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A Contingency Plan for the Management of Viral Outbreak

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ABSTRACT

This article is about the type of pathogen. A pathogen may also be referred to as an infectious agent, or simply a germ. The term is used to describe an infectious microorganism or agent, such as a virus, bacterium, protozoan, prion, viroid, or fungus. Viruses are found in almost every ecosystem on Earth and are the most numerous type of biological entity. A virus is a sub-microscopic infectious agent that replicates only inside the living cells of an organism. Viruses consist of nucleic acid and a protein coat. Usually the nucleic acid is RNA sometimes it's DNA. Viruses are able to cause many types of diseases, such as coronavirus, polio, ebola and hepatitis. Severe viral infections are more likely to occur in treatment regimens that are more immunosuppressive. Historically, the most frequent severe infections have been due to herpes viruses, but more recently, other pathogens, especially community respiratory and hepatitis viruses, have received increasing attention as major viral pathogens. This review provides an overview of novel guidelines applied to molecular diagnosis of viral infections and to control viral outbreak.

INTRODUCTION

A **virus** is a sub microscopic infectious agent that replicates only inside the living cells of an organism. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea.[1] Since Dmitri Ivanovsky's 1892 article describing a non-bacterial pathogen infecting tobacco plants, and the discovery of the tobacco mosaic virus by Martinus Beijerinck in 1898,[2] about 5,000 virus species have been described in detail,[3] of the millions of types of viruses in the environment.[4]

The origins of viruses in the evolutionary history of life are unclear: some may have evolved from plasmids pieces of DNA that can move between cells while others may have evolved from bacteria. In evolution, viruses are an important means of horizontal gene transfer, which increases genetic diversity in a way analogous to sexual reproduction.[5]

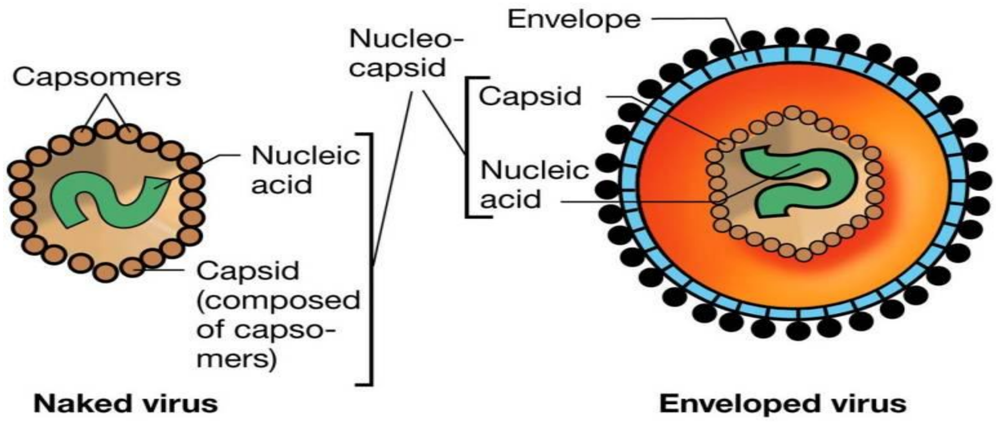

Figure No. 1: **Structure of Virus**

Most viruses that have been studied have a diameter between 20 and 300 nanometres.[6] A complete virus particle, known as a **virion**, consists of nucleic acid surrounded by a protective coat of protein called a capsid. These are formed from identical protein subunits called capsomeres.[7] Viruses can have a lipid "envelope" derived from the host cell membrane. The capsid is made from proteins encoded by the viral genome and its shape serves as the basis for morphological distinction.[8][9] Virally-coded protein subunits will self-assemble to form a capsid, in general requiring the presence of the virus genome. Complex viruses code for proteins that assist in the construction of their capsid. Proteins associated with nucleic acid are known as nucleoproteins, and the association of viral capsid proteins with viral nucleic acid is called a nucleocapsid. The capsid and entire virus structure can be mechanically (physically) probed through atomic force microscopy.[10][11] In general, there are four main morphological virus types: (Figure No. 1).

Helical

These viruses are composed of a single type of capsomere stacked around a central axis to form a helical structure, which may have a central cavity, or tube. This arrangement results in rod-shaped or filamentous virions which can be short and highly rigid, or long and very flexible. The genetic material (typically single-stranded RNA, but ssDNA in some cases) is bound into the protein helix by interactions between the negatively charged nucleic acid and positive charges on the protein. Overall, the length of a helical capsid is related to the length of the nucleic acid contained within it, and the diameter is dependent on the size and arrangement of capsomeres. The well-studied tobacco mosaic virus is an example of a helical virus.[12]

