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CHOLERA : A continuing challenge to Public Health

INTRODUCTION

Cholera is an acute diarrhoeal disease caused by Vibrio cholerae 01 or 0139. Though the disease primarily affects gastrointestinal tract (acute gastroenteritis), the exotoxin produced by Vibrios may lead to excessive (sometimes rapid) fluid and electrolyte loss resulting in dehydration, circulatory failure, shock and electrolyte imbalance. The chain of events may lead to acidosis, myocarditis, heart failure, tubular necrosis and eventual death unless timely intervention is carried out.

This disease has major historical and public health importance. It may spread like a wild fire in a community with overcrowding, poor sanitation and poor-hygiene.

Sometimes, this commoner disease can require real public health skills of the Health Administrators to control the malady as epidemiology (associated risk factors) of the said disease is known to vary according to different geographical locations, type and source of water supply, age group of affected persons and other local conditions and factors. This disease has environmental linkages and it is possible that global warming is increasing its incidence – a hypothesis that is thought nowadays.

Shortage of potable water plays an important role in the disease development. Other contributory factors could be: neutral or alkaline pH, increased salinity and faecal contamination of surface water or drinking water sources. This disease is clearly waterborne, though food borne transmission, is also reported. **Improvement of water supply and sanitation is the best strategy for the control of cholera and other diarrheal diseases - though expensive to the exchequer**.

Cholera outbreaks therefore need prompt diagnosis, treatment, public heath intervention and notification to the State and WHO. Areas endemic for cholera should have a regular system of surveillance to know the disease burden, its changing epidemiology and early warning signals of any outbreaks.

HISTORICAL PERSPECTIVE

History of cholera dates back to 18th Century when John Snow diagnosed a cholera outbreak in London city by pure epidemiological observation and analysis. He discovered that a handpump was responsible for the cholera outbreak and controlled the said outbreak by closure of that pump and water supply. This achievement of John Snow was commendable. He succeeded in the desired public health action long before the causative agent of cholera was discovered.

Cholera has been endemic in the Ganges Delta since time immemorial. There were annual epidemics in West Bengal and Bangladesh. From 1817 to 1926, the disease has spread worldwide resulting in six pandemics. The seventh pandemic that started in 1961 from Indonesia has spread to most of South Asia, Middle East, Africa, Southern Europe and Western Pacific regions.

The number of cholera cases notified to WHO during the year 2006 was 2,36,896 from 52 countries, including 6311 deaths, an overall increase of 79% compared with 2005. It could be due to several outbreaks that had occurred in the reporting countries. According to the

2005 data from WHO, the Indian subcontinent reported 46% of all cases notified from Asia with India notifying a total of 3155 cases and 6 deaths. Information about the occurrence of infection with Vibrio cholerae 0139, which emerged in the Bay of Bengal in 1992 is available from China only. The 0139 serogroup has the potential to become the cause of the next pandemic and WHO encourages countries from South East Asia to test Vibrio cholerae isolates for both 01 and 0139 serogroups. According to the data compiled by CBHI, the cholera situation in our country has improved. While in 1991 there were 7088 cases (150 deaths) the same declined to 2635 cases (3 deaths) in the year 2007. However this may not be actually true as there might be underreporting (CD Alert: Jan 2000) due to inadequate surveillance or non-availability of laboratory facilities.

EPIDEMIOLOGY

Epidemics of cholera are characteristically abrupt and often create an acute public health problem. Cholera is a waterborne disease and epidemics are known to occur following floods or during pilgrimage where large number of people may assemble during festival seasons like Kumbh festival of UP. Typical cases are characterized by the sudden onset of profuse, effortless, watery diarrhea followed by vomiting, increased thirst, rapid dehydration, muscular cramps and suppression of urine. Unless there is rapid replacement of fluid and electrolytes, the case fatality is likely to be high.

