Core Group of Experts comprising major stakeholders as well as state representatives was constituted under the chairmanship of Lt. Gen. (Dr.) J. R. Bhardwaj, PVSM, AVSM, VSM, PHS (Retd), Member, NDMA to assist in preparing the Guidelines. Several meetings of the Core Group were held to review the draft versions of the Guidelines in consultation with concerned ministries, regulatory bodies and other stakeholders to evolve a consensus on the various issues regarding the guidelines. During these deliberations, the core group felt that guidelines for the management of plant and animal pathogens should be taken up as a separate section in these guidelines. The various recommendations of the steering group and outcome of the workshop proceedings—'Pandemic Preparedness Beyond Health', held in April 2008 were also incorporated in these Guidelines.

3

Salient Gaps

The extensive experience of dealing with epidemics in diverse conditions does instil confidence in dealing with biological disasters. However, post-epidemic reviews of such situations, notably the Surat plague outbreak in 1994 and the subsequent one in Himachal Pradesh in 2001, the SARS outbreak of 2003, the avian influenza outbreak in 2006 and the Nipah outbreak in 2001 and 2007, have emphasised the need to strengthen the surveillance and public health delivery system in India. Current and emerging needs call for a mechanism to address the health impact of climate change, global warming, urbanisation, and population growth, all of which may be the trigger and/or enabling factors for biological disasters. This chapter identifies the important gaps and scope for improvement in the legal, institutional and operational framework to institute preparedness and put forth robust response.

3.1 Legal Framework

The Epidemic Diseases Act was enacted in 1897 and needs to be repealed. This Act does not provide any power to the centre to intervene in biological emergencies. It has to be substituted by an Act which takes care of the prevailing and foreseeable public health needs including emergencies such as BT attacks and use of biological weapons by an adversary, cross-border issues, and international spread of diseases. It should give enough powers to the central and state governments and local authorities to act with impunity, notify affected areas, restrict movement or quarantine the affected area, enter any premises to take samples of suspected materials and seal them. The Act should also establish controls over

biological sample transfer, biosecurity and biosafety of materials/laboratories.

3.2 Institutional Framework

In the MoH&FW, public health needs to be accorded high priority with a separate Additional DGHS for public health. In some states, there is a separate department of public health. States that do not have such arrangements may also have to take initiatives to establish such a department. The apex institution, NICD, is not geared to address the impact of environment changes, changing communicable disease spectrum (emerging and re-emerging diseases), obligations under IHR (2005), and to make optimal use of newer technologies. This would require a facelift in terms of infrastructure and human resources. Similar public health institutions are conspicuous by their absence in most of the vulnerable states. Even the best performing states do not have their own public health institution of eminence.

3.3 Operational Framework

3.3.1 Policy and Plans

At the national level, there is no policy on biological disasters. The existing contingency plan of MoH&FW is about 10 years old and needs extensive revision. All components related to public health, namely apex institutions, field epidemiology, surveillance, teaching, training, research, etc., need to be strengthened. The preventive and social medicine departments of medical colleges which churn out postgraduates

in the speciality with focus on academics, need to be oriented for public health management/administration.

For implementing IHR (2005), core capacity needs to be developed for surveillance, border control at ports and airports, quarantine facilities, etc. India needs to maintain a level of epidemiological intelligence to keep a track on our adversaries' biowarfare programmes. This applies to terrorist outfits using available in-house facilities to develop such weapons. A coordinated action plan of the intelligence agencies, MoH&FW and MoD needs to be put in place to gather intelligence and develop appropriate defence and deterrence strategies.

In almost all the states, state policies, plans and guidelines are non-existent. Each state needs to have a public health institution which would collect epidemiological intelligence, share information with the IDSP, provide for outbreak investigations and be capable of managing outbreaks. Within the state also it has been observed that interaction is lacking between the state health authorities and the local bodies, some of which have enormous civic functions to perform, including public health. The limited capacities of the Mumbai Municipal Corporation were evident in the wake of floods in Mumbai in 2005, the Surat Municipal Corporation fared no better during the floods in 2006 and the plague outbreak in 1994. Under the DM Act, 2005, DDMA is the authority to plan and execute the DM programme at the district level. In a substantial number of districts a DDMA is yet to be constituted.

3.3.2 Command Control and Coordination

At the operational level, Command and Control (C&C) is identifiable clearly at the district level, where the district collector is vested with certain powers to requisition resources, notify a disease, inspect any premises, seek help from the Army, state or centre, enforce quarantine, etc. However,

there is no concept of an incident command system wherein the entire action is brought under the ambit of an incident commander with support from the disciplines of logistics, finance, and technical teams, etc. There is an urgent need for establishing an incident command system in every district.

Unlike the Emergency Medical Relief Division (of DGHS) which coordinates and monitors all crisis situations, there is no such mechanism in the states. There is a need to establish EOCs in all state health departments with an identified nodal person for coordinating a well orchestrated response.

One of the lessons learned during the plague outbreak in Surat in 1994 and avian influenza in 2006 is the need to strengthen coordination with other sectors like animal health, home department, communication, media, etc., on a continuous basis for the management of outbreaks of this nature.

3.3.3 Human Resources

There is a shortage of medical and paramedical staff at the district and sub-district levels. There is also an acute shortage of public health specialists, epidemiologists, clinical microbiologists and virologists. There have been limited efforts in the past to establish teaching/training institutions for these purposes. PHFI, NICD and ICMR are responsible for filling up these gaps. NICD has started a masters course on Public Health. However, more efforts are needed in this direction.

There have been limited efforts to train hospital managers in managing mass casualty incidents, and this was mainly from 1996 onwards through WHO projects. The emphasis was on the district hospitals to have their own DM plans.

3.3.4 Surveillance

The IDSP does not reach the grass-root level and hence needs to be restructured. It should have

international networking with generic or disease specific networks (FluNet, Dengue Net, etc.) which presently do not exist. This would facilitate global monitoring of emerging and re-emerging diseases. Environmental surveillance and animal health surveillance needs to be an integral part of the IDSP. Areas which require attention are water quality monitoring, food safety and security, vector control, zoonotic sanitation and solid waste management, safe disposal of hazardous materials, including biomedical waste, etc.

The project should imbibe operational research tools such as mapping, use of GIS and GPS, vulnerability assessment, risk analysis and use of mathematical models. Simple issues such as case definitions and epidemics, threshold levels need to be established or adapted to suit Indian requirements. As of now the system is not able to detect early warning signs and generate data from which epidemiological intelligence can be extracted and used in decision-making. A reason for the spread of the Surat plague was the failure to detect early warning signs due to sudden ecological changes that might have created a spillover of sylvatic plague into the domestic environment, as had happened following the 1993 earthquake in Maharashtra.

3.3.5 Laboratories

Biosafety laboratories are required for the prompt diagnosis of the agents for effective management of biological disasters. There is no BSL-4 laboratory in the human health sector. BSL-3 laboratories are also limited. Major issues remain regarding biosecurity, indigenous capability of preparing diagnostic reagents and quality assurance. There is need for using sophisticated real time PCR methods for rapid diagnosis of biological agents through environmental sampling, particularly those that have the potential to be used as agents of BT. Other areas that need to be strengthened include developing DNA probes, sensors, markers, etc.

A need also exists for strengthening the networking of laboratories so that their expertise can be utilised quickly. During the plague outbreak in 1994, isolated strains had to be processed in international reference laboratories because of inadequate laboratory facilities. Since then a lot of progress has been made. Today, the country has the capability of doing viral characterisation through genomic studies. Some laboratories under ICMR are of international standards. The identification and development of at least one central reference laboratory to the standards of a WHO reference laboratory for influenza or HIV, is essential.

3.3.6 Primary Health Care

A network of sub-centres, PHCs and CHCs is the backbone of primary health care which is fundamental for detecting early warning signs of any impending outbreak in the community and instituting public health measures at the community level. At the village level, informed health workers are needed to keep a watch on adverse health events. NRHM is yet another valiant attempt at establishing an ASHA worker in each village. Two years into the project, ASHA workers are yet to take root.

Failing to establish village health workers, the sub-centres (one for 5,000 population) manned by MPWs/ANM are the existing first level of contact between a health functionary and the community. There are 142,655 sub-centres with about 2.1 lakh health workers. There is almost 50% vacancy in the position of male health workers. As BDM requires community based surveillance and case management, the health workers are the mainstay. Using the existing manpower would affect other functions assigned to them such as immunisation and maternal health. A substantial number of CHCs do not have a full complement of basic specialties. For all PHCs and CHCs, the district hospital is the first referral hospital for providing secondary care. Most district level hospitals, taluka hospitals and CHCs are not equipped to handle mass casualty

incidents. Isolation facilities and critical care facilities are lacking in them. In poorly performing states, 30–50% of their beds are in rural hospitals which are poorly maintained. Specialised capabilities for CBRN management in these hospitals are grossly inadequate/do not exist.

3.3.7 Transportation

As on date, all modes of transport are used in the event of disasters, be it personal vehicles, trucks, tractors, tempos or even bullock carts.

The major gaps are as follows:

- i) Lack of an Integrated Ambulance Network (IAN) and there is no ambulance system with advanced life-support facilities that is capable of working in biological disasters.
- ii) Sub-optimal usage of resources in the private sector.
- iii) No accreditation/standard for ambulances in India.

3.3.8 Hospital Facilities

Health care facilities are mainly restricted to urban areas and there is a palpable urban–rural divide as only 10.3% medical beds are available for 70% of the rural population. An estimate of the World Health Report indicates the requirement of 80,000 beds every year for the next five years that can be fulfilled only with the proactive involvement of private players in the medical field.

Government hospitals/medical college hospitals in major cities and state capitals have, on an average, more than 500 beds. Such facilities are available, within 100–150 km in the better performing states. Even in these hospitals emergency departments/critical care facilities are inadequate. However, surge capacity exists to manage mass casualty incidents but they are not equipped to handle CBRN disasters (except those

in the catchment areas of nuclear facilities). These hospitals have a significant scope for expansion and advancement. All hospitals are required to adopt procedures of quality accreditation. On the other hand, the country has world-class hospitals in the private sector. Their interface with the government and their utilisation in managing mass casualty incidents need to be strengthened.

The major pillars for supporting effective mass casualty management that need to be strengthened include pre-hospital care, pre-established incident command system, harmonisation of the concept of triage, communication network, transportation of mass casualties and upgradation of a medical setup to handle mass casualties.

3.3.9 Stockpile of Drugs/Vaccines/Disinfectants/Insecticides/PPE

State-run hospitals have limited medical supplies. Even in normal situations, a patient has to buy medicines. There is no stockpile of drugs, important vaccines like anthrax vaccine, PPE or diagnostics for surge capacity. In a crisis situation there is further incapacitation due to tedious procurement procedures. Inventory management/supply chain management concepts are not followed. Protection, detection, decontamination equipment are not available with most first responders. Decontamination, decorporation and CBRN treatment modalities are also grossly inadequate.

3.3.10 Psycho-social Care

There are some critical deficiencies in the provision of psycho-social care. The routine training of medical undergraduates, nurses and health workers for mental health services is grossly inadequate. There is virtually no emphasis on the mental health aspects of disasters even in the routine postgraduate training in psychiatry.

Although there have been efforts to provide community based psycho-social care during the early phases after a disaster, these services are usually withdrawn within a few weeks/months. The essence of any psycho-social care is the training of community workers to meet the needs of the community and this needs to be built into the system as a measure of all-time preparedness.

3.3.11 Training

There is a need to create public health teaching and training institutions in every state. Field epidemiology training for public health professionals and training for field workers needs to be augmented to make the field staff fully competent to support outbreak investigation and response. There is need to identify and train RRTs in all the districts to respond to any threat of outbreak. The training programmes in BDM are inadequate for doctors, nurses and paramedics. The orientation of clinical doctors to the detection of suspected cases and detection of early warning signals of disease may help in instituting rapid response to an outbreak situation. This requires preparation of guidelines/standard treatment protocols and wider dissemination of the same. Web based resource networks and knowledge networks need to be created for easy access to all stakeholders.

3.3.12 Risk Communication

During the plague outbreak in Surat, there was a mass exodus of people from the affected areas. The outbreak affected trade and tourism. Similarly, during the avian influenza outbreak among poultry in 2006, people stopped eating chicken, leading to a downturn in the poultry industry. Effective communication of the risks to the community empowers them to mitigate the risk. The available print and visual media need to be put to use for effective communication. Appropriate

communication materials and media plans are to be worked out in advance.

3.3.13 Community Participation and the Role of NGOs

An empowered community contributes to community action which is of prime importance in managing biological disasters. NGOs have been very active in mass casualty incidents such as earthquake, tsunami, fire, etc., however, this voluntarism is missing when it comes to biological disasters. Perhaps, the fear of acquiring the disease keeps the community and the NGOs at bay.

3.3.14 Role of the Media

The role of the media is very important. They are often not provided with the correct information, resulting in the spread of incorrect information which adds to the panic. The media should be used constructively to educate the community in recognising symptoms and reporting them early if found. The cooperation of the community may be ensured through judicious handling of the media.

3.3.15 Documentation

The areas of research and documentation need to be conceptualised and practiced all across the nation. The practice of documenting disease outbreaks and its scientific analysis is lacking in the country. There may be success stories which if documented and analysed may become best practices that can be adopted globally.

3.3.16 Financial Resources

DM has earmarked funds for emergency response which the state can operate, namely the Calamity Relief Fund (CRF) and the National Calamity Contingency Fund (NCCF). However, the

disasters for which CRF and NCCF can be utilised are defined. Biological disasters do not fall into this category. The states have no other funds which can be utilised for the containment of outbreaks. This has to be corrected. Biological disasters must

be brought under the purview of CRF/NCCF. Also, under the provisions of the DM Act, 2005, the National Disaster Response Fund will be created, and adequate funds will also be earmarked for the containment of biological disasters from this fund.

4

Guidelines for Biological Disaster Management

DM involves a planned and systematic approach towards understanding and solving problems in the wake of a disaster. Biological disasters, be they natural or man-made, can be prevented or mitigated by proper planning and preparedness. The Guidelines will address all aspects of BDM, including prevention, mitigation, preparedness, response, relief, rehabilitation and recovery. All important stakeholders including MoH&FW for natural biological disasters, MHA for BT, MoD for BW, and MoA for animal health and agroterrorism, along with the community, medical care, public health and veterinary professionals, etc., shall prepare themselves to achieve this objective. All concerned central ministries and departments of health in the states will prepare for the management of biological disasters based on the Guidelines and will constitute the national resource for management of mass casualty events arising out of biological disasters, including warfare and terrorism. The nodal ministry shall also lay down clear policies and plans including appropriate legal, institutional and operational framework that addresses all aspects of DM. The preparedness and response plan is to be prepared at the centre, state and district levels with the role and responsibilities of various stakeholders clearly defined. Disaster plans will be prepared by the nodal central ministries, state and district authorities on the basis of the guidelines issued by the national and state authorities. Sectoral coordination would ensure appropriate communication, command and control.

4.1 Legislative Framework

The policies, programmes and action plans need to be supported by appropriate legal instruments, wherever necessary, for effective management of biological disasters. The important means to develop a robust though flexible legal framework include:

4.1.1 Legal Framework

- i) It includes implementation of IHR (2005) which is needed for prevention, mitigation and control of the spread of diseases internationally.
- ii) The legal instruments are required to support the operational framework for managing prevailing and foreseeable public health concerns such as BT attacks, use of biological weapons by adversaries and cross-border issues.
- iii) Enough power will be given to the central government, state governments and local authorities to act with impunity, notify the affected area, restrict movements or quarantine the affected area, enter any premises to take samples of suspected materials and seal them.
- iv) The Act will also establish controls over biological sample transfer, biosecurity and biosafety of materials/laboratories.

For achieving the above objectives, the existing Acts, rules, regulations, etc., at various

levels will be reviewed and amended by the nodal ministry/state governments/local authorities, and new Acts enacted and Rules laid down to strengthen the management of biological disasters at the centre, state and district levels.

4.1.2 Policy, Programmes, Plans and Standard Operating Procedures

The concerned ministries would evolve plans for prevention, mitigation, preparedness and response to biological disasters based on the guidelines prepared by the national authorities. The programmes and plans to achieve the objectives set in the policy would be laid down with appropriate budgetary provisions.

Health is a state subject. The primary responsibility of managing biological disasters vests with the state government. The central government would support the state in terms of guidance, technical expertise, and with human and material logistic support. All the states will develop their own policies, plans and guidelines for managing biological disasters in accordance with the national guidelines and those laid down by SDMAS.

4.1.3 Institutional and Operational Framework

The MoH&FW would continue to be the nodal ministry for managing biological disasters.

The institutional and operational framework includes:

- i) NCMC and NEC will coordinate all the disasters including those of biological origin. The secretaries of NDMA and all important ministries, including the nodal ministry, will be members of these committees.
- ii) The intelligence and deterrence required for handling BT calls for an appropriate role of

MHA as the nodal ministry for handling it. The management structure needed to achieve the expected results will be identified and strengthened. This may be in the form of an appropriate crisis management structure, committees, task forces and technical expert groups within the ministry.

- iii) The public health division in DGHS needs to be strengthened and the responsibility for developing technical expertise should be vested with an officer of appropriate seniority.

A public health institution of eminence, matching international standards needs to be created, for which the following measures are required:

- i) The existing apex institution, NICD, will be strengthened to address the impact of environment changes, the changing communicable disease spectrum (emerging and re-emerging diseases), BT and meeting obligations under IHR (2005). This would require a facelift in terms of infrastructure and human resource inputs.
- ii) All existing public health institutions providing technical expertise in the area of field epidemiology, surveillance, teaching, training, research, etc., need to be strengthened. For implementing IHR (2005), core capacity needs to be developed for surveillance, border control at ports and airports, quarantine facilities, etc.
- iii) Each state will strengthen its public health infrastructure, including public health institutions which would collect epidemiological intelligence, share information with IDSP, provide for outbreak investigations and manage outbreaks.
- iv) Hospitals will develop capabilities to attend to mass casualties and public health emergencies with isolation facilities. In the

districts, DDMAAs will provide the requisite management structure for district DM, factoring in the requirements for managing biological disasters.

- v) The strategic approach for management of biological disasters given in the preceding points would only succeed with responsible participation of the government, private sector, NGOs and civil society.

A sound infrastructure is necessary for medical countermeasures, creating awareness among the public, raising human resources, logistic support and R&D for evolving novel technologies.

4.2 Prevention of Biological Disasters

Prevention and preparedness shall focus on the assessment of biothreats, medical and public health consequences, medical countermeasures and long-term strategies for mitigation. The important components of prevention and preparedness would include an epidemiological intelligence gathering mechanism to deter a BW/BT attack; a robust surveillance system that can detect early warning signs, decipher the epidemiological clues to determine whether it is an intentional attack; and capacity building for surveillance, laboratories, and hospital systems that can support outbreak detection, investigation and management. A multi-sectoral approach will be adopted involving MoH&FW, MHA, Ministry of Social Welfare, MoD and MoA. A biological disaster response plan is to be evolved based on this strategic approach by the nodal ministry. Preventive measures will be useful in reducing vulnerability and in mitigating the post-disaster consequences. Pre-exposure immunisation (preventive) of first responders against anthrax and smallpox must be done to enable them to help victims post-exposure. The important means for prevention of biological disasters include the following:

4.2.1 Vulnerability Analysis and Risk Assessment

Vulnerability analysis and risk assessment needs to be carried out at the macro and micro levels for existing diseases with epidemic potential, emerging and re-emerging diseases, and zoonotic diseases with potential to cause human diseases, etc., so that appropriate preventive strategies and preparedness measures explained in the foregoing paragraphs are instituted appropriately.

Important buildings and those housing vital installations need to be protected against biological agents wherever deemed necessary. This may be done through security surveillance, prevention, and restricting the entry to authorised personnel only by proper screening, and installing High Efficiency Particulate Air (HEPA) filters in the ventilation systems to prevent infectious microbes from entering the circulating air inside critical buildings.

Those exposed to biological agents may not come to know of it till symptoms manifest because of the varied incubation period of these agents. A high index of suspicion and awareness among the community and health professionals will help in the early detection of diseases.

When exposure is suspected, the affected persons shall be quarantined and put under observation for any atypical or typical signs and symptoms appearing during the period of observation. Health professionals who are associated with such investigations will have adequate protection and adopt recognised universal precautions. It often may not be possible to evolve an EWS. However, sensitisation and awareness will ensure early detection.

It is pertinent to develop adequate counter-terrorism measures against BT activities of terrorist groups by deterrents such as destruction of their funding mechanisms and continuing surveillance at all levels.

4.2.2 Environmental Management

Disease outbreaks are mostly due to waterborne, airborne, vector-borne and zoonotic diseases. Environmental monitoring can help substantially in preventing these outbreaks. Integrated vector management also needs environmental engineering for elimination of breeding places, supported with biological and chemical interventions for vector control. Biological events with mass casualty potential may result in a large number of dead bodies requiring adequate disposal procedures. The following measures will help in the prevention of biological disasters:

i) Water supply

A regular survey of all water resources, especially drinking water systems, will be carried out by periodic and repeated bacteriological culture for coliform microbes. In addition, proper maintenance of water supply and sewage pipeline will go a long way in the prevention of biological disasters and epidemics of waterborne origin such as cholera, hepatitis, diarrhoea and dysentery.

ii) Personal hygiene

Necessary awareness will be created in the community about the importance of personal hygiene, and measures to achieve this, including provision of washing, cleaning and bathing facilities, and avoiding overcrowding in sleeping quarters, etc. Other activities include making temporary latrines, developing solid waste collection and disposal facilities, and health education.

iii) Vector control

Vector control is an important activity which requires continuous and sustained efforts. Cooperation of the community is very essential for a successful integrated vector

management programme. The important components of vector control programmes are:

- a. Environmental engineering work and generic integrated vector control measures.
- b. Elimination of breeding places by water management, draining of stagnant pools and not allowing water to collect by overturning receptacles, etc.
- c. Biological vector control measures such as use of *Gambusia* fish, is an important measure in vector control.
- d. Outdoor fogging and control of vectors by regular spraying of insecticides.
- e. Keeping a watch on the rodent population and detection of early warning signs such as sudden fall in their numbers could preempt a plague epidemic. Protection against rodents can be achieved by improving environmental sanitation, storing food in closed containers and early and safe disposal of solid wastes. Killing of rodents associated with diseases such as plague and leptospirosis would require the use of rodenticides like zinc phosphides, digging and filling up of burrows, etc.

iv) Burial/disposal of the dead

Dead bodies resulting from biological disasters increase risk of infection if not disposed off properly. Burial of a large number of dead bodies may cause water contamination. With due consideration to the social, ethnic and religious issues involved, utmost care will be exercised in the disposal of dead bodies.

4.2.3 Prevention of Post-disaster Epidemics

India needs to maintain the necessary level of epidemiological intelligence to pick up early warning signals of emerging and re-emerging diseases of epidemic/pandemic potential. This would also require advance knowledge of the activities of our adversaries in developing a potential BW ensemble and its potential use during war and by terrorist outfits using available in-house facilities to develop such weapons. A coordinated action plan of the intelligence agencies, MHA, MoH&FW and MoD will be developed and put in place to gather intelligence and develop appropriate deterrence and defence strategies.

- i) The risk of epidemics are higher after any type of disaster, whether natural or man-made. These include waterborne diseases such as diarrhoea/dysentery, typhoid and viral hepatitis, or vector-borne diseases such as scabies and other skin diseases, louse-borne typhus and relapsing fever.
- ii) In certain natural disasters like floods, earthquakes, etc., disturbance of the environment increases the risk of rabies, snake bites and other zoonotic diseases. Preventive measures will be taken to deal with such eventualities by keeping reserves of adequate stocks of anti-rabies vaccine and anti-venom serum.

4.2.4 Integrated Disease Surveillance Systems

The IDSP will be operationalised at all district levels to detect early warning signals for instituting appropriate public health measures. The surveillance team will monitor the probable sources, modes of spread, and investigate the epidemics. The surveillance programme will also be integrated with the chain of laboratories of GoI including DRDO, ICMR, AFMS, and state governments/private laboratories. There is an urgent requirement of such systems to perform real-time monitoring

with information shared at the various levels of the health care system. Information of epidemics can be anticipated much in advance where epidemiologic assessment of surveillance data exists.

- i) The existing Integrated Disease Surveillance System will be rapidly expanded to cover the entire country.
- ii) The state and district IDSP units will be trained to acquire the capabilities of using standard case definition, regular data collection and analysing data to detect early warning signs and take actions to mitigate any outbreak.
 - a. The state epidemiological cell under DGHS will develop a simple format, depending upon the level of knowledge at each level on which data will be collected daily.
 - b. Irrespective of the data collected, the basic principle of surveillance will remain the same, i.e., use of standard case definition, maintaining regularity of the reports and taking action on the reports.
- iii) The surveillance could be active, passive, laboratory based or sentinel (collecting data from identified sentinel sites such as hospitals or health centres), or a combination of all of these to suit public health requirements.
- iv) Surveillance at airports, ports and border crossings will be strengthened with appropriate controls. IDSP needs to network with international surveillance networks such as GOARN, with support from WHO. Stringent inspection methodologies will also be made. The list of biological agents for export control as identified by the Australia Group is given as a ready reference on their website (www.australiagroup.net/en/biological_agents.html).

- v) Detection and containment of an outbreak would entail four basic steps:
 - a. Recognition and diagnosis by primary health care practitioners: Medical clinicians, including private practitioners, will report any unusual incidence of infectious disease or syndrome (an undiagnosed cluster of symptoms) with similar symptoms. Clinical laboratories would then attempt to identify the disease causing agent from the patient's blood, urine or other specimens.
 - b. Communication of surveillance information to public health authorities: Physicians and infectious diseases specialists who detect any unusual pattern of disease incidents, such as several patients with the same symptoms, shall report their observations to local or state public health departments.
 - c. Epidemiological analysis of the surveillance data: Epidemiologists from the health department shall interpret the surveillance data to make a tentative diagnosis and determine the source of the outbreak, the mode of transmission and the extent of exposure. They would then make recommendations for appropriate treatment and public health measures to contain the outbreak. The role of private care providers shall also be defined.
 - d. Delivery of appropriate medical treatment and public health measures: Infected individuals need to be treated. Quarantine and vaccination of their contacts and possibly exposed persons would be needed in situations where secondary spread is anticipated.
 - vi) Rapid Response Teams (RRTs): There will be RRTs at the national, state and district levels who would be trained under IDSP. If the disease is suspected to be of vector borne origin the RRT would comprise of an epidemiologist/public health specialist, physician, paediatrician, microbiologist (or trained pathologist), and entomologist. Any outbreak at the district level will be investigated by the district RRT and depending upon the report, the state/national RRT will be deployed. The RRT will be well-versed with the natural history of the disease as also in interpreting the epidemiological clues that would suggest an intentional outbreak.
 - vii) Confirmation of the specific type of microorganism(s) by the laboratory network.
 - viii) The emerging threats of Methicillin-Resistant *Staphylococcus aureus* (MRSA) will also be included in the surveillance programme.
- Confirming the type of microorganism causing the disease and testing its sensitivity to different drugs is necessary for the management of biological disasters. Therefore, it may be necessary to identify specific laboratories that are capable of supporting the integrated surveillance system.
- Disasters such as floods, cyclones, tsunamis and earthquakes require active event based surveillance to be established for detection of early warning signals. The existing state epidemiology cell/IDSP unit will be equipped with such surveillance systems if need be. MoH&FW will depute RRTs, which will establish a post-disaster surveillance mechanism till such time recovery takes place which can take four to six months. Special attention will be given to disease/injury surveillance, water quality monitoring and vector surveillance.

4.2.5 Pharmaceutical Interventions: Chemoprophylaxis, Immunisation and Other Preventive Measures

- i) Health care workers will be equipped with gloves, impermeable gowns, N-95 masks or powered air-purifying respirators. They must clean their hands prior to donning PPE for patient contact. After patient contact, they must remove the gown, leg and shoe covering, gloves, clean hands immediately, then proceed to the removal of facial protective equipment (i.e., personal respirators, face shields, and goggles) to minimise exposure of their mucous membranes with potentially contaminated hands. After the removal of all PPE they must clean their hands again.

All manufacturers of antibiotics, chemotherapeutics and anti-virals will be listed and their installed capacity ascertained. The centre/state governments will ensure availability of all such drugs and anti-toxins that are needed to combat a biological disaster. State governments would also enter into annual rate contracts for all such essential drugs that are required for managing biological disasters. Drugs that can be used for mass chemoprophylaxis will be stocked. Medical stores/organisations/depots will be identified in each state that will follow scientific inventory management for keeping a minimum stock of identified drugs and vaccines. Such centres will also stockpile requisite quantities of PPE, laboratory reagents, diagnostics and other consumables.

- ii) Aerosols are the most common method of delivery for biological agents. This is because the most lethal biological agents (anthrax, plague, smallpox and tularemia) are efficiently delivered by aerosol methods. Of the potential biological disaster agents, only plague, smallpox, and Viral

Hemorrhagic Fevers (VHFs) spread readily from person to person by respiratory aerosols and require more than standard infection control precautions (gown, mask with eye shield, gloves). Recognition of the clinical syndromes associated with various biological disaster agents will be useful tools for physicians to identify early victims and recognise patterns of disease. In general, tularemia, plague and anthrax cause respiratory pneumonia like illnesses. Plague would most likely progress very rapidly to severe pneumonia with copious watery or purulent sputum production, hemoptysis, respiratory insufficiency, sepsis and shock. Inhalational anthrax would be differentiated by its characteristic flu like symptoms, radiological findings of prominent symmetric mediastinal widening and absence of bronchopneumonia. Also, anthrax patients would be expected to develop fulminating, toxic, and fatal illness despite antibiotic treatment. Milder forms of inhalational tularemia could be clinically indistinguishable from Q fever. Medical personnel taking care of these patients will wear a HEPA mask in addition to standard precautions pending the results of a complete evaluation. Involvement of meteorological expertise will be needed to track aerosol clouds.

- iii) Recognition of the clinical syndromes associated with viruses causing VHFs such as *Filoviridae*: Ebola and Marburg, *Arenaviridae*: Lassa fever and New World Arena viruses, *Bunyaviridae*: Rift Valley fever, *Flaviviridae*: yellow fever, Omsk hemorrhagic fever and KFD. Symptoms include high fever, headache, malaise, arthralgias, myalgias, nausea, abdominal pain, and non-bloody diarrhea; temperature >101°F (38.3°C) of >3 weeks duration; severe illness, and no predisposing factors for hemorrhagic manifestations; and at least

two of the following hemorrhagic symptoms: hemorrhagic or purple rash, epistaxis, haematemesis, hemoptysis, blood in stools in the absence of any other established alternative diagnosis.

- iv) Biotoxins generated from various microbial agents have the potential to contaminate water and food and could be easily implanted in large populations through this mode. Therefore, it is necessary to have sufficient checks at places where these sources are located. There will be an adequate on-site contingency plan to detect any escape and arrangements for warning.
- v) Chemotherapy: Doxycycline is considered an initial chemoprophylactic broad-spectrum drug of choice in cases of respiratory illnesses due to strains of *Bacillus anthracis*, *Yersinia pestis*, *Francisella tularensis*, *Coxiella burnetii* and Brucellae. Other tetracyclines and fluoroquinolones might also be considered. There is no approved anti-viral drug for the treatment of VHF. However ribavirin will be considered initially as an anti-viral agent of choice in an outbreak due to VHF. There is no effective post-exposure prophylaxis available in the form of vaccines or anti-viral drugs. Vaccinations are currently available for anthrax, tularemia, plague, Q fever and smallpox. Immune protection against ricin and staphylococcal toxins may be feasible in the near future. People considered potentially exposed to VHF and all persons in contact with the patients diagnosed with VHF will be placed under medical surveillance which will continue for 21 days after the deemed potential exposure of the patients.
- vi) It is possible that more than one means of delivery and several agents may be present simultaneously in a biological disaster.

Zoonotic transmission of biological agents to humans is another likely possibility. Brucellosis, glanders and melioidosis affect domestic and wild animals which, like humans, acquire the diseases from inhalation or contaminated injuries. Natural reservoirs for Q fever include sheep, cattle, goats, cats, certain wild animals (including rodents), and ticks. Humans become infected with *F tularensis* by various modes, including bites by infective arthropods, handling infectious animal tissues or fluids, direct contact with or ingestion of contaminated water, food or soil, and inhalation of infective aerosols. Plague occurs most commonly in humans when they are infected by fleas. VHF are transmitted to humans via contact with infected animal reservoirs or arthropod vectors. Adequate preventive measures such as PPE will be adopted.

- vii) Legitimate access to important research and clinical material must be preserved. Prevention of unauthorised entry/exit of biological materials can be achieved by adopting adequate detection methods such as x-rays and other scanning methods to identify microorganisms, plant pathogens and toxins at international airports, ports, etc. Suitable assessment of the personnel, security, specific training and rigorous adherence to pathogen protection procedures are reasonable means of enhancing biosecurity. All such measures must be established and maintained through regular risk and threat assessments, reviews and updating of procedures. Checks for compliance with these procedures with clear instructions on roles, responsibilities and remedial actions will be integral to biosafety programmes and national standards for biosecurity. The subject is of prime importance and is dealt with in detail, in Chapter 5.

viii) Immunisation/vaccination programmes

India has a sizeable capability, built over the years, for implementation of its universal immunisation programme for six vaccine preventable diseases. It is capable of mass vaccination campaigns in disaster settings. Mass vaccination campaigns and prophylaxis programmes could be useful when indicated in diseases like tetanus, measles, typhoid, cholera, viral hepatitis, etc. Appropriate influenza vaccination, depending on the causative strain, may be considered when the situation demands it. Such campaigns may be required in pandemic influenza and BT attacks using smallpox virus or for any other emerging bacterial or viral etiologies. MoH&FW will lay down a clear vaccination policy, have a stockpile of vaccines, identify and train the vaccinators and have cold chain management. Capacity will be developed in the pharmaceutical sector for creating a viable high-tech infrastructure for vaccine research and production. Immunisation programmes under continuous monitoring and reporting mechanisms will be an effective preventive strategy. The details of immunoprophylactic and chemoprophylactic therapies to be administered during epidemiological out-breaks and biological disasters are shown in Annexure-B (Reference: <http://www.usamriid.army.mil/education/bluebook.html>).

Specific immunisation programmes will be initiated for laboratory personnel who are likely to come in contact or work with infectious agents.

4.2.6 Non-pharmaceutical Interventions

(A) Social Distancing Measures

Spread of communicable diseases in many conditions can be controlled or prevented by

reducing direct contact with patients. Social distancing measures such as closure of schools, offices and cinemas is recommended to prevent the gathering of large numbers of people at one place. Further, there could be a ban on cultural events, *melas*, etc. Entry to railway stations and airports could be restricted. There is evidence to suggest that social distancing measures, if properly applied, can delay the onset of an epidemic, compress the epidemic curve and spread it over a longer time, thus reducing the overall health impact. Social distancing measures, if required to be implemented in the context of an epidemic, may be voluntary or legally mandated. In either case, the public will be made aware of the action taken and its purpose.

