EPIDEMIOLOGY OF COMMUNICABLE DISEASES

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prevention & control of infectious diseases

CONCEPTS OF PREVENTION

The goals of medicine are to promote health, to preserve health, to restore health when it is impaired, and to minimize suffering and distress. These goals are embodied in the word

prevention

Successful prevention depends upon a

1-Knowledge of causation
2-Dynamics of transmission
3-Identification of risk factors and risk group
4-Availability of prophylactic or early detection and treatment measures.
5-An organization for applying these measures to appropriate persons or groups, and continuous evaluation of and development of procedures applied.

Control

- **Concept of control:**

The term disease control describes ongoing operations aimed at reducing:

- **The incidence of disease**
- **The duration of disease and consequently the risk of transmission**
- **The effects of infection, including both the physical and psychosocial complications**
- **The financial burden to the community.**

Every disease has certain weak points susceptible to attack. The basic approach in controlling disease is to identify these weak points and break the weakest links in the chain of transmission.

This requires sound epidemiological knowledge of the disease - that is :

- Magnitude
- Distribution in time, place and person
- Multifactorial causation
- Sources of infection and dynamics of transmission.

Frequently it may be necessary to institute more than one method of control simultaneously.

The choice of methods will depend upon factors such as availability of proper tools and techniques, relative cost effectiveness, efficiency and acceptability.

Control measures for the following :

1. **The reservoir or source of infection**
2. **The route (s) of transmission**
3. **The susceptible host (people at risk)**

- **Control activities focus on primary prevention or secondary prevention, but most programs combine both.**

The activities of disease prevention and control are now included in primary health care - it requires community participation (involvement), political support and inter- sectoral co-ordination.

Disease Cycle Intervention

The interaction of host, agent, and environment makes up the disease cycle.

The cycle must be broken to control the disease.

Some intervention concepts used for disease control programs

Surveillance programs **are designed to detect early cases of disease among hosts.**

Surveillance : continuous search of the factors that determine the occurrence and distribution of disease and other conditions of ill-health.

Objectives of surveillance:

- To provide information about new and changing trends in health status of a population
- To provide feed back which may be expected to modify policy and system
- Provide timely warning of public health disasters so that interventions can be mobilized.

Surveillance is a continuous process which involves three primary activities:

I . Collection of relevant data for a specified population, time period and/or geographic area;

ii . Meaningful analysis of data

Iii . Routine dissemination of data with accompanying interpretation.

Types of surveillance

- **Passive surveillance:** receiving of reports of infections/disease from physicians, laboratories and other health care professionals required to submit such reports as defined by public health legislation

- **Active surveillance:** Active disease surveillance is also based on public health legislation and refers to daily, weekly or monthly contacting of physicians, hospitals, laboratories, schools or others to “actively” search for cases

Usually seasonal or done during disease outbreaks

Duties of health care professionals in surveillance

- Identify and describe each individual having an infection as quickly as possible after exposure.
- Determine the source of infection.
- Identify exposed individuals to whom the infection may have been transmitted.
- Specify the frequency of occurrence of infection in population groups at risk by person, place and time.
- Identify populations that are experiencing, or might experience, an increased frequency of infection.
- Prepare and distribute surveillance reports to health care professionals participating in disease prevention and control activities.

Monitoring programs are like surveillance activities but are for hosts known to be infected with agents transmissible to others.

The same term is used for routine testing of the environment for pollution.

Eradication programs are aimed at the reservoir of infection for the purpose of completely removing the agent.

Eradication programs, when applied to certain small niches in a controlled environment, are often successful.

Immunization programs are directed toward the host to provide specific antibodies against agents.

They are usually directed at those individuals at the highest risk from the agent.

Behavior modification programs are aimed at changing the actions of the host that add to the level of risk of disease, allowing the host to enter environments where the agent is located.

PREVENTION of INFECTIOUS DISEASES

Primary prevention means preventing the occurrence of infectious diseases, and so having no cases.

Primary prevention can be achieved by general & specific measures.

1-General preventive measures:

a- **Sanitation of the environment: clean, pollution free.**

b- Clean, proper behavior and habits of the public through health education.

c- Health promotion of the public, with adequate nutrition, to raise the general body resistance.

2- Specific preventative:

a-Immunization; active & seroprophylaxis

b- Chemoprophylaxis.

3- Communicable Disease Control and the International Health Regulations(2005):

The IHR are a framework that will help countries minimize the impact and spread of public health threats. As an international treaty, the IHR are legally binding; all countries must report events of international public health importance. Countries are using the IHR framework to prevent and control global health threats while keeping international travel and trade as open as possible. The IHR, which are coordinated by the World Health Organization (WHO), aims to keep the world informed about public health risks and events.