In non-outbreak situations, cholera may present as simple gastroenteritis or as watery diarrhea. In an endemic situation, there could be many mild or asymptomatic cases or carriers. Unless stool samples are tested in a public health laboratory, most of cholera cases remain undiagnosed and pass off as simple diarrhea cases.

The disease is known to affect all age groups and both sexes. In endemic areas, cholera is predominantly a disease of children. A common notion that cholera does not usually infect

CASE DEFINITION (AS PER WHO)

Category	Case Definition
Suspected	· In an area where the disease is not known to be present- severe dehydration or death from acute watery diarrhea in a patient aged 5 years or more/ or · In an area where there is a cholera epidemic- acute watery diarrhea with or without vomiting in a patient aged 5 years or more
Confirmed	· A suspected case that is laboratory confirmed (isolation of Vibrio cholerae O1 or O139 from stools in any patient with diarrhea is the laboratory criteria for diagnosis)
Case Counted	· Only confirmed cases for a single isolated case. · All cases to be counted having epidemiological linkage to a confirmed case during epidemic

children below 2 yrs of age, is not entirely true as there are now, a number of studies available, which show that cholera is common not only in under 5 age group but also in infants.

EPIDEMIIOLOCICAL CHARACTERISITICS

a) **Infective material**: Stools or vomitus from cases or carriers.

b) **Mode of transmission**: Through faecally contaminated water, food or drinks. Direct person-to-person contact, especially in overcrowded, low sanitation settings, also plays an important role.

c) **Incubation period**: From few hours to 5 days; commonly 1-2 days.

d) **Infective dose**: 10^6 or more organisms. If the gastric acidity is neutralized then 10^3 organisms are sufficient.

e) **Period of communicability:** Case : 7 to 10 days; Convalescent carriers: 2 to 3 weeks.

f) **Attack rate**: Variable; depends upon endemicity, infective dose, age of the affected population, and outbreak soluation. In endemic regions, attack rate is usually below 1%. However, during outbreaks

in endemic areas, it is usually in the range of 2-5 %. During outbreaks in a non-endemic area with susceptible population, the attack rate may be as high as 30 %. The calculation of attack rate is important for the Public Health Administrator as it tells about the magnitude of the problem. Based on this data control measures logistics can be finalised.

g) **Source of infection**: The main source of infection is human being who is case or carrier.

h) **Reservoir**: Aquatic sources such as brackish water and estuaries often associated with algal blooms (planktons). Recent hypothesis states that global warming might increase the growth of zooplankton in aquatic environments due to rise in water temperature and thus may lead to an increased incidence of cholera in vulnerable areas.

i) **Population mobility**: Movement of population (pilgrimages, marriages, fairs and festivals) that leads to temporary overcrowding with ad-hoc arrangements enhances the risk of acquisition of infection. Slums and refugee camps are at risk.

j) **Lower socio-economic status**: Increased incidence of disease is attributable to poor hygiene, especially in rural areas where open-air defaecation is still prevalent.

k) **Immunity**: Natural infection confers immunity that may last for several years but re-infection is possible with new serogroup or increased infective dose.

LABORATORY DIAGNOSIS

Sample collection: Collect fresh stool specimen before the administration of antibiotics to the patients. Using a rubber catheter one can easily collect the liquid stool sample. One should use gloves while collecting/ handling samples. Rectal swabs should be of collected in field situations, specially during outbreaks. Apart from stool, attempt should be made to collect water or food samples (if any).

Transportation: Stool or rectal swab samples should be transported in alkaline peptone water (APW) or Venkatraman and Ramakrishnan (VR fluid) fluid at room temperature unless viral infection or dysentery/ diarrhea due to non-cholera organisms is suspected. Stool samples should preferably be collected in duplicate. In field situations, if transport medium is not available, the rectal swab can be placed in a sterile bijou bottle, sealed with leucoplast and sent to the testing laboratories.

Direct microscopic examination of stool specimen, if shows ***darting motility,*** cholera can be suspected. Motility ceases on mixing with polyvalent anti cholera diagnostic serum. This presumptive test can be used in field situations. During outbreaks, this test can become useful adjunct to diagnosis along with epidemiological information.