(B) Disease Containment by Isolation and Quarantine Methodologies

The spread of communicable diseases in many conditions can be controlled or prevented by isolation and quarantine, thereby reducing direct contact with patients. Other preventive measures are vector control, rodent and mosquito control, and food and environmental control. It includes:

- i) Isolation refers to isolating suspected cases in hospital settings. In the case of biological disasters such as pandemic influenza which affects millions, home isolation may have to be recommended to those who can be treated at home.
- ii) Quarantine refers to not only restricting the movements of exposed persons but also the healthy population beyond a defined geographical area or unit/institution (airport and maritime quarantine) for a period in excess of the incubation period of the disease. Restrictions in the movement of the affected population is an important method to contain communicable diseases. The status of the law and order mechanism of the state and district is an important factor in helping health authorities in this regard.

The precautions to be undertaken while isolating patients of biological disasters are provided in Annexure-C.

4.2.7 Biosafety and Biosecurity Measures

Strict compliance with biosafety and biosecurity provisions at all levels will deny the possibility of terrorists reaching facilities where such microorganisms are stocked and available. This will act as a second layer of defence and reduce the possibility of any bioterrorist activity. The important components of biosafety and biosecurity measures are explained below.

- i) Microorganisms are handled extensively in medical, agricultural and veterinary fields and in research laboratories. They are also used for the preparation of enzymes, sera and reagents which have commercial value and are handled exclusively by commercial manufacturers. Any contingency plan would, therefore, remain incomplete unless all such organisations/institutions where they are handled are also brought within its purview. There must be a system for inventory control in the laboratories dealing with bacteria, viruses or toxins which can be a source of potential causative agents for biological disasters. Therefore, specific information about organisms and toxins handled in different laboratories will be documented by the respective laboratories/organisations and secured.
- ii) Within the laboratory, dangerous pathogens must be housed inside secure incubators, refrigerators or storage cabinets when not in use. For research and clinical laboratories, the laboratory supervisor will be responsible for establishing a method for identifying authorised users of the laboratory and for establishing effective mechanisms for controlling access to the laboratory and detection of unauthorised individuals.

- iii) It may be necessary to develop a system of inventory for effective contingency planning. Bacteria and toxins are frequently exchanged between countries for research and training programmes. Though there is a system of checks for bulk import, small amounts of organisms packed in small containers can easily be brought into the country. The existing system designed to control these exchanges will be examined, strengthened and implemented properly.

Issues regarding biosafety and biosecurity measures are dealt with in detail in Chapter 5.

4.2.8 Protection of Important Buildings and Offices

Protection of important buildings against biological agents wherever deemed necessary, can be done by preventing and restricting entry to authorised personnel only, by proper screening. Installing HEPA filters in the ventilation systems of the air conditioning facilities will prevent infectious microbes from entering the air circulating inside critical buildings. The post-exposure approach will include effective decontamination and safety procedures.

4.3 Preparedness and Capacity Development

Preparedness will focus on assessment of biothreats, medical and public health consequences, medical countermeasures and long-term strategies for mitigation. An important aspect of medical preparedness in BDM includes the integration of both government and private sectors. A sound infrastructure is necessary both for medical countermeasures and R&D for evolving novel technologies. The important components of preparedness include planning, capacity building, well-rehearsed hospital DM plans, training of doctors and paramedics, and upgradation of

medical infrastructure at various levels to reduce morbidity and mortality. A multi-sectoral approach will be adopted to deal with any outbreak of infectious diseases—for this the involvement of MoH&FW, MHA, Ministry of Social Justice and Empowerment, MoD and MoA is essential. A biological disaster response plan is to be evolved on the basis of the national guidelines with due participation of health officials, doctors, various private and government hospitals, and the public at the national, state and district levels. There is need to establish institutes similar to NICD in each state of the country. Central and state government health departments also need to be equipped with state-of-the-art tools for rapid epidemiological investigation and control of any act of BT. The important components of preparedness are discussed in the ensuing paragraphs.

4.3.1 Establishment of Command, Control and Coordination Functions

At the operational level, C&C is clearly identifiable at the district level, where the district collector is vested with certain powers to requisition resources, notify diseases, inspect any premises, seek help from the Army, state or centre, enforce quarantine, etc. The incident command system needs to be encouraged and instituted so that the overall action is brought under the ambit of an incident commander who will be supported by logistics, finance, and technical teams etc. The Emergency Medical Relief Division (of DGHS) at the centre coordinates and monitors all crisis situations. Such a mechanism needs to be developed in the states also. EOCs will be established in all the state health departments with an identified nodal person as Director (Emergency Medical Relief) for coordinating a well orchestrated response.

4.3.2 Capacity Development

Capacity development requires the all-round development of human resources and infrastructure

for the establishment of a well-focused and functional organisation and the creation of a supportive socio-political environment. Attention is to be given to the development of infrastructural facilities in terms of trained manpower, mobility, connectivity, knowledge enhancement and scientific up-gradation for all stakeholders concerned with the management of biological disasters. Capacity development is an important component of preparedness for the management of biological disasters which includes the following:

(A) Human Resource Development

- i) The DHO will establish a centralised system for data collection from village to sub-centre level by the village health guide, from sub-centre to PHC level, and from PHC to DHO by the PHC in-charge. The development of a simple format to collect this information from lower level, PHC, district, state and central level will also be made. The DHO, in consultation with the state epidemiological cell, will develop a simple format for daily data collection, depending upon quantum of information available at each level. This format must be simple and informative.
- ii) Control rooms will be nominated/ established at different levels in order to get all the relevant information and transmit it to the concerned official. The addresses and telephone numbers of the district collector, DHO, hospitals, specialists from various medical disciplines like paediatrics, anaesthesia, microbiology etc., and a list of all stakeholders from the private sector will be available in the control room.
- iii) The shortfall of public health specialists, epidemiologists, clinical microbiologists and virologists will be fulfilled over a stipulated period of time. Teaching/training institutions for these purposes will be established. Till then PHFI, NICD and ICMR will fill this gap to some extent. The

microbiology and preventive and social medicine departments of medical colleges would orient their teaching/training towards public health management/administration. This calls for a review of the curriculum of public health teaching at the graduate and postgraduate levels by the Medical Council of India. The immediate deficiency of specialists will be met by conducting short-term training courses for medical officers.

(B) Training and Education

- i) The necessary training/refresher training will be provided to medical officers, nurses, emergency medical technicians, paramedics, drivers of ambulances, and QRMTs/MFRs to handle disasters due to natural epidemics/BT.
- ii) It is important that medical and public health specialists are able to identify the epidemiological clues that differentiate a natural outbreak from an intentional one. In view of this, structured BT related education and web-based training will be given for greater awareness and networking of knowledge so that they are able to detect early warning signs and report the same to the authorities, treat unusual illnesses, and undertake public health measures in time to contain an epidemic in its early stage.
- iii) Refresher training will be conducted for all stakeholders at regular intervals. An adequate number of specialists will be made available at various levels for the management of cases resulting from an outbreak of any epidemic or due to a biological disaster.
- iv) There is a need to evolve standardised training modules for different medical responders/community members for capacity building in the area of disaster management and to create adequate training facilities for the same.

- v) Selected hospitals will develop training modules and standard clinical protocols for specialised care, and will execute these programmes for other hospitals. Table-top exercises using different simulations will be used for training at different levels followed by full-scale mock drills twice a year.
- vi) A district-wise resource list of all the laboratories and handlers who are working on various types of pathogenic organisms and toxins will be prepared.
- vii) BDM related topics will be covered in the various continuing medical education programmes and workshops of educational institutions in the form of symposia, exhibition/demonstrations, medical preparedness weeks, etc. The Dos and Don'ts for various natural and man-made disasters are to be made as a part of community education programmes.
- viii) Biological disaster related education shall be given in various vernacular languages. Simple exercise models for creating awareness will also be formulated at the district level.
- ix) Biological disaster plans will be rehearsed as a part of training every six months.
- x) Knowledge of infectious diseases, epidemics and BT activities will be incorporated in the school syllabi and also at the undergraduate level in medical and veterinary colleges.

(C) Community Preparedness

Community members including public and private health practitioners are usually the first responders, though they are not so effective due to their limited knowledge of BDM. These people will be sensitised regarding the threat and impact of potential biological disasters through public awareness and media campaigns. The areas which need to be emphasised are:

- i) Risk communication to the community
 - a. Community education/awareness about various disasters and development of Dos and Don'ts.
 - b. The public will be made aware of the basic need for safe food, water and sanitation. They will also be educated about the importance of washing hands, and basic hygiene and cleanliness. The community will also be given basic information about the approach that health care providers will adopt during biological disasters.
 - c. Toll-free numbers and a reward system for providing vital information about any oncoming biological disaster by an early responder or the public will be helpful.
 - d. Definition of predisposing existing factors, endemicity of diseases, various morbidity and mortality indices. The availability of such data will help in planning and executing response plans.
 - ii) Community participation
 - a. Providing support to public health services, preventive measures such as chlorination of water for controlling the possibility of epidemics, sanitation of the area, disposal of the dead, and simple non-pharmacological interventions will be mediated through various resident welfare associations, ASHA/ANM, village sanitation committees, and PRIs.
 - b. Community level social workers who can help in rebuilding efforts, create counselling groups, define more vulnerable groups, take care of cultural and religious sensitivities, and also act as informers to local medical authorities during a biological disaster phase, will be created after proper training and education.
 - c. NGOs and Private Voluntary Organisations (PVOs) will be involved in educating and sensitising the community.
 - d. Supporting activities like street shows, dramas, posters, distribution of reading material, school exhibitions, electronic media, and publicity, etc., will be undertaken.
- A legally mandated quarantine in a geographic area, isolation in hospitals, home quarantine of contacts, and isolation management of less severe cases at homes would only be possible with active community participation.
- (D) Documentation**
- The experiences of various drills, the lessons learnt from them, and best practices so developed will be shared with all stakeholders/service providers. SOPs for their proper documentation and scientific analysis based upon the identified indicators specific to biological disasters will be made.
- (E) Research and Development**
- It is essential to develop new research methods and technologies which will facilitate rapid identification and characterisation of novel threat agents. Research pertaining to the development of new treatment modalities, specific biomarkers and advanced robotic tools needs overall review and upgradation to meet global standards. Innovative technologies will enhance the ability to respond quickly and effectively. This will require targeted and balanced fundamental research, as well as applied research for technology development to acquire medical capabilities.
- i) The recent development of genetic engineering techniques led to the

production of many types of bacteria and viruses in research laboratories. In most cases, detailed information about the diseases caused by them is not known. Early detection in such a situation becomes very difficult. Examples of novel biological threats that could be produced through the use of genetic engineering technology include:

- a. Microorganisms resistant to antibiotics, standard vaccines and/or therapeutics. They are also able to elude standard diagnostic methods.
 - b. Viral vectors such as adenovirus and vaccinia, as well as naked or plasmid DNA can be engineered for the sole purpose of delivering foreign genes into new cells.
 - c. Innocuous microorganisms genetically altered to possess enhanced aerosol and environmental stability characteristics which are able to produce a toxin, poisonous substance, or endogenous bio-regulator.
- ii) In view of the above biological threats, the necessary interventions will be taken care of by establishing a national institute responsible for biodefence research. The roles and responsibilities of this institute will be:
- a. Integrate and take a directional approach to the study of infectious disease outbreaks due to natural and man-made biological disasters.
 - b. Maintain a database of infectious agents and the newly emerging microbial pathogens of BW/BT importance.
 - c. Coordinate with the nodal institutions of the country identified as research centres by ICMR such as AIIMS, New Delhi; PGIMER, Chandigarh; NICD,

Delhi; NIV, Pune; DRDE, Gwalior; and IVRI, Mukteshwar.

- d. Development of capacities to evaluate the determinants for assessment of threat based upon the research interventions undertaken.
 - e. Institutions under MoH&FW/ICMR shall acquire the capability for developing mathematical models/forecast models/secular trend models to identify and assess biological threats to the local community and develop indicators that govern their conversion into a high consequence scenario.
 - f. The determinants of the threat level include information about the various biological organisms and toxins produced as well as the population under probable threat. The institutes will develop mechanisms for the assessment of threat.
- iii) Operational research
- Operational research would focus on research models to estimate the probable public health consequences of various threat scenarios and the specific medical countermeasures that will be adopted, and shall incorporate various assessment criteria to assess existing preparedness, modes for its optimal utilisation, enhanced requirements due to higher levels of incidence and the development of short- and long-term mitigation strategies. The mitigation strategies will then be taken up in a 'mission mode approach' for testing, evaluation and upgradation.
- iv) Long-term research
- Long-term research would focus on novel detection technologies, better ways to manage biological agents and development of novel broad-spectrum antibiotics, vaccines, and laboratory diagnostics.

4.3.3 Critical Infrastructure

The existing infrastructure of the health ministry, MoD and AFMS will be suitably upgraded to enable it to support BDM activities.

(A) Network of Laboratories

A network of laboratories will be created/ existing laboratories strengthened at the local, state, regional and national levels to support IDSP and to enhance diagnostic skills. The existing public health service and medical college laboratories in both government and private sectors will be strengthened for confirmation of microorganisms, testing their sensitivity and other molecular level studies. Central ministries/ departments of health will focus on the following:

- i) Some institutes will be nominated as referral laboratories including NICD, Delhi, and NIV, Pune, for investigation of viruses; National Institute of Cholera and Enteric Diseases (NICED), Calcutta, CRI, Kasauli and NICD, Delhi, for investigation of bacteria; and Indian Institute of Toxicology Research, Lucknow for investigation of toxins.
- ii) Existing disease specific surveillance laboratories (influenza surveillance network) would also be strengthened to cater to investigation of diseases with suspected viral etiologies.
- iii) All identified laboratories in the network need to follow biosafety norms and be classified according to the biosafety level. As apex institutions, efforts will be made to have a BSL-4 laboratory at NIV, Pune, and NICD. There will be at least one BSL-3 laboratory to represent each region.
- iv) Manufacturing facilities for standard diagnostic reagents need to be identified and encouraged in the pharmaceutical sector.
- v) In the context of BW/BT, the most important step in biodefence strategy is to evolve a

test for rapid detection and identification of the causative agent. The conventional microbiological methods viz., culture and immuno-diagnosis or serology take a long time (hours to days) and are too slow when rapid diagnosis is required to confirm early warning signs.

- vi) The identified apex/regional biosafety laboratories will establish a mobile detection system relying on technologies such as bioluminescence and biofluorescence (detection of BW agents through fast reacting bio reporter molecules).
- vii) There is a need to have national biodefence research centres where the latest molecular and other diagnostic facilities will be available to identify such genetically mutated microorganisms and also maintain a national database of all such organisms. Meanwhile, one of the ICMR and DRDO laboratories shall be designated for the purpose.
- viii) Provisions for adequate licensing and scrutiny and strict enforcement of biosecurity and biosafety will be ensured in food processing plants, storage warehouses, potable water reservoirs, and research laboratories.
- ix) Efforts are required to upgrade diagnostic laboratories attached to medical institutions at the state level. Responsibilities of these laboratories include the following:
 - a. Types of facilities and their levels of working.
 - 1) District laboratories to diagnose pathogens and their drug sensitivity.
 - 2) Medical college laboratories to confirm diagnosis and provide guidance in case of any doubt.

- 3) State referral laboratories: One laboratory in each state will be identified by the respective state governments as a state referral laboratory. Such a laboratory may be located in a medical college or if medical college does not exist in the state, then in a government hospital.
 - 4) National referral laboratories: The responsibility of national referral laboratories will be to help in investigation, isolation and characterisation of organisms and to provide guidance from time to time. Depending upon the types of organisms handled, there would be different norms in terms of location and capabilities.
- b. Other requirements of laboratories
- 1) There is a requirement for sufficient space with easy to clean walls, ceilings and floors, adequate illumination, bench tops impervious to water and resistant to disinfectants, acids, and alkaline or organic solvents.
 - 2) Safety systems to prevent fire and electrical emergencies, Emergency shower and eye wash facilities, first aid rooms, proper waste disposal facilities, autoclaves, steriliser, incinerators, facilities for treating waste water from laboratories are some other mandatory requirements.
- x) Creating a chain of public health laboratories with at least one such laboratory in each district. This includes:
- a. A referral system to be developed at the state and national level with advanced facilities for cultures and antibiotic sensitivity.
 - b. In some states, the departments of preventive medicine in medical colleges may be upgraded to serve this purpose.
 - c. This network will also be an integral part of the IDSP. These laboratories will have basic capabilities to collect and dispatch samples to the referral laboratory to isolate and detect microorganisms. For details, refer to the section on biosafety laboratories in Chapter 5.
- (B) Biomonitoring**
- i) The most important step in biodefence strategy is the rapid detection and identification of causative agents. Detection is the unspecific demonstration of increased concentrations of microorganisms in a particular environment whereas identification is the species determination of the detected microorganisms. An attack by BW agents is difficult to detect owing to the inherent intrinsic properties of the organism, such as aerosolised transmission of small-pox and other viruses causing vesicular skin eruptions. Their early detection and identification is critical for early implementation of specific countermeasures.
 - ii) Detection systems for BW agents will have the properties of rapidity, reliability, reproducibility, sensitivity and specificity so as to quickly diagnose the correct etiological agent from complex environmental samples before their widespread dissemination. It is essential to develop portable detectors and other devices based upon the need assessment analysis.
 - iii) Molecular techniques are useful in the early detection and identification. Capacity building is required to establish laboratories having molecular facilities to detect BW

agents, especially Genetically Modified Organisms (GMOs) which are difficult to detect by routine conventional microbiological techniques. Environmental samples (air, water, soil, etc.) may have low concentrations of the microorganisms and may not be detectable to enable analysis. The most important recent development in biodefence strategies is the on-line detection of possible BW agents through fast reacting bio reporter molecules.

- iv) **Bioluminescence and biofluorescence:** Various bioreporter molecules have been identified as signal generating systems. The biochemical reaction of organisms generates light which can be detected by conventional photo detectors.
- v) **Biosensors:** It is a type of probe in which the biological component interacts with an analyte which is then detected by an electronic component and translated into a measurable electronic signal. It is a reliable detection system for microbes with high selectivity and sensitivity. It can be of three types i.e., immunosensors, nucleic acid sensors and laser sensors and can be used in the laboratory for detection. Biosensor technology is the driving force in the development of various bio chips for the detection of pesticides, allergens, gaseous pollutants, and microorganisms in environmental samples.
- vi) **Bioprobes:** These are based on the sensor monitor properties of biological entities. Bees, beetles and other insects are being used as sentinel species in collecting real time information about the presence of toxins or similar threats. Biodetection can also be done through the development of biorobots.
- vii) **Molecular and other recent techniques:** With advances in molecular biology, it is now possible to identify the specific disease

producing gene of a microorganism without culturing it. Polymerase Chain Reaction (PCR) can detect the presence of the specific nucleic acid (DNA/Ribonucleic acid i.e., RNA) of the microorganism in 3–4 hours at extremely low concentrations. The advantage with this method is that identification can be made from non-living organisms. Loop mediated isothermal amplification technique for qualitative and quantitative detection of microorganisms is the latest advancement in rapid and accurate identification of BW agents in field conditions. Other variations and modifications of PCR are the newer methods for the detection and identification of BW agents. Laboratory confirmation for the presence of an agent is generally given on the basis of two or three supportive tests in the absence of a culture of the organisms. The test will be able to differentiate the organism from other closely related species. The reliability of the rapid tests depends upon its sensitivity to identify normal and genetically altered strains. The quality of sample collection would also affect the results of these tests. Other modern techniques for rapid detection and direct identification of the suspected BW agents are flowcytometry, fluorescent activated cell sorter, gas chromatography, mass spectrometry, gas chromatography-mass spectrometry and liquid chromatography-mass spectrometry, which can detect certain metabolites or chemical components of organisms.

(C) Technical and Scientific Institutions

Central/state/district authorities will identify and define the technical institutions and laboratories engaged in various scientific, research and technical advancements in detection and identification of various microbiological agents (BT

causative agents), exotic pathogenic microbes and genetically modified agents. These institutes will act as professional guiding resource centres and function as referral centres. Some of the laboratories will be designated as national referral laboratories. A suspected outbreak of any epidemic or BT will be addressed to the designated laboratory for proper and quick identification. Some of the important functions of these identified laboratories include:

- i) Identification and assessment of the biological threats to the local community and development of indicators to govern their conversion into a high consequence scenario. The determinants of threat include information about the various biological organisms and toxins produced as well as the population under the probable threat. The institutes will develop a mechanism for assessment of the threat.
- ii) These institutes will also develop research models to estimate the probable public health consequences of a threat scenario and the specific medical countermeasures for each biological agent.
- iii) The medical countermeasures that need to be adopted will incorporate the various assessment criteria to assess the existing preparedness, the modes for its optimal utilisation, the enhanced requirement due to higher levels of incidence and the development of short- and long-term mitigation strategies.
- iv) The mitigation strategies will then be taken up in the 'mission mode approach' for testing, evaluation and upgradation. Testing will also be done through mock drills.
- v) Based upon the mitigation strategies, the short-term and long-term goals of acquisition of various facilities, infrastructure and development of newer counter acting technologies will be defined. In addition, there will be a need to achieve self-

sufficiency in certain areas, especially for security purposes against BT as well as threats arising out of the continuous development of novel strains of microorganisms.

- vi) All the activities will be in harmony with each other and at the various laboratories identified at all levels.
- vii) The institutes will develop models based on a 'preventive strategy' intended to reduce vulnerability and to mitigate post-disaster consequences. The strategy will include public health preparedness, long-term focus on novel detection technologies, newer ways to manage different kinds of biological agents and development of novel broad-spectrum antibiotics, vaccines and biological system specific medical countermeasures, for example, to manage the hemopoietic syndrome, etc. The ideal medical countermeasures for biological agents will be highly effective for post-exposure prophylaxis and early symptomatic treatment with an excellent safety profile.

(D) Communication and Networking

Communication is a vital component of DM. The existing communication systems are vulnerable to failure during disasters, thus it is important to develop strategies to protect these systems and upgrade them and make them more resilient so that they can survive during disasters. The major guidelines include:

- i) Emergency communications network: Establishment of control rooms at the district, state and central levels and inclusion of private practitioners in the network through the IDSP. There will be terrestrial and satellite based hubs for fail-safe communication both vertically and horizontally.

- ii) Health network: All hospitals will be connected with IAN and QRMTs. They will have an intra-hospital horizontal network. Dedicated telephone numbers shall be made available to hospitals. The network shall also be integrated with police, fire and other helpline services.
- iii) Mobile tele-health: Mobile tele-health is another concept of tele-medicine that can be used for disasters by putting diagnostic equipment and information communication technology together on a vehicle to get connectivity from the affected site to advanced medical institutes where such connectivity already exists. Such systems may be placed in known disaster prone areas or could be moved at the onset of disasters. Such systems will be developed at the regional levels.
- iv) Communication through print and electronic media: The print and electronic media are the first reporting agencies in any disaster, thus they need to be integrated into the communication network so that correct information can be disseminated to the public. Normally there is panic in any biological disaster situation. The media strategy/plan for DM will address measures to allay public anxiety and fears arising out of outbreaks in general and BT in particular. Correct information disseminated by the media is useful for educating the community at times of disasters. The media will be coordinated by an earmarked officer of appropriate seniority.
- v) NGOs as part of the BDM network: NGOs and PVOs will be involved for community education and sensitisation. NGOs as of now have played a limited role in biological disasters as compared to hydrological or seismic disasters. They could play a role in rumour surveillance, reporting of events, implementation of non-pharmaceutical interventions, sensitisation of the public through the supporting role of the media, etc.
- vi) Role of international organisations: Under the IHR, WHO is the nodal agency that will give information of any outbreak of disease in the neighbourhood. WHO also provides technical advocacy on communicable disease alerts and response, provides technical experts, helps in capacity development through training, and laboratory support through WHO reference laboratories wherever required. Other organisations that provide technical expertise include CDC, OIE and FAO.

E) Public-private Partnership

The private sector has substantial infrastructure capabilities and is engaged in R&D for various products which is a part of biodefence research. Government technical agencies like DRDO and ICMR laboratories may collaborate with the private sector for developing more efficient biodefence tools such as vaccines. The private sector has the potential to play a major role in the nation's preparedness by integrating its capacities with governmental organisations such as DRDE and NICD. Some of the important recommendations include the following:

- i) Adoption of international best practices will be encouraged in combating biological disasters.
- ii) International pharmaceutical agencies and other technical laboratories that are engaged in the field of research and upgradation of specialised technologies for production of various vaccines like anthrax and smallpox and newer drugs, will be collaborated with for meeting the peak requirements of vaccines and drugs during biological disasters.

- iii) Sourcing and procurement of countermeasures currently available with manufacturing capacities in a ready state to enable their continuous supply.
- iv) Developing a contemporary system based on PPP for stockpiling, distribution and cold chain system for sophisticated diagnostic kits, vaccines and antibiotics.
- v) Collaborations can be made to establish infrastructure facilities required for response, as mutually decided by the government and the private sector. Possibilities will also be explored for investments by the private sector in the area of R&D, which can be decided upon the need of government.

Private sector facilities are required to be included in district-level DM plans and collaborative strategies shall be evolved at the district level for the utilisation of their manpower and infrastructure. Private medical and paramedical staff must be made part of the resource. Community based social workers can assist in first aid, psycho-social care, distribution of food, water, and organisation of community shelters under the overall supervision of elected representatives of the community.

4.4 Medical Preparedness

Medical preparedness will be based on the assessment of biothreat and the capabilities to handle, detect and characterise the microorganism. Specific preparedness will include pre-immunisation of hospital staff and first responders who may come in contact with those exposed to anthrax, smallpox or other agents. It further relates to activities for management of diseases caused by biological agents, EMR, quick evacuation of casualties, well-rehearsed hospital DM plans, training of doctors and paramedics and upgradation of medical infrastructure at various levels which will reduce morbidity and mortality. Medical

preparedness will also entail specialised facilities including chains of laboratories supported by skilled human resource for collection and dispatch of samples. The major aspects of medical preparedness are explained in the ensuing paragraphs.

4.4.1 Hospital DM Plan

Hospital planning will include both internal hospital planning, and for hospitals being part of the regional plan for managing casualties due to biological disasters. The major features will include the following:

- i) Hospital disaster planning will consider the possibility that a hospital might need to be evacuated or quarantined, or divert patients to other facilities.
- ii) The plan will be 'all hazard', simple to read and understand, easily adaptable with normal medical practices and flexible enough to tackle different levels and types of disasters.
- iii) The plan will include capacity development, development of infrastructure over a period of time and be able to identify resources for expansion of beds during a crisis.
- iv) The plan will be based on the need assessment analysis of mass casualty incidents. There will be a triage area and emergency treatment facilities for at least 50 patients and critical care management facilities for at least 10 patients.
- v) The quality of medical treatment of serious/critical patients will not be compromised. The development plan will aim at the survival and recuperation of as many patients as possible.
- vi) Hospitals will plan to recruit a sufficient number of personnel, including doctors and paramedical staff, to meet the patients' needs for emergency care.

- vii) It is essential that all hospital DM plans have the command structure clearly defined, which can be extrapolated to a disaster scenario, with clear-cut job definitions when an alert is sounded. Emergency services provided must be integrated with other departments of the hospital.
- viii) The hospitals will submit data on their capabilities to the district authorities and on the basis of the data analysis, the surge capacities will be decided by the district administration.
- ix) There is no universal hospital DM plan which can be implemented by all hospitals in all situations. Therefore, on the basis of their specific considerations, each hospital will develop a disaster plan specific to itself. The plan shall be available with the district administration and tested twice a year by mock drills.
- x) The hospital DM plan will cater for the increased requirement of beds, ambulances, medical officers, paramedics and mobile medical teams during a disaster. The additional requirement of disease-related medical equipment, disaster-related stockpiling and inventory of emergency medicines will also be factored into the hospital DM plan. The DM plan must be strengthened by associating the private medical sector.
- xi) Although the number of private hospitals are increasing, they are not appropriately planned to manage casualties resulting from an outbreak of any epidemic or biological disaster. There is a need for networking between public and private hospitals and hospital DM plans need to be updated at the district/state level through frequent mock drills. Firm administrative policies will be in place for developing such plans at the hospital level.
- xii) The registration and accreditation policy will make it mandatory to have a hospital DM plan.
- xiii) The existing infectious diseases hospitals will be remodelled to manage diseases with microorganisms that require a high degree of biosafety, security and infection control practices. There will be one such hospital in each state capital. In addition, the district hospitals and medical colleges will have isolation wards to manage such patients. Also, identified hospitals in vulnerable states will be strengthened for managing CBRN disaster victims by putting in place decontamination systems, critical care Intensive Care Units (ICUs) and isolation wards with pressure control and lamellar flow systems. The infectious control practices include the following:
 - a. When dealing with biological emergencies, the health workers associated with the investigation of such exposures will have adequate personal protection.
 - b. Depending upon the risk, the level of protection will be scaled up from use of surgical masks and gloves, to impermeable gowns, N-95 masks or powered air-purifying respirators. They will follow laid down SOPs for use of PPE. Infection control practices will be followed at all health care facilities, including laboratories.
 - c. Of the potential biological disaster agents, only plague, smallpox and VHFs are spread readily from person to person by aerosols and require more than standard infection control precautions (gowns, masks with eye shields, and gloves).
 - d. The suspected victims and those who have been in contact with them will

be advised to follow simple public health measures such as using masks/ handkerchief tied over the nose and mouth, frequent washing of hands, staying away from other people by at least a metre, etc.

- xiv) Every hospital has two major facets, administration and clinical care. Administrative activities involve setting the hospital disaster plan into action and nominating a nodal medical officer in the plan who will be in charge of emergencies and trauma care. The nodal officer will be responsible for getting updated information, initiating administrative action and coordinating with the heads of various clinical facilities. To handle biological disasters, a hospital DM plan will have the following facilities:
 - a. Medical and paramedical staff: It is important to train medical staff and paramedics properly in universal safety precautions, use of PPE, communication, triage, barrier nursing, and collection and dispatch of biological samples. A team of specialists must be made available to handle infectious diseases affecting various body systems and they will be suitably immunised against agents such as anthrax and smallpox.
 - b. Expansion of casualty area: If the hospital casualty ward is unable to accommodate a large number of casualties, provision will be made to use the patients' waiting hall, duly reoriented, to receive the casualties. Each major hospital will cater to at least 50 additional patients at times of disaster.
 - c. Isolation wards: Many biological agents cause infective diseases of various body systems which can spread the infection to other patients. Therefore, adequate number of isolation wards are required to be planned with surge capacity to accommodate a large number of patients. If required, side rooms, seminar rooms, other halls can be improvised for this purpose.
 - d. Security arrangements: Hospital security staff will prepare SOPs to prevent overcrowding of hospitals by visitors, relatives, VIPs, and the media at the time of a disaster. Help of the district administration will be sought, if required.
 - e. Identification of patients: The process will start at the time of giving first aid and triage. A system of labelling and identifying patients during spot registration by giving a serial number to the patient and putting an identification tag around the wrist can be done. In mass casualties, it can be supplemented by giving colour coded tags, such as red for serious patients, yellow for moderately serious patients, blue for those in need of observation and black for the dead.
 - f. Brought dead: All those brought in dead and patients who die while receiving resuscitation will be segregated and shifted to the mortuary through a separate route. Temporary mortuary facilities will be created to cater for a mass casualty incidence.
 - g. Diagnostic services: All laboratories and radio diagnostic services will be kept fully operational and utilised as and when required. These services will be available within the emergency treatment areas.
 - h. Communication: Both extramural and intramural communication facilities will

be made available. These can be further augmented by the use of mobile phones.

- i. Medical supplies: Adequate supply of essential drugs and non-drug items will be made available for at least 50 patients in the emergency complex itself for immediate use. Additionally, hospital medical stores will have adequate buffer stocks.
- j. Blood bank services: The services will cater for an adequate supply of safe blood and its components. Voluntary blood donations will be encouraged to fulfil the increased demand of blood.
- k. Other logistic support: Adequate, uninterrupted supply of water and electricity will be ensured for proper management of casualties.

The laying down of public health standards for hospitals and strengthening of CHCs across the nation for basic specialities on 24x7 basis under NRHM by GoI are steps in the right direction to strengthen medical care facilities in rural areas. NRHM initiatives will be expedited to reach every nook and corner of the country.

4.4.2 Mobile Hospitals and Mobile Teams

States will acquire and locate at least one mobile hospital at strategic locations. These hospitals can be attached to earmarked hospitals for their use in non-disaster periods. These will be manned by trained manpower and perform the following functions:

- i) To be mobilised to the disaster site for management of cases at times of any epidemic outbreak or biological disaster.
- ii) Provide on-site medical treatment to casualties as per triage and evacuation guidelines. The teams will also make a

complete assessment of the situation and transmit information to the appropriate authorities.

- iii) Additional medical teams will be mobilised to assist in handling the large number of casualties in the wake of a mass casualty event.
- iv) Adequate stock of medical stores, including essential drugs, will be stocked and made available to the medical teams.
- v) The stocking of emergency medical stores shall be done by the state government. Brick of medical stocks capable of treating 25/50/100 casualties will be kept ready to move with the QRMTs at short notice.
- vi) Drills will be conducted at regular intervals by mobile hospitals and mobile teams to keep them in a functional mode at all times.

4.4.3 Stockpile of Antibiotics and Vaccines

Government medical stores at the centre and states will stock sufficient quantities of essential drugs, antibiotics and vaccines based on the risk assessment. State and local public health authorities have to develop plans for distributing and administering these materials. There is a need to have a supply of readily available anthrax, smallpox and other vaccines, which will be administered rapidly in the event of an outbreak to contain the spread of the disease. All first responders will be vaccinated in an impending disaster situation.

A regular review of the shelf life and adequacy of the available stock of vaccines and medicines is essential. The pharmaceutical industry in the country will be kept updated with the threat perception of biological disasters and for possible need for drugs and vaccines in the event of a major disaster. A plan will be prepared to define the availability of antibiotics, anti-virals, vaccines, sera and other drugs from private pharmaceutical

companies who will be able to supply these items at short notice.

4.4.4 Public Health Issues

- i) The abrupt onset of large numbers of acutely ill persons, and rapid progression in a relatively high proportion of cases with upper respiratory symptoms affecting, among others, young healthy adults and children should alert medical professionals and public health authorities. Such an occurrence indicates a critical and unexpected public health event which can be the beginning of a biological disaster.
- ii) A strong public health infrastructure with effective epidemiologic investigating capabilities, practical training programmes, and preparedness plans is essential to prevent and control outbreaks of diseases, whether natural or man-made. A public relations officer will give information to the public, press, radio and other organisations as per the health policy. Panic is a critical element in a disaster and, therefore, DM plans will address measures to allay public anxiety and fear arising out of BT. A complete ban on the press or media is not the right approach in such circumstances. The media is very useful for disseminating proper information and educating the community during a disaster.
- iii) Availability of safe food, clean water, and minimum standards of hygiene and sanitation will be ensured. Vulnerable groups such as children, pregnant women, the aged and patients suffering from diseases like HIV/AIDS will be given special attention.
- iv) The routine training of medical undergraduates, nurses and health workers for mental health services is grossly inadequate. There is virtually no emphasis

on the mental health aspects of disasters even in the routine postgraduate training in psychiatry. There is a need for coordinated training services and monitoring at the district and state levels.