The IHR require that all countries have the ability to do the following:

Detect: Make sure surveillance systems and laboratories can detect potential threats
Assess: Work together with other countries to make decisions in public health emergencies
Report: Report specific diseases, plus any potential international public health emergencies, through participation in a network of National Focal Points
Respond: Respond to public health events
The IHR also include specific measures countries can take at ports, airports and ground crossings to limit the spread of health risks to neighboring countries, and to prevent unwarranted travel and trade restrictions.

One of the most important aspects of IHR is the requirement that countries will detect and report events that may constitute a potential public health emergency of international concern (PHEIC).

Under IHR, a PHEIC is declared by the World Health Organization if the situation meets 2 of 4 criteria:

Is the public health impact of the event serious?
Is the event unusual or unexpected?
Is there a significant risk of international spread?
Is there a significant risk of international travel or trade restrictions

Once a WHO member country identifies an event of concern, the country must assess the public health risks of the event within 48 hours.

If the event is determined to be notifiable under the IHR, the country must report the information to WHO within 24 hours.

Some diseases always require reporting under the IHR, no matter when or where they occur, while others become notifiable when they represent an unusual risk or situation.

Always Notifiable

- Smallpox
- Poliomyelitis due to wild-type poliovirus
- Human influenza caused by a new subtype
- Severe acute respiratory syndrome (SARS)

Other Potentially Notifiable Events:

May include cholera, pneumonic plague, yellow fever, viral hemorrhagic fever, and West Nile fever, as well as any others that meet the criteria laid out by the IHR.
Other biological, radiological, or chemical events that meet IHR criteria

Since the revised IHR were put into place, four PHEICs have been declared by WHO:

H1N1 influenza (2009)
Polio (2014)
Ebola (2014)
Zika virus (2016)

2014 and 2015 have been unprecedented years for potential PHEICs

In the months from January 2014 to February 2015, 321 possible PHEICs were reported to WHO

Most postings concerned the Middle East respiratory syndrome coronavirus (MERS-Co V) event, the influenza A (H7N9) virus event in China, and the outbreak of Ebola in West Africa.

Only about 1/3 of the countries in the world currently have the ability to assess, detect and respond to public health emergencies

CONTROL of INFECTIOUS DISEASES

Control means the measures to be taken for existing infectious diseases, with following objectives:

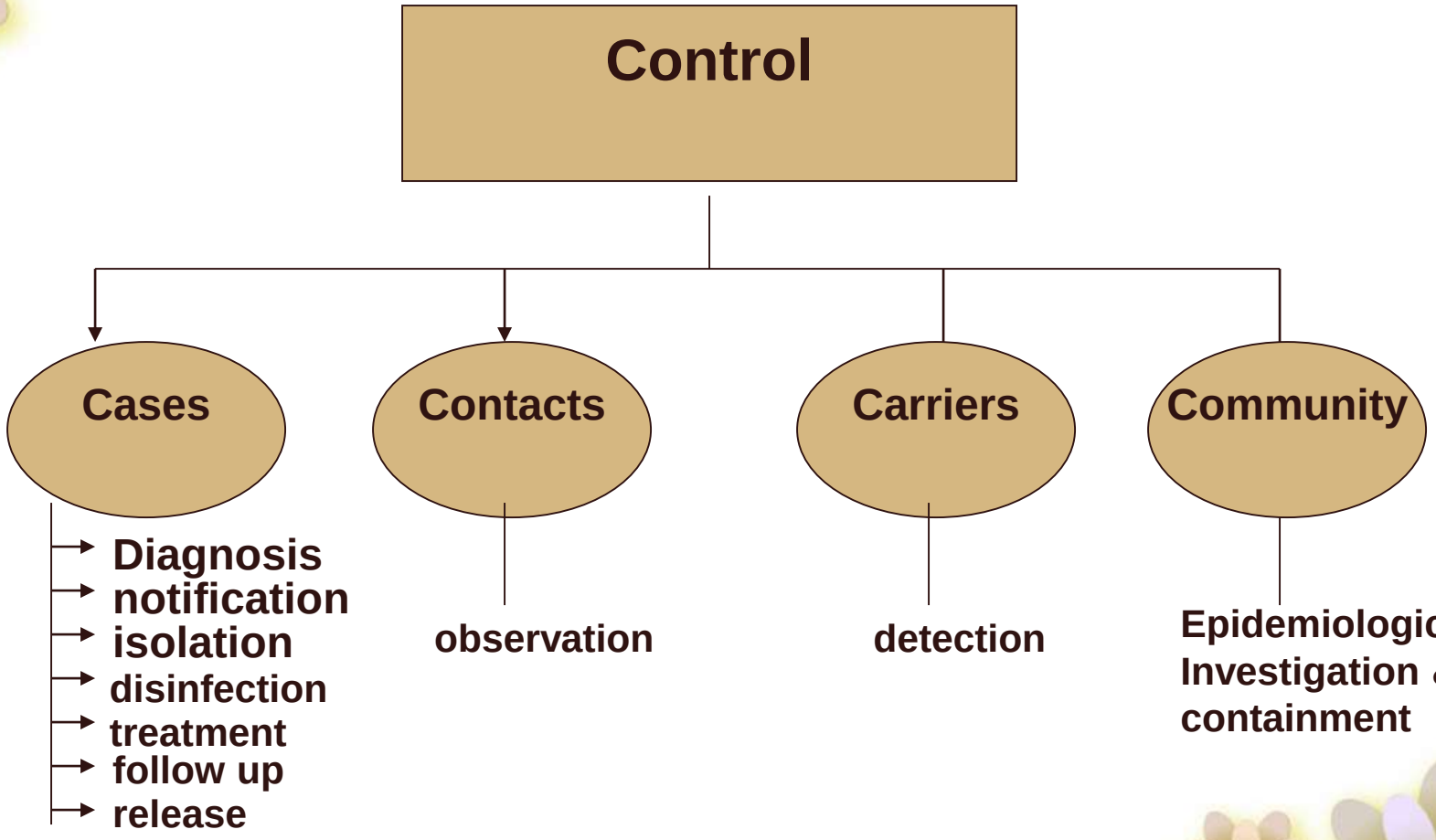
1-Case finding [detect cases]