Icosahedral

Most animal viruses are icosahedral or near-spherical with chiral icosahedral symmetry. A regular icosahedron is the optimum way of forming a closed shell from identical sub-units. The minimum number of identical capsomeres required for each triangular face is 3, which gives 60 for the icosahedron. Many viruses, such as rotavirus, have more than 60 capsomers and appear spherical but they retain this symmetry. To achieve this, the capsomeres at the apices are surrounded by five other capsomeres and are called pentons. Capsomeres on the triangular faces are surrounded by six others and are called hexons.[13] Hexons are in essence flat and pentons, which form the 12 vertices, are curved. The same protein may act as the subunit of both the pentamers and hexamers or they may be composed of different proteins.[14]

Prolate

This is an icosahedron elongated along the fivefold axis and is a common arrangement of the heads of bacteriophages. This structure is composed of a cylinder with a cap at either end.[15]

Envelope

Some species of virus envelop themselves in a modified form of one of the cell membranes, either the outer membrane surrounding an infected host cell or internal membranes such as nuclear membrane or endoplasmic reticulum, thus gaining an outer lipid bilayer known as a viral envelope. This membrane is studded with proteins coded for by the viral genome and host genome; the lipid membrane itself and any carbohydrates present originate entirely from the host. The influenza virus and HIV use this strategy. Most enveloped viruses are dependent on the envelope for their infectivity.[16]

Complex

These viruses possess a capsid that is neither purely helical nor purely icosahedral, and that may possess extra structures such as protein tails or a complex outer wall. Some bacteriophages, such as Enterobacteria phage T4, have a complex structure consisting of an icosahedral head bound to a helical tail, which may have a hexagonal base plate with protruding protein tail fibres. This tail structure acts like a molecular syringe, attaching to the bacterial host and then injecting the viral genome into the cell.[17]

Virus Classification

Biologists have used several classification systems, based on the morphology and genetics.

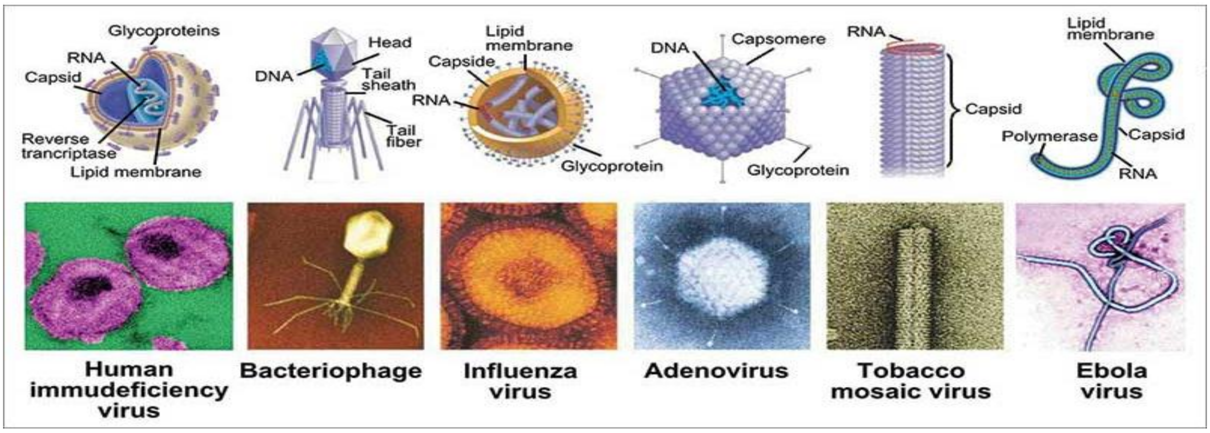

Figure No. 2: **Schematic representation of virus on the basis of morphology[18]**

DNA viruses

Table No. 1: DNA Virus Group I and Group II

Virus family	Examples (common names)	Virion naked/enveloped	Capsid symmetry	Nucleic acid type	Group
1. Adenoviridae	Adenovirus, infectious canine hepatitis virus	Naked	Icosahedral	Ds	I
2. Papovaviridae	Papillomavirus, polyoma viridae, simian vacuolating virus	Naked	Icosahedral	ds circular	I
3. Parvoviridae	Parvovirus B19, canine parvovirus	Naked	Icosahedral	Ss	II
4. Herpesviridae	Herpes simplex virus, varicella-zoster virus, cytomegalovirus, Epstein–Barr virus	Enveloped	Icosahedral	Ds	I
5. Poxviridae	Smallpox virus, cow pox virus, sheep pox virus, orf virus, monkey pox virus, vaccinia virus	Complex coats	Complex	Ds	I
6. Anelloviridae	Torque teno virus	Naked	Icosahedral	ss circular	II
7. Pleolipoviridae	HHPV1, HRPV1, HGPV1, His2V	Enveloped		ss/ds linear/circular	I/II

- **Group I**: viruses possess double-stranded DNA.
- **Group II**: viruses possess single-stranded DNA.