- v) Most victims at the scene of a disaster suffer from psycho-social problems. Some people, including relief workers, may develop post-traumatic stress disorders. The plan will involve community level social workers who can help victims of psycho-social problems.

4.5 Emergency Medical and Public Health Response

4.5.1 C&C for Medical and Public Health Response

C&C would follow a bottom-up approach. For disasters manageable at the district level, C&C will be activated at the Incident Command Post (ICP) and at the district.

- i) For biological disasters affecting many districts, C&C will also be activated at the state headquarters. For disasters affecting a number of states, C&C will be at the centre (in the nodal ministry) involving, if required, the NCMC, the NDMA and NEC.
- ii) The central RRTs will be activated by MoH&FW. NICD will be the nodal agency for outbreak investigations. The coordination, logistics and monitoring will be supported by the Emergency Medical Relief division of MoH&FW. The response plan of the MoH&FW will be activated. The control room in the C&C structure would, if required, function on 24x7 basis.
- iii) Progress will be monitored by the nodal ministry. For BT, the same modalities will be activated by MHA.

- iv) MoH&FW would support MHA's activities and NICD would conduct the outbreak investigations. Faced with a BW situation, the MoD will be the nodal ministry and all actions as per the War Book will be put in place.

4.5.2 Emergency Medical Response

A biological disaster can lead to mass casualty incidences, both intentional or otherwise. The development of infectious diseases depends on various factors such as type of agents, incubation period, immune status of individuals, amount of infectious agent entering the body, etc. However, a large number of cases arising in a short span of time may require prompt establishment of medical posts near the incident site. EMR at the site would depend upon the quick and efficient response of RRTs/MFRs deputed from the district, reinforced by those from the state and the centre. They would triage the patient, provide basic life-support if required at the site, and transport patients to the nearest identified health facility along with collection and dispatch of biological and environmental samples. If the incident command system is implemented then the RRT/MFR will be integrated with the ICP and function under the overall directions of the incident commander. Important components of an EMR plan are as follows:

- i) Pre-hospital care shall be established and operationalised using a trained medical force. EMR at the site will depend upon the quick and efficient response of MFRs.
- ii) MFRs must be trained in the use of PPE and in collection and dispatch of samples from air, water, food and biological materials. The standards for detection and basic life-support (airway maintenance, ventilation support, anti-shock treatment and preparation for transportation) will also be developed. EMR will be integrated with ICP and will function under the overall directions

of the incident commander (see Annexures D-F).

- iii) There will be periodic mock drills for checking response time and reducing it to a minimum. Periodic training and refresher training schedules will also be prepared.
- iv) The medical posts shall provide evacuation services, specialised health care, food, shelter, sanitation, etc. These will coordinate with other functionaries involved in search, rescue, helplines and information dissemination, transport, communication, power and water supply, and law and order.
- v) SOPs for providing hospital care and a command control centre with the district collector as supreme head, will be laid down and rehearsed using mock exercises.
- vi) The nodes of communication will be dovetailed with emergency services of the district. Inter-hospital and inter-services communication will be established at all levels.
- vii) Mechanisms for checking the status of coordination in planning, operations and logistic management will be developed.

4.5.3 Transportation of Patients

Occurrences of mass casualties are unlikely in the case of biological disasters. Development of infectious diseases depends on various factors such as type of agent, incubation period, immune status of the individual, amount of infectious agent entering the body, etc. Therefore, patients will arrive at hospitals sporadically, in an unpredictable manner, while many will go to private physicians. An exhaustive ambulance system, as required for other disasters, may not be needed here. However, ambulances must have the provision for collection of stool, vomitus, etc. Adequate intravenous fluid and antibiotics must be made available in addition to other emergency drugs, during transportation.

4.5.4 Treatment at Hospitals

In case of an epidemic outbreak or bioterrorist attack, the hospital DM plan will be activated. A specialised team or RRT consisting of clinician, epidemiologist, microbiologist and nurse will be made available for patient care in the hospital. The activation of a hospital DM plan includes some of the following important functions:

- i) Patients requiring decontamination (especially in the context of a BT attack using aerosols) will be decontaminated. Thereafter, they will be triaged and those requiring critical care will be managed accordingly.
- ii) Patients requiring isolation will be kept in isolation rooms/wards. The RRT shall assess the patient load and if required, the hospital surge capacity will be increased. Those requiring treatment at referral centres will be transferred. Till such time definitive diagnosis is not available, patients will be provided empirical treatment based on presumptive diagnosis.
- iii) Triage of patients will involve prioritisation based on the assessment by the clinical team. Initially, diagnosis will be done on clinical basis and treatment will be given accordingly.
- iv) Supportive treatment will be given immediately with the help of advanced equipment like ventilators for respiratory paralysis caused by botulinum toxin. Samples of various body fluids like blood, sera, urine, stool and sputum will be taken and dispatched to the laboratory for early culture and identification, characterisation, and antibiotic sensitivity test of isolates.
- v) Depending upon the type of infective disease involving various systems like respiratory tract or gastrointestinal tract, the patient will be directed to different wards for isolation or quarantine.
- vi) Clinical suspicion and epidemiological investigation of such situations must be supported by definitive diagnosis by high quality laboratory tests. Laboratory diagnosis is the mainstay on which further response will be determined.
- vii) Establishing a diagnosis and detection system and identifying causative agents will be the most important response to a biological disaster. This procedure of identifying a disease agent in the environment is far more complex than identifying chemicals or toxins. The detection will be carried out by using standard laboratory tests of suspected samples collected from the environment, i.e., swabs and wipes from suspected surfaces, air samples, soil, food, and water.
- viii) Once the diagnosis has been confirmed by culture and antibiotic sensitivity of organisms, a bacterial infection will be treated with appropriate antibiotics. In case of viral infections an anti-viral agent like cyclovir may be used.
- ix) Administration of immunomodulators which enhance the immunity of the body to fight infection are useful for treating infections.
- x) Other supportive treatment like IV fluid, vitamins and proper nutrition, along with nursing care, will be ensured.

The hospitals would, throughout the crisis, follow strict infection control practices. If the surge capacity is exceeded, the services of private hospitals and nursing homes will be requisitioned. Institutions such as the Indian Medical Association and other professional bodies would also be approached.

4.5.5 Domiciliary Care

Not all patients will be needing hospital care. Those who can be treated at home will be given

necessary treatment as an outpatient and then asked to report in case of deterioration of the symptoms. Institutions like IRCS are capable of providing large numbers of trained volunteers and their resources will be tapped. Equally important will be the involvement of NGOs for such purposes.

4.5.6 Public Health Response

(A) Outbreak Investigation

An RRT will be deployed for outbreak investigation. A standard case definition will be followed, the guiding principle being to identify as many suspect cases as possible. There will be situations in which the RRT would have to lay down its own case definition. The suspect cases will be identified and if the situation so warrants, all the contacts will be traced and kept under observation/quarantine. Line listing of all cases and contacts will be prepared. The requisite clinical samples will be taken and transported to the nearest identified laboratories.

(B) Instituting Public Health Measures

Surveillance mechanisms will be activated and, if need be, active house-to-house surveillance will be followed, especially if the strategy is to stamp out the disease in the formative stages of the epidemic. Pharmaceutical and non-pharmaceutical interventions appropriate to the situation will be implemented. Other public health measures pertaining to drinking water, sanitation and vector control (depending upon the nature of the outbreak) shall be followed. Patients need to be provided appropriate treatment on outpatient basis or in identified hospitals, depending upon the severity of the case. Public health units, primary health care points and hospitals need to follow standard infection control practices. For diseases amenable to immunisation, an appropriate immunisation strategy will be followed.

Appropriate orders will be issued under the enabling legal instrument to mandate isolation and quarantine. Central to the success of quarantine will be making available all essential services in the quarantined area. A large number of police and security personnel may have to be deployed for restricting the movement of people beyond the defined geographic area. The authorities at the district level would also issue, if the situation so warrants, appropriate orders for implementing social distancing measures. The success of non-pharmaceutical interventions lies in the active cooperation of the civil society. Village committees, resident welfare associations and PRIs would supplement the efforts of the government in disease containment.

(C) Risk Communication

The risk will be conveyed to the community through simple and precise messages. It might be done using all available communication channels including word of mouth communication. To disseminate information to a wider audience in a short span of time, print/visual media may be used. Effort will be made to prevent/reduce panic among the public and create awareness about adopting risk reduction/health seeking behaviour.

(D) Psycho-social Care

Biological disasters of rapid onset and high mortality would create mass hysteria and panic among the public. It might induce mass exodus from the affected area thereby spreading the disease further. The movement of such population into unaffected communities could result in strong resentment among communities not yet affected. Those families subjected to bereavement of their near and dear ones would also reflect in higher psycho-social morbidity. MoH&FW through its mental health institutions and NGOs would provide adequate psycho-social care.

(E) Post-outbreak Surveillance

Even after the control of a natural/intentional outbreak, there would be heightened surveillance to detect fresh cases. The public will be informed to report fresh cases to the health authorities. There might even be a reward system for those who report a fresh case, especially in situations where active house-to-house or sentinel surveillance is not possible/sustainable in the longer run. There could also be serological studies to assess immune levels. Laboratories might also conduct laboratory based surveillance using a sampling framework.

(F) Media

An identified person, knowledgeable about the event will be designated to address the media as part of the district DM plan. As far as possible, the information sharing has to be transparent. The media would also have the obligation of reporting the event correctly and not sensationalising the issue, so that it does not create panic among the public.

(G) Inter-sectoral Coordination

Response to a biological disaster might require coordination between a number of departments, namely animal health sector, human health, home, defence, intelligence, civil aviation, tourism, shipping, and transport. MoH&FW would coordinate between all these departments for appropriate actions that need to be taken by the concerned departments. The identified task group would meet on a regular basis till the crisis is over.

(H) Monitoring

MoH&FW/MHA would closely monitor at the central level, any event that needs attention and take it to its logical conclusion. All important stakeholders, including NCMC and NDMA, will be kept informed of the situation. Daily situational reports will be sent to all concerned. The

appropriate authorities will be informed if help from international agencies is required.

(I) Evaluation

Once the outbreak has been contained, the entire process will be reviewed. The gaps/bottlenecks in implementing the plan will be identified and addressed. The lessons learned and the best practices adopted will be documented for future reference.

The success of the management of biological disasters, including BT, will depend upon the coordinated response of fully prepared RRTs/MFRs, including medical teams of specialists backed up by suitable communication, updated IDSP, and an adequate chain of laboratories and hospital care facilities.

4.6 Management of Pandemics

Epidemics arising in one part of the world are nowadays rapidly disseminated to other areas due to rapid transportation. The recent epidemic of SARS is one such instance. Infected individuals (or even vectors) can travel to far removed parts of the world before they manifest clinical features. Biological disasters, including BT, is a specific category of disaster that travels across borders by virtue of human or logistic functions that seek international cooperation to mitigate its effects. This issue directly concerns international biosafety and biosecurity norms.

The exchange of health intelligence has become important and international responsibilities often transcend national compulsions. IHR (2005) holds a member country to be duty bound to improve its public health capabilities to prevent and control the spread of any such disease within the country and prevent it from spreading beyond its borders. The wide disparity between nations in their capacity to tackle epidemics would mean that

competent medical teams from one nation would need to work in another country, thereby raising sovereignty issues. These matters have to be viewed in a global perspective. International agencies like WHO, FAO and OIE have a presence in all countries and coordinate such activities.

WHO has already developed and built an improved event management system to manage public health emergencies. It has also developed strategic operations at its Geneva headquarters and regional offices around the world, which are available round-the-clock to manage emergencies. WHO has also been working with its partners to strengthen the GOARN, which brings together experts from around the world to respond to disease outbreaks. The support to the international community is in the form of supply of epidemiological information and action on acquired infections. The interface between national and international agencies is normally well defined.

A competent central office in the country under the aegis of the nodal ministry (MoH&FW) which has access to national-level data and is equipped to transmit relevant information to the stakeholders, is needed. Surveillance of and remedial action against threats need to be rapidly evolved to satisfy both national and international needs.

The ongoing surveillance for avian influenza is an example of such interaction. The international agency, in this case WHO, not only supports designated national laboratories but also stockpiles appropriate prophylactic and therapeutic agents. Thus, in the case of avian influenza (bird flu) stockpiles of oseltamivir and vaccine for combating outbreaks are available for dispatch to affected regions. Nevertheless, national capability to anticipate, detect, mitigate and control exotic pathogens needs to be in place. A properly functioning epidemiological mechanism capable of immediately preparing an action plan for the management of any emergency would effectively

combat the threat. However, the capacity to identify and address exotic pathogens is required to be built. MoH&FW will prepare a comprehensive plan based on the above guidelines, which will be activated at the time of an alert, on the occurrence of a pandemic.

Pandemic preparedness is not restricted to the health sector alone. It has been extended to cover non-health stakeholders also, thereby requiring overall preparedness measures. It is pertinent to identify all the essential service providers and to make adequate provisions for their business continuity during pandemic or biological disaster situations. The issues of advocacy and guidance, planning at each level, linkages between various emergency functionaries, community awareness specific to pandemic preparedness, multi-sectoral coordination and capacity development using PPP will be developed in the plans. The mechanism for regional level cooperation to address non-health issues will be developed. The 'all hazard' plans so developed will be practiced through mock exercises. To address this vital issue with respect to the existing scenario in the Southeast Asian region, NDMA had organised an international conference in which various Indian experts and delegates from international agencies participated. The deliberations during this conference have been developed as a comprehensive report—'Pandemic Preparedness beyond Health' (please visit www.ndma.gov.in for the same). The recommendations of these deliberations are to be considered while developing the plans and carrying out other preparedness measures.

4.7 International Cooperation

International cooperation is a necessary element in the management of pandemics. The various activities that will be undertaken to enhance harmony in the functioning of an international regime in the management of biological disasters are as follows:

- i) Establishment of an adequate mechanism to enhance the level of interaction between the various state and non-state actors that are required to work in tandem during such events.
- ii) The development of provisions for strict compliance of existing international treaties/conventions at various levels
- iii) A web-based forum for continuous interaction of experts to develop necessary strategic measures that need to be integrated with present global practices.
- iv) A national web-based forum on the same lines also needs to be developed that would interact with international forums for exchange of information.
- v) The forum will also conduct workshops, seminars and conferences for direct interaction and exchange of ideas.
- vi) The forum will also promote the official interaction of state actors to evolve new policies and programmes in the changing dynamics of any global threat of BT.
- vii) Interaction between various pharmaceutical companies, NGOs, state and non-state actors will allow the exchange of technologies that exist in other nations.
- viii) The stockpiling of various vaccines and essential drugs to combat newly emerging threats under the guidance of global health organisations will become cost-effective by regional level planning. This, in turn, will enhance the inherent capability of the member nations to respond to such attacks.
- ix) In order to achieve the development of deterrence against newly developing GMOs, international-level research collaboration is essential.
- x) Joint international mock exercises may be conducted, based on the vulnerability assessment of different areas to enhance the level of coordination between various national and global players.
- xi) The management of pandemics requires the pooling of medical logistics, trained human resources and other essentials at the international level.
- xii) The management of pandemics also requires a transparent and collaborative approach wherein the affected countries will make a combined effort to mitigate the impact.

Success in managing biological disasters depends upon the level of coordination between various stakeholders, their medical preparedness, knowledge, and awareness of their responsibilities. Such a process is highly complex at the international level and requires the initiation and coordination of pre-determined plans in the immediate phase.

5

Guidelines for Safety and Security of Microbial Agents

'A safe and healthful laboratory environment is (also) the product of responsible institutional leadership. National codes of practice foster and promote good institutional leadership in biosafety'

Emmet Barkley, WHO

Disease diagnosis, human or animal sample analysis, epidemiological studies, scientific research and pharmaceutical developments—all of these activities are carried out in biological laboratories in the government and private sectors. Biological materials are handled worldwide in laboratories for numerous genuine, justifiable and legitimate purposes, where small and large volumes of live microorganisms are replicated, cellular components extracted and many other manipulations are undertaken for purposes ranging from educational, scientific, medical and health-related to mass commercial and/or industrial production. Among them, an unknown number of facilities, large and small, work with dangerous pathogens, or their products, every day. Technological advances have enabled an increasing number of people to cultivate, study and modify pathogenic organisms. This, unfortunately, also permits dual use of the technology. Under these circumstances it is necessary for legitimate laboratories dealing with pathogenic (or potentially pathogenic) microbes to ensure that there is no intentional removal of agents. These measures are dealt with under the term biosecurity. Biosafety is the term used to cover laboratory activities designed to protect the laboratory worker from infection by the organisms handled by him. Laboratory biosafety is the term used to describe the containment principle,

technologies and practices that are implemented to prevent unintentional exposure to pathogens and toxins and their accidental release.

5.1 Biological Containment

Biological containment, which ensures that infectious microorganisms remain in the laboratory, is the principal feature that distinguishes containment laboratories from basic laboratories. A variety of overlapping integrated engineering systems are installed in a containment laboratory to prevent uncontrolled escape of infectious microorganisms from the building, to safeguard the health of the surrounding community, to prevent unintentional spread of disease among man and animals, by man to man, animal to animal, animal to man, and man to animal transfer, and to prevent false laboratory reports due to cross contamination.

In addition to the engineering system, a positive attitude of employees towards biological safety, and their adherence to approved guidelines, are essential for total biocontainment. To summarise, biological security is the end product of the interaction of the built facility with its management and operational philosophies and the environment in which it operates.

Recent developments in molecular biology, including recombinant DNA technologies, have changed the age-old scenario of microbiology. Incorporation of foreign genes in the host gene, utilising prokaryotic or eukaryotic cells might pose several problems of biosafety. An increasingly important consideration in biotechnology research and applications is that workers in these fields

(molecular biology) are not necessarily trained in microbiological techniques, including safe handling of pathogens.

5.2 Classification of Microorganisms

Microorganisms are classified on the basis of the risks levels that their handling entails. This is different when human/animal/plant specimens, GMOs, environmental isolates and experimental animal samples are dealt with. Each of these categories requires specific guidelines. The scheme for risk based classification of microorganisms is intended to provide a method for defining the minimal safety conditions that are necessary when using these agents. It designates five classes of hazardous agents such as Risk Group I, II, III, IV and V. Each country should draw up a classification by risk group of the agents encountered in that country. The organisms not encountered in the country may be considered as special category (Risk Group V). The following classification is in conformity with the classification of human and animal pathogens.

5.2.1 Risk Group-I: Low individual and community risk

This group includes agents of no or minimal hazard under ordinary conditions of handling, that can be used safely in the laboratory without special apparatus or equipment and using techniques generally acceptable for non-pathogenic materials.

5.2.2 Risk Group-II: Moderate individual risk and limited community risk

This class includes agents that may produce diseases of varying degrees of severity resulting from accidental inoculation or infection or other means of cutaneous penetration. Effective treatment and preventive measures are available and the risk of spread is limited. These agents can usually be adequately and safely contained by ordinary laboratory techniques.

5.2.3 Risk Group-III: High individual risk and low community risk

A pathogen that usually produces serious human/animal diseases but does not ordinarily spread from one infected individual to other.

5.2.4 Risk Group-IV: High individual risk and high community risk

Agents that usually produce serious human or animal diseases and may be readily transmitted from one individual to another directly or indirectly. They need stringent conditions for their containment. Precautions are needed when entomological experiments are conducted in the same laboratory areas.

5.2.5 Risk Group: Special category

Foreign human/animal pathogens that are not present in a country and need stringent containment facilities for handling.

5.3 Biologics

Biologics derived by recombinant DNA techniques or developed from hybridomas may be classified into three broad categories based on the biological characteristics of the new product and the safety concerns they present.

5.3.1 Category-I

This category includes inactivated recombinant DNA-derived vaccines, bacterins, bacterin-toxoids, virus subunits or bacterial subunits. These nonviable or killed products pose no infectious risks.

5.3.2 Category-II

This category includes products which have been modified by the addition of one or more genes. Precaution must be taken to ensure that

the deletion or addition of genetic materials does not impart increased virulence, pathogenicity and enhanced survival period of these organisms, than those found in natural or wild type forms. The genetic information added or deleted must specify characterised DNA segments, including base pair analysis, amino acid sequence, restriction enzyme sites, as well as phenotypic characterisation of the altered organisms.

5.3.3 Category-III

This category includes live vectors which carry foreign genes that code for immunising antigens and/or immuno-stimulants. Live vectors may carry more than one recombinant derived foreign genes since they can carry large numbers of new genetic information. They are also efficient for infecting and immunising target animals. Currently used live vectors are vaccinia and other pox viruses, bovine papilloma virus, adenoviruses, simian virus-40 and yeasts.

5.4 Laboratory Biosafety

Animal experimentation with pathogens requires facilities to ensure appropriate levels of environmental quality, safety and care. Laboratory animal facilities are extensions of the laboratory and in some institutions are integral to and inseparable from the laboratory. Biosafety levels recommended for working with infectious agents *in vivo* and *in vitro* are comparable.

The three basic elements of containing microorganisms in a laboratory are laboratory practices and techniques, safety equipment (primary containment barrier) and facility design (secondary containment barrier). Incorporation of these elements into a laboratory is required for safe handling of human and animal pathogens, including recombinant organisms of various risk groups. These form the basis for classification of laboratories. Four BSLs, in ascending order, are described for laboratories dealing with

microorganisms of Risk Groups I, II, III and IV. These laboratories are designated as BSL 1, 2, 3 and 4. The descriptions of BSL 1–4 are parallel to those of P 1–4 in the National Institute of Health, USA, guidelines for research involving DNA technology and are consistent with the general criteria used in assigning agents to classes 1–4 in the classification of pathogens on the basis of risks.

5.4.1 Biosafety Level-1 (BSL-1)

Such a laboratory is suitable for handling Risk Group-I organisms and is referred to as a basic laboratory. Undergraduate and teaching laboratories come under this category. The laboratory is not separated from the general traffic in the building. The work is generally carried out on open bench-tops without the use of primary containment equipment. However, good laboratory practices and techniques should be followed while handling organisms.

5.4.2 Biosafety Level-2 (BSL-2)

This category of laboratory is suitable for carrying out work on Risk Group-II organisms. The level of biosafety is similar to that of BSL-I. Besides following good laboratory practices and techniques, some additional aspects like closing the doors when work is in progress and adherence to a biosafety manual should be adopted. Safety equipment like biological safety cabinets (Class I or II) or other protective devices should be used when the procedures involved could create aerosols.

5.4.3 Biosafety Level-3 (BSL-3)

BSL-3 laboratories are suitable for undertaking work with Risk Group-III organisms. The laboratories under this category include clinical, diagnostic, research or production facilities where infectious agents, which may cause serious/lethal diseases, are used. Laboratory workers have special training in carrying out the work and are supervised by

scientists. Infectious materials are handled in biological safety cabinets (Class I, or II). The laboratory has special design features of negative air pressure with restricted access zones, sealed penetrations and directional air flow.

Enforcement of biosafety guidelines, including decontamination of materials in the laboratory, are critical elements in the handling of pathogens. The safety equipment used in this category of laboratory are biosafety cabinets (Class I, II, III) or a combination of personal protective or physical containment devices, e.g., clothing, masks, gloves, respirators, centrifuge safety cups, sealed centrifuge rotors and animal isolators. For BSL-3 laboratories, the design features should be such that the infectious agents handled in the laboratory should not escape into the environment. The laboratory is separated from unrestricted traffic within the building. Physical separation of the laboratory from access corridors will be provided by clothing changes, showers, air locks and other access facilities. Table tops shall be impervious to water and resistant to acid, alkali, solvents and heat. A sink will be located near the laboratory exit which is elbow or foot operated. Exhaust air filtered through the HEPA filters of biosafety cabinets will be discharged directly to the outside or through a building exhaust system having thimble connections.

5.4.4 Biosafety Level-4 (BSL-4)

BSL-4 laboratories are suitable for carrying out work with Risk Groups-IV and V (exotic) pathogens which pose serious threats to the human and animal population. Personnel working in the laboratory have specific training in procedures of handling high-risk pathogens and understand the function of various biosafety equipment and design of the laboratory. A safety department will formulate the biosafety rules and regulations, which will be followed strictly. Good laboratory practices must be followed to ensure safe handling of organisms at the workplace to avoid spillage, aerosol

generation, cross contamination and accidental infection of the workers. In addition, the two-person rule should apply, whereby no individual works alone within the laboratory. A system shall be set up for reporting laboratory accidents and exposures, employee absenteeism and medical surveillance of laboratory associated illnesses.

All the procedures within the facility will be carried out in Class III biological safety cabinets or in Class I and II biological safety cabinets in conjunction with a ventilated life-support system.

The BSL-4 laboratory has specific design features. It should be such that organisms handled in the laboratory do not escape into the environment through man, material, air or water (effluent). To achieve this, the laboratory should be under graded negative air pressure and should have arrangements for sterilisation of outgoing materials by autoclaving (both steam and ethylene oxide), formalin fumigation (air locks), surface decontamination (dunk tank), effluent treatment (steam sterilisation) and air filtration system with HEPA filters.

When pathogens of high-risk groups having zoonotic importance are handled, the personnel will wear a one-piece positive pressure suit which is ventilated by a life-support system. A specially designed suit area shall be provided in the laboratory facility. Entry to this area shall be through an air lock fitted with airtight doors. A chemical shower should be provided to decontaminate the surface of the suit before the worker leaves the area.

Normally, the requirements for biosafety and biosecurity are congruent. However, it is worthwhile noting that such laboratories may be performing clandestine research in which case these two activities will be in conflict. In any case, each institution will:

- i) Recognise that laboratory security is related to but differs from laboratory safety.

- ii) Control access to areas where biologic agents or toxins are used and stored.
- iii) Know who is in the laboratory area.
- iv) Know what materials are being brought into the laboratory area.
- v) Know what materials are being removed from the laboratory area.
- vi) Have an emergency plan.
- vii) Have a protocol for reporting incidents.

5.5 Microorganism Handling Instructions

Microorganisms should always be handled in appropriate facilities. Thus, it will be wrong to handle a Category III organism in a BSL-2 facility. This is probably not possible in the country at present since an adequate number of containment facilities do not exist. A dilemma arises when samples from outbreaks are being studied. In these cases it will be prudent to handle the samples at the highest containment level appropriate to the suspected infective agent. Once the aetiological agent is identified it will be handled in the appropriate facility.

The purpose of this part of the document is to define the scope and applicability of 'laboratory biosafety' recommendations, narrowing them strictly to human, veterinary and agricultural laboratory environments. The operational premise for supporting national laboratory biosecurity plans and regulations generally focuses on dangerous pathogens and toxins. In this document, the scope of laboratory biosecurity is broadened by addressing the safekeeping of all Valuable Biological Materials (VBM), including not only pathogens and toxins, but also scientifically, historically and economically important biological materials such as collections and reference strains, pathogens and toxins, vaccines and other pharmaceutical products, food products, GMOs, non-pathogenic microorganisms, extraterrestrial

samples, cellular components and genetic elements. This is done in order to raise awareness of the need to secure collections of VBM. Through microbiological risk assessments performed as an integral part of an institution's biosafety programme, information is gathered regarding the type of organisms available at a given facility, their physical location, the personnel who require access to them, and the identification of those responsible for them. Laboratory biosecurity risk assessment should further help establish whether this biological material is valuable and warrants tighter security provisions for its protection, that presently may be insufficient through recommended biosafety practices. This approach underlines the need to recognise and address the ongoing responsibility of countries and institutions to ensure a safe and secure laboratory environment.

5.5.1 Laboratory Biosecurity Measures

It will be based on a comprehensive programme of accountability for VBMs that includes:

- i) Regularly updated inventories with storage locations.
- ii) Identification and selection of personnel with access.
- iii) The planned use of VBM.
- iv) Clearance and approval processes.
- v) Documentation of internal and external transfers within and between facilities.
- vi) Inactivation and/or disposal of the unwanted/surplus material.

5.5.2 Institutional Laboratory Biosecurity Protocols

These protocols should include how to handle breaches or near-breaches in laboratory biosecurity, including:

- i) Incident notification.
- ii) Reporting protocols.

- iii) Investigation reports.
- iv) Recommendations and remedies.
- v) Oversight and guidance through the biosafety committee.

The protocols should also include how to handle discrepancies in inventory results, and describe the specific training to be given, and the minimal training that personnel must be required to follow. The involvement, roles and responsibilities of public health and security authorities in the event of a security breach should also be clearly defined.

5.6 Countering Biorisks

5.6.1 Accountability for VBM

While it is difficult to mitigate the consequences of theft of VBM, i.e., possible misuse, diversion, etc., after they have left a given facility, it is easier to minimise the probability of such an event happening, by establishing appropriate controls to protect VBM from unauthorised access or loss. Unauthorised access is the result of inappropriate or insufficient control measures to guarantee selective access. Losses of VBM often result from poor laboratory practices and poor administrative controls to protect and account for these materials. It is important to establish practical, realistic steps that can be taken to track and safeguard VBM. Indeed, comprehensive documentation and description of VBM retained in a facility may represent confidential information, as much as records and documentation of access to restricted areas. However, such documentation may prove useful, for example, to help discharge a facility from possible allegations. For useful reference, it is recommended that such records be collected, maintained and retained for some time before they are eventually destroyed.

Specific accountability procedures for VBMs require the establishment of effective control procedures to track and document the inventory, use, manipulation, development, production, transfer and destruction of these materials. The objective of these procedures is to know which materials exist in a laboratory, where they are located, and who has the responsibility for them at any given point in time. To achieve this, management should define:

- i) Which materials (or forms of materials) are subject to material accountability measures.
- ii) Which records should be kept, by whom, where, in what form and for how long.
- iii) Who has access to the records and how access is documented.
- iv) How to manage the materials through operating procedures associated with them (e.g., where they can be stored and used, how they are identified, how inventory is maintained and regularly reviewed, and how destruction is confirmed and documented).
- v) Which accountability procedures will be used (e.g., manual log book, electronic tables, etc.).
- vi) Which documentation/reports are required.
- vii) Who has responsibility for keeping track of VBMs.
- viii) Who should clear and approve the planned experiments and the procedures to be followed.
- ix) Who should be informed of and review the planned transfer of VBMs to another laboratory.

5.6.2 Transport of Materials

The use and storage of VBM should be limited to clearly identified areas. The only VBM permitted outside a restricted area should be those that are

being moved from one location to another for specific, authorised reasons. Transport security endeavours to provide a measure of security during the movement of biological materials outside of the access-controlled areas in which they are kept until they arrive at their destination. Transport security applies to biological materials within a single institution and also between institutions. Internal material transport security includes reasonable documentation, accountability and control over VBM moving between secured areas of a facility, as well as internal delivery associated with shipping and receiving processes. External transport security should ensure appropriate authorisation and communication between facilities before, during and after external transport, which may involve a commercial transportation system. The recommendations of the UN Model Regulations for the Transport of Dangerous Goods provides countries with a framework for the development of national and international transport regulations and include provisions addressing the security of dangerous goods, including infectious substances, during transport by all modes. Based on these recommendations, each country has to evolve its own regulations appropriate to its national situation.

5.6.3 Elements of a Laboratory Biosecurity Plan

Laboratory biosecurity should specifically address the policies and procedures associated with physical biosecurity, staff security, transportation security, material control and information security. It should also include emergency response protocols that address security related issues, such as specific instructions concerning situations when outside responders may be called (fire brigade, emergency medical personnel or security personnel), including the protocol to follow once on site and the scope of authority of all the parties involved. It is important for the laboratory security plan to anticipate the most likely situations that would require exceptional

access. Just as training is essential for good biosafety practices, it is also essential to train for good biosecurity practices, particularly in emergency situations. Hence, regular training of all personnel on security policies and procedures helps ensure correct implementation. A national system of periodically validated certification of personnel will be desirable.

Laboratory biosecurity describes both a process and an objective that is a key requirement for public health and welfare. It requires consideration of the reason for developing regulations, what the objects of the regulations are, how regulations are written, who develops regulations, and who pays for their development and application. It includes the generation and sharing of scientific knowledge, and involves bioethical considerations such as transparency of decision-making, public participation, confidence and trust, and responsibility and vigilance in protecting society. Effective laboratory biosecurity is a societal value that underwrites public confidence in biological science.

5.6.4 Training

Laboratory biosecurity training, complementary to laboratory biosafety training and commensurate with the roles, responsibilities and authorities of staff, should be provided to all those working at a facility, including maintenance and cleaning personnel, staff involved in ensuring the security of the laboratory facility and to external first responders. Such training should help understand the need for protection of VBM and equipment and rationale for the laboratory biosecurity measures adopted, and should include a review of relevant national policies and institution-specific procedures. Training should provide for protection, assurance and continuity of operations. Procedures describing the security roles, responsibilities and authority of personnel in the event of emergencies or security breaches should also be provided during

training, as well as details of security risks judged not significant enough to warrant protection measures. The biorisk management plan should ensure that laboratory personnel and external partners (police, fire brigade, medical emergency personnel) participate actively in laboratory biosecurity drills and exercises, conducted at regular intervals, to revise emergency procedures and prepare personnel for emergencies.

Training should also provide guidance on the implementation of codes of conduct and should help laboratory workers understand and discuss ethical issues. Training should also include the development of communication skills among partners, improvement of productive collaboration, and endorsement of confidentiality or of communication of pertinent information to and from employees and other relevant parties. Training should not be a one-time event—it should be offered regularly and taken recurrently. It should represent an opportunity for employees to refresh their memories and to learn about new developments and advances in different areas. Training is also important in providing occasions for discussion and bonding among staff members, and in strengthening of team spirit among members of an institution.

5.6.5 National Code of Practice for Biosecurity and Biosafety

A national code of practice for biosecurity and biosafety needs to be prepared and promulgated. Based on such a code of practice, accreditation of laboratories with respect to the handling of microbial material will be undertaken at the national level. Only accredited laboratories will be permitted to undertake outbreak investigations, epidemiological analysis and vaccine research. A network of such laboratories is required for a country of India's size. The network for human (medical), veterinary and agricultural infections would probably have to be independent, but points of contact will

be essential as both the hosts and pathogens will be subject to similar life processes and also interact with each other. An overseeing National Committee for Microbial Activities needs to be set up to coordinate the field and gradually build up the laboratory infrastructure to develop the national capacity to deal with the issues. The ability to handle biological disasters, be they natural or man-made, could be built into the system. Personnel management will be crucial for the success of the activity and will be a mandate for the committee. Some of the international guidelines that could form the basis for the development of the national guidelines are:

(A) Laboratory Biosafety

- i) WHO – Laboratory Biosafety Manual (LBM), 3rd Edition.

(B) Laboratory Biosecurity

- i) WHO – LBM, 3rd Edition.
- ii) WHO – Biorisk Management. Laboratory biosecurity.
- iii) Organisation for Economic Cooperation and Development (OECD) — Security Requirements for Biological Resource Centres.

C) Transport of Infectious Substances

- i) UN Recommendations on the Transport of Dangerous Goods: Model Regulations.
- ii) International Civil Aviation Organisation Requirements/International Air Transport Association Standards.