Culture methods:

(a) Bile salt agar medium (BSA) (pH 8.6) is used routinely for culturing the stool sample after enrichment in APW for 4-6 hrs. The translucent, oil drop like colonies on BSA that stain as gram negative coccobacilli, are oxidase, lysine and ornithine positive suggest isolation of Vibrio cholerae. Unless antisera is available locally such presumptive strains could be stocked in 1% nutrient agar slants and sent to regional or national reference laboratories for serotype and biotype confirmation.

(b) TCBS (Thiosulphate Citrate Bile Salt Sucrose agar) is a good selective medium that is used extensively for the isolation of vibrios. This medium depicts yellow colonies and can be used in field situations. The medium identify cases even in the presence of lesser number of cholera bacilli for eg. in antibiotic treated cases, carriers etc.

SEROTYPING OF VIBRIOS

The organism that causes cholera can be serotyped using polyvalent cholera O1 antiserum and labelled as Vibrio cholerae serogroup O1. If agglutination with anticholera O1 antiserum is negative, then an attempt should be made with Vibrio cholerae O 139 antiserum. If agglutination does not occur with both VC O1 or O 139 then the isolate is labelled as Non agglutinable (NAG) vibrios or Non cholera vibrios (NCV) or Non O1 Vibrios. This is a misnomer as the isolate can still

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be typed with some antiserum provided antisera for all cholera serogroups are made available. Both VC O1 and O139 serogroups can be further divided into 3 serological sub- types namely Inaba, Ogawa and Hikojima.

During 1992, VC O139 Bengal was first discovered from Bangladesh. Due to non-availability of specific O139 antiserum, initial O139 serotypes were diagnosed as NAG. Later specific O139 cholera antiserum became available. This can now be used routinely. Therefore, isolation of NAG strains in large numbers should arouse suspicion for a new emerging serogroup.

Biotyping: There are two biotypes: classical and El -tor. The classical biotype that used to cause severe cholera outbreaks in the past has been replaced these days by El –Tor biotypes (Characterized by resistance to Mukherjee cholera phage V, hemolysis on blood agar plates and chicken cell agglutination) that are less severe but leads to more extensive morbidity.

TREATMENT

Cholera can be effectively treated provided early intervention with Oral Rehydration Solution (ORS) or IV fluids is undertaken. Mortality rates can be brought down to less than 1% by early and effective rehydration therapy. As per the details given in table1, the patient should receive rehydration therapy.

Packets of **WHO-ORS** are generally available at all PHCs, Sub-centres and hospitals. The ORS solution should be made fresh daily with boiled drinking water after it has been cooled to room temperature. This reconstituted ORS solution should be used within 24 hrs. After reconstitution of ORS solution, it should not be boiled again for sterilization purposes.

Intravenous Rehydration: It is required for the rapid correction of fluid and electrolyte imbalance in severely dehydrated patients who are in shock or are unable to retain fluid due to excessive vomiting. Such patients require immediate attention and transfer to a nearby hospital or treatment centre. The solutions

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Table-1

Dehydration Stage	Signs	Treatment
Severe	Lethargic, unconscious, floppy Sunken eyes Drinks poorly/ unable to drink, Mouth very dry Skin pinch goes back very slowly No tears (only for children)	IV therapy+ antibiotics+ ORS
Mild	Restless and irritable Sunken eyes Dry mouth Thirsty, drinks eagerly Skin pinch goes back slowly No tears (only for children)	ORS + very close monitoring
No dehydration	None of the above signs	ORS at home

Source: Cholera Outbreak: Assessing the outbreak response and improving preparedness. WHO 2004. Global Task Force on Cholera Control.

recommended by WHO for intravenous rehydration are:

a) Ringer's Lactate Solution

b) Diarrhoea Treatment Solution

c) Normal Saline (if nothing else is available)

These should be given under supervision of medical doctor in the hospital.