RNA viruses

Table No. 2: RNA Virus Group III, IV and V

Virus Family	Examples (common names)	Capsid naked/enveloped	Capsid Symmetry	Nucleic acid type	Group
1. Reoviridae	Reovirus, rotavirus	Naked	Icosahedral	Ds	III
2. Picornaviridae	Enterovirus, rhinovirus, hepatovirus, cardiovirus, aphthovirus, poliovirus, parechovirus, erbovirus, kobuvirus, teschovirus, coxsackie	Naked	Icosahedral	Ss	IV
3. Caliciviridae	Norwalk virus	Naked	Icosahedral	Ss	IV
4. Togaviridae	Rubella virus, Eastern equine encephalitis	Enveloped	Icosahedral	Ss	IV
5. Arenaviridae	Lymphocytic choriomeningitis virus, Lassa fever	Enveloped	Complex	ss(-)	V
6. Flaviviridae	Dengue virus, hepatitis C virus, yellow fever virus, Zika virus	Enveloped	Icosahedral	Ss	IV
7. Orthomyxoviridae	Influenzavirus A, influenzavirus B, influenzavirus C, isavirus, thogotovirus	Enveloped	Helical	ss(-)	V
8. Paramyxoviridae	Measles virus, mumps virus, respiratory syncytial virus, Rinderpest virus, canine distemper virus	Enveloped	Helical	ss(-)	V
9. Bunyaviridae	California encephalitis virus, Sin nombre virus	Enveloped	Helical	ss(-)	V
10. Rhabdoviridae	Rabies virus, Vesicular stomatitis	Enveloped	Helical	ss(-)	V
11. Filoviridae	Ebola virus, Marburg virus	Enveloped	Helical	ss(-)	V
12. Coronaviridae	SARS-CoV-2	Enveloped	Helical	Ss	IV

13. Astroviridae	Astrovirus	Naked	Icosahedral	Ss	IV
14. Bornaviridae	Borna disease virus	Enveloped	Helical	ss(-)	V
15. Arteriviridae	Arterivirus, equine arteritis virus	Enveloped	Icosahedral	Ss	IV
16. Hepeviridae	Hepatitis E virus	Naked	Icosahedral	Ss	IV

- **Group III**: viruses possess double-stranded RNA genomes, e.g. rotavirus.

- **Group IV**: viruses possess positive-sense single-stranded RNA genomes. Many well known viruses are found in this group, including the picornaviruses (which is a family of viruses that includes well-known viruses like Hepatitis A virus, enteroviruses, rhinoviruses, poliovirus, and foot-and-mouth virus), SARS virus, hepatitis C virus, yellow fever virus, and rubella virus.

- **Group V**: viruses possess negative-sense single-stranded RNA genomes. The deadly Ebola and Marburg viruses are well known members of this group, along with influenza virus, measles, mumps and rabies. (Figure No. 2)

Reverse transcribing viruses

Table No. 3: Reverse transcribing viruses

Virus Family	Examples (common names)	Capsid naked/enveloped	Capsid Symmetry	Nucleic acid type	Group
1. Retroviridae	HIV	Enveloped		dimer RNA	VI
2. Caulimoviridae	Caulimovirus, Cacao swollen-shoot virus (CSSV)	Naked			VII
3. Hepadnaviridae	Hepatitis B virus	Enveloped	Icosahedral	circular, partially ds	VII

- **Group VI**: viruses possess single-stranded RNA viruses that replicate through a DNA intermediate. The retroviruses are included in this group, of which HIV is a member.

- **Group VII**: viruses possess double-stranded DNA genomes and replicate using reverse transcriptase. The hepatitis B virus can be found in this group.[19]

The most commonly-used classification method today is called the Baltimore classification scheme which is based on how messenger RNA (mRNA) is generated in each particular type of virus.[20]

Viruses are classified in several ways: by factors such as their core content, the structure of their capsids, and whether they have an outer envelope. Viruses may use either DNA or RNA as their genetic material. The virus core contains the genome or total genetic content of the virus. Viral genomes tend to be small, containing only those genes that encode proteins and those virus cannot obtain from the host cell. This genetic material may be single or double stranded. It may also be linear or circular. While most viruses contain a single nucleic acid, others have genomes that have several, which are called segments. The type of genetic material (DNA or RNA) and its structure (single- or double-stranded, linear or circular, and segmented or non-segmented) are used to classify the virus core structures.[21]

Table No. 4: Virus Classification by Genome structure and Core

Core Classification	Examples
RNA DNA	Rabies virus, retrovirus Herpesviruses, Smallpox virus
Single-stranded Double-stranded	Rabies virus, retroviruses Herpesviruses, Smallpox virus
Linear Circular	Rabies virus, retroviruses Herpesviruses, Smallpox virus Papillomaviruses, bacteriophages
Non-segmented: genome consists of a single segment of genetic material Segmented: genome is divided into multiple segments	Parainfluenza viruses Influenza viruses

Viruses can also be classified by the design of their capsids. Isometric viruses have shapes that are roughly spherical, such as poliovirus or herpes viruses. Enveloped viruses have membranes surrounding capsids. Animal viruses, such as HIV, are frequently enveloped. Head and tail viruses infect bacteria and have a head that is similar to icosahedral viruses and a tail shape like filamentous viruses. Capsids are classified as naked icosahedral, enveloped icosahedral, enveloped helical, naked helical, and complex. For example, the tobacco mosaic virus has a naked helical capsid. The adenovirus has an icosahedral capsid.