2-Management of cases, and protecting them against hazards and sequel of disease.

3-Protecting susceptible contacts and other groups who may be exposed to infection

4-Preventing or minimizing spread of disease in the involved community

Control of infectious diseases (the 4 “C”s)



Control measures are taken for:

a-Reservoirs of infection: man [cases, carriers] and animals.
b-Contacts [home, school, work…].
c-The community.

A-Control of Reservoirs

1-Animal reservoirs: for infectious diseases having animal reservoirs

a-Eradication, if practically applicable, rodents, and stray dogs & cats.
b-Control of farm& pet animals, to prevent or minimize animal – animal, and animal- man spread of infection.

Control measures of animal include:

- **Sanitary clean animal environment.**
- **Veterinary care, including immunization& segregation of diseased animals.**
- **Protection of man against occupational infection and transmission of infection.**

2-Human Reservoirs : control of cases and carriers

I-Control of carriers: may be difficult to control, since the majority is unnoticed, and only a small percent may come to notice: convalescent& contact carriers of diagnosed cases.

Carriers can be detected on laboratory examination on: -- - Control of some infectious diseases:

1- Examining convalescent & contacts of diagnosed cases.

2- Epidemiologic study to trace the reservoirs of infection.

Pre employment & periodic examination of certain occupational groups.

II – Control of cases

a- Case – finding: clinical diagnosis, and laboratory confirmation if necessary.

b- Notification: cases, of definite or suspected diagnosis, must be notified to the local health office.

Value of notification:

- To take prevention & control measures for the cases, and contacts and the community if necessary.
- To help tracing source and channels of infection, in outbreak or epidemic.
- To collect significant statistical data.

List of Notifiable Communicable Diseases

First Group : Diseases to be notified immediately

Cholera

Acute Flaccid Paralysis [AFP] and poliomyelitis

HIV/ AIDS

Viral hemorrhagic fevers

Falciparum Malaria

Diphtheria ,Measles, Botulisms, Neonatal tetanus, Meningococcal Meningitis, Plague, Yellow fever, Undulant fever, Anthrax, Typhus, G. Measles

Congenital rubella syndrome

Unexpected or unusual disease or events

Second Group : Diseases to be notified weekly

Rabies, Pertussis, Cutaneous Leishmaniasis, Visceral Leishmaniasis, Viral hepatitis (B), Shigellosis, Acute diarrhea.