Antibiotic Therapy: Antibiotic should be used with reservation depending upon requirements of the case, its severity, age of the patients and local susceptibility pattern of Vibrios. It diminishes the duration of diarrhoea, reduces the volume of rehydration fluids and shortens the duration of vibrio excretion. The antibiotic can be started by the treating clinician keeping in mind the age, drug, and route of administration. Resume feeding with a normal diet when vomiting is under control. Breast feeding of infants and young children should be continued.

Mass chemoprophylaxis is neither effective non recommended for control of cholera outbreak.

PREVENTION AND CONTROL

(a) Control of cholera

The following strategies are useful for the control of cholera in an outbreak situation.

- ➢ Epidemiological investigations
- ➢ Establishment of cholera treatment centers
- ➢ Improve sanitation
- ➢ Provision of safe drinking water and food supply
- ➢ Proper disposal of night soil/sewage
- ➢ Health education (Table-2)

Table-2 : Key points for public education about cholera

To prevent cholera
- Drink water only from a safe source or water that has been disinfected (boiled or chlorinated)
- Cook food or reheat it thoroughly and eat it while it is still hot. Boil milk before drinking. Avoid ice creams from unreliable sources
- Avoid uncooked food unless it can be peeled or shelled
- Wash your hands after any contact with excreta and before preparing or eating food
- Dispose off human excreta promptly and safely
- Avoid ice from unreliable sources

Remember
- With proper treatment cholera is not fatal
- Take patients with suspected cholera immediately to a health worker for treatment
- Give increased quantities of fluids as soon as diarrhoea starts.

(b) Immunization

The efficiency of the cholera vaccine is limited and duration of protection is short, hence it is essential that vaccine is used with discrimination. Cholera vaccines can be used as an adjunct to other preventive measures such as drug prophylaxis, proper sanitation and health education. Immunization against cholera is not regarded as an effective means of preventing the spread of cholera internationally.

Cholera vaccination is not mandatory for international travel.

(c) Action on occurrence of the disease

(i) Isolation: The patient must be isolated in a special fly proofed ward. Adequate arrangements for hospitalization of all critically ill and dehydrated patients must be made.

(ii) Disinfection: Disinfect soiled beddings, clothing, floors of wards with cresol (5%). The stool and vomit should be poured into a receptacle containing 5% cresol solution and left for 4 hrs before disposal.

(iii) Notification: Since 15 June 2005, the official notification of cholera is no longer mandatory but countries are required to inform WHO of public health events of international concern

(iv) Attendants: Should be isolated from the nursing staff of main hospital. They should disinfect their hands after contact with patients, their beddings etc. They should be inoculated against cholera before hand.

(v) Contacts: They need not be isolated. They should be kept under surveillance for 5 days.

(vi) Food and drinks: Control for the safety of food and drinks is most important as detailed in Table-2.

(vii) Mild cases: A search for mild cases should be carried out by examination of the stools of all those who are suffering from diarrhea.

STEPS OF OUTBREAK INVESTIGATIONS

A team comprising of clinician, epidemiologist and microbiologist should be rushed to the affected site.

For a suspected cholera outbreak affecting about 200 persons with about 20 severe cases, following materials are suggested for an immediate supply to tackle the outbreak for initial two days:

(A) For treatment

Establishment of Cholera Treatment Units (CTU) (preferably with isolation facility) at Local Level with dedicated staff conversant with drip treatment should be attempted on priority basis for any

suspected cholera outbreak. If facilities for IV treatment cannot be arranged at Local level then transportation should be made available for early shifting of cases to nearby CHC or PHC under ORS or IV drip cover.

i.   ORS Packets:

    a. WHO formula: 400 packets

    b. Isotonic formula: 200 packets

ii. Ringer lactate solution: 200 bottles

iii. Normal saline: 200 bottles.

iv. IV drip sets: 30

v.   Disposable needles: size: 18 /20/21: 50 each.