Table No. 5: Virus classification by Capsids structure

Capsids classification	Examples
Naked icosahedral	Hepatitis A Virus, Poliovirus
Enveloped icosahedral	Herpes simplex virus, rubella virus, HIV-I
Enveloped helical	Influenza viruses, mumps virus, measles virus, rabies virus
Naked helical	Tobacco mosaic virus
Complex with many proteins, combination of icosahedral and helical capsid structure	Herpesviruses, hepatitis B virus

The most commonly used system of virus classification was developed by Nobel Prize-winning biologist David Baltimore in the early 1970s. The Baltimore classification scheme groups viruses according to how the mRNA is produced during the replicative cycle of the virus. Positive polarity means that the genomic RNA can serve directly as mRNA and a negative polarity means that their sequence is complementary to the mRNA.

Table No. 6: Baltimore classification

Group	Characteristics	Mode of mRNA production	Example
I	Double-Stranded DNA	mRNA is transcribed directly from the DNA template	Herpes Simplex (Herpesvirus)
II	Single-Stranded DNA	DNA is converted to double stranded form before RNA is transcribed	Canine (Parovirus)
III	Double-Stranded RNA	mRNA is transcribed from the RNA genome	Childhood gastroenteritis (Rotavirus)
IV	Single-Stranded RNA (+)	Genome functions as mRNA	Common cold (Pircornavirus)

V	Single-Stranded RNA (-)	mRNA is transcribed from the RNA genome	Rabies (Rhabdovirus)
VI	Single stranded RNA viruses with reverse transcriptase	Reverse transcriptase makes DNA from the RNA genome; DNA is then incorporated in host genome; mRNA is transcribed from the incorporated DNA	Human Immunodeficie ncyVirus (HIV)
VII	Double stranded DNA viruses with reverse transcriptase	The viral genome is double stranded DNA, but viral DNA is replicated through an RNA intermediate; the RNA may serve directly as mRNA or as a template to make mRNA	Hepatitis-B Virus (Hepadnavirus)

Viral Infection

A viral infection is a proliferation of a harmful virus inside the body. Viruses cannot reproduce without the assistance of a host. Viruses infect a host by introducing their genetic material into the cells and hijacking the cell's internal machinery to make more virus particles. With an active viral infection, a virus makes copies of itself and bursts the host cell (killing it) to set the newly-formed virus particles free. Symptoms of the viral illness occur as a result of cell damage, tissue destruction, and the associated immune response.

Contagiousness refers to the ability of a virus to be transmitted from one person (or host) to another. Viral infections are contagious for varying periods of time depending on the virus.[22]

Table No. 7: Mode of Transmission

Routes	**Diseases**
Food born and waterborn	Traveller’s diarrhoea, Cholera, Typhoid fever
Air born	TB, SARS, Mumps, diphtheria, measles
Vector Born	Malaria, Yellow fever, Dengue, Chikungunya
Animal Born	Rabies, Brucellosis, Leptospirosis
Blood Born	Hepatitis B and C, HIV/AIDS and Syphilis
Soil Born	Anthrax, Ascariasis, Trichuris
Sexually Transmitted	Hepatitis, HIV/AIDS and Syphilis
Recreational Water	Leptospira, Pseudomanas

An incubation period refers to the time between exposure to a virus (or other pathogen) and the emergence of symptoms. The contagious period of a virus is not necessarily the same as the incubation period.[23]

Table No. 8: Incubation period of various viral diseases

Disease	Incubation Period (days)
Influenza	1 – 2
Common Cold	1 – 3
Bronchiolitis, Croup	3 – 5
Severe Acute respiratory disease	2 – 10
Dengue	5 – 8
Herpes Simplex	5 – 8
Enterovirus disease	6 – 12
Poliomyelitis	5 – 20
Measles	9 – 12
Smallpox	12 – 14
Chickenpox	13 – 17
Mumps	16 – 20
Rubella	17 – 20
Mononucleosis	30 – 50
Hepatitis A	15 – 40
Hepatitis B and C	50 – 150
Rabies	30 – 100
Papilloma (Warts)	50 – 150
AIDS	1 – 10 Yr

Viral Outbreaks spread worldwide:

1. **Smallpox** came to North America in the 1600s. People had symptoms of high fever, chills, severe back pain, and rashes. Starting from the Northeast, smallpox wiped out entire Native American tribes. Over 70 percent of the Native American population dropped. In 1721, 844 of the 5,889 Bostonians who had smallpox died from it.