6

Guidelines for Management of Livestock Disasters

Agriculture and allied sectors account for about 24% of India's Gross Domestic Product (GDP). Of this, animal husbandry and dairy accounts for about 25% and fisheries a shade over 4%. Livestock also provide gainful employment to the rural poor and women. These figures actually represent a steady flow of essential food products, draught animal power, manure, employment, income and export earnings. Distribution of livestock wealth in India is more egalitarian, compared to land. Hence, from the equity and livelihood perspectives, it is considered an important component in poverty alleviation programmes.

In sheer numbers, India is second in cattle and first in buffalo population of 185 million and 98 million respectively, second in goat with 124 million, third in sheep with 61 million and seventh in poultry with 489 million. The livestock sector produced approximately 98 million tonnes of milk, 44 billion eggs, 48.5 million kg of wool, and 6 million tonnes of meat in 2004–05. The total export earnings from livestock, poultry and related products was US \$ 1080.82 million in 2003–04, out of which the leather sector accounted for 54.24% and meat and its products accounted for 35.78%. The fisheries sector's contribution is no less impressive, either, with 6.4 million tonnes of fish production during the same period.

The livestock revolution provides a significant opportunity for livestock farmers in the poorer regions to partake in economic activity and may provide a way for many of them to escape poverty. However, for this to occur there is need for an increase in the quantity and quality of animal products for trade at the local level and for a

significant improvement in the livestock sector complying with the rules of international trade in animals and its products. In our country not only do livestock provide milk, meat, draught power, transport, manure, hides, wool, etc., but animals also provide a relatively safe investment option and give the owner social security.

6.1 Losses to the Animal Husbandry Sector due to Biological Disasters

6.1.1 Losses due to Natural Disasters

Natural disasters have negative economic consequences in the livestock sector, particularly in developing countries. Droughts, earthquakes, floods, ice storms, wildfires, cyclones, tsunamis, etc., create havoc with human and livestock population. These lead to a negative impact on the infrastructure of our country by reducing an important source of income in rural areas and hindering the distribution of foods and goods.

6.1.2 Losses due to Infectious Diseases in Animals

With increasing globalisation, the persistence of Trans-boundary Animal Diseases (TADs) anywhere in the world poses a serious risk to the world's animal, agriculture and food security and jeopardises international trade. Furthermore, animal production and marketing under formal trade schemes tends to institutionalise and protect systems that are increasingly demanding in both quality and sanitary product innocuity. Recent animal health emergencies, including Foot and

Mouth Disease (FMD) and bird flu have highlighted the vulnerability of the livestock sector to serious damage by epidemic diseases and its reliance on efficient animal health services and practices at all levels. The significance of animal diseases (including zoonoses) on human health and welfare is also being increasingly recognised.

At both local and international levels, the presence of animal diseases has a significant negative impact on opportunities for trade. In developed countries, trends in the livestock industry have seen an increase in scales of operation, a reduction in the number of holdings, and a substantial increase of the importance of livestock and livestock product markets, and higher frequency and speed of movement of animals and animal products. As a consequence, the introduction of infectious diseases to susceptible animals causes increasingly heavy losses in both developed and developing countries. Although the small holding pattern of livestock rearing in India offers relative advantages over the intensive farming system in minimising losses due to TADs, the loss absorption capacity, as in other non-industrialised nations, is less.

6.2 Potential Threat from Exotic and Existing Infectious Diseases

Among the eight to ten globally recognised, most harmful TADs which can inflict enormous losses on livestock of a country or region in a short span of time, five are existing in the country, e.g., FMD, PPR, Newcastle disease, hog cholera and bluetongue. Of these, there are official control programmes against the first four to minimise losses to livestock. India has been successful recently in eradicating rinderpest, another dreaded trans-boundary infection which used to devastate cattle and other ruminants for centuries. Although it was exotic until recently, Highly Pathogenic Avian Influenza (HPAI), commonly referred to as bird flu,

has already invaded the country on two occasions in successive years, 2006 and 2007. Through high alacrity and timely intervention, it has been possible both times to control this dreaded infection with potential for a human pandemic, within a relatively short period of time. India has also been successful in the past in eradicating another dreaded infection of the equine species, i.e., South African horse sickness, which invaded the country in the early 1960s and is still present in the list of TADs. The remaining TADs, e.g., vesicular stomatitis, African swine fever and transmissible gastro-enteritis continue to be a threat to Indian livestock as well as scores of other microbial infections with potential for quick spread and mass mortality. Added to the threat potential to livestock population is the zoonotic dimension of several animal diseases such as anthrax, brucellosis, West Nile fever, TB, Japanese encephalitis, bird flu, rabies, etc.

6.3 Consequences of Losses in the Animal Husbandry Sector

Be it animal disease or a natural disaster, the consequences of loss of livestock in large numbers are predictable. These are primarily:

- i) Food scarcity due to shortage of animal origin food, e.g., milk, meat and eggs.
- ii) Economic crisis due to escalation of food prices (the value of milk output in India is equal to the combined value of paddy and wheat produced).
- iii) Environmental contamination leading to epidemics due to massive animal mortality.
- iv) Loss of valuable germ-plasm and biodiversity.
- v) Loss of employment starting from primary producers, down the food processing and marketing chain.
- vi) Loss of traction power, shortage of manure.
- vii) Emotional shock to animal owners.

6.4 Present Status and Context

Central and state governments, voluntary agencies and international organisations are working towards reducing the impact of disasters and minimising the loss of animal life and production on account of natural disasters and infectious diseases. These efforts are mainly directed in developing shelter and providing for prophylaxis and treatment, and feed and fodder for disaster impact reduction. The issues of compensation due to loss in livestock following natural calamities are generally handled by the revenue departments of state governments on the basis of the estimation of losses made by the animal husbandry departments. A compensation mechanism for losses due to infectious diseases does not exist, unless covered under some insurance scheme.

6.4.1 Legislative and Regulatory Framework

(A) National

The veterinary services are backed by suitable central and state legislations.

- i) National Legislation:
 - a. The Indian Veterinary Council Act, 1984 regulates veterinary practices in the country.
 - b. The Livestock Importation (Amendment) Act, 2001 provides modalities of International Animal Health Certification.
 - c. The Livestock Importation Act, 1898, as amended in 2001, regulates entry of livestock and livestock products.

These importations are allowed subject to fulfillment of health/quarantine requirements specified by the GoI that are developed depending upon the disease status of the exporting country

and the species of livestock/type of product to be imported.

- ii) State Laws:

At state level each state enforces either its own animal disease control Act or in case the state does not have an Act, the Act of a neighbouring state is enforced for prevention and control of infectious diseases. Some of the state Acts are enumerated below:

 - a. The Goa, Daman & Diu Diseases of Animals Act, 1974.
 - b. The Gujarat Diseases of Animals (Control) Act, 1963.
 - c. The Himachal Pradesh Livestock and Birds Diseases Act, 1968 and Himachal Pradesh Livestock and Birds Diseases, Rules, 1971.
 - d. The Jammu and Kashmir Animal Diseases (Control) Act Svt. 2006, (1949).
 - e. The Madhya Pradesh Cattle Diseases Act, 1934 and Madhya Bharat Animal Contagious Diseases Act, 1959.
 - f. The Bombay Animal Contagious Diseases (Control) Act, 1948.
 - g. The Orissa Animal Contagious Diseases Act, 1949.
 - h. The Punjab Livestock and Birds Diseases Act, 1948 and Punjab Contagious Diseases of Animals Rules, 1953.
 - i. The Rajasthan Animal Diseases Act, 1959 and Rajasthan Animal Diseases Rules 1960.
 - j. The Bengal Diseases of Animals Act, 1944.
 - k. The Andhra Pradesh Cattle Diseases Act, 1866; Andhra Pradesh Cattle Diseases (Extension and Amendment) Act, 1961; Bye Laws made under Andhra Pradesh Cattle Diseases Act, 1866.

- l. The Karnataka Animal Diseases Control Act, 1961: Karnataka Diseases (Control) Rules, 1967.
- m. The Madras Rinderpest Act, 1940.
- n. The Madras Cattle Diseases Act, 1866.
- o. The Kerala Prevention and Control of Animal Diseases Act, 1967.

Note: The UTs of Andaman and Nicobar Islands and Lakshadweep do not have any animal disease legislation. However, in the Andaman and Nicobar Islands and Lakshadweep islands the respective directors of animal husbandry have powers related to the control and elimination of infectious diseases of livestock.

The various state Acts provide that if an animal is believed to be affected with a scheduled disease, the owner should report the fact to the nearest veterinary practitioner. The Acts also provide for isolation of infected animals, disposal of carcasses and infected material by burial or burning, disinfection of premises and vehicles, banning of cattle fairs and markets or congregation of animals during any outbreak. Non-compliance with the provisions of the law is deemed a cognisable offence and punishable with fine or imprisonment, or both. With a view to preventing the transmission of infection to disease free areas, the Acts provide that animals should move to such areas only through prescribed routes and before entering the area, animals should be held for observation in a temporary quarantine station where, if necessary, they should be vaccinated and marked. The state Acts also provide for safeguarding eradicated or disease-free areas from where a particular disease has been eliminated, by regulating the entry of livestock into such an area and observing such precautions as may be necessary to maintain the 'eradicated' or 'free' status against a particular disease. Thus, there are adequate legal provisions in all the states of India for the prevention and control of animal diseases.

(B) International

Several of the UN organisations as well as inter-governmental organisations provide the framework for development of the animal husbandry sector in member countries, including marketing, international trade, food safety and regional cooperation. These are:

i) Food and Agriculture Organization (FAO)

FAO is primarily responsible for the establishment of guidelines and recommendations on good agricultural practices for the management of animal diseases and zoonoses. It is involved in the development of programmes and coordination of activities with other relevant organisations for the effective prevention and progressive control of important animal diseases, including the promotion of collection and analysis of information on the national distribution and impact of these diseases, and provision of relevant technical assistance, particularly to developing countries.

ii) World Organisation for Animal Health

The need to fight animal diseases at the global level led to the creation of the Office International des Epizooties (OIE) through an international agreement signed on 25 January, 1924. In May 2003, the Office became the World Organisation for Animal Health but kept its historical acronym OIE. OIE is the inter-governmental organisation responsible for improving animal health worldwide. It is recognised as a reference organisation by the WTO and as of May 2007, had a total of 169 Member Countries and Territories. OIE maintains permanent relations with 35 other international and regional organisations and has regional and sub-regional offices in every continent.

The organisation is placed under the authority and control of an International Committee consisting of delegates designated by the governments of all member countries. The day-to-day operations of OIE is managed at its headquarters in Paris and placed under the responsibility of a Director General elected by the International Committee. The headquarters implements the resolutions passed by the International Committee, which have been developed with the support of Commissions elected by the delegates.

OIE is primarily responsible for the establishment of standards, guidelines and recommendations relevant to animal diseases and zoonoses in accordance with its Statutes and as defined in the WTO-Sanitary and Phyto-Sanitary (SPS) Agreement (refer to Chapter 7). Its mandate includes development and updating of international science-based reference standards and validation of diagnostic tests published in the Terrestrial Animal Health Code, Aquatic Animal Health Code, Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, and Manual of Diagnostic Tests for Aquatic Animals. The OIE list of infectious diseases of terrestrial animals is provided in Annexure-G.

iii) International Health Regulation (IHR)

The revised IHR that was adopted by the World Health Assembly in 2005 is an international legal instrument that came into force on 15 June 2007, replacing the earlier IHR. The purpose and scope of IHR (2005) is to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international

traffic and trade. IHR (2005) is legally binding on all WHO member states.

iv) Codex Alimentarius Commission (CAC)

The CAC was established in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. The main purpose of this programme is to protect the health of consumers, ensure fair trade practices in the food trade, and promote coordination of all food standards work undertaken by international governments and NGOs. The Codex Alimentarius system presents a unique opportunity for all countries to join the international community in formulating and harmonising food standards and ensuring their global implementation. It also allows them a role in the development of codes governing hygienic processing practices and recommendations relating to compliance with those standards.

v) The Global Framework for Progressive Control of Trans-boundary Animal Diseases (GF-TADs)

This is a joint FAO/OIE initiative which combines the strengths of both organisations to achieve agreed common objectives. GF-TADs is a facilitating mechanism which will endeavour to empower regional alliances in the fight against TADs, to provide for capacity building and to assist in establishing programmes for the specific control of certain TADs based on regional priorities.

The overall objective of GF-TADs is to limit the ravages of animal diseases on the livelihoods of livestock-dependent people around the world and to promote safe and healthy trade through strengthening local

and national capabilities. FMD was identified as the principal animal disease of global concern in all the consultations carried out during the preparation of this programme. In order to obtain the necessary information for the promotion of early prevention and early reaction, close interaction among national animal health services for achieving a sound regional understanding of disease occurrence is required. GF-TADs will rely on the action of countries' veterinary services and those of regional, specialised animal health organisations. Since international animal health monitoring is able to single out geographical dynamics of disease occurrence only when countries report the presence of diseases, GF-TADs intends to contribute to the strengthening of national structures and mechanisms to fulfil such reporting functions effectively.

vi) Existing International Warning Systems for Diseases

OIE has an information system that includes the dissemination of early warning messages whenever epidemiologically significant events are officially reported to its Central Bureau, within hours of their receipt. This alert system is aimed at decision-makers, enabling them to take necessary preventive measures as quickly as possible.

In order to improve transparency and animal health information quality, OIE has also set up an animal health information search and verification system for non-official information from various sources on the existence of outbreaks of diseases that have not yet been officially notified to the OIE.

FAO, through the emergency prevention system priority programme established in 1994, developed an early warning and response system aimed at disease

containment, based on official OIE data, ground information stemming from field projects, collaborators, consultancy missions or personal contacts and provides analyses of the situation, disseminated through bulletins, electronic messages and other reports.

WHO has developed an outbreak tracking and verification system for human diseases, which, for zoonotic diseases such as Rift Valley fever, brucellosis, TB, rabies and food-borne diseases, will be shared with OIE and FAO in GF-TADs.

6.4.2 Prevention and Preparedness: National Scenario

Animal husbandry and veterinary services is a state subject and falls within the purview of the state government. As a consequence each state government and UT has its own department of animal husbandry and veterinary services. Veterinary services are provided at state veterinary hospitals, dispensaries and mobile veterinary clinics which are staffed by veterinary graduates holding a degree in veterinary science and animal husbandry recognised by the Veterinary Council of India (VCI) and State Veterinary Councils. Prevention of animal diseases, control and surveillance is also an important function of the state veterinary services.

Subjects such as animal quarantine, prevention of inter-state transmission of diseases, regulatory measures for quality of biologicals and drugs, import of biologicals, livestock, livestock products and control of diseases of national importance are the responsibilities of the central government.

The DADF of the MoA handles the central animal health services. The central government formulates schemes and policies for the control and eradication of diseases in the country.

India has about 47,000 registered veterinary practitioners engaged in different activities. More than 70% of the registered veterinary practitioners are in the state government services. The country has 8,720 veterinary hospitals and polyclinics, 17,820 veterinary dispensaries, and 25,433 Veterinary Aid Centres (VACs) and mobile veterinary clinics totalling 51,973 centres. In addition, there are border posts which besides their border duties also work as disease reporting posts. Thus the total number of disease reporting posts is 52,390. These disease reporting units form the backbone of the disease surveillance system and have an effective coverage. There are 51,973 animal disease reporting units in 641,169 villages in India. 86,073 veterinary personnel (24,767 veterinary graduates and 61,306 veterinary field assistants) look after the animal health aspects. Thus, for animal disease surveillance, disease reporting and veterinary cover, on an average one disease reporting post caters to the needs of 12.33 villages, 5,464 bovines (cattle and buffaloes) and 3,499 sheep and goats. However, in the event of any disaster, these services are often found wanting.

(A) National Veterinary Services

The provision of these services is the responsibility of the DADF of the MoA. Subjects such as animal quarantine, providing health regulatory measures for import/export of livestock and livestock products, animal feeds, etc., and prevention of inter-state transmission of animal diseases and control of diseases of national importance are the responsibilities of the central government.

The central government has a special responsibility for safeguarding against any new disease threatening to enter the country. In the event of an emergency in the livestock sector, the DADF activates its National Animal Disease Emergency Committee (NADEC) to monitor, evaluate and issue necessary guidelines to handle

the emergency. At the state level, a similar committee, i.e., the state animal disease emergency committee is activated. All important stakeholders, including specialists in the subject are members of these committees.

(B) Sub-national Veterinary Services

The provision of veterinary services falls within the purview of the state governments. Veterinary services are provided at state veterinary hospitals and dispensaries, and mobile veterinary clinics. Immunisation against prevalent endemic animal diseases, animal disease reporting, surveillance and controlling disease outbreaks are important functions of the state veterinary service. Delivery of veterinary services at state level is done both by field and laboratory services of each state and UT.

There is an inbuilt disease surveillance system in the country. Administratively, each state comprises of several districts. Each district is divided into tehsils/talukas, which are further divided into villages. A village is the smallest administrative unit at the grass-root level.

There is a well-knit infrastructure of government veterinary services units at each level. Broadly, state headquarters and large district towns have veterinary polyclinics, each district headquarter has a veterinary hospital and each tehsil headquarter has a veterinary dispensary. Veterinary assistant surgeons/veterinary officers who are veterinary graduates head all these institutions. At the village level, veterinary services are provided by VACs. Each VAC caters to the needs of about 5–10 villages. VACs are headed by veterinary field assistants who are non-graduate, para-veterinary personnel. They are given one to two years of training after matriculation in state-run government veterinary training schools. They impart preliminary veterinary services to farmers and administer preventive vaccination to livestock against prevalent infectious diseases.

A VAC is the first disease information unit at the grass-root level. Under the provisions of state disease control acts, a livestock owner or any other government or private personnel functioning in the area having knowledge about the onset of an infectious disease in livestock is supposed to inform the VAC. The VACs communicate disease outbreak information to the veterinary dispensary/hospital, which in turn passes on the information to the district veterinary officer and which further flows to the director of veterinary services. The state director sends a monthly report to Gol. Reporting of disease as per the OIE list of diseases is presently an important function of this disease surveillance system.

There are 250 disease investigation laboratories in India for providing disease diagnostics services. Many states have disease investigation laboratories at the district level. Each state has a state-level laboratory which is well equipped and has specialist staff in various disciplines of animal health.

Beside the state disease investigation laboratories there is one central and five referral regional disease diagnostics laboratories funded by the DADF. Each state agriculture university/veterinary college also has disease diagnostic facilities. At the national level, the IVRI, and specially its Centre for Animal Disease Research and Diagnostics based at Izatnagar (Bareilly) and the Disease Diagnostic Laboratory of the National Dairy Development Board (NDDB) at Anand, Gujarat, are highly specialised laboratories providing disease diagnostic services. In order to monitor ingress of exotic diseases, a state-of-the-art laboratory exists at HSADL, Bhopal with BSL-4 standards. By and large, all state-level laboratories, regional diagnostic laboratories, laboratories of ICAR/NDDB and HSADL are capable of diagnosing animal diseases.

(C) Animal Disease Management

In order to control diseases in economically important livestock and to undertake the obligatory functions related to animal health in the country, Gol is implementing a scheme for livestock health and disease control with the following components:

i) Assistance to States for Control of Animal Diseases (ASCAD)

Under this component, assistance is provided to state governments/UTs for the control of economically important diseases affecting livestock and poultry by way of immunisation, strengthening of existing state veterinary biological production units, strengthening of existing state disease diagnostic laboratories, holding workshops/seminars and in-service training to veterinarians and para-veterinarians. The programme is being implemented on a 75:25 sharing basis between the centre and the states, however, 100% assistance is provided for training and seminars/workshops. The states are at liberty to choose the diseases for immunisation as per the prevalence and importance of the disease in their state/region. Besides this, the programmes envisage collection of information on the incidence of various livestock and poultry diseases from states/UTs and compile the same for the whole country.

ii) National Project on Rinderpest Eradication (NPRE)

The objective of this scheme is to strengthen veterinary services and eradicate Rinderpest and Contagious Bovine Pleuro-Pneumonia (CBPP) and to obtain freedom from these infections following the path prescribed by OIE. The country has gained the status of 'Freedom from Rinderpest and CBPP Infections'. However, surveillance is still carried on.

iii) Foot and Mouth Disease Control Programme (FMD-CP)

To prevent economic losses due to FMD and develop herd immunity in cloven-footed animals, FMD-CP is being implemented in 54 specified districts of the country since 2003–04 as part of the Tenth Plan with 100% central funding for cost of vaccines, maintenance of cold chain and other logistic support to undertake vaccination. The state governments are providing other infrastructure and manpower for the programme. Six-monthly vaccination drives are carried out in the identified districts. The programme has considerably reduced losses due to this infection in the areas where it is being implemented.

iv) Professional Efficiency Development (PED)

The objective of this scheme is to regulate veterinary practice and maintain a register of veterinary practitioners as per the provisions of the Indian Veterinary Council Act, 1984 (IVC Act). In order to upgrade the skill of veterinarians, a Continuing Veterinary Education Programme has been initiated.

Under the Central Sector Scheme of the Directorate of Animal Health, schemes for Animal Quarantine and Certification Services, Disease Diagnostic Laboratories (central/regional laboratories) and the National Veterinary Biological Products Quality Control Centre (Institute of Animal Health) are functioning.

v) Animal Quarantine and Certification Services (AQCS)

While efforts have been made to ensure better livestock health in the country, simultaneous efforts are equally necessary to prevent entry of any disease into the country from outside through the import of livestock and livestock products. With this objective in view, four AQCS Stations, one

each at Mumbai, Kolkata, Delhi and Chennai, have been established. These stations are equipped to deal with all imports into the country.

vi) Functions of AQCS in India:

- a. Quarantine/testing of imported livestock and livestock products.
- b. Export certification of livestock/livestock products as per the requirements of the importing country and as prescribed in the Terrestrial Animal Health Code, OIE.
- c. Implementation of various provisions of the Livestock Importation Act, 1898 (as amended in 2001).

(vii) National Veterinary Biological Products Quality Control Centre (Institute of Animal Health)

In order to ensure the quality of veterinary biologicals used in the country for the prevention and control of infectious diseases, Gol has established the National Veterinary Biological Products Quality Control Centre at Baghpat, Uttar Pradesh, which is expected to start functioning soon. The institute has the following objectives:

- a. To recommend licensing of manufacturers of veterinary vaccines, biologicals, drugs, diagnostics and other animal health preparations in the country.
- b. To establish standard preparations for use as reference materials in biological assays.
- c. To ensure quality assurance of the veterinary biologicals both produced indigenously and through imports.

(vii) Livestock Insurance Scheme

Apart from the regular health schemes, the Livestock Insurance Scheme has also been

formulated with the twin objectives of providing a protection mechanism to farmers and cattle rearers against any eventual loss of their animals due to death and to demonstrate the benefit of the insurance of livestock to the people and popularise it with the ultimate goal of attaining qualitative improvement in livestock and their products. This centrally sponsored scheme has been implemented on a pilot basis in 2005–06 and 2006–07 during the Tenth Five-Year Plan in 100 selected districts. Under the scheme, crossbred and high yielding cattle and buffaloes are being insured at their current market price.

6.4.3 Research and Development in Livestock Health

The development of therapeutics and prophylactics against animal health problems, as well as developing best practices for disease management, disease epidemiology and surveillance for diseases are done primarily by a highly specialised laboratory under specialised animal science institutions like ICAR. Besides these institutions, state agricultural and veterinary universities, NDDB and several private sector establishments are also involved in the development of vaccines or diagnostics for livestock diseases.

6.4.4 Production of Veterinary Biologicals and Pharmaceuticals

Vaccines are manufactured both in the private sector as well as in the state-run biological production centres. The quality aspects of the manufacturing plants are regulated by the Drug Controller of India under MoH&FW. Compared to the number of livestock and poultry, as well as the number of diseases that are prevalent in the country, the infrastructure for such production is

inadequate. In the event of increased demand to meet the ideal standards of livestock health management, production facilities will be found wanting in terms of capacity and also in terms of good manufacturing practices with the state-controlled units.

6.5 Challenges

DM in livestock, be it due to infectious diseases or natural calamities, is inadequately addressed in the country. The professional and other stakeholders dealing with livestock are not adequately trained in this vital aspect of livestock management. The course curricula of veterinary and animal sciences do not adequately address this. Infectious disease control in livestock, particularly the existing ones, is well covered during training in universities. The capacity for timely detection of an exotic disease which has the potential of becoming a disaster, and its subsequent management so that it can be minimised, will require to be built up. A case in point is the recent incursion of bird flu into the country. Vital time were lost in its first experience in the country where the disease was initially confused with another existing disease in poultry with almost similar clinical manifestations. Through a series of training programmes, people have been trained to handle a possible emergency in case of any further occurrence of bird flu. However, simultaneous occurrences in several places in the country could still seriously stretch resources. It is essential that adequate stress be given to quality manpower development in the management of disease-related emergencies in livestock.

6.5.1 Existing Gaps in Animal Disaster Management

The following gaps could thus be identified in the management of disasters in livestock, be it due to natural calamities, diseases or an act of war:

- i) Inadequate trained manpower for DM: The existing livestock health management setup at both the state and central levels consists of veterinary professionals trained in routine management of animal diseases. There is a need to train veterinary professionals in the comprehensive management of animal emergencies of disastrous proportions. A separate force of trained volunteers should also be raised at the state and district levels to assist veterinary professionals in managing animal emergencies.
- ii) Inadequate training facility for staff in the management of disasters: At present, the training given to veterinary professionals is primarily in routine diseases management. Training objectives are confined to the management of endemic diseases only, no organised training is provided in the management of large-scale epidemics/pandemics such as bird flu, etc. In view of emerging animal pandemics such as bird flu, FMD, etc., there is an urgent need to institutionalise specialised training in the management of large-scale animal emergencies.
- iii) Inadequate biosecured laboratories for handling dangerous pathogens: Presently there is only one laboratory at HSADL, Bhopal, with BSL-4 standards. The recent experience with the bird flu outbreak revealed the inadequacy to cater for an epidemic/pandemic. There is a need to establish more regional laboratories of BSL-4 level to cater to emerging contingencies.
- iv) Lack of mobile veterinary laboratories/clinics to work at the emergency site: In case of epidemics occurring in remote and isolated places, on-the-spot primary diagnosis is a crucial aspect of emergency measures. Valuable time wasted in getting the diagnosis done at far-off laboratories can be saved with the availability of mobile diagnosis laboratories in the districts.
- v) Inadequate inter-state disease and emergency disease reporting system: The existing routine and paper-based disease reporting system is both time-consuming and ineffective in managing disease control and containment. The existing system should be replaced with a wide area network-based disease reporting system throughout the country.
- vi) Lack of policy in border areas regarding the movement of livestock in and around neighbouring countries where the borders are porous: The existing quarantine facilities, especially along the international borders with Nepal, Bhutan, Myanmar and Bangladesh are grossly inadequate in preventing the spread of TADs. The various security forces guarding these borders could be utilised by giving them the necessary policy backup, training and infrastructure.
- vii) Inadequate preparedness for animal DM at the district and state levels: Presently, animal health emergencies are not catered for in DM plans in many states and districts. As a policy guideline, inclusion of contingency measures for managing animal emergencies should be made mandatory.
- viii) Lack of a national policy for the rehabilitation of the animal husbandry sector after a disaster: Post-disaster rehabilitation of both disaster-struck animals as well as farmers is of paramount importance due to the obvious health and economic implications. There is a need to lay down policies for systematic and organised management of rehabilitation efforts.

6.6 Guidelines for the Management of Livestock Disasters

6.6.1 Risk and Vulnerability Assessment

Disasters that could lead to an emergency situation in the animal husbandry sector may arise

primarily due to the following four categories of risks:

- i) Natural disasters: Flood, drought, cyclone, tsunami, earthquake, etc.
- ii) Infectious diseases: Zoonotic and non-zoonotic.
- iii) Fodder poisoning.
- iv) Miscellaneous: War (conventional war, BW or BT).

(A) Natural Disasters

India is vulnerable to most types of natural disasters and its vulnerability varies from region to region and a large part of the country is exposed to these natural hazards which often turn into disasters, causing a significant disruption of the social and economic life of communities arising from the loss of life and property, including livestock. The risk factors required to be included in the risk assessment analysis with respect to a group of natural disasters are listed below:

- i) Cyclic Drought and Famine
 - a. Breeding capacity.
 - b. Fertility.
 - c. Pregnancy and lactation.
 - d. Population drift due to
 - heavy economic losses
 - scarcity of feed and fodder
- ii) Tsunami, heavy snowfall and rain, flood
 - a. High mortality rate among livestock due to drowning (generally they are not set free to move to highland areas, making them vulnerable to the situation).
 - b. Unavailability of clean drinking water.
 - c. Outbreak of diseases due to improper disposal of carcasses.

- d. Public health problems.
- iii) Earthquake
 - a. Injured livestock lead to problems of their maintenance.
 - b. Death or desperation of the owners leads to neglect of the livestock thereby increasing the indirect losses.

The above factors will be used to define the steps of risk and vulnerability assessment. The major recommendations for district/state authorities include:

- i) Development of 'multi-hazard' risk and vulnerability mapping of the districts.
- ii) Development of demographic maps of areas with dense/scarcie population of livestock.
- iii) Other factors that compound/reduce the contained risk, including variable climatic conditions and availability of medical logistics.

(B) Infectious Diseases

Emergency animal diseases are not always the same as exotic or foreign animal diseases. Outbreaks of infectious diseases are of many types:

- i) Any unusual outbreak of an endemic disease in exponential frequency causing significant change in the epidemiological pattern of that particular disease.
- ii) The appearance of a previously unknown disease in a particular region.
- iii) Animal health emergencies caused due to non-disease events, for example, a major chemical residue problem in livestock or a food safety problem such as hemorrhagic uraemic syndrome in humans caused by the contamination of animal products by verotoxic strains of *E. coli*.

- iv) Deliberate introduction of exotic microorganisms in a targeted region.

A risk analysis will enumerate the mitigation strategy to be outlined for the prevention of such livestock diseases:

- i) Mitigation measures will be developed, based on the risk assessment analysis, to control the spread of such diseases.
- ii) Mapping will be done of infectious diseases endemic to the area and level of prevalence in the past.
- iii) Surveillance mechanisms will be set up to detect exotic microorganisms to prevent outbreaks and high priority diseases that may lead to national emergencies.
- iv) Large-scale epidemics which may occur due to the introduction of a new disease or infectious agent or uncontrolled movement of animals resulting in mixing of the susceptible and infected population, have to be checked.
- v) Genetic mutation in an otherwise innocuous infectious agent, climatic changes or disruption of the environment necessitate changes in husbandry and DM practices. Routine monitoring/surveillance of field flocks will be undertaken, particularly in seasons which are conducive to such epidemics.
- vi) The vaccination status of all livestock will be periodically checked.

(C) Fodder Poisoning

Nitrate accumulation in plants leads to nitrate/nitrite poisoning which is a potential danger to grazing animals with pigs being most susceptible, followed by cattle, sheep and horses. In order to keep a check on such cases, awareness among the local community must be created so that they take proper care of their animals and prevent them from eating poisonous toxic materials. Based on

the above approach, the following activities will be undertaken:

- i) Listing of the various poisonous materials, including braken fern, *Lantana camara*, parthenium, rati (*Abrus prectorus*), dhatura (thorn apple), kaner (oleandar); cyanogenic plants like immature maize, sorghum banchari, cereal affected with egrot, India pea; nitrate and nitrite containing plants, etc.; and the measures to prevent the availability of such materials to livestock.
- ii) Exotic/cross breeds are more susceptible to damage under drought conditions than indigenous breeds. Livestock owners will be made aware of how to take proper care of these exotic/cross breeds.
- iii) Certain areas will be demarcated for fodder production, especially of Crassulacean Acid Metabolism (CAM) varieties of plants, particularly in desert areas. Pastures should also be developed for migratory sheep and goat and clean grain made available for pigs and poultry.

(D) Trans-boundary Animal Diseases

TADs are a major cause of economic losses to the livestock industry and are those infectious diseases which could spread fast and have the potential to cause considerable mortality or losses in productivity. TADs have the capability to seriously affect earnings from export of livestock or its products.

A TAD epidemic such as avian influenza (bird flu) or FMD has the same characteristics as other natural disasters—it is often a sudden and unexpected event, has the potential to cause major socio-economic consequences of national dimensions and even threaten food security, may endanger human life, and requires a rapid national-level response. The following diseases are of immense importance from both animal husbandry and public health perspectives:

- i) Non-zoonotic diseases
 - a. FMD*
 - b. Peste des Petits Ruminants (PPR)*
 - c. Rinderpest
 - d. Vesicular stomatitis
 - e. African Swine Fever (ASF)
 - f. Classical Swine Fever (CSF)*
 - g. Contagious Bovine Pleuropneumonia (CBPP)
- ii) Diseases with known zoonotic potential
 - a. Anthrax*
 - b. Bovine Spongiform Encephalopathy (BSE)
 - c. Brucellosis (*B. melitensis*)*
 - d. Crimean Congo hemorrhagic fever
 - e. Ebola virus
 - f. Food-borne diseases
 - g. Highly Pathogenic Avian Influenza (HPAI)*
 - h. Japanese encephalitis*
 - i. Marburg hemorrhagic fever
 - j. New World screwworm
 - k. Nipah virus
 - l. Old World screwworm
 - m. Q fever
 - n. Rabies*
 - o. Sheep pox*/goat pox*
 - p. Tularemia
 - q. Venezuelan equine encephalomyelitis
 - r. West Nile virus

(* indicates presence of the disease in India)

Almost all the diseases mentioned above have the potential to assume epidemic proportions, yet a few important ones that have been endemic in

India and could possibly play havoc with the national economy as well as public health are FMD, rinderpest, PPR and avian influenza (H5N1).

The major recommendations to contain these endemic diseases which have epidemic potential are as follows:

- i) Strict quarantine inspection and testing will be undertaken for any form of imported germplasm prior to release.
- ii) In case of avian influenza, special care will be taken during the migratory season to prevent mixing of wild and domestic population of birds.

Exotic animal diseases have managed to enter India a number of times causing severe loss to the livestock industry. A risk analysis will monitor the emergence and re-emergence pattern of exotic diseases:

- i) HPAI emerged in two instances though it has been stamped out of indigenous territory.
- ii) Exotic diseases like bluetongue in sheep, infectious bovine rhinotracheitis in cattle, PPR in sheep and goat or infectious bursal disease in poultry have now become endemic in the country. Effective vaccines are available in our country to manage these livestock diseases.
- iii) Exotic diseases prevailing in other countries which have a higher vulnerability potential of re-emergence in Indian livestock, for example rinderpest, which is still prevalent in some parts of Africa and is one of the most dreadful infections of cattle until recent times.
- iv) Presently, Indian livestock is vaccinated against serotypes 'O', 'A' and 'Asia 1', but is highly vulnerable to world serotypes 'C', 'SAT 1', 'SAT2' and 'SAT 3' and the antigenic variants of existing serotypes that require constant surveillance.