vi. Micro drip set: 10

vii. Pediatric cannula size 24: 50 nos

(B) For microbiological sample collection

i.   Cary Blair Medium: 20

ii.   Rectal swab: 30

iii. Alkaline Peptone water: 20

iv.   Plain Universal Container or MacCartney's Bottle: 20

v.   Polypropylene autoclavable screw capped bottle 500 ml capacity: 10

vi.   Leucoplast or Sticker type of Label: 2 sheets/ rolls.

vii. Discarding Bag (5 litres)-50

viii. Zipper Bags: 50 pcs

ix.   Marker Pen:2; Ball Pen: 2

x.   Scissors: one pair

xi.   Binocular microscope for Hanging Drop preparation

xii. Vaccine Carrier with ice: For transportation of water samples or in case viral diarrhea is suspected.

xiii. Samples should be sent with following information preferably in a tabulated form: Name; age; sex; father's name; complete residential address (town/ locality/ taluka);

date of onset of illness; date of sample collection; type of sample collected (stool in plain bottle/ rectal swab in Cary Blair/ rectal swab in APW / Stool in Cary Blair); whether the patient took any antibiotics prior to sample collection. It should be signed by the Medical Officer in charge with address, fax/ email/ contact no.

(**C) For epidemiological investigations**

1. A simple Performa needs to be developed to investigate any gastroenteritis outbreak and a possible suggestion is as under:

Name; age; sex; no. of members in the household; date of onset of diarrhea; no. of members suffering from diarrhea; any history of antibiotic taken prior to this. The Performa can be further modified if needed. The important information is number of cases and deaths by area, by time period and by population subgroups. Calculation of attack and case fatality rates allows comparison of different areas and periods. The distribution of cases according to sex, age, social class etc. should be calculated.

2. For environmental sanitation, water quality checking and treatment of these items may be carried. **Chlorine tablets**: 5000 tablets along with black polythene for distribution in the community; **bleaching powder** (25 kg in HDPE bag with min 33% available chlorine); Orthotoluidine Kit for checking chlorine in water, IEC material (Posters), WHO ORS packets – 1000. 4-5 samples from the area can be collected and sent to the public health laboratory for bacteriological and chemical analyses.

3. A working case definition should be formed based on the examination of initial 10-15 cases. This case definition should be local situation specific and may vary as per the situation or need of the case.

4. What is the possible mode of transmission of the outbreak? Is it water borne/ food borne/food poisoning type.

5. An attempt should always be made to identify the risk factors that may have contributed or precipitated the cholera outbreak. Common known risk factors that are known to cause diarrhoea outbreaks are: faecal contamination of drinking water sources; floods leading to overflowing of rainwater into wells; shallow hand pumps and wells getting sewage or fecal contamination due to adjoining leaking septic tank , leaking drinking water pipes drawing fecal contamination from adjacent pipes; lack of health care facility or health care facility at a distant place; lack of availability of potable water; overcrowding; open air defaecation; no hand washing ritual; use of night soil for growing vegetables.

FUTURE DIRECTIONS

Since all diarrhoeal diseases are mainly waterborne, there is a need to develop a comprehensive national programme for the control of diarrhoeal diseases (including cholera) supported by an improved sanitary, economic and educational campaign. Such a programme with an integrated approach should aim at carrying out continuous surveillance for cholera and other waterborne diarrhoeal diseases for the generation of useful data and early warning signals.