End: In 1770, Edward Jenner developed a vaccine from cow pox. It helps the body become immune to smallpox without causing the disease.

Now: After a large vaccination initiative in 1972, smallpox is gone from the United States. In fact, vaccines are no longer necessary.

2. **Yellow fever** epidemic in the Caribbean Islands sailed in, carrying the virus with them. Yellow fever causes yellowing of the skin, fever, and bloody vomiting. Five thousand people died, and 17,000 fled the city.

End: The vaccine was developed and then licensed in 1953. One vaccine is enough for life. It's mostly recommended for those 9 months and older, especially if you live or travel to high-risk areas. You can find these specific countries at the Centers for Disease Control and Prevention (CDC) website.

Now: Mosquitoes are key to how this disease spreads, especially in countries like Central and South America and Africa. Eliminating them has been successful in controlling yellow fever. While yellow fever has no cure, someone who does recover from the illness becomes immune for the rest of their life.

3. Cholera, an infection of the intestine, between 1832 and 1866. The pandemic began in India, and swiftly spread across the globe through trade routes. New York City was usually the first city to feel the impact. An estimated two to six Americans died per day during the outbreak.

End: It's unclear what ended the pandemics, but it may have been the change in climate or quarantines. The last documented outbreak in the United States was in 1911. Immediate cholera treatment is crucial, as it can cause death. Treatment includes antibiotics, zinc supplementation, and rehydration.

Now: Cholera still causes nearly 130,000 deaths a year worldwide, according to the CDC Trusted Source. Modern sewage and water treatment have helped eradicated cholera in some countries, but the virus is still present elsewhere. You can get a vaccine for cholera if you're planning to travel to areas that are high-risk. The best way to prevent cholera is to wash hands regularly with soap and water, and avoid drinking contaminated water.

4. **Scarlet fever** epidemics came in waves. During the 1858 epidemic, 95 percent of people who caught the virus were children.

End: Older studies argue that scarlet fever declined due to improved nutrition, but research shows that improvements in public health were more likely the cause.

Now: There is no vaccine to prevent strep throat or scarlet fever. It's important for those with strep throat symptoms to seek treatment as quickly as possible. Your doctor will typically treat scarlet fever with antibiotics.

5. **Typhoid fever** epidemics of all time broke out between 1906 and 1907 in New York. Mary Mallon, often referred to as "Typhoid Mary," spread the virus to about 122 New Yorkers during her time as a cook on an estate and in a hospital unit. About five of those 122 New Yorkers passed away from the virus. Annually, 10,771 people passed away from typhoid fever.

Medical testing showed that Mallon was a healthy carrier for typhoid fever. Typhoid fever causes sickness and red spots to form on the chest and abdomen.

End: A vaccine was developed in 1911, and an antibiotic treatment for typhoid fever became available in 1948.

Now: Today typhoid fever is rare. But it can spread through direct contact with infected people, as well as consumption of contaminated food or water.

6. **Influenza virus** actually doesn't come from Spain. It circulates the globe annually, but seriously affected the United States in 1918. The flu would return later in 1957 as the "Asian flu" and cause nearly 70,000 deaths before a vaccine became available.

End: After the end of World War I, cases of the flu slowly declined. None of the suggestions provided at the time, from wearing masks to drinking coal oil, were effective cures. Today's treatments include bed rest, fluids, and antiviral medications.

Now: Influenza strains mutate every year, making last year's vaccinations less effective. It's important to get your yearly vaccination to decrease your risk for the flu.

7. **Diphtheria** peaked in 1921, with 206,000 cases. Diphtheria causes swelling of the mucous membranes, including in your throat that can obstruct breathing and swallowing. Sometimes a bacterial toxin can enter the bloodstream and cause fatal heart and nerve damage.

End: By the mid-1920s, researchers licensed a vaccine against the bacterial disease. Infection rates plummeted in the United States.

Now: Today more than 80 percent of children in the United States are vaccinated. Those who contract the disease are treated with antibiotics.

8. **Polio** is a viral disease that affects the nervous system, causing paralysis. It spreads through direct contact with people who have the infection. The first major polio epidemic in the United States occurred in 1916 and reached its peak in 1952. Of the 57,628 reported cases, there were 3,145 deaths.

End: Three years later, Dr. Jonas Salk developed a vaccine. By 1962, the average number of cases dropped to 910. The CDC Trusted Source reports that the United States has been polio-free since 1979.

Now: Getting vaccinated is very important before traveling. There's no cure for polio. Treatment involves increasing comfort levels and preventing complications.

9. **Measles** is a virus that causes a fever, runny nose, cough, red eyes, and sore throat, and later a rash that spreads over the whole body. It's a very contagious disease and can spread through the air. In the early 20th century, most cases involved children, due to inadequate vaccination coverage.

End: Doctors began to recommend a second vaccine for everyone. Since then, each year has had fewer than 1,000 cases.