The risk management practices based on these prevailing risk factors will include:

- i) Check on the unhindered movement of animals across the states; incursion of any new infectious disease that could cause serious losses of livestock.
- ii) Diseases like HPAI with an inherent zoonotic potential will be kept under constant surveillance.
- iii) Risk maps will have trend maps with periodic shift patterns, time intervals of re-emergence and consequence management analysis of increase/reduction in the overall risk due to the introduction of exotic breeds.
- iv) Human disease surveillance data and probabilities of shift from livestock to humans or vice versa will be mapped to define the areas that require adoption of appropriate mitigation strategies.

(E) Miscellaneous Causes

India may have remained blissfully unaware of the losses in livestock due to the Bhopal gas tragedy or the consequences of arsenic or other toxic elements that may not only cause acute loss of livestock but are also potentially hazardous for public health as livestock produce is directly related to the human food chain. The impact of major accident hazard units such as nuclear reactors and hazardous waste dumping sites are examples of slow and impending livestock disaster situations. The major recommendations include:

- i) Development of risk management plans for incident site contamination levels and ecological studies to define the routing of the various toxins to livestock.
- ii) Regular health surveys of the livestock of these regions by an assigned authority, based on mutually agreed mechanisms between the public and private sectors.

- iii) Ensuring the availability of emergency kits with farmers and people living in the vicinity of known hazardous factories/nuclear laboratories, etc.

6.6.2 Capacity Development

A large number of farmers in rural India suffer loss of livestock due to various diseases. It is essential to prevent and mitigate such losses by capacity development in the following areas:

- i) Immediate relief in terms of emergency aid through Veterinary Assistance Teams (VATs), temporary makeshift shelters and emergency provision for water and feed packages. A disaster often impacts the surroundings, altering the landscape's character, feel, smell, look and layout. It is important to provide an alternative shelter, clean and uncontaminated water and ensure that damaged grain and mouldy hay or feed or forage that may have been contaminated by chemicals or pesticides is not consumed by them.
- ii) Infrastructure for disposal of dead animals: Burial/disposal methods of animal carcasses and other products (tissues) of animal origin will continue to be an important and necessary concern. The purpose of a 'secure' burial is to physically isolate wastes from the environment and to prevent contamination of water and air. At the village level, some suitable land should be identified beforehand, for any emerging contingency. Ideally, incineration facilities for proper disposal of animal carcasses are essential as specific disease control measures during epidemics.
- iii) Infrastructure for containment of epidemics: Any attempt to contain an emerging pandemic virus at its source is a demanding and resource-intensive operation. The feasibility of rapid containment depends on

the number of contacts of the initial cases and the ability of government authorities to ensure basic infrastructure and essential services to the affected population. The infrastructure for various services including shelter, power, water, sanitation, food, security, and communications will be developed to maintain strict infection control in isolation/quarantine facilities. Training of first responders for proper culling of birds by animal husbandry teams is essential to prevent the spread of bird flu.

- iv) Organised rehabilitation packages for livestock livelihood: A programme that delivers a comprehensive package of combined services including restocking, shelter construction and income-raising activities; water and sanitation interventions; health, nutrition and psychological stress amelioration with education and disaster preparedness, will be undertaken.
 - a. Building infrastructure for disease forecasting: Disease surveillance should utilise modern computing and communication technology to convert data into useable information quickly and effectively. Accurate and efficient data transfer with rapid notification to key partners and constituents is critical for effectively addressing the threat of emerging diseases.
 - b. Training of farmers on mitigation of disaster losses: Villagers (livestock farmers, including women) should be given intensive DM training. This will include preparation for post-earthquake, flood, cyclone and fire situations. The objective of the programme is to help build, within a short period of time, a mechanism that can respond to natural calamities and facilitate early recovery. Outcomes of the training should include better

coordination with relief and rescue efforts of government and humanitarian agencies so as to avoid the mismanagement that often hampers relief operations following natural disasters.

- c. Awareness programme on accidental and man-made chemical/biological disasters: A well-organised training programme of veterinary professionals as well as administrative officials in livestock emergency management is the need of the hour. A brief module in the form of a workshop should be organised to apprise the concerned parties of the emerging threat perceptions and their countermeasures. The training facilities available with KVKs as well as agriculture universities should be utilised.
- d. Enhancement of the capabilities of emergency field and laboratory veterinary services, especially for specific high-priority livestock disease emergencies. Accurate and timely laboratory analysis is critical for identifying, tracking and limiting threats to livestock health. The national network of animal health laboratories will be strengthened for a more efficient livestock health system and augmentation of its capacity to respond effectively to livestock health disasters.

6.6.3 Inter-departmental Support

Several essential government services, other than MoA, will be invaluable during crisis to mitigate impact on the animal husbandry sector. These include, inter alia:

- i) Defence forces (notably the Army and Air Force) which can provide support for such

activities, including transportation of personnel and equipment to disaster or disease outbreak sites, particularly when these are inaccessible to normal vehicles; provision of food and shelter; protection of disease control staff in areas with security problems and provision of communication facilities between national and local disease control headquarters and field operations.

- ii) Veterinary professionals of the Army and various forces guarding the border, viz., Assam Rifles, Border Security Force (BSF), Indo-Tibet Border Police (ITBP) and Sashastra Seema Bal (SSB) will be trained and co-opted in the containment of TADs.
- iii) Police or security forces for assistance in the application of necessary disease control measures such as enforcement of quarantine and livestock movement, control measures, and protection of staff if necessary.
- iv) Public works department, for provision of earth-moving and disinfectant-spraying equipment, and expertise in the disposal of slaughtered livestock in eradication campaigns.
- v) National or state emergency services for logistics support and communications. Defence forces and various paramilitary forces will be equipped and entrusted to provide necessary logistics and communication backup in case of emergency.
- vi) Revenue Department services for compensation against losses. A uniform policy for compensation that has necessary legislative backing will be entrusted to the Revenue Department to ensure implementation.
- vii) Liaison with, and involvement of, relevant persons and organisations outside the government animal health services who also have a role in animal health emergency

preparedness planning. This would include, inter alia, the National Veterinary Association, livestock industry groups, national/state authorities and Departments of Finance, Health and Wildlife.

6.6.4 Livestock Management during Disasters

The following preparations are essential for management of animals during disasters:

- i) Development of flood, cyclone and other natural calamity warning systems. In principle, an EWS would make it possible to avoid many adverse economic and human costs that arise due to the destruction of livestock resources every year. Reliable forecasting would also allow state governments to undertake more efficient relief interventions. Other tools that may provide early warning signals include field monitoring and remote sensing systems. Ideally, field monitoring should provide monthly flows of information on the availability of water and the general state of crop and livestock production. Useful production parameters include marketing trends, particularly the balance of trade between livestock and grain foods, and anthropomorphic measures such as the mean arm circumference of children under five. Remote sensing, which relies on imagery satellites, is a valuable tool when used in conjunction with field monitoring. These tools will be integrated to develop an effective EWS.
- ii) Establishment of fodder banks at the village level for storage of fodder in the form of bales and blocks for feeding animals during drought and other natural calamities is an integral part of disaster mitigation. The fodder bank must be established at a secure highland that may not be easily affected by a natural calamity. A few fodder banks

- will be developed as closed facilities to prevent them from getting contaminated.
- iii) Supply of feed ingredients at nominal cost from the Food Corporation of India: Most grain rations for cattle and sheep provide enough protein to maintain a satisfactory 10–12% level. But when we feed livestock in emergency situations—mostly low-protein materials such as ground ear corn, grain straws or grass straws—a protein supplement is needed. Adequate reserves as per the availability of resources will be developed.
 - iv) Conservation of monsoon grasses in the form of hay and silage during the flush season greatly help in supplementing shortage of fodder during emergencies such as drought or flood. The objective is to preserve forage resources for the dry season (hot regions) or for winter (temperate regions) in order to ensure continuous, regular feed for livestock. It is an important disaster mitigation strategy.
 - v) Development of existing degraded grazing lands by perennial grasses and legumes. As a majority of the population in drought-prone areas depends on land-based activities like crop farming and animal husbandry, the core task for development will be to promote rational utilisation of land for supplementing fodder requirements during emergencies.
 - vi) Provision of free movement of animals for grazing from affected states to the unaffected reduces pressure on pastures and also facilitates early rehabilitation of the affected livestock. In emergency situations, the presence of livestock can exacerbate conflict when refugees with animals compete for reduced forage and water resources. To prevent this, what is technically known as emergency destocking programme, will be instituted. This programme provides for the intentional removal of animals from a region before they die.
 - viii) Treatment and vaccination of animals against contagious diseases in flood affected areas. Routine prophylactic vaccination of livestock in flood-prone area significantly reduces the severity of the post-disaster outbreak of any endemic diseases. Since animals affected by floods are prone to pick up infectious diseases, vaccination and veterinary camps will be set up to treat and immunise livestock against various diseases. The creation of a community based animal health care delivery system may significantly reduce livestock deaths in a region. Vaccination programmes and primary animal health care will prevent some of the drastic losses associated with the onset of rains.
 - ix) Provision of compensation on account of distressed sale of animals and economic losses to farmers due to death or injury of livestock. Compensation for animals and other property affected by an emergency due to an animal disease outbreak is an integral part of the strategy for eradicating or controlling disease. A legislation that provides the power to destroy livestock and property, and ultimately determines the process by which compensation is to be paid, will be enacted and implemented by the respective legislative bodies.

6.6.5 Disposal of Dead Animals during Disasters

Carcasses can be a hazard to the environment and other animals and require special handling. To minimise soil or water contamination and the risk of spreading diseases, guidelines for proper carcass disposal must be followed. Disposal options include calling a licensed collector to

remove dead stock or burial in an approved animal disposal pit. Alternatives include incineration and burial. Burial avoids air contamination associated with burning carcasses and is economical. Since the heat in the pile eliminates most pathogens, burial can also improve the biosecurity of farming operations.

A plan for the disposal of dead livestock should address selection of the most appropriate site in each village or cluster of villages for burial or burning, disinfection process, provision of costs for burial or burning, material and equipment required for burial and burning, etc. A prototype guideline for disposal of livestock is provided for reference (Annexure-H).

6.6.6 Strategy for Emergency Management

- i) There will be efforts to prevent an emergency, reduce the likelihood of its occurrence or reduce the damaging effects of unavoidable hazards long before an emergency occurs. Flood and fire insurance policies for farms are important mitigation activities.
 - ii) It is pertinent to develop plans regarding what to do, where to go, or who to call for help before an event occurs—actions that will improve chances of successfully dealing with an emergency. These include preparedness measures such as posting emergency telephone numbers, holding disaster drills and installing warning systems.
 - iii) Efforts need to be made to respond safely to an emergency by converting preparedness plans into action. Seeking shelter from a cyclone or moving out of the buildings during an earthquake are both response activities. The Gol Action Plan for management of the outbreak of bird flu is an example of the effective handling of an outbreak of livestock disaster in the country.
- iv) A comprehensive strategy for recovery actions to bring back normalcy, including assistance for repairs and other losses will be identified in DM plans.

Safety is an important aspect of a response plan and every action plan will enumerate different responding activities to be undertaken for the effective management of livestock disasters. The response plan will be rehearsed to remove the plausible anomalies in actions.

6.6.7 Steps for Prevention, Mitigation and Preparedness

DM plans at all levels will include the following important measures:

- i) Public awareness about natural disasters that different regions and the country are most likely to experience and their consequences on the livestock sector.
- ii) Provisions to establish adequate facilities to predict and warn about the disasters periodically, including forecasting disease outbreaks. This could only be achieved by a well networked surveillance mechanism that proactively monitors emerging infections and epidemics.
- iii) Development and implementation of relevant policies, procedures and legislation for management of disasters in the animal husbandry sector. The livestock health infrastructure in India, modelled to provide routine veterinary cover, needs reorganisation in view of emerging epidemics/challenges. The existing animal husbandry policies will be revisited and if required, modified to cater to changing realities.
- iv) Mobilise the necessary resources, e.g., access to feed, water, health care, sanitation and shelter, which are all short-term measures. In the long term, resettlement

- programmes, psycho-social, economic and legal needs (e.g., counselling, documentation, insurance) are required to be undertaken.
- v) Another long-term strategy is required to readjust the livestock production system in the country from a biosecurity point of view so that in the event of the entry of any new, dangerous pathogen, the losses could be minimised by segregation.
 - vi) Initiation of PPP in livestock emergency management, especially in the field of vaccine production, will go a long way in combating animal health emergencies of infectious origin. Similar partnership in feed manufacturing as well as livestock production will minimise the losses due to other livestock emergencies.
 - vii) Commissioning of risk assessments on high-priority disease threats and subsequent identification of those diseases whose occurrence would constitute a national emergency.
 - viii) Appointment of drafting teams for the preparation, monitoring and approval of contingency plans. Implementation of simulation exercises to test and modify animal health emergency plans and preparedness are also necessary.
 - ix) Assessment of resource needs and planning for their provision during animal health emergencies.
 - x) Central/state governments will develop/ establish an adequate number of R&D and biosafety laboratories in a phased manner for dealing with animal pathogens.
 - xi) A dedicated establishment, preferably under DADF, may be entrusted with the overall monitoring of the national state of preparedness for animal health emergencies.
 - xii) Development of active disease surveillance and epidemiological analysis capabilities and emergency reporting systems.
 - xiii) A computer-based national grid of surveillance and disease reporting should be developed for timely detection and containment of any emergent epidemic.
 - xiv) An intelligence cell—Central Bureau of Health Intelligence under DGHS should be raised to assist the proposed National Animal Disaster Emergency Planning Committee (NADEPC).
 - xv) Immunisation of all persons who are likely to handle diseased animals such as anthrax infected cattle and animals.

6.6.8 Research and Development

The need for strategic research to mitigate risks of biological disasters in livestock—a vital component of the human food chain—is in no way different from risks to humans. The world is slowly moving towards the ‘one health: animal health and public health’ concept, as it has been seen that most newly emerging human epidemics in the last decade in various parts of the world had originated in livestock or other animals and birds. Therefore, the requirements of R&D efforts for livestock DM are similar these discussed in Chapter 4. Research institutions of ICAR, defence organisations, ICMR, DBT and CSIR will identify areas of potential threat and disasters in livestock and fisheries and readjust their research priorities to address these concerns to be in readiness for any eventuality.

7

Guidelines for Management of Agroterrorism

The agricultural sector comprising of crop plants and animals are susceptible to a large number of diseases and pests in nature, some of which assume epidemic proportions due to the appearance of more severe or virulent strains/races/biotypes of the pests in a given area under certain favourable conditions, causing huge economic losses. The present chapter, mainly focuses on the disease/pest outbreaks in the agrarian sector which are deliberately brought about by malafide intentions. The key difference between natural epidemics and those that are deliberately induced is an element of vigilance that needs special attention by intelligence agencies for the management of agroterrorism.

Agroterrorism is clearly not aimed at agriculture per se but at crippling the economy. Indeed, agroterrorism certainly has a number of advantages for the perpetrator over the more anticipated forms of BW aimed directly at humans. The agents are generally not hazardous to man and so can be produced and carried with minimal risk. The technical and operational challenges are reduced, since the pathogens rapidly reproduce and are easily disseminated—such as by walking in a field with contaminated shoes, hiring a crop duster to infect wheat fields, wiping a cow's nose with an infected handkerchief. All these actions could easily go unnoticed yet be sufficient to spread disease. Moreover, the trend of planting monocultures having a high degree of genetic homogeneity, the concentration of a single crop in one region and the intensive rearing of animals all aid in the spread of disease. The targets are vulnerable and the security levels low.

Agroterrorists could release damaging insects, viruses, bacteria, fungi or other microbes as bioweapons that are mainly aimed at wiping out crops or farm animals. They also could attempt to poison processed foods. Although the consequences of an agroterrorism attack are substantial, relatively little attention has been focused on this threat worldwide. Agricultural and food industries—the most important industries in the world are most vulnerable to disruption. It is also an easy way to cause huge damage when compared to other terrorist attacks, and the capabilities that terrorists would need for such an attack are not considerable. The incidences of agroterrorism in Colorado during WW II, attacks on Cuban crops, the citrus tanker disease in Florida and deliberate attacks in Sri Lanka are some of the cited examples.

7.1 Dangers from Exotic Pests

In the past, a number of plant and animal diseases and pests have been introduced through import of seeds/planting materials/livestock and livestock products and many of them have become established and continue to cause economic losses every year. In the case of crops, the important diseases include bunchy top in banana, potato wart, downy mildew in sunflower, chickpea blight, San Jose scale in apple, coffee berry borer, the invasive weed *Lantana camara* and more recently the biotype 'B' of whitefly *Bemisia tabaci* (most efficient vector of the tomato leaf curl virus). The diseases affecting animals include infectious bovine rhinotracheitis, PPR, blue tongue, equine

infectious anaemia, infectious bursal disease, reo and adeno viruses, etc.

The banana bunchy top disease was recorded for the first time in 1943 in Kottayam District in the erstwhile princely State of Travancore (now Kerala). The disease was believed to have come from Sri Lanka (then Ceylon). An eradication programme initiated in the 1950s met with little success as the virus spread through the aphid vector, viz., *Pentalonia nigronervosa*. Subsequently, the disease spread to Assam, Kerala, Orissa, Tamil Nadu and West Bengal. The central government issued a domestic quarantine notification in 1959 prohibiting transportation of banana planting material from the above states to any other state/UT. However, in the absence of effective implementation of domestic regulatory measures, the disease continued to spread to other states and its incidence was reported from most banana-growing areas of the country. Of late, the banana bunchy top disease has completely wiped out the hill banana cultivation in the lower Palani Hills area of Tamil Nadu.

The coffee berry borer (*Hypothenemus hampei*) was first reported in the Gudalur area of Nilgiris District in Tamil Nadu in 1990. The pest was believed to have been introduced through infested coffee beans brought by Sri Lankan repatriates settled in Gudalur area. Surveys carried out in 1992 have revealed incidence of the pest in coffee growing areas of Wyanad District of Kerala and Kodagu (Coorg) District of Karnataka. The central government issued a notification in 1992 prohibiting the movement of coffee beans (seeds) and planting material from Nilgiris, Wyanad and Kodagu Districts. With the removal of restrictions on the pooling of coffee by the Coffee Board and introduction of the free sale quota, the pest continued to spread to newer areas due to unrestricted movement of infested berries to curing places located outside these three districts. The infested area was about 10,000 ha in 1993 and

the incidence of berry borer damage as high as 60–70% in a few badly managed plantations in Byrambada area of Kodagu District. Late harvesting also aggravated the buildup of berry borer population. Recently, the incidence of berry borer has been reported from the coffee growing areas of lower Palani Hills.

The damage potential of dangerous pests and diseases which have not yet been reported from India is high especially if misused or mishandled. These can cause immense harm to human beings and ecosystems on a large scale, which is an issue of great concern. Thus, the agricultural economy is vulnerable to serious threats from exotic pests.

Diseases that have the potential to be used as bioweapons are listed below:

(A) Bacterial and Fungal Pathogens

- i) Bacterial wilt and ring rot in potato (*Clavibacter michiganensis* sub sp. *sepedonicus*).
- ii) Fire blight in apple and pear (*Erwinia amylovora*).
- iii) Black pod in cocoa (*Phytophthora megakarya*).
- iv) Powdery rust in coffee (*Hemelia coffeicola*).
- v) Sudden death in oak (*Phytophthora ramorum*).
- vi) South American leaf blight in rubber (*Microcyclus ulei*).
- vii) Vascular wilt in oil palm (*Fusarium oxysporum* f sp. *elaedis*).
- viii) Soybean downy mildew (*Peronospora manshurica*).
- ix) Blue mold in tobacco (*P. hyocyami* sub sp. *tabacina*).
- x) Tropical rust in maize (*Physopella zaeae*).

(B) Virus, Viroid and Phytoplasma

- i) Barley stripe mosaic virus.
- ii) Coconut cadang-cadang (Viroid).
- iii) Palm lethal yellowing (Phytoplasma).

(C) Plant Parasitic Nematodes

- i) Pine wood nematode (*Bursaphelenchus xylophilus*).
- ii) Red ring nematode in coconut (*Rhadinaphelenchus cocophilus*).

(D) Insect Pests

- i) Mediterranean fruit fly (*Ceratitidis capitata*).
- ii) Cotton boll weevil (*Anthonomus grandis*).
- iii) Russian wheat aphid (*Diuraphis noxia*).

7.2 Basic Features of an Organism to be used as a Bioweapon in the Agrarian Sector

For an organism to be used as a bioweapon, it should possess certain basic characteristics. These include high adaptability to a wide range of ecological conditions and easy amenability for mass production and discrete packaging with no special requirements of storage, etc. The organism should also have a strong competitiveness, high rate of propagation to be able to spread far and wide with minimum inoculum, and also have the ability to propagate persistently. The organism should also affect a key crop grown over large areas so as to cause significant losses to the target country or to an important agro-industry.

7.3 Dangers from Indigenous Pests

Apart from the threat of exotic destructive agricultural pests, their strains/isolates/biotypes reported also have a potential for use as bioweapons comprising viruses such as rice tungro bacilliform virus with four variables isolated from

South Asia; rice tungro spherical virus whose Indian isolate is different from Southeast Asian isolates; cotton leaf curl virus which causes severe damage in Pakistan but has limited distribution in India; groundnut bud necrosis virus having a wide host range; banana bunchy top virus with five identified strains; and tobacco streak virus, citrus tristeza virus and mungbean yellow mosaic virus which have reported several strains. The pathogens causing serious diseases where variability has been reported are cereal rusts caused by *Puccinia triticina* (whose spores are airborne of which a number of virulent pathotypes are known), rice blast (*Pyricularia oryzae*, where a high degree of variability has been reported), *Bulkholderia solanacearum* (whose race 2 is not known in India) and *Xanthomonas campestris* pv *malvacearum* (of which the most virulent pathovar in Africa, XcmN, is not known in India). The insects where biotypes have been reported include *Bemisia tabaci* (a highly polyphagous pest which attacks more than 600 host plant species has 16 known biotypes); brown plant hopper (*Nilaparvata lugens*, where biotypes from India differ from those in other Asian countries); rice gall midge (*Orseolia oryzae*, has six biotypes known from India) and red flour beetle (*Tribolium castaneum*, whose strains show variability in the level of pesticide resistance). Several races have also been reported for nematodes like *Meloidogyne incognita*, *M. javanica*/*M. arenaria* and *Heterodera avenae*.

7.4 Present Status and Context

The economy of India is largely linked to the growth of agriculture as it is a predominantly agrarian country. Indian agriculture has made rapid progress in taking the annual foodgrain production from 51 million tonnes in the early 1950s to 200 million tonnes at the turn of the century, thereby making the country self-reliant in food production. However, the liberalisation of world trade in agriculture since the establishment of WTO in 1995 has brought in many challenges apart from opening

up new vistas for growth and diversification of agriculture. We need to sustain food security along with economic and environmental security.

Under the present scenario of liberalised trade in agriculture, there is an increasing likelihood of a number of serious exotic pests gaining entry and establishment through bulk imports. Among these are moko wilt in banana, which has seriously threatened banana cultivation in Central and South America. Further, lethal yellowing of coconut is another dreadful disease which was responsible for the loss of more than half a million coconut palms in Jamaica, which was worst affected and created havoc in the Caribbean region. Cadang-cadang is another destructive disease in coconut reported from Philippines and Guam. The red ring nematode causes serious losses to coconut and other palms in tropical America. The South American leaf blight in rubber is another disease of quarantine concern which, so far, is not known to have occurred in Southeast Asia, but is still a serious concern to rubber producing countries in this region. Coffee berry disease is of sufficient concern to India and has caused serious losses in coffee production in African countries. Further, two destructive pathogens of cocoa, viz., swollen shoot virus and witches' broom though not known to have occurred yet in India, are of sufficient concern to cocoa production in the country. Likewise there are many pests that attack plants against, which we need to safeguard our country.

It may be mentioned that a number of destructive pests/diseases have recently been intercepted in quarantine, which highlights the risk of introduction of these pests/diseases through indiscriminate imports. The interceptions in plants include insects like *Anthonomus grandis* on *Gossypium* sp from USA, *Ephestia elutella* on *Triticum aestivum* from Italy, nematodes like *Ditylenchus dipsaci* in *Allium cepa* from England, *Heterodera schachtii* in *Beta vulgaris* from Germany; pathogens like *Peronospora manshurica* in *Glycine* spp from several countries and viruses

like cowpea mottle virus on *Vigna unguiculata* from the Philippines and *Alfalfa mosaic virus* on *Vigna unguiculata* from Nigeria.

7.4.1 Legislative and Regulatory Framework

The legislative and regulatory framework at the national and international level for the management of agroterrorism activities are discussed in the following sections.

(A) National

i) Destructive Insects and Pests Act, 1914

The quarantine law was enacted for the first time in India in 1914 as the Destructive Insects and Pests (DIP) Act. A gazette notification entitled 'Rules for Regulating the Import of Plants etc., into India' was published in 1936. Over the years, the DIP Act has been revised and amended several times. However, it was further amended to meet the emerging scenario of liberalised trade under WTO.

The DIP Act (1914) provides for the following:

- a. It prohibits or regulates the import into India or any part thereof or any specific place therein or any article or class of articles.
- b. It also prohibits or regulates the export from a state or the transport from one state to another state in India of any plants and plant materials, diseases or insects, likely to cause infection or infestation.
- c. It authorises the state government to make rules for the detention, inspection, disinfection or destruction of any pest or class of pests or of any article or class of articles, in respect of which the central government has issued notifications.

In 1984, a notification was issued under the DIP Act, namely Plants, Fruits and Seeds (Regulation of Import into India). The order, popularly known as the PFS Order, was revised in 1989 after the announcement of the New Policy on Seed Development by Gol in 1988, proposing major modifications for smooth quarantine functioning. The new policy covered the import of seeds, planting materials of wheat, paddy, coarse cereals, oil seeds, pulses, vegetables, flowers, ornamentals and fruit crops. While liberalising imports, care has been taken to ensure that there is absolutely no compromise on plant quarantine requirements. Though there are several requirements under the PFS Order, 1989, the most important are:

- a. No consignment would be imported into India without a valid import permit issued by the concerned competent authority: (a) for bulk consignments the import permit issued by the Plant Protection Advisor to Gol; (b) for importing germplasm of agri-horticultural crops, the Director of the National Bureau of Plant Genetic Resources (NBPGR) is authorised by Gol to issue import permits, both for government institutions as well as private seed companies; (c) for forest plants, the Forest Research Institute, Dehradun; and (d) for the remaining plants of economic and general interest, the Botanical Survey of India, Kolkata. No consignment will be imported unless accompanied by an official phyto-sanitary certificate issued by an official agency of the exporting country.
- b. Seeds/planting materials requiring isolation growing under detention, to be grown in an approved post-entry quarantine facility.

- c. Import of soil, earth, sand, compost, plant debris accompanying seeds/planting materials is not permitted. Besides, hay, straw or any other material of plant origin are not to be used as packing material.
 - d. Special conditions for import of plants, seeds for sowing, planting and consumption mentioned under Schedule II (Clause 4) of the Order.
- ii) Plant Quarantine (Regulation of Import into India) Order, 2003.

With liberalised trade under the WTO Agreements, there has been a pressing need for complying with international phytosanitary regulations. Therefore, to fill in the gaps in the existing PFS Order, viz., regulating the import of germplasm/GMOs/transgenic plant material; live insects/fungi including biocontrol agents etc.; and to fulfil India's obligations under the international Agreements, the Plant Quarantine (PQ) (Regulation of Import into India) Order, 2003 came into force from 1 January 2004. Under this Order, the need for incorporation of additional/special declarations for freedom of imported commodities from quarantine and alien pests on the basis of standardised Pests Risk Analysis, particularly for seed/planting materials, is also taken care of.

Under the PQ Order, 2003, the scope of plant quarantine activities has been widened with the incorporation of additional definitions. The salient features of the Order are:

- a. Pest Risk Analysis (PRA) has been made a precondition for imports.
- b. Prohibition has been imposed on the import of commodities with weeds/alien species contamination as per Schedule VIII; and restriction on the import of packaging material of plant origin, unless treated.

- c. Provisions have been included for regulating the import of soil, peat and sphagnum moss; germplasm/GMOs/transgenic material for research; live insects/microbial cultures and biocontrol agents and timber and wooden logs.
- d. Agricultural imports have been classified as (a) Prohibited plant species (Schedule IV); (b) Restricted species where import is permitted only by authorised institutions (Schedule V); (c) Restricted species permitted only with additional declarations of freedom from quarantine/regulated pests and subject to specified treatment certifications (Schedule VI) and ; (d) Plant material imported for consumption/industrial processing permitted with normal Phyto-sanitary Certificate (Schedule VII).
- e. Additional declarations have been specified in the Order for import of 400 agricultural commodities, specifically listing 600 quarantine pests and 61 weed species (now 31 as per Amendment III of the PQ Order, 2003).
- f. Notified points of entry have been increased to 130 from the existing 59.
- g. Certification fee and inspection charges have been rationalised.

So far, 10 amendments of the PQ Order, 2003, have been notified to WTO revising definitions, clarifications regarding specific queries raised by quarantine authorities of various countries, with revised lists of crops under Schedules IV, V, VI, and VII. The revised list under Schedule VI and VII now include 411 and 284 crops/commodities, respectively (www.plantquarantineindia.org). Besides, NBPGR has also conducted a PRA for 95 species which have been notified

under Schedule VI of the PQ Order, 2003, after vetting by DPPQS.

iii) Environment Protection Act (EPA), 1986

In the UN Conference on the Human Environment held at Stockholm in 1972, in which India participated, it was urged that all countries should take appropriate steps for protection and improvement of the human environment. Consequently, the EPA was enacted in 1986 to protect and improve the environment and prevent hazards to human beings, other living creatures, plants and property.

The Environment (Protection) Rules, 1989 came later for the purpose of protecting and improving the quality of the environment and preventing and abating environmental pollution. In its various schedules, relevant provisions have been made for the management and handling of hazardous wastes; rules for manufacture, storage and import of hazardous chemicals; and rules for the manufacture, use, import/export and storage of hazardous microorganisms, genetically engineered organisms or cells. It empowers the central government to prohibit or restrict the handling of hazardous substances, including their export and import in different areas either in qualitative or quantitative terms because of its potential to cause damage to the environment, human beings, other living creatures, plants and property. Both living modified organisms (LMOs) and invasive alien species are covered under EPA, however, it does not state in clear terms the modality for restriction and prohibition of these potential threats to the environment.

iv) Biological Diversity Act, 2002

The Biodiversity Act primarily addresses the issue of access to genetic resources and associated knowledge of foreign

individuals, institutions or companies, and equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people. In order to safeguard the interests of the people of India the proposed exceptions are:

- a. Free access to biological resources for use within India for any purpose other than commercial use.
- b. Use of biological resources by *vaidis* and *hakims*.
- c. Free access to the Indian citizens to use biological resources within the country for research purposes.
- d. Collaborative research through government sponsored or government approved institutions subject to the overall policy guidelines and approval of the central government.

There is need to take care of the provisions of the PQ Order, 2003 while dealing with the 'Regulation of Access to Biological Diversity'—prepare a list of pests which have a wide host range to predict their impact on biodiversity and have a mechanism for in-country movement of disease-free material, including those for research.

v) GM Crops

Genetic engineering tools and recombinant DNA technology have led to the development of transgenic or genetically modified crops with a novel combination of genetic materials.

Biosafety framework in India:

The GM crops developed through biotechnological applications are passed through a stringent regulatory framework before its approval by the Gol. The Ministry of Environment and Forests (MoEF) and DBT are the nodal agencies for implementation

of the above-mentioned regulations. There are six statutory bodies involved:

- a. Recombinant DNA Advisory Committee under DBT to recommend appropriate safety regulations in recombination research, use and applications.
- b. The Institutional Biosafety Committee to prepare site-specific plans for the use of genetically engineered microorganisms.
- c. Review Committee on Genetic Manipulation under DBT to oversee all research and field trials on LMOs.
- d. The Genetic Engineering Approval Committee under MoEF to consider proposals related to the release of genetically engineered organisms into the environment.
- e. The State Biotechnology Coordination Committee to inspect, investigate and take punitive action in case of violations of safety and control measures in the handling of genetically engineered organisms.
- f. The District Level Committee to monitor safety regulations in installations engaged in the use of genetically modified organisms and their applications in the environment.

vi) Disaster Management Act, 2005

Refer to Chapter 2 of this document.

(B) International

i) Agreement on the Application of Sanitary and Phyto-sanitary Measures

This Agreement, commonly known as SPS Agreement of WTO of which India is a signatory member, concerns the application of food safety, animal and plant health

regulations. It recognises the government's rights to take sanitary and phyto-sanitary measures but stipulates that they must be based on science, should be applied only to the extent necessary to protect human, animal and plant life or health and should not arbitrarily or unjustifiably discriminate between members where identical or similar conditions prevail. The Agreement aims to overcome health-related impediments of plants and animals to market access by encouraging the 'establishment, recognition and application of common sanitary and phyto-sanitary measures by different Members'.

SPS measures are defined as any measure applied to protect animal or plant life or health from risks arising from the entry, establishment or spread of pests and diseases; to protect human or animal life or health from risks arising from additives, contaminants, toxins or disease causing organisms in food, beverages or foodstuffs; and to protect human life or health from risks arising from diseases carried by animals. There are three standard-setting international organisations whose activities are considered to be particularly relevant to its objectives: FAO/WHO, CAC, OIE, and the international and regional organisations operating within the framework of the International Plant Protection Convention (IPPC).

ii) Global Developments in the wake of SPS Agreement of WTO

Recently, the Department of Agriculture, Fisheries and Forestry of the Commonwealth of Australia established Biosecurity Australia for conducting import risk analyses as per the Australian Quarantine Inspection Service's Import Risk Analysis Process. Biosecurity Australia is responsible for the development of phyto-

sanitary standards and it has set up an import conditions database. Further, Biosecurity Australia is actively involved in negotiations with trading partners and international fora to maintain, gain or improve access to export markets for live animals and their genetic material, plants, and plant products.

Similarly, New Zealand's Ministry of Agriculture and Forestry has established Plants Biosecurity, which has implemented an integrated biosecurity system for imported agricultural/horticultural products. The New Zealand Ministry of Agriculture and Forestry Biosecurity Authority is responsible for the development and implementation of plant import health standards and its officials have been closely associated with the development of international standards on phyto-sanitary measures.

Canada also has established an independent self-sustaining Canadian Food Inspection Agency, an umbrella organisation for implementation of SPS measures related to animal and plant products. Uruguay and Chile have established self-sustaining agricultural quarantine inspection services for enforcing SPS measures totally in line with the WTO-SPS Agreement and forged strong economic integration among Argentina, Brazil, Bolivia and Paraguay.