Some of the Outbreak/Endemic Cholera reports – Epidemiological Features and Attack Rates

Name of the study or Locality	Year of reporting/Type of study	No of cases, Population (Attack rate /Incidence)	Ref	Endemic cholera	Comments/Contributory Factors/Main findings of the study	No of Severe dehydration or hospital admission cases (deaths)
Kolkata slum	2004/Outbreak investigations	89, 4409, **(2 %)**	A	Outbreak over an endemic area	Leakage in drinking water pipe line, slum area, poor sanitation, poor hygiene	3
Garulia town, North 24 Parganas	2005/Outbreak investigations	1590, 7000**(22.7%)**	B	Outbreak over an endemic area	Sewage contamination of drinking water pipes, open drainage system, leakage in pipelines	15 (4 deaths)
Brick field, South Western Calcutta	2000/Outbreak investigations	71, 246**(28.9%**)	C	Outbreak over an endemic area	Migrant Laborers (Bihar) in brick fields, storage of drinking water in open containers, overcrowding, open air defecation led to water contamination, poor personal hygiene, explosive outbreak	24 (death)
Delhi and adjoining UP and Haryana	2007/Hospital based surveillance	Yr 2003: 1524 cases Yr 2004: 1782 cases Yr 2005: 945 cases	D	Endemic cholera	Enhanced surveillance helped in bringing down cases from 47.7 percent in 2003 to 36.8 percent in 2005; 32.7 % cases were below 5 yrs of age , 16.2 % cases were infants .	-
Delhi	July 2001-Nov 2002/Hospital based surveillance	133 cases	E	Endemic cholera	13 cases (9.8%) : below 1 yr 66 cases (49.6 %) : 1-5 yrs	-
India, Korea, Indonesia, Mozambique	2008 / August 2001-July 2003 / Population based surveillance	**Jakarta:** 0.5/1000/yr; **Kolkata** 1.6/1000/yr; **Beira** :4.0/1000/year	F	Endemic cholera	Age specific incidence was highest under 5yrs. **Kolkata**: 2-5 yrs: 6.2 /1000/yr; Under 2 yrs: 8.6/1000/yr **Jakarta**: 2-5 yrs: 1.2 /1000/yr; Under 2 yrs: 3.2/1000/yr **Beira: 2-5 yrs:** 8.8 /1000/yr	-

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Integrated Disease Surveillance Project (IDSP)

- Integrated Disease Surveillance Project (IDSP) was launched by Hon'ble sUnion Minister of Health & Family Welfare in November 2004. It is a decentralized, state based surveillance program in the country. It is intended to detect early warning signals of impending outbreaks and help initiate an effective response in a timely manner.

- The project was implemented in Mizoram in 2004-05, in Manipur, Tripura, Nagaland and Meghalaya in 2005-06, and in Arunachal Pradesh, Sikkim and Assam in 2006-07.

- All the states are reporting weekly outbreak alerts to the Central Surveillance Unit. Six states are sending weekly epidemiological data also in IDSP reporting format. The list shows outbreaks detected and responded to by the IDSP in the NE States in the past 6 months.

Outbreaks detected through IDSP in last 6 months in the North Eastern States

State (District)	Disease/Illness	Date of reporting of outbreak	No. of cases	No. of deaths	Comments
Arunachal Pradesh (Papum Pare)	Measles	December 2007	29	5	District RRT investigated and confirmed outbreak of measles in unimmunized children.
Manipur (Churachandpur)	Deaths in children	February 2008	—	28	Rapid Response Team (RRT) from district visited the affected area. The team confirmed that there was no outbreak and some children died due to Acute respiratory tract infection, Pneumonia, & non-availability of health care.
Assam (Jorhat & Golaghat)	Acute Diarrhoeal Disease (ADD)	March 2008	34	13	The cases were reported from the tea estates in the affected districts. ADD outbreak was confirmed as cholera.
Meghalaya (All districts except South Garo Hills)	Meningitis	March 2008	389	44	Following an alert from a Private hospital and state IDSP preliminary report, a central RRT team assisted the state authorities in the investigation of outbreak.
Tripura (West Tripura)	Measles	March 2008	20	1	Measles cases in one locality, investigated by District RRT and confirmed as measles.
Sikkim (West District)	Dysentery	March 2008	40	1	Investigated by District RRT.
Mizoram (Lunglei)	Acute Diarrhoeal Disease (ADD)	April 2008	80	0	District RRT investigated the outbreak.