Now: The United States experienced another outbreak of measles in 2014 and 2015. The CDC reports Trusted Source that this outbreak was identical to the measles outbreak in the Philippines in 2014. Be sure to get all the vaccinations your doctor recommends.

10. **Cryptosporidium**, a parasitic disease that causes dehydration, fever, stomach cramps, and diarrhoea. About 403,000 became ill, and more than 100 people died, making it the largest waterborne outbreak in United States history.

End: Most people recovered on their own. Of the people who passed, the majority had compromised immune systems.

Now: Improved water filtrations helped eradicate this disease, but an estimated 748,000 cases of cryptosporidium still occur each year. Cryptosporidium spreads through soil, food, water, or contact with infected feces. Be sure to practice personal hygiene, especially when camping.

11. **Pertussis**, known as whooping cough, is highly contagious and one of the most commonly occurring diseases in the United States. These coughing attacks can last for months. Infants too young for vaccination have the highest risk for life-threatening cases. Ten infants died during the first outbreak.

End: A whooping cough outbreak comes every three to five years. The CDC reports Trusted Source that an increase in the number of cases will likely be the "new normal".

Now: The occurrence of the disease is much less than it was. The CDC recommends Trusted Source that pregnant women get a vaccination during the third trimester to optimize protection at birth.

12. **HIV** first appeared to be a rare lung infection. Now we know that HIV damages the body's immune system and compromises its ability to fight off infections. AIDS is the final stage of HIV and the 6th leading cause of death in the United States among people 25 to 44 years old.

HIV may be transmitted sexually or through blood/body fluids from person to person. It can be transmitted from mother to unborn baby if not treated.

Now: While there is no cure for HIV, you can decrease your risk through safety measures like making sure your needles are sterilized and having protected sex. Safety measures can be taken during pregnancy to prevent the disease from being transmitted from an infected mother to child. For emergencies, PEP (post-exposure prophylaxis) is a new antiretroviral medicine that prevents HIV from developing within 72 hours.[24]

13. **COVID-19** Firstly Corona virus (2019-nCoV) was isolated from Wuhan market China at 7 Jan. 2020. Corona virus causes respiratory infection including pneumonia, cold, sneezing and coughing. Corona virus transmitted human to human or human to animal via airborne droplets.

Now: Several case of severe acute respiratory syndrome caused by corona and their mortally more than 1000 patient was reported in 2003. As of 18 April 2020, according to the **Ministry of Health & Family Welfare**, a total of 14378 COVID-19 cases, (including 76 foreign nationals) have been reported in 32 states/union territories. These include 1991 who have been cured/discharged, 1 who has migrated and 480 deaths. There is no special vaccine for this yet. Only supportive therapy is the treatment strategy followed by health professionals.[25]

Plan for the Management of viral outbreak:

Outbreaks were considered over when 6 days (two incubation periods) had elapsed from the time of isolation of the last case.

Objectives:

• Provide guidance to the public on the event, disease, prevention, and when to seek health care.

• Provide guidance to clinicians on diagnosis, treatment, and prevention, including infection control.

• Implement disease control measures (e.g. prophylactic antibiotics, PPE, isolation)

• Ensure that health care systems are functional, coordinated and able to meet the needs of the situation.

• Collect and disseminate information epidemiological information about the incident (e.g. source of the outbreak, duration, who is at risk, geographic extent, how many people are affected).

• Facilitate laboratory diagnosis/confirmatory testing.

Upon identification of an outbreak, medical officers provide information on disease onset, symptoms, location, and other pertinent information for each patient. The medical officer would also initiate a standard set of immediate control measures, such as case isolation, personnel and facility inspection and provision of basic hygiene and public health advice to the affected unit or office personnel. In addition, an epidemiology team from medical headquarters would be dispatched to confirm the presence of a viral outbreak, and to advise on the need for additional control measures to further reduce spread, if necessary. Outbreaks were monitored by active surveillance and case identification, and included tracking the number of new cases from the affected unit daily.

Standard outbreak control measures that were implemented across the outbreaks included isolation of all cases as soon as identified, daily screening of all contacts inspection of living quarters for possible facilitating factors, such as overcrowding, increasing the ventilation within the living quarters, and thorough cleaning of equipment and surfaces used by infected personnel. Strict instructions were given to all personnel not to share personal effects, such as towels, which might act as fomites for disease transmission, and to pay closer attention to personal hygiene measures such as hand washing.

The short incubation period may contribute to the rapid spread of disease, producing the explosive outbreaks observed. Our experience suggests that infection control interventions, such as active case surveillance and isolation, education to improve personal hygiene, and measures to improve ventilation and relieve overcrowding, may be effective in reducing disease spread during outbreaks.