The European Union has forged strong economic integration and adopted common plant health directives to protect the interests of the member countries. The Animal and Plant Health Inspection Service (APHIS) is an independent service established under the United States Department of Agriculture (USDA) which is responsible for implementing SPS measures. A list of national standards on phyto-sanitary measures is provided in Annexure-I.

iii) Major challenges under the WTO-SPS Agreement for developing countries

In the wake of implementation of the WTO-SPS Agreement, developing countries have to face the following challenges:

- a. Review and updating of phyto-sanitary legislation and regulations to give effect to the international agreement and establish a nodal point for enquiries and information exchange, including a notification procedure.
- b. Establishment of national standards on SPS measures in line with international standards to undertake pest risk analysis and identify pest-free areas and scientifically justify the high level of protection in the absence of pest risk assessment.
- c. Recognition of the equivalence of specific measures through bilateral or multilateral agreements.
- d. Strengthening of backup research in quarantine for diagnosis and treatment.
- e. Capacity building in terms of infrastructure and expertise.

iv) Biological and Toxin Weapons Convention
Refer to Chapter 4 of this document.

v) Convention on Biological Diversity (CBD)

In 1992, the largest ever meeting of world leaders took place at the UN Conference on Environment and Development in Rio de Janeiro, Brazil. A historic set of agreements were signed at this 'Earth Summit', including CBD, the first global agreement on the conservation and sustainable use of biological diversity. The biodiversity treaty gained rapid and widespread acceptance. Over 150 governments signed the document at the Rio conference, and since then more than 175 countries have ratified the Agreement.

The Convention had three main goals, viz., conservation of biodiversity, sustainable use of the components of biodiversity, and sharing the benefits arising from the commercial and other utilisation of genetic resources in a fair and equitable way. The Convention was comprehensive in its goals and dealt with an issue so vital to humanity's future that it stands as a landmark in international law. It recognises for the first time that the conservation of biological diversity was 'a common concern of humankind' and is an integral part of the development process. The Agreement covers all ecosystems, species and genetic resources. It links traditional conservation efforts to the economic goal of using biological resources sustainably. It sets principles for fair and equitable sharing of the benefits arising from the use of genetic resources, especially those destined for commercial use. It also covers the rapidly expanding field of biotechnology, addressing technology development and transfer, benefit-sharing and biosafety. The Convention is legally binding and the signatory member countries are obliged to implement its provisions.

Article 8 (h) of CBD, 1992 emphasises on preventing the introduction and eradication or control of those invasive alien species which threaten other species, habitats or ecosystems. These alien species are recognised as the second largest threat to biological diversity and natural resources, after habitat destruction. Article 8 (g) of the Convention directs the members to establish or maintain means to regulate, manage or control the risks associated with the use and release of LMOs which are likely to have adverse environmental impacts on the conservation and sustainable use of biological diversity, also taking into account the risks to human health and, specifically,

focusing on transboundary movements. Recognising the potential risk arising from LMOs, Article 19.3 of CBD provides for the safe transfer, handling and use of LMOs. After several meetings the parties adopted the International Protocol on Biosafety in January 2000.

7.4.2 National Organisation

Indian Council of Agricultural Research

ICAR is an autonomous apex body responsible for the organisation and management of research and education in the fields of agriculture, animal sciences and fisheries. To fulfil its mission, ICAR aims to achieve the following mandate:

- i) To plan, undertake, aid, promote and coordinate research and education, extension in agriculture, horticulture, plantation crops, animal sciences, fisheries, agroforestry, home science and allied sciences.
- ii) To act as a clearing house for research and general information relating to agriculture, animal husbandry, fisheries, agroforestry, home science and allied sciences through its publications and information system, and instituting and promoting transfer of technology programmes.
- iii) To look into the problems relating to broader areas of rural development concerning agriculture, including post-harvest technology, by developing cooperative programmes with other organisations such as the Indian Council of Social Science Research, CSIR, Bhabha Atomic Research Centre, Agricultural and Processed Food Products Export Development Authority, the Ministry of Food Processing Industries, MHA, state agricultural universities and central research institutes.

ICAR has established several research centres in order to meet the agricultural research and education needs of the country. It is actively pursuing HRD in the field of agricultural sciences by setting up numerous agricultural universities across the country. The Technology Intervention Programmes form an integral part of ICAR's agenda, making KVKs responsible for training, research and demonstration of improved technologies. ICAR, through its various institutes, carries out research work on the detection and management of both indigenous and exotic pests and diseases of livestock, plants, animals and fisheries, and undertakes quarantine processing of plant germplasm and research material, including that of transgenics, at NBPGR. HSADL, Bhopal, has the facilities to work with exotic disease-causing microbes under high containment conditions.

7.4.3 International Organisations

(A) World Trade Organization

WTO, established on 1 January 1995, is the legal and institutional foundation of the multilateral trading system. It is the platform on which trade regulations among countries evolve through collective debate and negotiation and which in turn have a broad scope in terms of commercial activity and trade policies for all the member countries. The WTO Agreement contains more than 60 agreements in 29 individual legal texts covering everything from services to government procurement, rules of origin and intellectual property (<http://www.wto.org>). Of these, the Agreement on the Application of Sanitary and Phyto-sanitary (SPS) measures is in fact the one which is going to have major implications on biosecurity in trade. It covers measures to be adopted by countries to protect human health from diseases; human or animal life from food-borne risks; and animals and plants from pests and diseases. The specific aims of SPS measures are

to ensure food safety and to prevent the spread of diseases among animals and plants.

In order to achieve these targets, international standards need to be developed for which WTO has assigned the responsibilities as follows:

- i) For food safety: CAC, Vienna, a subsidiary organ of FAO, and WHO has been authorised for all matters related to food safety evaluation and harmonisation.
- ii) For animal health and zoonosis: OIE, Paris, develops the standards, guidelines and recommendations.
- iii) For plant health: IPPC at FAO, Rome, is the source for International Standards for the Phytosanitary Measures affecting trade.

These three organisations are often referred to as the 'Three Sisters' who are observers and contributors to the SPS committee meetings. They also serve as experts who advise WTO dispute settlement panels.

The main purpose of WTO is to promote free trade flow, serve as a forum for trade negotiations and serve as a dispute settlement body, based upon the principles of non-discrimination, equal treatment and predictability. Agriculture was brought under the purview of multilateral trade negotiations and this has led to apprehensions among the people that implementation of the provisions of the agreement will have an adverse effect on domestic agricultural production, exports and imports.

(B) Food and Agricultural Organization

FAO is an organ of the UN which has a number of programmes on plant and animal biosecurity. IPPC, as mentioned earlier, has its secretariat in FAO and takes care of plant biosecurity issues. IPPC develops international standards on phytosanitary measures through a Commission on Phyto-

sanitary Measures and networks with all regional plant protection organisations at the global level. FAO has a biosecurity portal which is a storehouse of knowledge and information on all aspects of animal and plant diseases and gives information on the various Technical Cooperation Projects undertaken in the developing world. It also promotes or sponsors various training programmes on issues related to pest risk analysis, EWS, etc.

7.4.4 Prevention and Preparedness: National Context

DPPQS under the Department of Agriculture and Cooperation of MoA has a network of 29 PQ stations at various international airports, seaports and land frontiers to check bulk imports of grains, seeds and other planting materials for the presence of diseases and pests that may be associated with these materials. Though a few of these stations are well equipped, in general they lack trained manpower and infrastructure to handle imported materials effectively and quickly. As far as quarantine of imported research material (germplasm, transgenic planting material) is concerned, it is undertaken by ICAR at NBPGR, which has both the expertise and the laboratory and post-entry quarantine facilities (including a containment facility of CL-4 level) to do the job effectively.

(A) Legislation

The new PQ (Regulation of Import into India) Order, 2003 is an attempt to comply with the various provisions of the SPS Agreement of WTO of which India is a signatory. The new PQ Order has however evoked many queries from the European Commission, US Department of Agriculture (USDA), Canada, and other developed countries. The PQ order is being looked into for suitable amendments to promote trade and not to use quarantine measures as a technical barrier to trade.

(B) Recent Developments in Strengthening Plant Quarantine Facilities

Keeping in view the significant role played by phyto-sanitary services in the safe conduct of global trade in agriculture, MoA has established modern pest diagnostic laboratory facilities with high-tech scientific equipment at five regional centres at Amritsar, Chennai, Kolkata, Mumbai and New Delhi under the FAO-United Nations Development Programme (UNDP) Project. The Project was aimed at developing and strengthening plant quarantine facilities at major ports through capacity building and HRD. Further, under this project, various expert consultations were organised in drafting PQ legislation; training programmes/workshops in pest risk analysis and surveillance; preparation of operational manuals; setting up of laboratory diagnostic facilities; designing of glass house facilities; quality systems and auditing; etc.

Besides, a PQ website, www.plantquarantineindia.org was designed and hosted under the above-mentioned project. The PQ website provides information about contact points, plant quarantine setup, PQ Act and regulations, New Seed Policy guidelines, quarantine procedures for issuance of permit, import clearance, post-entry quarantine inspection and export inspection and certification of agriculture commodities. But it needs to be upgraded in a dynamic mode. Also, a suitable software package was developed for creating a database on endemic pests of prioritised commodities. Quality Systems-International Standards Organisation (ISO) 9002 certification has been implemented for quarantine screening and laboratory testing of import/export plants and plant material at the Regional PQ Station, Chennai. This involved preparation of quality policy manual/quality procedures manual for documentation of the procedures being practiced and periodical review and auditing to ensure these procedures are being followed through corrective and preventive actions.

(C) Recent Attention given to Technical Issues

- i) Steps are now being taken to conduct PRA on priority commodities of export/import, though still in an ad hoc manner.
- ii) The database on endemic pests is being developed at Regional PQ Station, Chennai, and the database on pests of quarantine significance to India are being developed at NBPGR, New Delhi. These will be complimentary and serve as a backbone of information for developing PRA.
- iii) Amendments to the revised PQ Order, 2003 are being brought about, keeping in view the global demands for facilitating trade.
- iv) A task force on phyto-sanitary capacity building has been recently set up to look into the immediate and long-term training needs at different levels.
- v) Steps are also being taken to establish a PQ authority which would make the system more dynamic from the operational and financial aspects.

7.5 Guidelines for Biological Disaster Management—Agroterrorism**7.5.1 Legislative and Regulatory Framework**

Quarantine legislations are in place and have been revised. Specific regulatory measures will be developed to deal with agroterrorism. It should include strong legislative and administrative policies for import/export processes related to application of SPS measures; to implement survey and control, including emergency actions against pests; to search, seize, inspect, treat or destroy infected/infested material; to enact or enforce SPS regulations; to negotiate, establish and comply with bilateral agreements; and to allow and perform auditing and monitoring of SPS activities.

7.5.2 Risk and Vulnerability Assessment

Mechanisms to assess the risk of attack on agricultural crops/storage godowns will be defined and developed based on threat analysis.

As far as imports are concerned, steps are being taken to gear up pest risk analysis for imported commodities, but it is still in process. An organised system dedicated to carry out pest risk analysis against identified quarantine pests will be established. This requires an independent unit for risk analysis with trained manpower and computer and internet facilities.

(A) Integrated Pest Surveillance System

- i) An effective integrated pest surveillance system and organisation devoted to performing field inspection and pest survey activities for the detection, delimitation or monitoring of established pests, as well as a system and organisation devoted to the detection of new pests will be introduced.
- ii) Specific systems will be required for identification, establishment and maintenance of pest-free areas according to international standards.

(B) Intelligence Gathering and Secured Dissemination of Information

The agriculture departments of the district/state agricultural machinery will work out the modalities at the local/regional levels for intelligence gathering and secured dissemination of information. Such processes will be developed knowing the fact that the stakeholders are generally farmers, a majority of whom have small land holdings and need to be protected from any unforeseen calamity to avoid chaos at all levels.

7.5.3 Prevention and Early Detection

- i) The first step to ward off ultimate harm from an agroterrorist attack in the field is to have

a mechanism for early detection of the disease. This again highlights the importance of integrated pest surveillance with the component of early detection as one of its mandates.

- ii) At the field level, this would involve proper education and awareness programmes for the villages to ward off intentional attacks by suspected agroterrorists on their crops/animals/livestock and also to equip them with the emergency curative measures to be taken in such a situation.
- iii) DDMA's will ensure that there is enough stock of disinfectants and vaccines for animals; and chemicals, biopesticides and biocontrol agents to save crops from any suspected attack.
- iv) For imports, the quarantine network will be strengthened especially at land frontiers of the country through which agroterrorists can easily bring in exotic pests in a clandestine manner.

7.5.4 Preparedness

(A) Emergency Control and Treatment

- i) An EOC will be established as a national hub for incident operations support, communications, and information dissemination pertaining to the management of animal and plant incidents and all similar hazards. The EOC will integrate and provide overall monitoring and operations support and serve as the primary point of coordination during agricultural health emergencies.
- ii) The EOC has to be used in both routine and emergency situations. When an emergency situation is not underway, the Centre's facilities will be used to monitor and report on international and domestic surveillance of pest pathogens and disease conditions of concern and to conduct advanced training.

- iii) The EOC will have advanced security features such as a secured room with infrared motion sensors and cameras, sound masking and a secure phone line. The communication capabilities will include video teleconferencing, advanced computer interfaces, GIS mapping and a strong multimedia component.
- iv) A system and organisation for performance of quarantine treatments, including emergency pest control activities for new pest introductions, will be defined.
- ii) Post-entry quarantine facilities for materials known to carry latent infections of pests will also be developed and maintained.
- iii) An antisera bank of exotic viruses, a database on sequences of virus specific primers and also a repository of seeds of indicator hosts will be developed for specialised detection and identification of viruses of exotic origin.
- iv) Professionals will be trained to identify new pests or strains unknown to a particular region.

(B) Development of National Standards on Phyto-sanitary Measures

The establishment of national standards on phyto-sanitary measures in line with international standards is of critical concern to meet the stiff challenges under international agreements. Currently, there are 27 such international standards. Therefore, it is necessary to review the 21 national standards (Annexure-I).

Also, certain new standards will be developed on priority for the following:

- i) Guidelines for aluminum phosphide fumigation.
- ii) Guidelines for surveillance, consignments in transit, pest reporting, sampling and diagnostic protocols.
- iii) SOPs and manuals will be developed for operational purposes.

7.5.5 Capacity Development

- i) The quarantine stations at sea ports, airports and land frontiers will be upgraded in terms of facilities and expertise for detection and identification of exotic pests and salvaging of the infected/infested material by developing suitable disinfestation protocols.

7.5.6 Documentation

- i) SDMAs and DDMAAs will ensure the development of a proper documentation of pest surveillance data of the state, and methods for early detection of diseases and pests, including exotic diseases not known to occur in the region. They will undertake management of options and emergency operations, including contact points, etc., in case of any agroterrorist activity.
- ii) The documentation must be available in the regional/local language also as the stakeholders generally do not have a high literacy profile.

7.5.7 Research and Development

(A) Academic and Scientific Research Institutions

The designated institutions will be directed by the respective authorities/departments/ministries to undertake the following activities:

- i) Generation of comprehensive epidemiological data on important pests/diseases to determine their tolerance limits. This would also help in developing pest risk analysis.

- ii) Development of sensitive detection and salvaging techniques to detect low levels of infections as the quarantine samples need to be subjected to various techniques for detection of a variety of pests. This is more challenging in the case of small samples of germplasm as besides being sensitive, the technique also needs to be non-destructive.
 - iii) Development of suitable alternatives to methyl bromide, a widely used quarantine fumigant which is being phased out because of its adverse environmental impacts. This is now designated as an ozone-depleting substance and a potential health hazard to various organisms in the Montreal Protocol (1987). India has ratified the Montreal Protocol and is legally committed to phase out the use of methyl bromide except for pre-shipment and quarantine purposes, by 2015.
 - iv) Development of molecular techniques for the detection of races/biotypes/strains will also be intensified as they are also considered pests under the IPPC definition of pests. These detection techniques should be sensitive enough to detect even low levels/concentrations of pests.
 - v) Studies on factors affecting the likelihood of survival of pests under different conditions of transport, mode of dispersal, distribution of hosts/alternate hosts at the destination, potential for establishment, reproductive strategy and method of pest survival, potential vectors and natural enemies of the pest in the area, etc., will be urgently undertaken to authentically prepare a PRA during exchange.
- of SPS measures to ensure their consistent application or justification in maintaining such measure or modification to the changed situation will be put in place by the departments of agriculture, both central and state.

(C) Linkages with National Programmes

At present, the staff of DPPQS works in isolation and is not really getting the benefits of the various research organisations of ICAR and state agricultural universities for the detection and identification of pests and for control strategies. An active linkage will be developed between the All India Coordinated Research Projects and activities of DPPQS in order to have comprehensive survey and surveillance programmes. After the National Agricultural Technology Project ended, ICAR started the National Agricultural Innovation Project in 2007 with assistance from the World Bank. In this research, projects in the fields of agronomy, soil science, horticulture, plant breeding, extension, etc., are submitted by state agriculture universities and national institutes, and approved by the Project Implementation Unit in Krishi Anusandhan Bhavan II in Pusa, New Delhi.

(B) Accreditation of Laboratories

An auditing system to monitor the implementation and evaluation of the effectiveness

8

Implementation of the Guidelines

The National Guidelines on BDM have been formulated as part of an integrated national 'all hazard' approach for the management of disasters. The prime aim is to reduce the occurrence and mitigate to the lowest level possible the effects of biological disasters affecting mankind, livestock and crops, and the associated risks posed to health, life and environment. It is ensured that all aspects of preparedness required are covered for prevention, mitigation and quick and efficient response, including measures pertaining to relief, recovery and rehabilitation. The BDM approach aims to institutionalise the implementation of initiatives and activities covering the entire continuum of the disaster management cycle. The objective is to develop a national community that is informed, resilient and prepared to face disasters with minimal loss of life while ensuring adequate care for the survivors. Therefore, it will be the endeavour of the central and state governments and local authorities to ensure its implementation in an efficient, coordinated and focused manner. This can be accomplished by forging reciprocal relationships as envisaged by the institutional mechanism set up through the DM Act, 2005, viz., the NDMA, SDMAs and DDMA.

The primary responsibility of preparedness and response shall continue to remain with the state and district authorities. Further capacity enhancement and reinforcement of the system, whenever required, will be provided by the central and state governments. Initiatives like PPP will be encouraged for further revamping the system. In order to optimise the use of resources while ensuring effectiveness and promptness, the response to biological disasters will be highly

structured and coordinated. The following factors are considered critical for ensuring a seamless and harmonious functioning of all concerned stakeholders during the management of biological disasters:

- i) Institutionalisation of programmes and activities at the ministerial/department level.
- ii) Identification of the various stakeholders/agencies/institutions with precise roles, responsibilities, a clear chain of command and work relationships.
- iii) Rationalisation and augmentation of the existing regulatory framework and infrastructure.
- iv) Matching infrastructure, capacity development and response mechanisms for overall preparedness.
- v) Improved inter-ministerial and inter-agency communication, coordination and networking at all levels.

MoH&FW, as the nodal ministry, will foresee the implementation of the guidelines at the national level. The other stakeholders in biological emergency management are MoD, MoR, MoL&E, MoA, DADF at the central level; ministries/ departments of health of the states/UTs; scientific and technical institutions, academic institutions in agriculture, life sciences, zoological sciences, animal husbandry, medical, biomedical and paramedical field; and professional bodies, corporate sector, NGOs and the general community.

Implementation of the Guidelines will begin with the formulation of a biological disaster

preparedness plan as part of an 'all hazard' DM plan in all districts, states/UTs and central ministries. The enabling phase will be used to build necessary capacity, taking into consideration the existing elements such as techno-legal regimes, stakeholder initiatives, emergency plans, gaps, priorities based on vulnerabilities and risk assessment. The existing DM plans at various levels will be further revamped/strengthened to address biological disaster preparedness. The central ministries/departments, states/UTs and districts will prepare and implement DM plans at all levels that address the strategic, operational and administrative aspects through an institutional, legal and operational framework.

These Guidelines have set modest goals and objectives of biological disaster preparedness to be achieved by mustering all stakeholders through an inclusive and participative approach. All concerned ministries of GoI, the state governments, UT administrations and district authorities will allocate appropriate financial and other resources, including dedicated manpower and targeted capacity development, for successful implementation of the Guidelines. A list of important websites is given in Annexure-J.

8.1 Implementation of the Guidelines

8.1.1 Preparation of the Action Plan

Implementation of the Guidelines at the national level will begin with the preparation of a detailed action plan (involving programmes and activities) by MoH&FW that will promote coherence among different BDM practices and strengthen mass casualty management capacities at various levels. Line ministries such as MoD, MoR, MoL&E, MHA, and MoA, etc., will also prepare their respective preparedness plans as part of 'all hazard' DM plans and action plan. In view of the expected role of these important line ministries in management of mass casualties in the event of

national calamities, they should also cater for developing additional capacities besides meeting their own requirements, in their preparedness plan.

The plan will be simple, realistic, functional, flexible, concise, holistic and comprehensive, encompassing networking of medical, laboratory and public health components. The plan would lay special emphasis on the most vulnerable groups/communities to enable and empower them to respond and recover from the effects of biological disasters.

The National Plan needs to include:

- i) Measures to be taken for minimisation/reduction of biological disasters (leading to zero tolerance), or mitigation of their effects (leading to avoidable morbidity and mortality).
- ii) Measures to be taken for integration of mitigation procedures in the development plans.
- iii) Measures to be taken for preparedness and capacity development to effectively respond to any threatening mass casualty situation.
- iv) Roles and responsibilities of the nodal ministry, different ministries or departments of the GoI, institutions, community and NGOs in respect of the measures specified in clauses i), ii), and iii) above.

The action plan will spell out detailed work areas, activities and agencies responsible, and indicate targets and time frames for implementation and be continually reviewed and updated. The identified tasks, to the extent possible, will be standardised to have SOPs and resource inventory, etc. The action plan should have an inbuilt mechanism to coordinate with other ministries and NEC. The plan will also specify indicators of progress to enable their monitoring and review within the ministry and by the National Authority.

The plan would be sent to NDMA through NEC for approval.

The ministries/agencies concerned, in turn, will:

- i) Issue guidance on the implementation of the plans to all stakeholders.
- ii) Obtain periodic reports from the stakeholders on the progress of implementation of the DM plans.
- iii) Evaluate the progress of implementation of the plans against the time frames and take corrective action, wherever needed.
- iv) Disseminate the status of progress and issue further guidance on implementation of the plans to stakeholders.
- v) Report the progress of implementation of the plans to the nodal ministry.

MoH&FW will keep the National Authority apprised of the progress on a regular basis. Similarly, concerned state authorities/departments will develop their state-level DM plans and dovetail it with the national plan and keep the National Authority and SDMA informed. The state departments/authorities concerned will implement and review the execution of the DM plans at the district and local levels along the above lines.

8.1.2 Implementation and Coordination at the National Level

Planning, execution, monitoring and evaluation are four facets of the comprehensive implementation of the Guidelines. If desired, the nodal ministry can co-opt an expert nominated by the National Authority during the planning stage so that the desired results are achieved through the action plan. The consultative approach increases ownership of the stakeholders in the solution process by bringing clarity to the roles and responsibilities with regard to various preparedness activities. Detailed documentation

of the monitoring mechanism to be employed for undertaking a transparent, objective and independent review of the National Disaster Management Guidelines—Management of Biological Disasters will be worked out. A separate group of experts may be earmarked for evaluation to get an objective, third-party feedback on the effectiveness of the activities based upon the Guidelines.

The important issues while preparing the action plan include:

- i) Adopting a single window approach for conducting and documenting the activities outlined in the guidelines in each of the stakeholder ministries, departments, state governments, agencies and organisations.
- ii) Laying down the roles and responsibilities of all stakeholders at the state and district levels for managing biological disasters and to assist them in terms of the required resources.
- iii) Developing detailed documents on how to ensure implementation of each of the activities envisaged in the Guidelines so as to attain a synergy among various activities and ensure coordination.
- iv) Ascertaining medical preparedness measures, including capacity development to effectively respond to intentional and non-intentional incidences of biological disasters.
- v) Incorporating measures for the prevention of biological disasters, or the mitigation of their effects by integration of mitigation measures in the development plans.
- vi) Coordinating with line ministries such as MoD, MoR, civil aviation and ESIC networks for maintaining their resources and ensuring these are available during biological emergencies.

- vii) Ensuring professional expertise for the dissemination, monitoring and successful and sustainable implementation of the various plans at all levels.
- viii) Ensuring that the skills and expertise of professionals are periodically updated corresponding to global best practices according to the spirit of the emergency medical management framework for BDM.

The national plans would lay emphasis on identified critical gaps in managing biological disasters and would strengthen the government hospitals and assist the states in putting up requisite infrastructure, including specialised capabilities, for managing mass casualties arising out of biological disasters. This may include self-contained mobile hospitals that can be airlifted or transported by road, rail or waterways to the disaster affected area, especially if the health facilities at local levels themselves are affected. A coordinated and synergistic partnership with the private sector, NGOs and Red Cross will help in providing critical resources during response operations and assist in restoring essential services.

8.1.3 Institutional Mechanisms and Coordination at the State and District Level

The state/UT governments may adopt in their plan the measures indicated in para 8.1.2 above, as applicable. The respective state/UT/district authorities will develop the biological disaster preparedness plans based upon the BDM Guidelines as a part of 'all hazard' DM plans. The measures indicated at the national level may be adopted to ensure effective implementation by regular monitoring at the state level by the concerned authorities. The state will also allocate resources and provide necessary finances for efficient implementation of the plans. Since most activities under the Guidelines are community-centric and require the association of professional

experts for planning, implementation and monitoring, the state DDMA's will formulate suitable mechanisms for their active involvement at various levels.

The India Disaster Resource Network database will be strengthened by the states by continual updating, enhancement and integration with the respective DM plans. The activities are to be taken up in project mode with a specifically earmarked budget (both plan and non-plan) for each activity. The approach followed will emphasise preparedness and disaster-specific risk reduction measures, including technical and non-technical mitigation measures that are environment and technology friendly and sensitive to the special requirements of the vulnerable groups and communities.

8.1.4 District Level to Community Level Preparedness Plan and Appropriate Linkages with State Support Systems

A number of weaknesses have been identified with regard to awareness generation, response time and actions like evacuation, medical assistance and other timely actions for detection, early warning, vaccination, quarantine, evacuation, medical management activities and public health issues. This is specially observed in the district DM plans and has been found to be a weak link in emergency management. The central and state governments will evolve mechanisms through mock exercises, awareness programmes, training programmes, etc., with a view to sensitise and prepare the officers concerned for initiating prompt and effective response during such emergencies.

The CMO of the district will be in charge of the overall medical management of both government and private set-ups during disaster events. Prior arrangements will be worked out with the private sector to ensure that all these resources can be adopted in disaster situations. He will be

responsible for preparing the district BDM plan as part of the district DM plans based on the BDM Guidelines.

Disaster resilience is the ability of the community to anticipate disasters and react quickly and effectively when they strike. The process of building resilience will be made through awareness generation, organising health and sanitation fairs, involving them in mock exercises to give direction to their actions, PPP and development of local capacities by education and training programmes.

8.2 Financial Arrangements for Implementation

After any disaster, central and state governments provide funds for immediate relief and rehabilitation to address the immediate needs of the affected population in terms of food, water, shelter and medicine. Different disasters in the past have revealed that expenditure on response, relief, recovery and rehabilitation far exceeds the expenditure on prevention, mitigation and preparedness. With the paradigm shift in the government's focus on activities during the pre-disaster phase, adequate funds will be allocated for prevention/mitigation, preparedness and capacity development rather than concentrating only on management at the time of a disaster. The basic principle of 'return on investment' may not be applicable in the immediate context but the long-term impact will be highly beneficial. Thus, financial strategies will be worked out such that necessary finances are in place and flow of funds are organised on a priority basis by identification of necessary functions in all the phases of preparedness, prevention/mitigation, response, relief, recovery and rehabilitation. Important activities in this respect include:

- i) Central ministries/departments and the state governments will mainstream DM efforts in their development plans.

- ii) Specific allocations will be made for carrying out disaster preparedness and mitigation efforts in the annual as well as development plans.
- iii) On the basis of the multi-hazard vulnerability status of the particular area, the 'all hazard' DM plan will have requisite inbuilt mitigation mechanisms, including earthquake-resistant structures for hospital buildings and other health care management institutions in the government and private sectors.
- iv) The developmental plans will have suitable techno-financial measures for establishing an effective health care system for the hospitals to ensure preparedness and overall management.
- v) The concerned ministries/departments will initiate mitigation projects for upgradation of existing infrastructure to meet the enhanced requirement of risk reduction and risk management.
- vi) Private stakeholder will allocate sufficient funds for the purpose of disaster-specific prevention/mitigation and medical preparedness measures for BDM.
- vii) Wherever necessary and feasible, the central ministries and departments and urban local bodies in the states may initiate discussions with corporate sector undertakings to support disaster-specific risk reduction practices and establishment of medical set-up to deal with all disasters as part of PPP and corporate social responsibility.

Central and state governments will facilitate the development and design of appropriate risk-avoidance, risk-sharing and risk-transfer mechanisms in consultation with financial institutions, insurance companies and reinsurance agencies. The insurance sector will be encouraged

to promote medical insurance mechanisms covering BDM aspects in the future. A national strategy for risk transfer through insurance, using the experiences of micro-level initiatives in some states and global best practices will be developed to reduce the financial burden of the government. Detailed mechanisms for insurance are required to be evolved during the response, relief and rehabilitation phases.

8.3 Implementation Model

The institutional and operational framework, including hospital infrastructure available with the state and district health authorities in the government sector, needs further revamping and strengthening. The private sector health care institutions should also form an important medical resource for the management of mass casualties during biological disasters. As on date, none of the major hospitals in the government/private sector are fully equipped and geared for managing mass casualties, particularly victims of natural outbreaks, epidemics and BT activities. The implementation plan has to be drawn up at each level setting a target in terms of time line, and reviewed each year and at every level to evaluate the degree of achievement, reasons for shortfall, and corrective action for timely implementation. The experience gained in the initial phase of the implementation is of immense value, to be utilised not only to make mid-term corrections but also to frame long-term policies and guidelines after comprehensive review of the effectiveness of DM plans undertaken in the short term.

8.3.1 Suggested Broad Time Frame for the Implementation of National Guidelines

The time lines proposed for the implementation of various activities in the Guidelines are considered both important and desirable, especially in case of those non-structural measures for which no clearances are required from central or other

agencies. Precise schedules for structural measures will, however, be evolved in the BDM management action plan that will follow at the central ministries/state level duly taking into account the availability of financial, technical and managerial resources. In case of compelling circumstances warranting a change, consultation with NDMA will be undertaken, well in advance, for adjustment on a case-to-case basis. All identified activities under the action plan for preparedness in BDM management will be prepared as part of the 'all hazard' management plan, listed below, for implementation.

(A) Short-term Plan (0–3 Years)

- i) Regulatory framework.
 - a. Dovetailing of existing Acts, Rules and Regulations with the DM Act, 2005.
 - b. Enactment/amendment of any Act, Rule and Regulation, if necessary, for better implementation of all health programmes across the country for disaster management.
 - c. Implementation of IHR, CBD and WHO guidelines through international cooperation.
- ii) Prevention.
 - a. Strengthening of integrated surveillance systems based on epidemiological surveys, detection and investigations of disease outbreaks.
 - b. Establishment of EWS.
 - c. Coordination between public health, medical care and intelligence agencies to prevent BT.
 - d. Rapid health assessment and provision of laboratory support.
 - e. Institution of public health measures to deal with emergencies as an outcome of biological disasters.

- f. Immunisation of first responders and adequate stockpiling of necessary vaccines.
- iii) Preparedness.
 - a. Identifying infrastructure needs for formulating mitigation plans.
 - b. Equipping MFRs/QRMTs with all material logistics and backup support.
 - c. Upgrading of earmarked hospitals for CBRN management.
 - d. Communication and networking system with appropriate intra-hospital and inter-linkages with state ambulance/transport services, state police departments and other emergency services.
 - e. Mobile tele-health services.
 - f. Laying down minimum standards for water, food, shelter, sanitation and hygiene.
 - g. Organising community awareness programmes for first aid, general triage and Dos and Don'ts to mitigate the effects of biological emergencies and define their role as a part of the community DM plan.
 - h. Sensitise and define the role of public, private and corporate sectors for their active participation.
 - i. Capacity development.
 - 1) Knowledge management.
 - Sensitising and defining the role of public, private and corporate sectors for their active participation.
 - 2) Human resource development.
 - Strengthening of NDRF, MFRs, medical professionals, paramedics and other emergency responders.
- Development of human resources for monitoring and management of delayed health effects, mental health and psycho-social care.
- 3) Education and training.
 - Inclusion of knowledge of BDM in the educational curricula of stakeholders.
 - Knowledge management.
 - Proper education and training of personnel using information networking systems by holding continuing medical education programmes and workshops.
- j. Community preparedness.
 - 1) Community awareness programmes for first aid.
 - 2) Dos and Don'ts to mitigate the effects of medical emergencies due to the effect of biological agents.
 - 3) Define roles as a part of the community DM plan.
- k. Hospital preparedness.
 - 1) Hospital DM plans.
 - 2) Developing tools to augment surge capacities to respond to any mass casualty event following a biological disaster.
 - 3) Identifying, stockpiling, supply chain and inventory management of drugs, equipment and consumables, including vaccines and other agents for protection, detection and medical management.
- l. Specialised health care and laboratory facilities.

1) Upgradation of existing and establishment of new biosafety laboratories and high containment facilities.

supplies such as vaccines, antibiotics, etc.

m. Scientific and technical institutions for applied research and training.

1) Post-disaster medical documentation procedures and epidemiological surveys.

2) Regular updation on certain issues by adopting activities in R&D modes initially by pilot studies.

(C) Long-term Plan (0–8 Years)

The long-term action plan will address the following important issues:

i) Knowledge of BDM as a part of 'all hazard' training programmes should be addressed in the present curriculum of science and medical undergraduate and postgraduate courses.

ii) Establishing of national stockpile of vaccines, antibiotics and other medical logistics.

iii) Initiating relevant postgraduate courses.

iv) Training programmes in the areas of emergency medicine and BDM as a part of 'all hazard' training programmes will be conducted for hospital administrators, specialists, medical officers, nurses and other health care workers.

v) Public health emergencies with the potential of causing mass casualties due to covert attacks of biological agents would also be addressed in the plan by setting up integrated surveillance systems, rapid health assessment, investigation of outbreak, providing laboratory support and instituting public health measures.

vi) Provision for quality medical care.

vii) Strengthening of the existing institutional framework and its integration with the activities of NDMA, state authority/SDMA, district administration/DDMA and other stakeholders for effective implementation.

viii) Implementing a financial strategy for allocation of funds for different national/state/district-level mitigation projects.

ix) Establishing an information networking system with appropriate linkages with state ambulance/transport services, state police departments and other emergency services. The states will ensure proper education and

(B) Medium-term Plan (0–5 Years)

i) Prevention.

a. Strengthening of IDSP and EWS at regional levels.

b. Incorporation of disaster-specific risk reduction measures.

ii) Preparedness.

a. Institutionalisation of advanced EMR system (networking ambulance services with hospitals).

iii) Capacity development.

a. Strengthening of scientific and technical institutions for knowledge management and applied research and training in CBRN management.

b. Continuation and updation of HRD activities.

c. Developing community resilience.

d. Hospital preparedness.

1) Testing of various elements of the emergency plan through table top exercises and mock drills.

2) Specialised health care and laboratory facilities.

3) Ensuring stockpile of medical countermeasures and medical

training of the personnel using this information networking system.