Third Group: Diseases to be notified monthly

Viral hepatitis, Brucellosis, Chicken pox, Bilharziasis, Toxoplasmosis, Hydatid cysts, Viral meningitis, Bacterial meningitis, Mumps, TB, Extra pulmonary TB, STDs, Scabies, Leprosy, Benign malaria, Pneumonia, Animal bite, Typhoid, Cutaneous Anthrax, Influenza.

c. Isolation: **is defined as " separation , for the period of communicability of infected persons or animals from others in such places under such conditions , as to prevent or limit the direct or indirect transmission of the infectious agent from those infected to those who are susceptible ,or who may spread the agent to others".**

Isolation of patients is indicated for infectious disease having the following epidemiological features:

1-high morbidity and mortality
2-high infectivity

3-no significant extra human reservoir
4-infectious cases easily recognizable

5-chronic carriers are not a significant part of the reservoir.

The infectious case must be isolated, either at home or hospital or special places, according to the nature of disease& home condition, period of isolation varies according to nature of disease. It is usually for the period of communicability .

Isolation is more carefully applied and in most cases replaced by surveillance because of improvements in epidemiological and disease control technologies. Today isolation is recommended only when the risk of transmission of the infection is exceptionally serious.

Value of Isolation:

- To stop activity and movement of the case in the community, thus prevent spread of infection.
- To protect the case against the risk of secondary infection, when exposed to contacts & visitors.

Types of isolation

1-Depending on mode of spread and severity of disease

- Standard isolation
- Strict isolation
- Protective isolation
- High security isolation

- **2- Depending upon place of isolation**
  - **Hospital isolation**
  - **Home isolation**
- **3-Based on method**
  - **Physical isolation : isolating the person from the rest of community**
  - **Chemical isolation : giving rapid effective treatment to make the patient non –infectious as quickly as possible.**

d-Disinfection: is the process of destroying pathogenic organisms outside the body, by direct exposure to chemical or physical agents

Types of disinfection are :

1- Prophylactic
2-Concurrent
3-Terminal

Prophylactic Disinfection

As preventive measure to prevent the onset of disease such as chlorination of water, scrubbing and washing hands of health care providers, sterilization of instruments before using for surgery.

Concurrent disinfection: is carried out during the course of disease for :

- Excreta and discharge, any object or material used in nursing, soiled articles & fomites

Terminal disinfection: disinfection for the last time, after transferring the case to hospital, or cure or death.

e-Treatment:

- **Specific therapy for bacterial disease, chemotherapy& antitoxins.**
- **Nursing and proper feeding**
- **Symptomatic treatment**
- **Prevention & control of sequelae and complications [2nd bacterial infection, dehydration…]**

f-Release:

The case can leave isolation, and return to school or work if:

- **Clinical recovery { becoming clinically free}**
- **Satisfactory general condition**
- **Becoming bacteriologically free, in diseases having convalescent carriers**

III Control of Contacts: a contact is the person who has been in association with the case at any time during the i.p and until discovered and isolated.

- Forms of Contacts: house holds including family contacts; work, school.
- The local health office is responsible for control of contacts of notified cases.

1-Enlistment: special [contact list] is filled for names& personal data.

2-Examination: for case-finding if any; general condition, body temp, & any manifestations.

3-No exposure to isolated cases.

4-Surveillance, segregation ,quarantine or isolation according to disease:

a-Surveillance: in most infectious diseases, contacts are put under supervision, every day for the incubation period of the disease, for case-finding, mean while, they go to work& school.

Personal ***SURVEILLANCE*** the practice of close medical or , other supervision of contacts to permit early recognition of infection or illness but without restricting their movements.

C-Segregation:

Contacts of the following diseases are excluded from school or work [not isolated].

- **Diseases having contact carriers e.g. enteric a & diphtheria, food handlers & school personnel contacts are excluded from work, and bacteriologic ally examined until prove not to be carriers.**

- **Diseases which are highly infectious in the early days, measles, susceptible contacts are excluded from school, and so will not be at school, otherwise spread infection, if get diseased.**

A quarantine is used to separate and restrict the movement of persons; it is a 'state of obligatory isolation

This is often used in connection to disease and illness, such as those who may possibly have been exposed to a communicable disease.

Quarantine which was once a popular method of disease control has now declined in popularity.

With better techniques of early diagnosis and treatment, quarantine, as a method of disease control, has become outdated.

It has been replaced by active surveillance.

Removal of susceptible children to homes of immune persons; or establishment of a sanitary boundary to protect uninfected from infected portions of a population.

c-Isolation: contacts of cholera [non endemic areas], pneumonic plague& pneumonic anthrax are isolated each for a certain period of time; since these diseases are serious, and so if any of the contacts is diseased, he will be isolation, and not exposed to others to infection.

5- Specific protection: by immunization or chemoprophylaxis, if available.