Additional surveillance mechanisms should be created to enable earlier case detection and prevent delays in detection and reporting of cases. Our experience suggests that early intervention in an outbreak, with an emphasis on surveillance, early detection, personal hygiene, and active detection of cases may help limit the extent of an outbreak and reduce the impact of the disease in terms of working days lost to illness.[26]

Planning for epidemic outbreak requires the coordination of all members of the healthcare team. Significant resources and the coordination of government, hospital administration, and clinician actions are needed to adequately care for such patients.

At the hospital level, all members of the healthcare team (cleaning staff, pharmacy, respiratory therapy, laboratory services, nursing, and physicians) need to collaborate.[27]

The prevention and control of outbreaks need integrated multidisciplinary surveillance systems and response plans.[28] The Integrated Vector Management (IVM) is the primary option to prevent and control outbreaks. (Figure No. 3)

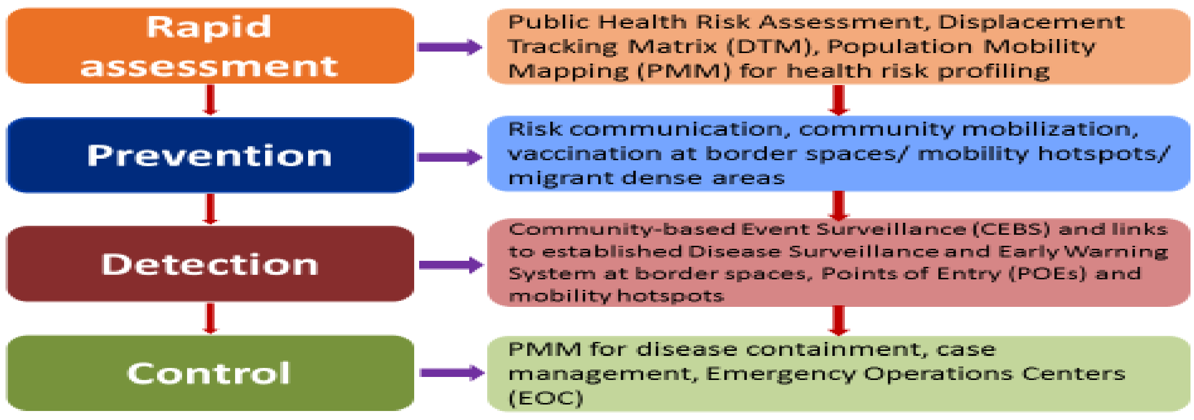

Figure No. 3: Disease Surveillance, Early warning and Response in outbreak situation

Epidemic prone diseases threaten public health security, reports considerable morbidity and mortality annually. Interestingly, where emergency epidemic preparedness plans are in place, timely detection of outbreaks is followed by a prompt and appropriate response.[29]

Outbreak management has been described as the process of anticipating, preventing, preparing for, detecting, responding, and controlling epidemics in order that the health and economic impacts are minimized.[30] Early detection through a sensitive surveillance system is required to know when and where the outbreak occurs to limit its spread.[31][32] Most importantly, a co-ordinated and rapid investigation is required to describe the outbreak and identify interventions. Following which an effective response will be required to implement appropriate control measures.[31] An outbreak management would not be complete without an evaluation to identify what went right and wrong before and during the outbreak.[30] Moreover when all the activities are put together in a plan, and then we have an Outbreak Preparedness and Response Plan (OPR). The elements of an outbreak preparedness will include to ensure that routine surveillance system can detect outbreaks as soon as it occurs, and to ensure that staff are organized to confirm, investigate, and respond to outbreaks.[31][33][34]