- x) Training of NDRF, MFRs, paramedics and other emergency responders. Identification and recognition of training institutions for training of medical officers, paramedics and MFRs for emergency medicine and DM.
- xi) Development of post-disaster medical documentation procedures and epidemiological surveys.

To conclude, the present system of preparedness and arrangements for mass casualty management in a biological disaster are required to function in a more coordinated and proactive manner. MoH&FW, state governments/district administration, will enhance their capacities with the help of the private sector. The existing DM plans at various levels will be further revamped/strengthened to address the management of mass casualties due to biological disasters.

9

Summary of Action Points

The present chapter provides a summary of all the guidelines mentioned in Chapters 4–7 for the management of biological emergencies. The important action points are discussed in the following pages.

1. Legislative framework

Legislative framework includes the establishment of a legal, institutional and operational framework which clearly defines the policy, programmes, plans, SOPs, and institutional and operational framework. Its role will be to implement IHR (2005) and other legal mechanisms, mechanisms to manage BT activities, cross-border issues, provisions to quarantine the areas affected by epidemics or pandemics and various aspects of transportation of biological samples, biosafety and biosecurity aspects and upgradation of existing infrastructure supported by various technical experts.

Policies and guidelines issued by NDMA will be the basis for developing DM plans by various stakeholders and service providers both in the government (nodal and line ministries, state government and district administration) and private set-up at each level. The response to various biological disasters will be coordinated by NDMA/NEC/NCMC, SDMAs and DDMA.

(para 4.1)

2. Capacity development for the prevention of biological disasters

The activities related to vulnerability and risk analysis of various epidemics in the aftermath of

natural disasters or biological threats associated with a particular region will be undertaken by the DM authority at each level. Based on this, the IDSP will be upgraded and strengthened. Facilities and amenities will be developed to cover all issues of environmental management like water supply, personal hygiene, vector control, burial/disposal of the dead and the risk of occurrence of zoonotic disorders.

The existing IDSP programme will be expanded and state/district IDSP units will be equipped with trained personnel for data collection, standard case definition, and its integration with the information received from GOARN, WHO. These personnel will also be trained for dissemination of appropriate information to the public health authorities, epidemiological analysis and confirmation of the microorganism involved using the integrated laboratory network followed by deployment of RRTs. Pre-exposure (preventive) immunisation of first responders against anthrax and smallpox must be practiced.

The nodal health ministry (i.e., MoH&FW) and other line ministries and departments of health, state/district administrations will undertake necessary preventive measures in DM and developmental plans.

(para 4.2.1–4.2.4)

3. Pharmaceutical and non-pharmaceutical interventions and biosafety/biosecurity measures

Tools will be developed to monitor the status of available pharmaceutical interventions including

antibiotics, chemotherapeutics and anti-virals, and listing of essential drugs that may be required to manage biological emergencies. On-site contingency planning will be done to contain biotoxins within the laboratory premises. Various immunisation and vaccination programmes will be undertaken and the existing arrangements will be strengthened.

Mechanisms to employ various non-pharmaceutical interventions like social distancing measures, and isolation and quarantine techniques will be adopted at various levels.

A database of the inventories of various laboratories handling hazardous microorganisms, will be developed to ensure the implementation of various biosafety and biosecurity measures at these institutions. Provisions of biosecurity applicable to imported articles to prevent any mass casualty event of biological origin, will be undertaken.

The nodal ministry (i.e., MoH&FW) and line ministries will undertake various pharmaceutical and non-pharmaceutical interventions in their DM and development plans. Similarly, state/district authorities will also develop capacities at their respective levels.

(para 4.2.5–4.2.8)

4. Preparedness: establishment of command, control and coordination functions

A well-orchestrated medical response to biological disasters will only be possible by having a command and control function at the district level with the district collector as commander. The CMO will be the main coordinator for management of biological emergencies.

NDMA/NEC will coordinate at the central level while SDMA/DDMAs will coordinate the various functions at their respective levels.

(para 4.3.1)

5. Capacity development of human resource, training and education, community, standardised documentation procedures and R&D

The roles of various health and non-health professionals at various levels in the management of a biological crisis will be defined. Control rooms to support the field responders will be set up. These professionals will be trained through refresher courses to fill the prevailing gaps.

The various training modules will be developed/standardised and implemented at each level by district/state authorities and nodal/line ministries.

Educational institutions will organise symposia, exhibition/demonstrations, medical preparedness weeks and will also provide education on disaster medicine in the concerned vernacular languages. Various aspects of the management of infectious diseases related to BT will also be disseminated through educational programmes.

Various provisions will be made according to the SOPs laid down by the ministries/departments concerned.

Community awareness about the delivery of services in various civic amenities will be strengthened so that appropriate knowledge is developed and provided to the stakeholders in such a manner that it does not spread panic. This is intended to enhance participation of the community in all phases of the DM cycle and be resilient enough to tackle biological emergencies. All the practices and training schedules will be coupled with mock exercises followed by documentation and evaluation of lessons learnt to improve the existing system.

The aspect of community preparedness will be included in the DM plans developed at each

level by respective authorities and ministries concerned using the PPP mode.

R&D will cater for biodefence and operational research with models to develop checks on various public health consequences, thereby evaluating various mitigation strategies after testing them at numerous stages. These will lay the foundation for long-term research interventions to be undertaken to mitigate the impact of such emergencies.

MoH&FW, MoD and MHA will develop various research strategies in conjunction with ICMR, CSIR, DRDO and other research organisations with adequate funding for these projects. NDMA will act as a facilitator, and advisory and monitoring body to ensure the implementation of identified tasks at the national level.

(para 4.3.2)

6. Development of critical infrastructure for management of biological emergencies

The development of a laboratory network including national/state level referral laboratories, and district level diagnostic laboratories with medical colleges to confirm diagnosis under a single integrated framework is a felt need of the day. On a similar basis, a chain of public health laboratories will also be developed and networked with IDSP.

The critical infrastructure will also be supported by biomonitoring techniques based on advanced molecular and biochemical techniques. To capture these capabilities at one place, the various scientific and technical institutions will be identified and upgraded based on their needs analysis. The main focus of these institutions will be to develop various models based on the preventive strategy.

Upgradation of the existing emergency communication network, health network, including IAN and mobile tele-health, print and electronic

media channels, networking of NGOs and international organisations will be undertaken in the immediate phase. The overall development of infrastructure will also cater for PPP models in the various programmes and plans.

Nodal and line ministries at the central level and departments of health, SDMAs/DDMAs at the state/district level will identify the various requirements of critical infrastructure to be developed with PPP models to mitigate the impact of biological disasters.

(para 4.3.3)

7. Medical preparedness for management of biological disasters

Various activities like hospital disaster management planning (para 4.4.1), upgradation of earmarked hospitals, development of mobile hospitals and mobile medical teams supported by adequate medical logistics including essential medicines, antibiotics, vaccines, PPEs, etc., will be undertaken on priority basis at each level.

A disaster-resilient public health infrastructure must include an effective inbuilt mechanism to keep a check on the early warning signs of an outbreak, make available safe food, water, personal hygiene facilities and also have the capacity to provide psycho-social care. The roles of various stakeholders/service providers like MoH&FW as nodal ministry, other line ministries having health care facilities and departments of health at the state/district levels will provide an integrated framework to manage public health emergencies.

The various response protocols—including emergency medical response by instituting the ICP under the overall directions of the incident commander, transportation of patients and treatment at the hospitals—will be developed and practiced through regular mock drills in a simulated environment.

State/district health departments will have the basic responsibility and fulfil the structural and non-structural requirements in their respective development and DM plans. In addition, the nodal ministry will incorporate the cross-cutting issues to be implemented throughout the country through national programmes identified in their DM plans.

(para 4.4.)

8. Institution of mechanism for public health response

The response mechanism will include outbreak investigation by RRTs, standard case definition, surveillance, follow up, collection of biological samples and transportation to the nearest laboratories for analysis. The various pharmaceutical and non-pharmaceutical interventions so required will be instituted immediately. Provision of risk communication and modes to provide psycho-social care, media management, inter-sectoral coordination followed by continuous monitoring and evaluation of the standard case, are some of the principle activities that would be integrated in district DM plans for managing biological disasters of multiple origin.

The district DM plan for BDM will be the basic functional unit which will be in coherence with state/national DM plans to ensure prompt and effective response in the aftermath of biological disasters.

(para 4.5)

9. Establishment of provisions for management of pandemics

Biological disasters are different from other types of emergencies and can cross borders, causing various concerns in terms of global surveillance, monitoring of human and logistic functioning across the borders, health intelligence, guidelines framed by WHO, optimal utilisation of information available with GOARN and resources available with member states at the global level. Similar concerns are applicable at multiple district/

state levels within the country. These two levels of functioning require to be in synergy with each other.

The management of pandemics is a cross-cutting issue and specific preparedness plans will be developed to contain these disasters within the lowest possible limits of spread under the overall guidance of IHR (2005). A properly functioning epidemiological mechanism, will be used to prepare an action plan for the management of avian flu, and similar incidences to effectively combat the inherent risks. Various international best practices will be tested and incorporated in the DM plans by the nodal and line ministries to prevent the spread of biological disasters across international boundaries.

(para 4.6)

10. Developing a mechanism for enhancing international cooperation

During the preparedness phase, various interactive forums will be developed to evaluate the common problems and identify viable solutions for prompt and effective management of biological emergencies. The mechanism for international cooperation will include both resource sharing, stockpiling of medical logistics at the regional level, joint international mock exercises and knowledge management systems.

Various mitigation strategies addressing international cooperation will be identified in the DM plans at each level by DDMA, SDMA and the nodal/line ministries concerned.

(para 4.7)

11. Preparedness for biological containment of microbial agents

Provisions that ensure the containment of infectious microorganisms within the laboratory, will be developed in the DM plans. Various aspects of biosafety and biosecurity will also be developed in the DM plans.

SOPs for biosafety and biosecurity will be developed by the respective laboratories in accordance with the National Code of Practice for Biosecurity and Biosafety.

(para 5.1)

12. Classification of microorganisms and biologics

The scheme for risk-based classification of microorganisms is intended to provide a method for defining the minimal safety conditions that are necessary when using these agents. It designates five classes of hazardous agents such as Risk Groups I, II, III, IV, and V. Each country should draw up a classification for risk groups of the agents encountered in that country.

The nodal ministry through its laboratories and surveillance system will collect, classify and make available the requisite data at a secure national portal.

(para 5.2–5.3)

13. Biosafety laboratories and microorganism handling instructions

Existing BSLs will be upgraded and new ones developed at various levels based on the need and threat assessment. The differences between the requirements of various levels will be an important factor of consideration while doing need assessment analysis. SOPs of the functioning of such laboratories will also be laid down and strictly monitored. Instructions on the handling of microorganisms will also be laid down.

The nodal ministry along with line ministries and health departments of state governments will assess the existing situation and undertake development of such critical structures through developmental plans. Upgradation of existing laboratories will be carried out, if needed.

(para 5.4–5.5)

14. Development of counter biorisk measures

The existing and newly emerging biorisks will be addressed through the accountability criteria in relation to VBM, secured system of transportation of such materials, development of laboratory biosecurity plans, training of human resources and provision of all logistics/facilities and development/strict implementation of the National Code of Practice for Biosecurity and Biosafety. These will be incorporated into the respective BDM plans.

These aspects will be developed and integrated as SOPs in the district/state DM plans. At the national level, global best practices will be incorporated in the DM plans, if needed.

(para 5.6)

15. Risk and vulnerability assessment of livestock

The various risks posed to livestock during natural disasters, i.e., spread of infectious diseases, fodder poisoning, TADs, various types of wars including conventional wars, BW or BT will be analysed to develop a comprehensive mitigation strategy.

Relevant studies will be undertaken at each level by the respective authority/ministry/department concerned.

(para 6.6.1)

16. Capacity development: management of livestock

This includes the development of VATs, infrastructure for disposal of carcasses, containment of epidemics; temporary shelters, organised rehabilitation package for livestock livelihood, awareness programmes and preparedness for emergency field and laboratory veterinary services. SOPs will be laid down to enhance inter-

departmental support and strengthen the weak linkages.

Capacity development will be undertaken at the district/state/national levels by the ministries/departments concerned as a part of their respective DM plans.

(para 6.6.2–6.6.3)

17. Preparedness for livestock management during disasters

Various mitigation activities, including development of EWS, establishment of fodder banks, availability of low cost feed ingredients, conservation of monsoon grasses, development of existing degraded grazing lands, free movement of animals for grazing, treatment and vaccination of animals, and strategy for compensation on account of loss and disposal of dead animals during disasters will be planned/undertaken. A comprehensive strategy for emergency management will be developed and steps for prevention, mitigation and preparedness for management of livestock during disasters will be laid down. The various R&D activities to mitigate the impact on livestock during disasters will be undertaken.

(para 6.6.4–6.6.8)

18. Establishment of legislative and regulatory framework and early detection facilities based on risk management practices

The existing quarantine legislations will be revisited and modified, if needed. Strict enforcement of SPS measures and the related activities thereof at all levels, will be ensured. Risk assessment of plausible attacks on agricultural fields and adequate measures for pest risk analysis with trained manpower and equipment will be developed. It includes the development of the integrated pest surveillance system, intelligence gathering and secured dissemination of information for a comprehensive risk management framework.

Preventive measures for early detection of agroterrorism activities will also be outlined. Various provisions will be developed at each level by the respective departments/ministries or authorities.

(para 7.5.1–7.5.3)

19. Preparedness for management of agroterrorism activities

The preparedness measures include provisions for emergency control and treatment, development of national standards on phyto-sanitary measures and other related activities.

It includes various capacity building measures including SOPs for documentation. It is pertinent to evolve newer R&D activities to mitigate the impact of such situations and strengthen support mechanisms such as accreditation of laboratories and development of linkages of local level initiatives with national/state programmes.

(para 7.5.4–7.5.7)

20. Development of an 'all hazard' implementation strategy

The strategy outlines the requirements for development of a BDM action plan by the nodal ministry, measures to implement and coordinate various activities at the national level, and institutional framework and coordination at the state/district levels. Adequate strategy will be evolved to develop linkages and state support systems. Necessary financial arrangements will be made for implementation of all the plans developed at the district/state/national levels. An implementation model with suggested broad time frames as short- medium- and long-term plans for 0–3, 0–5 and 0–8 years, respectively have been recommended.

(para 8.1–8.3)

It is the responsibility of the various stakeholders/service providers to identify various aspects of BDM activities under different plans at different levels.

Annexures

Annexure-A

Refers to Chapter 1, Page 03

Characteristics of Biological Warfare Agents

Disease	Transmit Human to Human	Infective Dose (Aerosol)	Incubation Period	Duration of illness	Lethality (approx. case fatality rates)	Persistence of Organism	Vaccine Efficacy (aerosol exposure)
Anthrax	No	8,000 - 50,000 spores	1-6 days	3-5 days (usually fatal if untreated)	High	Very stable - spores remain viable for > 40 years in soil > 100 days in human beings	As recommended and approved by National Regulatory Authority
Brucellosis	No	10-100 organisms	5-60 days (usually 1-2 months)	Weeks to months	<5% untreated	Very stable	No vaccine
Cholera	Rare	10-500 organisms	4 hours - 5 days (usually 2-3 days)	≥ 1 week	Low with treatment, high without	Unstable in aerosols & fresh water; stable in salt water	No data on aerosol
Glanders	Low	Assumed low	10-14 days via aerosol	Death in 7-10 days in septicemic form	> 50%	Very stable	No vaccine
Melioidosis	Low	Assumed low	1-21 days (up to years)	Death in 2-3 days with septicemic form (untreated)	19-50% for severe disease	Very stable; survives indefinitely in warm moist soil or stagnant water	No vaccine
Plague	Moderate, Pneumonic	100-500 organisms	1-7 days (usually 2-3 days)	1-6 days (usually fatal)	High unless treated within 12-24 hours	For up to 1 year in soil; 270 days in live tissue	3 doses not protective against 118 LD ₅₀ in monkeys

Disease	Transmit Human to Human	Infective Dose (Aerosol)	Incubation Period	Duration of illness	Lethality (approx. case fatality rates)	Persistence of Organism	Vaccine Efficacy (aerosol exposure)
Tularemia	No	10-50 organisms	1-21 days (average 3-6)	≥ 2 weeks	Moderate if untreated	For months in moist soil or other media	80% protection against 1-10 LD ₅₀
Smallpox	High	Assumed low (10-100) organisms)	7-17 days (average 12)	4 weeks	High to moderate	Very stable	Vaccine protects against large doses in primates
Venezuelan Equine Encephalitis	Low	10-100 organisms	2-6 days	Days to weeks	Low	Relatively unstable	TC 83 protects against 30-500 LD ₅₀ in hamsters
Viral Hemorrhagic Fevers	Moderate	1-10 organisms	4-21 days	Death between 7-16 days	High to moderate depends on agent	Relatively unstable - depends on agent	No vaccine
Botulism	No	0.001 µg/kg is LD ₅₀ for type A	12 hours -5 days	Death in 24-72 hours; lasts months if not lethal	High without respiratory support	For weeks in nonmoving water and food	3 dose efficacy 100% against 25-250 LD ₅₀ in primates
Staph Enterotoxin B	No	0.03 µg/person incapacitation	3-12 hours after inhalation	Hours	< 1%	Resistant to freezing	No vaccine
Ricin	No	3-5 µg/kg is LD ₅₀ in mice	18-24 hours	Days - death within 10-12 days for ingestion	High	Stable	No vaccine
T-2 Mycotoxins	No	Moderate	2-4 hours	Days to months	Moderate	For years at room temperature	No vaccine

Source: Medical Management of Biological Casualties handbook, Sixth edition, April 2005; USAMRIID, Fort Detrick Frederick, Maryland

Annexure-B

Refers to Chapter 4, Page 43

Vaccines, Prophylaxis, and Therapeutics for Biological Warfare Agents

ANTHRAX

VACCINE/TOXOID	DEVELOPMENT
<p>Emergent BioThrax™ Anthrax Vaccine (AVA)</p> <p>Preexposure^(A): licensed for adults 18-65yr old, 0.5 mL SC @ 0, 2, 4 wk, 6, 12, 18 mo then annual boosters</p> <p>Postexposure^(A): Under INDvise Contingency Use Protocol for volunteer anthrax vaccination SC@ 0, 2, 4 wk in combination with approved and labeled antibiotics</p> <p>Pediatric Annex^{IND} for postexposure use.</p>	<p>Recombinant protective antigen (rPA) vaccine</p>
CHEMOPROPHYLAXIS	DEVELOPMENT
<p>Ciprofloxacin^(A): 500 mg PO bid (adults), 15mg/kg (up to 500mg/dose) PO bid (peds)^(A), or</p> <p>Doxycycline^(A): 100 mg PO bid (adults), 2.2mg/kg (up to 100mg/dose) PO bid (peds < 45kg)^(A) or (if strain susceptible):</p> <p>Penicillin G procaine: 1,200,000U q 12 hr (adults)^(A), 25,000U/kg (maximum 1,200,000 unit) q 12 hr (peds)^(A), or</p> <p>Penicillin V Potassium: 500 mg q 6 hr (adults), or</p> <p>Amoxicillin: 500mg PO q 8 hr (adults and children>40kg), 15mg/kg q 8 hr (children<40kg),</p> <p>Plus, AVA (postexposure)^(IND)</p> <p>1. Fully immunized (completed 6 shot primary series and up-to-date on annual boosters, or 3 doses within past 6 mo): continue antibiotics for at least 30 days.</p> <p>2 Unimmunized: 3 doses of AVA 0.5cc SQ at 0, 2, 4 weeks^(IND). Continue antibiotics for at least 7-14 days after 3rd dose.</p> <p>3 No AVA used: continue antibiotics for at least 60 days</p>	<p>Anthrax Immune Globulin (AIG)</p>
CHEMOTHERAPY	
<p>Inhalational, Gastrointestinal, or SystemicCutaneous Disease:</p> <p>Ciprofloxacin : 400 mg IV 1 12 h initially then by mouth (adult)^(A) 15 mg/kg/dose (up to 400mg/dose) q 12 h (peds)^(A), or</p> <p>Doxycycline: 200 mg IV, then 100 mg IV q 12 h (adults)^(A) 2.2mg/kg (100mg/dose max) q 12 h (peds < 45kg)^(A), or (if strain susceptible),</p>	<p>Anthrax Immune Globulin (AIG)</p>

Contd

<p>Penicillin G Procaine: 4 million units IV q 4 h (adults)^(A) 50,000U/kg (up to 4M U) IV q 6h (peds)^(A)</p> <p>PLUS, One or two additional antibiotics with activity against anthrax. (e.g. clindamycin plus rifampin may be a good empiric choice, pending susceptibilities). Potential additional antibiotics include one or more of the following: clindamycin, rifampin, gentamicin, macrolides, vancomycin, imipenem, and chloramphenicol.</p> <p>Convert from IV to oral therapy when the patient is stable, to complete at least 60 days of antibiotics.</p> <p>Meningitis: Add Rifampin 20mg/kg IV qd or Vancomycin 1g IVq12h</p>	
<p>COMMENTS</p>	
<p>In 2002 the American Committee on immunization Practices (ACIP) recommended making anthrax vaccine available in a 3-dose regimen (0, 2, 4 weeks) in combination with antimicrobial postexposure prophylaxis under an IND application for unvaccinated persons at risk for inhalational anthrax.</p> <p>Penicillins should be used for anthrax treatment or prophylaxis only if the strain is demonstrated to be PCN-susceptible.</p> <p>According to CDC recommendations, amoxicillin prophylaxis is appropriate only after 14-21 days of fluoroquinolone or doxycycline and only for populations with contraindications to the other drugs (children, pregnancy)</p> <p>Oral dosing (versus the preferred IV) may be necessary for treatment of systemic disease in a mass casualty situation.</p> <p>Cutaneous Anthrax: Antibiotics for cutaneous disease (without systemic complaints) resulting from a BW attack involving BW aerosols are the same as for postexposure prophylaxis. Cutaneous anthrax acquired from natural exposure could be treated with 7-10 days of antibiotics.</p>	<p>AIG is serum from human AVA recipients with high anti-PA titers.</p>

Brucellosis

<p>VACCINE/TOXOID</p>
<p>None</p>
<p>CHEMOPROPHYLAXIS</p>
<p>Can try one of the treatment regimens for 3-6 weeks, for example:</p>
<p>Doxycycline : 200mg po qd (adults)^(A) , plus Rifampin: 600mg PO qd</p>
<p>CHEMOTHERAPY</p>
<p>Inhalational, Gastrointestinal, or SystemicCutaneous Disease</p>
<p>Significant infection: Doxycycline: 100mg PO bid for 4-6 wks (adults)^(A) , 2.2 mg/kg PO bid (peds), plus Streptomycin 1g IM qd for first 3 wks (adults)^(A) , or Doxycycline^(A) + Gentamicin (if streptomycin not available)</p>
<p>Less severe disease:</p>
<p>Doxycycline 100mg PO bid for 4-6 wks (adults)^(A) , plus Rifampin 600-900 mg/day PO qd for 4-6 wks (adults)^(A) , 15-20mg/kg (up to 600-900mg) qd or divided bid (peds)</p>
<p>Others used with success: TMP/SMX 8-12mg/kg/d divided qid, plus Rifampin (may be preferred therapy during pregnancy or in children <8yrs), Or Ofloxacin + Rifampin</p>
<p>Long-term (up to 6 mo) therapy for meningoencephalitis, endocarditis: Rifampin + a tetracycline + an aminoglycoside (first 3 weeks)</p>
<p>COMMENTS</p>
<p>Ideal chemoprophylaxis is unknown. Chemoprophylaxis not recommended after natural exposure.</p>
<p>Avoid monotherapy (high relapse). Relapse common for treatments less than 4-6 weeks.</p>

Glanders & Melioidosis

VACCINE/TOXOID
None
CHEMOPROPHYLAXIS
Can try one of the treatment regimens for 3-6 weeks, for example: Doxycycline : 200mg po qd (adults) ^(A) , plus Rifampin: 600mg PO qd
CHEMOTHERAPY
Severe Disease: ceftazidime (40mg/kg IV q 8hrs), or imipenem (15mg/kg IV q 6hr max 4 g/day), or meropenem (25mg/kg IV q 8hr, max 6g/day), plus , TMP/SMX (TMP 8 mg/kg/day IV in four divided doses) Continue IV therapy for at least 14 days and until patient clinically improved, then switch to oral maintenance therapy (see “mild disease” below) for 4-6 months. Melioidosis with septic shock: Consider addition of G-CSF 30ug/day IV for 10 days. Mild Disease: Historic: PO doxycycline and TMP/SMX for at least 20 weeks, plus PO chloramphenicol for the first 8 weeks. Alternative: doxycycline (100 mg po bid) plus TMP/SMX (4 mg/kg/day in two divided doses) for 20 weeks.
COMMENTS
Little is known about optimum therapy for glanders, as this disease has been rare in the modern antibiotic era. For this reason, most experts feel initial therapy of glanders should be based on proven therapy for the similar disease, melioidosis. One potential difference in the two organisms is that natural strains of <i>B. mallei</i> respond to aminoglycosides and macrolides, while <i>B. pseudomallei</i> does not; thus, these classes of antibiotics may be beneficial in treatment of glanders, but not melioidosis. Severe Disease: If ceftazidime or a carbapenem are not available, ampicillin/sulbactam or other intravenous beta-lactam/beta-lactamase inhibitor combinations may represent viable, albeit less-proven alternatives. Mild Disease: Amoxicillin/clavulanate may be an alternative to Doxycycline plus TMP/SMX, especially in pregnancy or for children <8yr old.

Plague

VACCINE/TOXOID	DEVELOPMENT
	Recombinant F1-V Antigen Vaccines, DoD & UK
CHEMOPROPHYLAXIS	
Ciprofloxacin: 500 mg PO bid x 7 d (adults), 20mg/kg (up to 500mg) PO bid (peds), or Doxycycline: 100 mg PO q 12 h x 7 d (adults), 2.2 mg/kg (up to 100mg) PO bid (peds), or Tetracycline: 500 mg PO qid x 7 d (adults)	
CHEMOTHERAPY	
Streptomycin: 1g q 12hr IM (adults) ^(A) , 15mg/kg/d div q 12hr IM (up to 2 g/day)(peds) ^(A) , or Gentamicin: 5 mg/kg IM or IV qd or 2 mg/kg loading dose followed by 1.7 mg/kg IM or IV (adults), 2.5 mg/kg IM or IV q8h (peds). Alternatives: Doxycycline: 200 mg IV once then 100 mg IV bid until clinically improved, then 100 mg PO bid for total of 10-14 d (adults) ^(A) , or Ciprofloxacin: 400mg IV q 12 h until clinically improved then 750 mg PO bid for total 10-14 d, or Chloramphenicol: 25 mg/kg IV, then 15 mg/kg qid x 14 d.	FDA-approved therapeutics

Contd

<p>A minimum of 10 days of therapy is recommended (treat for at least 3-4 days after clinical recovery). Oral dosing (versus the preferred IV) may be necessary in a mass casualty situation.</p> <p>Meningitis: add Chloramphenicol 25mg/kg IV, then 15mg/kg IV qid.</p>	
<p>COMMENTS</p>	
<p>Greer inactivated vaccine (FDA licensed) is no longer available.</p> <p>Streptomycin is not widely available in the US and therefore is of limited utility. Although not licensed for use in treating plague, gentamicin is the consensus choice for parenteral therapy by many authorities. Reduce dosage in renal failure.</p> <p>Chloramphenicol is contraindicated in children less than 2 yrs. While Chloramphenicol is potentially an alternative for post-exposure prophylaxis (25mg/kg PO qid), oral formulations are available only outside the US.</p> <p>Alternate therapy or prophylaxis for susceptible strains: trimethoprim-sulfamethoxazole</p> <p>Other fluoroquinolones or tetracyclines may represent viable alternatives to ciprofloxacin or doxycycline, respectively.</p>	

Q Fever

<p>VACCINE/TOXOID</p>
<p>Inactivated Whole Cell Vaccine (Preexposure)^{(IND):} DoD Laboratory Use Protocol using Australian QvaxTM vaccine in at-risk laboratory personnel.</p>
<p>CHEMOPROPHYLAXIS</p>
<p>Doxycycline: 100 mg PO bid x 5 d (adults), 2.2mg/kg PO bid (peds), or Tetracycline: 500 mg PO qid x 5d (adults)</p> <p>Start postexposure prophylaxis 8-12 d post-exposure.</p>
<p>CHEMOTHERAPY</p>
<p>Acute Q-fever: Doxycycline: 100 mg IV or PO q 12 h x at least 14 d (adults)^(A), 2.2 mg/kg PO q 12 h (peds), or Tetracycline: 500 mg PO q 6 hr x at least 14 d</p>
<p>Alternatives: Quinolones (eg ciprofloxacin), or TMP-SMX, or Macrolides (eg clarithromycin or azithromycin) for 14-21 days. Patients with underlying cardiac valvular defects: Doxycycline plus Hydroxychloroquine 200mg PO tid for 12 months</p>
<p>Chronic Q Fever: Doxycycline plus quinolones for 4 years, or Doxycycline plus hydroxychloroquine for 1.5-3 years.</p>
<p>COMMENTS</p>
<p>Q-Fever vaccine manufactured in 1970. Significant side effects if administered inappropriately; sterile abscesses if prior exposure/skin testing required prior to vaccination. Time to develop immunity – 5 weeks.</p> <p>Initiation of postexposure prophylaxis within 7 days of exposure merely delays incubation period of disease.</p> <p>Tetracyclines are preferred antibiotic for treatment of acute Q fever except in:</p> <ol style="list-style-type: none"> 1. <u>Meningoencephalitis:</u> fluoroquinolones may penetrate CSF better than tetracyclines 2. <u>Children < 8yrs (doxycycline relatively contraindicated):</u> TMP/SMX or macrolides (especially clarithromycin or azithromycin). 3. <u>Pregnancy:</u> TMP/SMX 160mg/800mg PO bid for duration of pregnancy. If evidence of continued disease at parturition, use tetracycline or quinolone for 2-3 weeks.

Contd

Tularemia

VACCINE/TOXOID	
Live attenuated vaccine (Preexposure) ^(IND)	
DoD Laboratory Use Protocol for vaccine. Single 0.1ml dose via scarification in at-risk researchers.	
CHEMOPROPHYLAXIS	
Ciprofloxacin: 500 mg PO q 12 h for 14 d, 20mg/kg (up to 500mg) PO bid (peds), or	
Doxycycline: 100 mg PO bid x 14 d (adults), 2.2mg/kg (up to 100mg) PO bid (peds<45kg), or	
Tetracycline: 500 mg PO qid x 14 d (adults)	
CHEMOTHERAPY	
Streptomycin: 1g IM q12 h days x at least 10 days (adults) ^(A) , 15mg/kg (up to 2g/day) IM q12h (peds) ^(A) , or	
Gentamicin: 5 mg/kg IM or IV qd, or 2 mg/kg loading dose followed by 1.7 mg/kg IM or IV q 8 h x at least 10 days (adults) ^(A) , 2.5mg/kg IM or IV q 8 h (peds), or	
Alternatives:	
Ciprofloxacin 400 mg IV q 12 h for at least 10d (adults), 15mg/kg (up to 400mg) IV q 12 h (peds), or	
Doxycycline: 200 mg IV, then 100 mg IV q 12 h x 14-21 d (adults) ^(A) , 2.2mg/kg (up to 100mg) IV q 12 h (peds<45kg), or	
Chloramphenicol: 25mg/kg IV q 6 h x 14-21 d, or	
Tetracycline: 500 mg PO qid x 14-21 d (adults) ^(A)	
COMMENTS	
Vaccine manufactured in 1964.	
Streptomycin is not widely available in the US and therefore is of limited utility. Gentamicin, although not approved for treatment of tularemia likely represents a suitable alternative. Adjust gentamicin dose for renal failure	
Treatment with streptomycin, gentamicin, or ciprofloxacin should be continued for 10 days; doxycycline and chloramphenicol are associated with high relapse rates with course shorter than 14-21 days. IM or IV doxycycline, ciprofloxacin, or chloramphenicol can be switched to oral antibiotic to complete course when patient clinically improved.	
Chloramphenicol is contraindicated in children less than 2 yrs. While Chloramphenicol is potentially an alternative for post-exposure prophylaxis (25mg/kg PO qid), oral formulations are available only outside the US.	

Botulinum Toxins

VACCINE/TOXOID	DEVELOPMENT
Pentavalent Toxoid Vaccine ^(IND) (Preexposure use only)	DoD rBONT Heptavalent Vaccine
HBIG, DoD pentavalent human botulism immune globulin, types A-E ^(IND) . IND for pre-exposure prophylaxis for high risk individuals only.	
CHEMOPROPHYLAXIS	
DoD equine antitoxins ^(IND) In general, botulinum antitoxin is not used prophylactic ally. Under special circumstances, if the evidence of exposure is clear in a group of individuals, some of whom have well defined neurological findings consistent with botulism, treatment can be contemplated in those without neurological signs.	

defined neurological findings consistent with botulism, treatment can be contemplated in those without neurological signs.	
CHEMOTHERAPY	
CDC trivalent equine antitoxin for serotypes A, B and E. A and B are licensed and E is a CDC IND Product. BabyBig™, California Health Department, types A and B Human lyophilized IgG ^(A) HE-BAT, DoD heptavalent equine botulism antitoxin, types A-G ^(IND) HFabBAT, DoD de-specified heptavalent equine botulism antitoxin, types A-G ^(IND)	Monoclonal antibodies
COMMENTS	
Pentavalent Toxoid Vaccine failed potency testing for Serotypes D and E. FDA has concerns about all of the other Serotypes potency. Must initiate series 13 weeks before potential exposure for optimum protection. Skin test for hypersensitivity before equine antitoxin administration.	

Ricin Toxin

VACCINE/TOXOID	DEVELOPMENT
COMMENTS	
Inhalation: supportive therapy G-I: gastric lavage, superactivated charcoal, cathartics.	Availability of ricin vaccine contingent upon transition of candidate to advanced development and upon availability of funds.

Staphylococcus Enterotoxins

VACCINE/TOXOID	DEVELOPMENT
	DoD recombinant SEB Vaccine
CHEMOPROPHYLAXIS	
CHEMOTHERAPY	
COMMENTS	
Supportive care including assisted ventilation for inhalation exposure.	Currently insufficient funding for JVAP development to IND product.

Encephalitis Viruses

VACCINE/TOXOID	DEVELOPMENT
JE live attenuated vaccine ^(A) VEE Live Attenuated Vaccine ^(IND) (DoD Laboratory Use Protocol for Preexposure) TC-83 strain, for initial immunizations	VEE (V3526) Vaccine.