III Community Control Measures

Sporadic cases of endemic infectious diseases can be readily controlled by control measures for cases& contacts, but if epidemic or outbreak appears or threatens to occur, prevention & control measures are needed to protect the at risk community.

1-Applied prevention: measures of primary prevention are applied in relation to the particular disease under control;

--- Adequate ventilation& spacing of confined places in respiratory infections, especially meningococcal meningitis.

---- Super chlorination of water supply and sanitary disposal of wastes in food borne infections.

---- Health education of the at- risk group or pop, for encountered disease, especially personal precautions.

---- Specific prevention; mass active immunization or chemoprophylaxis of at risk- group, if available for the encountered disease.

2-Control measures:

a-Case finding and control of cases & contacts.

b-Epidemiologic investigation, to trace source& channels of infection.

c-Drastic control measures, been taken, if necessary e.g. closing schools.

The Use of Drugs in the Control of Infections

Apart from the treatment of individual patients, antimicrobial agents are used as part of the strategy for controlling infectious diseases. The drug may:

1- Protect the uninfected individual

2- Arrest the progression of disease and reverse pathological damage

3- Eliminate infection and thereby prevent further transmission of disease

These qualities are exploited in the use of drugs for:

- **Chemotherapy:** the treatment of sick individuals.
- **Chemoprophylaxis:** the protection of persons who are exposed to infection – malaria.
- **Chemo suppression:** the prevention of severe clinical manifestation and complications in infected persons.

STRATEGIES: drugs have been used successfully as the main strategy for control of some endemic diseases. Strategies for large scale use of drugs in disease control include the following variants.

1-Mass chemotherapy: this strategy entails the treatment of all persons in the community, whether infected at the time of the survey or not. If a single examination of faeces, blood or urine shows that a high infection rate, say 50% or more, serial examinations will reveal that transmission is very high and that at some time or another, most of the community will acquire the infection, in such situations, it is more cost- effective to treat every one without establishing the presence of infection in each subject.

2-Selective population chemotherapy: this involves treatment of all persons that are found to be infected at initial and subsequent surveys, for example control of intestinal parasite infections, schistosomiasis control programs and malaria eradication programs.

3-Targeted chemotherapy: this involves treating only those individuals harboring heavy infections and / or high risk groups, for example treatment of person's age 5-20 years for S. haematobium infection.

In highly endemic areas and in the absence of an integrated approach to disease control (involving sanitation, health education, and community participation), prevalence rates of infection tend to return to pretreatment levels with a relatively short time, usually a year.

Simulation models suggest that for some parasitic infections, targeted chemotherapy is most effective for the control of morbidity as opposed to the control of transmission.

These various strategies for large scale use of drugs are being applied in the control of several infectious diseases notably trachoma, schistosomiasis, and malaria.

DRUG SPECIFICATION: the ideal drugs for use in developing countries should meet the following specifications

1-Efficacy: the drug should be effective against all strains of the pathogen, the occurrence or emergence of resistant strains would limit the usefulness of the drug.

2-Safety: the drug can be used safely by health personnel who have limited skills, it can be safely administered to persons who would not remain under continuous medical supervision, there should be a wide margin between the effective and toxic dose and should be no dangerous side effects.

3-Simple regimens: the dosage regimen should be simple and preferably administered by mouth, single dose treatment should be available.

4-Acceptable: the drug should be well tolerated by persons of the target age group and should have no unpleasant side effects.

5-Affordable: the cost of the drug should permit its use within the limited budgets of the developing countries.

ERADICATION of INFECTIOUS DISEASE

Eradication literally means to "tear out by roots"

Eradication of disease implies termination of all transmission of infection by extermination of the infectious agent, eradication is an absolute process, and not a relative goal.

It is "all or none phenomenon".

The word eradication is reserved to cessation of infection and disease from the whole world.

getting rid of the causative organism and consequently disease, in certain area or country or the world; no reported cases, nor reservoirs of infection. It achieved for a limited number of infectious diseases.

Today, smallpox is the only disease that has been eradicated.

The feasibility of eradicating polio appears to be greater than that ofothers diseases like Measles.

ELIMINATION of INFECTIOUS DISEASE

Disease elimination between control and eradication, an intermediate goal hasbeen described, called "regional elimination"

The term elimination" is used to describe interruption of "transmission of disease, as for example, elimination of measles, polio and diphtheria from large geographic regions or areas.

Regional elimination is now seen as an important precursor of eradication.

means that existing endemic disease so controlled to reach the level of ' no reported cases'. This is usually by protection of at risk group or population, while the causative agent not necessarily eliminated.