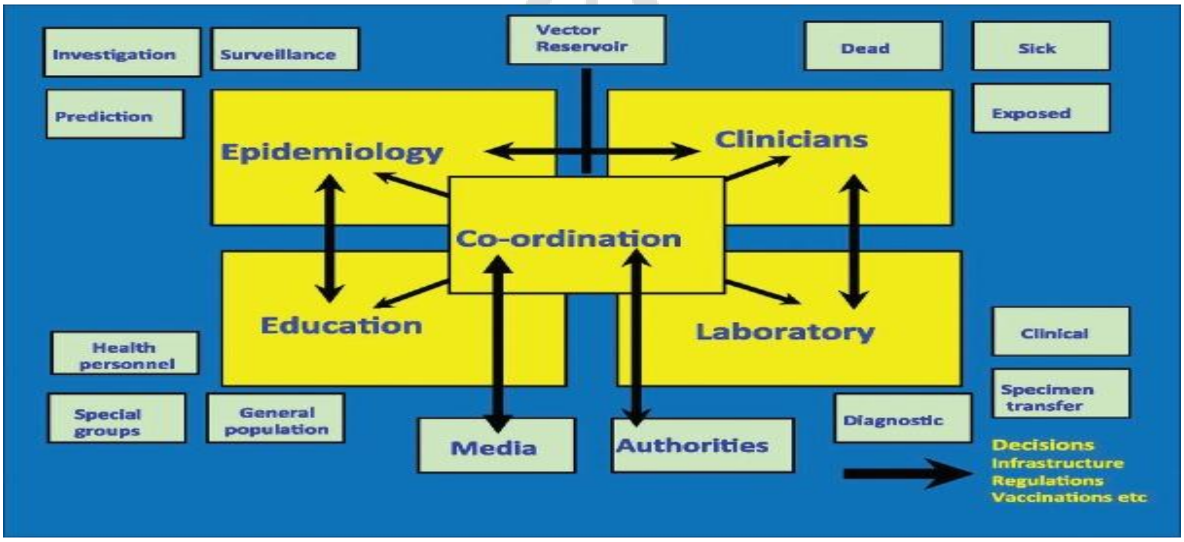

Figure No. 4: Outbreak management using an emergency operating center model

For an effective outbreak, expertise in epidemiology, clinical medicine, health education, and laboratory medicine are required.[33]

Although laboratory testing may not be required in all epidemics, the laboratory experts are involved in specimen transportation, transfers, and diagnosis. The needs to educate the general population and special groups such as the health workers are usually necessary during outbreak. (Figure No. 4)

The roles and responsibilities of committees are as follows: The management committees are to review and approve the plan on epidemics, mobilize resources, coordinate and monitor activities, monitor resource utilization, and coordinate post-epidemic evaluation, while the RRTs are specifically involved in investigation of rumors or outbreaks, proposing and carrying out appropriate strategies and measures for rapid containment of the outbreak, preparing detailed investigation report and contributing to the post-outbreak evaluation.

If many cases are mild or asymptomatic and therefore undetected, a survey of the entire population is sometimes conducted to determine the extent of infection. A questionnaire could be distributed to determine the true occurrence of clinical symptoms, or laboratory specimens could be collected to determine the number of asymptomatic cases.

The data collection form should include the following types of information about each case.

- **Identifying information**. A name, address, and telephone number is essential if investigators need to contact patients for additional questions and to notify them of laboratory results and the outcome of the investigation. Names also help in checking for duplicate records, while the addresses allow for mapping the geographic extent of the problem.

- **Demographic information**. Age, sex, race, occupation, etc. Provide the person characteristics of descriptive epidemiology needed to characterize the populations at risk.

- **Clinical information**. Signs and symptoms allow investigators to verify that the case definition has been met. Date of onset is needed to chart the time course of the outbreak. Supplementary clinical information, such as duration of illness and whether hospitalization or death occurred, helps characterize the spectrum of illness.

- **Risk factor information**. This information must be tailored to the specific disease in question. For example, since food and water are common vehicles for hepatitis A but not hepatitis B, exposure to food and water sources must be ascertained in an outbreak of the former but not the latter.

- **Reporter information**. The case report must include the reporter or source of the report, usually a physician, clinic, hospital, or laboratory. Investigators will sometimes need to contact the reporter, either to seek additional clinical information or report back the results of the investigation.[35]

Disease Containment Implementation Branch

The purpose of the Disease Containment Implementation Branch is to implement measures to minimize the spread of infectious disease.

Disease containment methods include:

Community Mitigation

Community mitigation strategies are used when it is determined that group level activities should be altered to reduce the spread of disease. Community mitigation may target specific populations like workplace employees and clients, public transportation riders, attendees at large public gatherings (e.g. sporting events, religious services) to reduce the transmission of disease during group activities include non-pharmaceutical interventions like social distancing, healthy habits, workplace modifications, school cancellation of events and other approaches that protect the public as much as possible, daily activities.

Isolation and Quarantine. Isolation is the separation of infected persons from others for the period of communicability in order to prevent the transmission of the agent. Quarantine is the limitation of freedom of movement of persons who may have been exposed to a communicable disease, in order to prevent contact with unexposed persons. The quarantine period is equal to the longest usual incubation period (time from exposure to development of symptoms). These is to apply person-to-person transmitted diseases in which it is possible to distinguish whether an individual is infected.

Mass Prophylaxis. Mass prophylaxis is a public health to dispense pharmaceuticals administer vaccine to potentially exposed populations and those at risk of exposure in order to prevent infection.

Restriction, Exclusion, and Clearance. Restriction, exclusion, and clearance are intended to decrease transmission of an infectious disease from exposed persons in sensitive occupations or situations to vulnerable susceptible populations. When there are actions that promote transmission and when there are environments in which identified vulnerable susceptible populations may become infected.

Post Exposure Prophylaxis (PEP). PEP is a medication or vaccine given to prevent exposed persons from developing disease and thereby reducing transmission.[36]

CONCLUSION

This review article, therefore, discussed the principles of epidemic management using an emergency branch model and provide guidance on what is expected to be done in preparing for epidemic of the disease at the health facilities, local and state government levels in line with the Integrated Disease Surveillance and to monitor disease trends and respond to outbreaks in early rising phase through trained Rapid Response Team to prevent unnecessary deaths and disabilities.

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