Contd

VEE Inactivated Vaccine ^(IND) (DoD Laboratory Use Protocol for Preexposure) C-84 strain, for booster immunizations	
EEE Inactivated Vaccine ^(IND) (DoD Laboratory Use Protocol for Preexposure)	
WEE Inactivated Vaccine ^(IND) (DoD Laboratory Use Protocol for Preexposure)	
CHEMOPROPHYLAXIS	
None	
CHEMOTHERAPY	
No specific therapy. Supportive care only.	
COMMENTS	
VEE TC-83 vaccine manufactured in 1965. Live, attenuated vaccine, with significant side effects. 25%-35% of recipients require 2-3 days bed rest. Time to develop immunity – 8 weeks. VEE TC-83 reactogenic in 20%. No seroconversion in 20%. Only effective against subtypes 1A, 1B, and 1C. VEE C-84 vaccine used for non-responders to VEE TC-83. Must be given prior to EEE or WEE (if administered subsequent, antibody response decreases from 81% to 67%).	
EEE vaccine manufactured in 1989. Antibody response is poor, requires 3-dose primary (one month) and 1-2 boosters (one month apart). Primary series yields antibody response in 77%; 5%-10% of non-responders after boosts. Time to immunity – 3 months.	
WEE vaccine manufactured in 1991. Antibody response is poor, requires 3-dose primary (one month) and 3-4 boosters (one month apart). Primary series antibody response in 29%, 66% after four boosts. Time to develop immunity – six months.	
EEE and WEE inactivated vaccines are poorly immunogenic. Multiple immunizations are required.	

Hemorrhagic Fever Viruses

VACCINE/TOXOID	DEVELOPMENT
Yellow Fever live attenuated 17D vaccine ^(A)	Adenovirus vectored Ebola Vaccine Ebola DNA vaccine
AHF vaccine ^(IND) (x-protection for BHF)	
RVF inactivated vaccine ^(IND) (DoD IND for high-risk laboratory workers)	
CHEMOPROPHYLAXIS	
Lassa fever and CCHF: Ribavirin 500mg PO q 6 hr for 7 days (Not FDA approved for this use)	
CHEMOTHERAPY	
Ribavirin (CCHF/Lassa/KHF): 30 mg/kg (up to 2g) IV initial dose; then 16 mg/kg (up to 1g) IV q 6 h x 4 d; then 8 mg/kg (up to 500mg) IV q 8 h x 6 d (adults) ^(IND)	Passive antibody for AHF, BHF, Lassa fever, and CCHF.
<u>Mass Casualty Situation (Arenavirus, Bunyavirus, or VHF of unknown etiology. Not FDA-approved or IND)</u> Ribavirin: 2000mg PO; then 600mg PO bid (if > 75kg), or 400mg PO in am and 600mg PO in PM (if ≤ 75kg) for 10 days (adults), 30mg/kg then 15mg/kg divided bid for 10 days (peds)	
COMMENTS	
Aggressive supportive care and management of hypotension and coagulopathy very important. Human antibody used with apparent beneficial effect in uncontrolled human trials of AHF.	Ebola DNA vaccine in human trials at NIH

<p>Human experience with postexposure ribaririn use for VHF exposure is limited to a few cases exposed to CCHF and Lassa. Any use for this purpose should be ideally under IND.</p> <p>Consensus statement in JAMA from 2002 suggests using Ribavirin to treat clinically apparent hemorrhagic fever virus infection of unknown etiology using doses from CCHF/Lassa/KHF IND.</p>	
<p>Smallpox</p>	
<p>VACCINE/TOXOID</p> <p>Wyeth Dryvax™ (1:1) (Preexposure)^(A)</p> <p>Aventis Pasteur Smallpox Vaccine (APSV) (Preexposure)^(IND)</p> <p>Cell Culture derived Vaccines (all NYCBOH strain): - Dynport Vaccine (Preexposure)^(IND) - Acambis/Acambis-Baxter Vaccines (ACAM1000 and ACAM2000) (Preexposure)^(IND)</p>	<p>DEVELOPMENT</p> <p>Attenuated Vaccinia Vaccines: Acambis Modified Vaccinia Ankara (MVA) VaxGen LC16m8 strain</p>
<p>CHEMOPROPHYLAXIS</p>	
<p>Wyeth Dryvax™ (1:1) (Postexposure)^(IND)</p> <p>Use of Smallpox Vaccine in Response to Bioterrorism:</p> <p>Wyeth Dryvax™ (1:5 dilution)^(IND)</p> <p>CDC IND. If Dryvax™ (1:5) used up, not available, or need both vaccines, then use: APSV (1:5 dilution)^(IND)</p>	<p>DoD IND for APSV (1:5) Contingency Use</p>
<p>CHEMOTHERAPY</p>	
<p>Cidofovir for treatment of smallpox^(IND) :</p> <ul style="list-style-type: none"> - Probenecid 2g PO 3 h prior to cidofovir infusion. - infuse 1L NS 1 h prior to cidofovir infusion - Cidofovir 5mg/kg IV over 1 hr - repeat probenecid 1g PO 2 h and again 8 h after cidofovir infusion completed. <p>For Select Vaccine Adverse reactions (Eczema vaccinatum, vaccinia necrosum, ocular vaccinia w/o keratitis, severe generalized vaccinia):</p> <ol style="list-style-type: none"> 1. VIG IV (Vaccinia Immune Globulin – intravenous formulation). 100mg/kg IV infusion. 2. VIG-IM (Vaccinia Immune Globulin – intramuscular formulation). 0.6ml/kg IM. 3. Cidofovir 5mg/kg IV infusion (as above). 	<p>Oral formulations of cidofovir derivatives</p> <p>Monoclonal Vaccinia Immune Globulins</p>
<p>COMMENTS</p>	
<p>Dryvax™ - Wyeth calf lymph vaccinia vaccine 100 dose vials undiluted: 1 dose by scarification. Greater than 97% take after one dose within 14 days of administration.</p> <p>Dryvax™ is effective (either preventing <u>or</u> attenuating resulting disease) up to at least 4 days post exposure.</p> <p>Dryvax™ (1:1) FDA license approved 25 Oct 2002.</p> <p>APSV is also known as the Salk Institute (TSI) vaccine, a frozen, liquid formulation using the NYCBOH vaccine strain via calf-lymph production also used in the Dryvax™</p> <p>Pre and post exposure vaccination recommended if > 3 years since last vaccine.</p> <p>Recommendations for use of smallpox vaccine in response to bioterrorism are periodically undated by the Centers for Disease Control and Prevention (CDC), and the most recent recommendations can be found at http://www.cdc.gov.</p>	

Annexure-C
Refers to Chapter 4, Page 44

Patient Isolation Precautions

Standard Precautions

- Wash hands after patient contact.
- Wear gloves while touching blood, body fluids, secretions, excretions and contaminated items.
- Wear a mask and eye protection, or a face shield during procedures likely to generate splashes or sprays of blood, body fluids, secretions or excretions.
- Proper handling of patient-care equipment and linen in a manner that prevents the transfer of microorganisms to people or equipment.

Use proper precautions while handling a mouthpiece or other ventilation device as an alternative to mouth-to-mouth resuscitation.

Standard precautions are employed in the care of all patients

Airborne Precautions

Standard Precautions plus:

- Place the patient in a private room that has monitored negative air pressure, a minimum of six air changes/hour, and appropriate filtration of air before it is discharged from the room.
- Wear respiratory protection when entering the room.
- Limit movement and transport of the patient. Place a mask on the patient, if the patient needs to be moved.

Conventional Diseases requiring Airborne Precautions: Measles, Varicella, Pulmonary TB.

Biothreat Diseases requiring Airborne Precautions: Smallpox.

Droplet Precautions

Standard Precaution plus:

- Place the patient in a private room or cohort them with someone with the same infection. If not feasible, maintain at least three feet between patients.
- Wear a mask when working within three feet of the patient.
- Limit movement and transport of the patient. Place a mask on the patient, if the patient needs to be moved.

Conventional Diseases requiring Droplet Precautions: Invasive *Haemophilus influenzae* and meningococcal disease, drug-resistant pneumococcal disease, diphtheria, pertussis, mycoplasma, Group A Beta Hemolytic Streptococcus, influenza, mumps, rubella, parvovirus.

Biothreat Diseases Requiring Droplet Precautions: Pneumonic Plague

Contact Precautions

Standard Precautions plus:

- Place the patient in a private room or cohort them with someone with the same infection if possible.
- Wear gloves when entering the room. Change gloves after contact with infective material.
- Wear a gown when entering the room if contact with patient is anticipated or if the patient has diarrhea, a colostomy or wound drainage not covered by a dressing.
- Limit the movement or transport of the patient from the room.
- Ensure that patient-care items, bedside equipment, and frequently touched surfaces receive daily cleaning.
- Dedicate use of noncritical patient-care equipment (such as stethoscopes) to a single patient, or cohort of patients with the same pathogen. If not feasible, adequate disinfection between patients is necessary.

Conventional Diseases requiring Contact Precautions: Methicillin Resistant Staphylococcus aureus, Vancomycin Resistant Enterococcus, Clostridium difficile, Respiratory Syncytial Virus, parainfluenza, enteroviruses, enteric infections in the incontinent host, skin infections (Staphylococcal Scalded Skin Syndrome, Herpes Simplex Virus, impetigo, lice, scabies), hemorrhagic conjunctivitis.

Biothreat Diseases requiring Contact Precautions: VHF.

For more information, see: Garner JS. Guidelines for Infection Control Practices in Hospitals. Infect Control Hosp Epidemiol 1996;17:53-80.

Annexure-D
Refers to Chapter 4, Page 59

Laboratory Identification of Biological Warfare Agents

Disease/ Agent	Gold Standard	Antigen Detection	IgG	IgM	PCR	Animal
Aflatoxin Aflatoxins	Mass Spectrometry	X				
Anthrax <i>Bacillus anthracis</i>	FA/Std. Microbiology	X	X	X	X	X
Brucellosis <i>Brucella sp.</i>	FA/Std. Microbiology	X	X	X	X	X
Cholera <i>Vibrio cholerae</i>	Std. Microbiology /Serology	X(toxin)	X	X	X	
Glanders <i>B. mallei</i>	Std. Microbiology		X	X	X	
<i>B. pseudomallei</i>	Std. Microbiology		X	X	X	
Plague <i>Yersinia pestis</i>	FA/Std. Microbiology	X	X	X	X	X
Tularemia <i>F. tularensis</i>	FA/Std. Microbiology	X	X	X	X	X
Q Fever <i>C. burnetii</i>	FA/Eggs or Cell Cx/ Serology	X	X	X	X	X
Smallpox Orthopox Viruses	Virus Isolation/ FA /Neutralization	X	X		X	X
Venezuelan Equine Encephalitis Arboviruses (incl. Alphaviruses)	Virus Isolation/FA, Neutralization	X	X	X	X	X
Viral Hemorrhagic Fevers Filoviruses	Virus Isolation /Neutralization	X	X	X	X	X
Hantaviruses	Virus Isolation/ FA/ Neutralization	X	X	X	X	X
Botulism Bot Toxins (A-G)/ <i>C. botulinum</i>	Mouse Neutralization/ Standard Microbiology	X			*	X
Saxitoxin Saxitoxin	Bioassay		(neutralizing antibodies)		X	
Shigellosis <i>Shigella sp.</i>	Std. Microbiology	X			X	

Staph Enterotoxin B SEB Toxin	ELISA	X	X		*	X
Ricin Ricin Toxin	ELISA	X	X	X	X	X
T-2 Mycotoxins T-2 Mycotoxins	Mass Spectrometry	X				
Tetrodototoxin Tetrodotoxins	Bioassay	X	(neutralizing antibodies)			X
<i>C. perfringens</i> /Toxins	Std. Micro./ELISA (Alpha & Enterotoxin)	X	X		X	

* Toxin gene detected — only works if cellular debris including genes present as contaminant. Purified toxin does not contain detectable genes.

ELISA — enzyme-linked immunosorbent assays.

FA — indirect or direct immunofluorescence assays.

Std. Micro./serology — standard microbiological techniques available, including electron microscopy. Not all assays are available in field laboratories.

X — Advisable.

Annexure-E
Refers to Chapter 4, Page 59

Specimens for Laboratory Diagnosis

Disease	Face or Nasal Swab ¹	Blood Culture	Smear	Acute & Convalescent Sera	Stool	Urine	Other
Anthrax	+	+	Pleural & CS fluids mediastinal lymph node spleen	+	+/- (GI dz)	-	Cut. lesion aspirates or 4mm punch biopsy
Brucellosis	+	+	-	+	-	-	Bone marrow and spinal fluid cultures; tissues, exudates
Cholera	-	-	-	+	+	-	
Glanders & Melioidosis	+	+	Sputum and abscess aspirates	+	-	+/-	Abscess culture
Plague	+	+	Sputum	+	-	-	Bubo aspirate, CSF, sputum, lesion scraping, lymph node aspirate
Tularemia	+	+	² +	+	-	-	
Q-fever	+	⁴	Lesions	+	-	-	Lung, spleen, lymph nodes, bone marrow biopsies
Venezuelan Equine Encephalitis	+	³	-	+	-	-	CSF
Viral Hemorrhagic Fevers	+	³	-	+	-	-	Liver
Botulism	+	-	-	-	-	-	Serum or other fluids for mouse bioassay
Staph Enterotoxin B	+	-	-	+	+	+	Lung, kidney
Ricin Toxin	+	-	-	+	+	+	Spleen, lung, kidney
T-2 Mycotoxins	+	-	-	-	+	+	Serum, stool, or urine for metabolites
Clostridial Toxins	+	-	Wound tissues	+	+	-	

¹ Within 18–24 hours of exposure

² Fluorescent antibody test on infected lymph node smears. Gram stain has little value.

³ Virus isolation from blood or throat swabs in appropriate containment.

⁴ *C. burnetii* can persist for days in blood and resists desiccation. Ethylene Di-amine Tetra Acetic Acid anticoagulated blood preferred. Culturing should not be done except in BSL-3 containment.

Medical Sample Collection for Biological Threat Agents

This guide helps to determine which clinical samples to collect from individuals exposed to aerosolised biological threat agents or environmental samples from suspect sites. Proper collection of specimens from patients is dependent on the time frame following exposure. Sample collection is described for 'Early post-exposure', 'Clinical', and 'Convalescent/Terminal/Postmortem' time frames. These time frames are not rigid and will vary according to the concentration of the agent used, the agent strain, and predisposing health factors of the patient.

- Early post-exposure: when it is known that an individual has been exposed to a bioagent aerosol, aggressively attempt to obtain samples as indicated.
- Clinical: samples from those individuals presenting with clinical symptoms.
- Convalescent/Terminal/Postmortem: samples taken during convalescence, the terminal stages of infection or toxicosis or postmortem during autopsy.

Shipping Samples: Most specimens sent rapidly (less than 24 h) to analytical labs require only blue or wet ice or refrigeration at 2° to 8°C. However, if the time span increases beyond 24 h, contact the USAMRIID 'Hot-Line' (1-888-USA-RIID) for other shipping requirements such as shipment on dry-ice or in liquid nitrogen.

Blood samples: Several choices are offered based on availability of the blood collection tubes. Do not send blood in all the tubes listed, but merely choose one. Tiger-top tubes that have been centrifuged are preferred over red-top clot tubes with serum removed from the clot, but the latter will suffice. Blood culture bottles are also preferred over citrated blood for bacterial cultures.

Pathology samples: Routinely include liver, lung, spleen, and regional or mesenteric lymph nodes. Additional samples requested are as follows: brain tissue for encephalomyelitis cases (mortality is rare) and the adrenal gland for Ebola (good to have but not absolutely required).

Bacteria and Rickettsia

Convalescent/Early post-exposure Clinical Terminal/Postmortem

<p>Anthrax <i>Bacillus anthracis</i> <u>0 – 24 h</u> Nasal and throat swabs, induced respiratory secretions for culture, FA, and PCR</p>	<p><u>24 to 72 h</u> Serum (TT, RT) for toxin assays Blood (E, C, H) for PCR. Blood (BC, C) for culture</p>	<p><u>3 to 10 days</u> Serum (TT, RT) for toxin assays Blood (BC, C) for culture. Pathology samples</p>
<p>Plague <i>Yersinia pestis</i> <u>0 – 24 h</u> Nasal swabs, sputum, induced respiratory secretions for culture, FA, and PCR</p>	<p><u>24 – 72 h</u> Blood (BC, C) and bloody sputum for culture and FA (C), F-1 Antigen assays (TT, RT), PCR (E, C, H)</p>	<p><u>>6 days</u> Serum (TT, RT) for IgM later for IgG. Pathology samples</p>

Tularemia <i>Francisella tularensis</i> <u>0 – 24 h</u> Nasal swabs, sputum, induced respiratory secretions for culture, FA and PCR	<u>24 – 72 h</u> Blood (BC, C) for culture Blood (E, C, H) for PCR Sputum for FA & PCR	<u>>6 days</u> Serum (TT, RT) for IgM and later IgG, agglutination titers. Pathology Samples
BC: Blood culture bottle C: Citrated blood (3-ml)	E: EDTA (3-ml) H: Heparin (3-ml)	TT: Tiger-top (5 – 10 ml) RT: Red top if no TT

Bacteria and Rickettsia

Convalescent/Early post-exposure Clinical Terminal/Postmortem

Glanders <i>Burkholderia mallei</i> <u>0 – 24 h</u> Nasal swabs, sputum, induced respiratory secretions for culture and PCR.	<u>24 – 72 h</u> Blood (BC, C) for culture Blood (E, C, H) for PCR Sputum & drainage from skin lesions for PCR & culture.	<u>>6 days</u> Blood (BC, C) and tissues for culture. Serum (TT, RT) for immunoassays. Pathology samples.
Brucellosis <i>Brucella abortus, suis, & melitensis</i> <u>0 – 24 h</u> Nasal swabs, sputum, induced respiratory secretions for culture and PCR.	<u>24 – 72 h</u> Blood (BC, C) for culture. Blood (E, C, H) for PCR.	<u>>6 days</u> Blood (BC, C) and tissues for culture. Serum (TT, RT) for immunoassays. Pathology samples
Q-Fever <i>Coxiella burnetii</i> <u>0 – 24 h</u> Nasal swabs, sputum, induced respiratory secretions for culture and PCR.	<u>2 to 5 days</u> Blood (BC, C) for culture in eggs or mouse inoculation Blood (E, C, H) for PCR.	<u>>6 days</u> Blood (BC, C) for culture in eggs or mouse inoculation Pathology samples.
BC: Blood culture bottle C: Citrated blood (3-ml)	E: EDTA (3-ml) H: Heparin (3-ml)	TT: Tiger-top (5 - 10 ml) RT: Red top if no TT

Toxins

Convalescent/Early post-exposure Clinical Terminal/Postmortem

<p>Botulism Botulinum toxin from <i>Clostridium botulinum</i> <u>0 – 24 h</u> Nasal swabs, induced respiratory secretions for PCR (contaminating bacterial DNA) and toxin assays. Serum (TT, RT) for toxin assays</p>	<p><u>24 to 72 h</u> Nasal swabs, respiratory secretions for PCR (contaminating bacterial DNA) and toxin assays.</p>	<p><u>>6 days</u> Usually no IgM or IgG Pathology samples (liver and spleen for toxin detection)</p>
<p>Ricin Intoxication Ricin toxin from Castor beans <u>0 – 24 h</u> Nasal swabs, induced respiratory secretions for PCR (contaminating castor bean DNA) and toxin assays. Serum (TT) for toxin assays</p>	<p><u>36 to 48 h</u> Serum (TT, RT) for toxin assay Tissues for immunohisto-logical stain in pathology samples.</p>	<p><u>>6 days</u> Serum (TT, RT) for IgM and IgG in survivors</p>
<p>Staph enterotoxigenesis <i>Staphylococcus</i> Enterotoxin B <u>0 – 3 h</u> Nasal swabs, induced respiratory secretions for PCR (contaminating bacterial DNA) and toxin assays. Serum (TT, RT) for toxin assays</p>	<p><u>2 - 6 h</u> Urine for immunoassays Nasal swabs, induced respiratory secretions for PCR (contaminating bacterial DNA) and toxin assays. Serum (TT, RT) for toxin assays</p>	<p><u>>6 days</u> Serum for IgM and IgG Note: Only paired antibody samples will be of value for IgG assays...must adults have antibodies to staph enterotoxins.</p>
<p>T-2 toxicosis <u>0 – 24 h postexposure</u> Nasal & throat swabs, induced respiratory secretions for immunoassays, HPLC/ mass spectrometry (HPLC/MS).</p>	<p><u>1 to 5 days</u> Serum (TT, RT), tissue for toxin detection</p>	<p><u>>6 days postexposure</u> Urine for detection of toxin metabolites</p>
<p>BC: Blood culture bottle C: Citrated blood (3-ml)</p>	<p>E: EDTA (3-ml) H: Heparin (3-ml)</p>	<p>TT: Tiger-top (5 - 10 ml) RT: Red top if no TT</p>

Viruses

Convalescent/Early post-exposure Clinical Terminal/Postmortem

<p>Equine Encephalomyelitis VEE, EEE and WEE viruses <u>0 – 24 h</u> Nasal swabs & induced respiratory secretions for RT-PCR and viral culture</p>	<p><u>24 to 72 h</u> Serum & Throat swabs for culture (TT, RT), RT-PCR (E, C, H, TT, RT) and Antigen ELISA (TT, RT), CSF, Throat swabs up to 5 days</p>	<p><u>>6 days</u> Serum (TT, RT) for IgM Pathology samples plus brain</p>
<p>Ebola <u>0 – 24 h</u> Nasal swabs & induced respiratory secretions for RT-PCR and viral culture</p>	<p><u>2 to 5 days</u> Serum (TT, RT) for viral culture</p>	<p><u>>6 days</u> Serum (TT, RT) for viral culture. Pathology samples plus adrenal gland.</p>
<p>Pox (Smallpox, monkeypox) <i>Orthopoxvirus</i> <u>0 – 24 h</u> Nasal swabs & induced respiratory secretions for PCR and viral culture</p>	<p><u>2 to 5 days</u> Serum (TT, RT) for viral culture</p>	<p><u>>6 days</u> Serum (TT, RT) for viral culture. Drainage from skin lesions/ scrapings for microscopy, EM, viral culture, PCR. Pathology samples</p>
<p>BC: Blood culture bottle C: Citrated blood (3-ml)</p>	<p>E: EDTA (3-ml)H: Heparin (3-ml)</p>	<p>TT: Tiger-top (5 - 10 ml) RT: Red top if no TT</p>

Environmental samples can be collected to determine the nature of a bioaerosol either during, shortly after, or well after an attack. The first two along with early post-exposure clinical samples can help identify the agent in time to initiate prophylactic treatment. Samples taken well after an attack may allow identification of the agent used. While the information will most likely be too late for useful prophylactic treatment, this information along with other information may be used in the prosecution of war crimes or other criminal proceedings. This is not strictly a medical responsibility. However, the sample collection concerns are the same as for during or shortly after a bioaerosol attack and medical personnel may be the only personnel with the requisite training. If time and conditions permit, planning and risk assessments should be performed.

Like in any hazmat situation a clean line and exit and entry strategy should be designed. Obviously, if one is under attack and in the middle of the bioaerosol, there can be no clean line. Depending on the situation, personnel protective equipment should be donned. The standard Gas Mask is effective against bioaerosols. If it is possible to have a clean line then a three person team is recommended, with one clean and two dirty. The former would help decontaminate the latter. Because the samples may be used in a criminal prosecution, what, where, when, how, etc., of the sample collection should be documented both in writing and with pictures. Consider using waterproof disposable cameras and waterproof notepads, as these items also need to be decontaminated. The types of samples taken can be extremely variable. Some of the possible samples are:

- Aerosol Collections in Buffer Solutions
- Soil
- Swabs
- Dry Powders
- Container of Unknown Substance
- Vegetation
- Food/Water
- Body Fluids or Tissues

What is collected will depend on the situation. Aerosol collection during an attack would be ideal, assuming you have an aerosol collector. Otherwise anything that appears to be contaminated can either be sampled by swabbing the item with swabs if available, or absorbent paper or cloth. The item itself could be collected if not too large. In the case of well after the attack, collection samples of dead animals or people can be taken in a manner similar to samples that are taken during an autopsy. All samples should ideally be double bagged in ziploc bags (the inner bag decontaminated with dilute bleach before placing in the second bag) labelled with the time and place of collection along with any other pertinent data. If ziploc bags are not available, use whatever expedient packaging is available which appears to reduce the chance of sample contamination and infection of personnel handling the sample.

Note: This above chart has been downloaded from Medical Management of Biological Casualties handbook, Sixth edition, April 2005; USAMRIID, Fort Detrick Frederick, Maryland.

This may be suitably modified under the guidance of a microbiologist.

Annexure-G
Refers to Chapter 6, Page 77

OIE List of Infectious Terrestrial Animal Diseases

1. The following diseases are included within the category of multiple species diseases:

- Anthrax
- Aujeszky's disease
- Bluetongue
- Brucellosis (*Brucella abortus*)
- Brucellosis (*Brucella melitensis*)
- Brucellosis (*Brucella suis*)
- Crimean Congo haemorrhagic fever
- Echinococcosis/hydatidosis
- Foot and mouth disease (FMD)
- Heartwater
- Japanese encephalitis
- Leptospirosis
- New world screwworm (*Cochliomyia hominivorax*)
- Old world screwworm (*Chrysomya bezziana*)
- Paratuberculosis
- Q fever
- Rabies
- Rift Valley fever
- Rinderpest
- Trichinellosis
- Tularemia
- Vesicular stomatitis
- West Nile fever

2. The following diseases are included within the category of cattle diseases:

- Bovine anaplasmosis
- Bovine babesiosis
- Bovine genital campylobacteriosis
- Bovine spongiform encephalopathy (BSE)
- Bovine TB
- Bovine viral diarrhoea
- Contagious Bovine Pleuro Pneumonia (CBPP)
- Enzootic bovine leukosis

- Haemorrhagic septicaemia
- Infectious bovine rhinotracheitis/infectious pustular vulvovaginitis
- Lumpy skin disease
- Malignant catarrhal fever (Wildebeest only)
- Theileriosis
- Trichomonosis
- Trypanosomosis (tsetse transmitted)

3. The following diseases are included within the category of sheep and goat diseases:

- Caprine arthritis/encephalitis
- Contagious agalactia
- Contagious caprine pleuropneumonia
- Enzootic abortion of ewes (ovine chlamydiosis)
- Maedi-visna
- Nairobi sheep disease
- Ovine epididymitis (*Brucella ovis*)
- Peste des petits ruminants
- Salmonellosis (*S. abortusovis*)
- Scrapie
- Sheep pox and goat pox

4. The following diseases are included within the category of equine diseases:

- African horse sickness
- Contagious equine metritis
- Dourine
- Equine encephalomyelitis (Eastern)
- Equine encephalomyelitis (Western)
- Equine infectious anaemia
- Equine influenza
- Equine piroplasmiasis
- Equine rhinopneumonitis
- Equine viral arteritis
- Glanders
- Surra (*Trypanosoma evansi*)
- Venezuelan equine encephalomyelitis

5. The following diseases are included within the category of swine diseases:

- African swine fever
- Classical swine fever
- Nipah virus encephalitis

- Porcine cysticercosis
- Porcine reproductive and respiratory syndrome
- Swine vesicular disease
- Transmissible gastroenteritis

6. The following diseases are included within the category of avian diseases:

- Avian chlamydiosis
- Avian infectious bronchitis
- Avian infectious laryngotracheitis
- Avian mycoplasmosis (*Mycoplasma gallisepticum*)
- Avian mycoplasmosis (*Mycoplasma synoviae*)
- Duck virus hepatitis
- Fowl cholera
- Fowl typhoid
- HPAI in birds and low pathogenicity notifiable avian influenza in poultry
- Infectious bursal disease (Gumboro disease)
- Marek's disease
- Newcastle disease
- Pullorum disease
- Turkey rhinotracheitis

7. The following diseases are included within the category of lagomorph diseases:

- Myxomatosis
- Rabbit haemorrhagic disease

8. The following diseases are included within the category of bee diseases:

- Acarapisosis of honey bees
- American foulbrood of honey bees
- European foulbrood of honey bees
- Small hive beetle infestation (*Aethina tumida*)
- *Tropilaelaps* infestation of honey bees
- Varroosis of honey bees

9. The following diseases are included within the category of other diseases:

- Camel pox
- Leishmaniasis

Disposal of Animal Carcasses: A Prototype

1. If death was caused by a highly infectious disease

- Clean and disinfect the area after the carcass is removed.
- Wear protective clothing when handling deadstock and thoroughly disinfect or dispose of clothing before handling live animals.
- Properly dispose of contaminated bedding, milk, manure, or feed.
- Check with the State Veterinarian about disposal options. Burial may not be legal. Special methods of incineration or burial may be used in cases of highly infectious diseases.
- Limit the access of the deadstock collector and his vehicle to areas well away from other animals, their feed and water supply, grazing areas, or walkways.

The standard site requirements for disposal of dead animals are:

- 6 feet above bedrock, 4 feet above seasonal high ground water.
- 2 feet of soil on top, final cover.
- Greater than 100 feet from property lines.
- Greater than 300 feet from water supplies.

2. Composting deadstock

If you compost your deadstock, follow the steps listed below:

A. Decide what method you will use. Burial methods include static piles, turned windrows, turned bins, and contained systems. Information on the first three methods is available on several websites listed under 'Resources on deadstock disposal.'

- Static piles with minimum dimensions of 4 feet long, by 4 feet wide, by 4 feet deep are by far the simplest to use.
- Turned windrows may be an option for farmers already composting manure in windrows.
- Turned bin systems are more common for handling swine and poultry mortalities.
- The eco-pod is a contained system developed by Ag-Bag, which has been used to compost swine and poultry mortalities.

B. Select an appropriate site.

- Well-drained with all-season accessibility.
- At least 3 feet above seasonal high ground water levels.
- At least 100 (preferably 200) feet from surface waterways, sinkholes, seasonal seeps, or ponds.
- At least 150 feet from roads or property lines—think about which way the wind blows.
- Outside any Class I groundwater, wetland or buffer, or Source Protection Area contact—NRCS for verification.

C. Select and use effective carbon sources.

- Use materials such as wood chips, wood shavings, coarse sawdust, chopped straw or dry heavily bedded horse or heifer manure as bulking materials. Co-compost materials for the base and cover must allow air to enter the pile.
- If the bulking materials are not very absorbent, cover them with a 6-inch layer of sawdust to prevent fluids from leaching from the pile.
- Cover the carcass 2 feet deep with high-carbon materials such as old silage, dry bedding (other than paper), sawdust, or compost from an old pile.
- Plan on a 12' x 12' base for an adult dairy animal. The base should be at least 2 feet deep and should allow 2 feet on all sides around the carcass.
- When composting smaller carcasses, place them in layers separated by 2 feet of material.

D. Prepare the carcass.

- After placing the carcass on the base, lance the rumen of adult cattle. Explosive release of gasses may uncover the pile releasing odours and attracting scavengers.

E. Protect the site from scavengers.

- Adequate depth of materials on top of the carcass should minimise odours and the risk of scavengers disturbing the pile.
- Scavengers may be deterred by the temperatures within the pile, but, if not, an inexpensive fence of upside down hog wire may be adequate to avoid problems.

F. Monitor the process.

- Keep a log of temperature, carcass weight, and co-compost materials when each pile is started. Weather and starting materials will affect the process.
- Measure pile temperature with a compost thermometer 6 to 8 inches from the top of the pile and deep within to check for proper heating. Check daily for the first week or two. Pile temperature should reach 65°C for 3 consecutive days to eliminate common pathogens.
- Record events or problems such as scavenging, odours, or liquid leaking from the pile. Wait. Most large carcasses will be fully degraded within 4-6 months. Smaller carcasses take less time. Turning the pile after 3 months can accelerate the process.

List of National Standards on Phyto-sanitary Measures

S.NO.	TITLE OF STANDARD	NSPM NO.
1.	Plant Quarantine Operation Systems Manual	1
2.	Import Inspection Manual	2
3.	Export Inspection Manual	3
4.	Post-Entry Quarantine Inspection Manual	4
5.	Pest Risk Analysis–Technical Methodology	5
6.	Guidelines for Auditing of Plant Quarantine Activities	6
7.	Guidelines for Reporting of Plant Quarantine Activities	7
8.	Guidelines for Certification of Forced Hot-Air Treatment Facilities for Wood Packaging Material	8
9.	Guidelines for Export Inspection and Phytosanitary Certification of Fresh Mango (<i>Mangifera indica</i>) Fruits to P. R. China	9
10.	Guidelines for Development of National Standards for Phytosanitary Measures	10
11.	Quarantine Treatments and Application Procedures -1. Methyl Bromide Fumigation	11
12.	Guidelines for Assessment, Accreditation and Auditing of Fumigation Agencies	12
13.	Requirements for Establishment of Pest Free Areas for Mango Nut Weevil (<i>Sternochetus mangiferae</i>) and Pulp Weevil (<i>Sternochetus frigidus</i>)	13
14.	Requirements for Establishment of Pest Free Areas for Tephritid Fruit Flies	14
15.	Guidelines for Certification of Hot-Water Immersion Treatment Facilities	15
16.	Pest Risk Analysis: Administrative Process Manual	16
17.	Guidelines for Regulating Export, Import and Release of Biological Control Agents and other Beneficial Organisms	17
18.	Guidelines for Certification of Heat Treatment Facilities for Niger Seed for Export to USA	18
19.	Requirements for Establishment of Pest Free Areas for Brown Rot (<i>Ralstonia solanacearum</i>) of Potato	19
20.	Guidelines for Certification of Vapour Heat Treatment facilities for Fresh Fruits	20
21.	Guidelines for Certification of Irradiation Treatment Facilities for Fresh Fruits	21

New standards/guidelines need to be developed on a priority basis for aluminum phosphide fumigation; surveillance; consignments in transit; pest reporting; and, sampling and diagnostic protocols. SOPs and manuals for the above must also be developed for the operational aspects.

Annexure-J
Refers to Chapter 8, Page 109

Important Websites

Ministry/Institute/Agency	Website
Ministry of Home Affairs	http://mha.nic.in/
Ministry of Health and Family Welfare	http://mohfw.nic.in/
Ministry of Agriculture	http://agricoop.nic.in/
Ministry of Defence	http://mod.nic.in/
National Disaster Management Authority	www.ndma.gov.in
Council of Scientific and Industrial Research	http://www.csir.res.in/
Defence Research Development Organisation	http://www.drdo.org/
Department of Biotechnology	www.dbtindia.nic.in
National Institute of Virology	www.icmr.nic.in/pinstitute/niv.htm
National Institute of Communicable Diseases	www.nicd.org
Indian Veterinary Research Institute	www.ivri.nic.in
World Health Organization	www.who.int
Indian Council of Agricultural Research	www.icar.org.in
United Nations Children's Fund	www.unicef.org
National Institute of Cholera and Enteric Diseases	www.niced.org
Public Health Foundation of India	www.phfi.org
National Institute of Epidemiology	www.icmr.nic.in/pinstitute/nie.htm
Vector Control Research Centre	www.pon.nic.in/vcrc/
International Health Regulations	www.who.int/csr/ihr/en/
Centers for Disease Control and Prevention	www.cdc.gov
National Bureau of Plant Genetic Resources	www.nbpgr.ernet.in
Disaster Management Institute	www.dmibpl.org
Armed Forces Medical Services	www.indianarmy.gov.in/dgafms/index.htm
The Australia Group	www.australiagroup.net/en/biological_agents.html

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