Pathogens and Virulence

Microorganisms that cause infections and/or disease are called pathogens, and the characteristics that enable them to cause disease are referred to as virulence factors.

Most virulence factors protect the organism against host attack or mediate damaging effects on host cells.

The terms pathogenicity and virulence reflect the degree to which a microorganism is capable of causing disease

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Organisms that only cause infection when one or more of the host's defense mechanisms are disrupted or malfunction are known as opportunistic pathogens, and the infections they cause are referred to as opportunistic infections.

On the other hand, several pathogens known to cause serious infections can be part of a person's normal flora and never cause disease in that person. However, the same organism can cause lifethreatening infection when transmitted to other persons

Survival Against the Immune System

BOX 3-8 Microbial Strategies for Surviving the Immune System

- Pathogen multiplies and invades so quickly that damage to host is complete before immune response can be fully activated, or organism's virulence is so great that the immune response is insufficient
- Pathogen invades and destroys cells involved in the immune response
- Pathogen survives, unrecognized, in host cells and avoids detection by immune system
- Pathogen covers its antigens with a capsule so that an immune response is not activated
- Pathogen changes antigens so that immune system is constantly fighting a primary encounter (i.e., the memory of the immune system is neutralized)
- Pathogen produces enzymes (proteases) that directly destroy or inactivate antibodies

OUTCOME OF INFECTIOUS DISEASES

Basically, outcome depends on the state of the host's health, the virulence of the pathogen, and whether the host can clear the pathogen before infection and disease cause irreparable harm or death (Figure 3-11).

The time for a disease or infection to develop also depends on host and microbial factors. Infectious processes that develop quickly are referred to as acute infections, and those that develop and progress slowly, sometimes over a period of years, are known as chronic infections. Some pathogens, particularly certain viruses, can be clinically silent inside the body without any noticeable effect on the host before suddenly causing a severe and acute infection. During the silent phase, the infection is said to be latent.

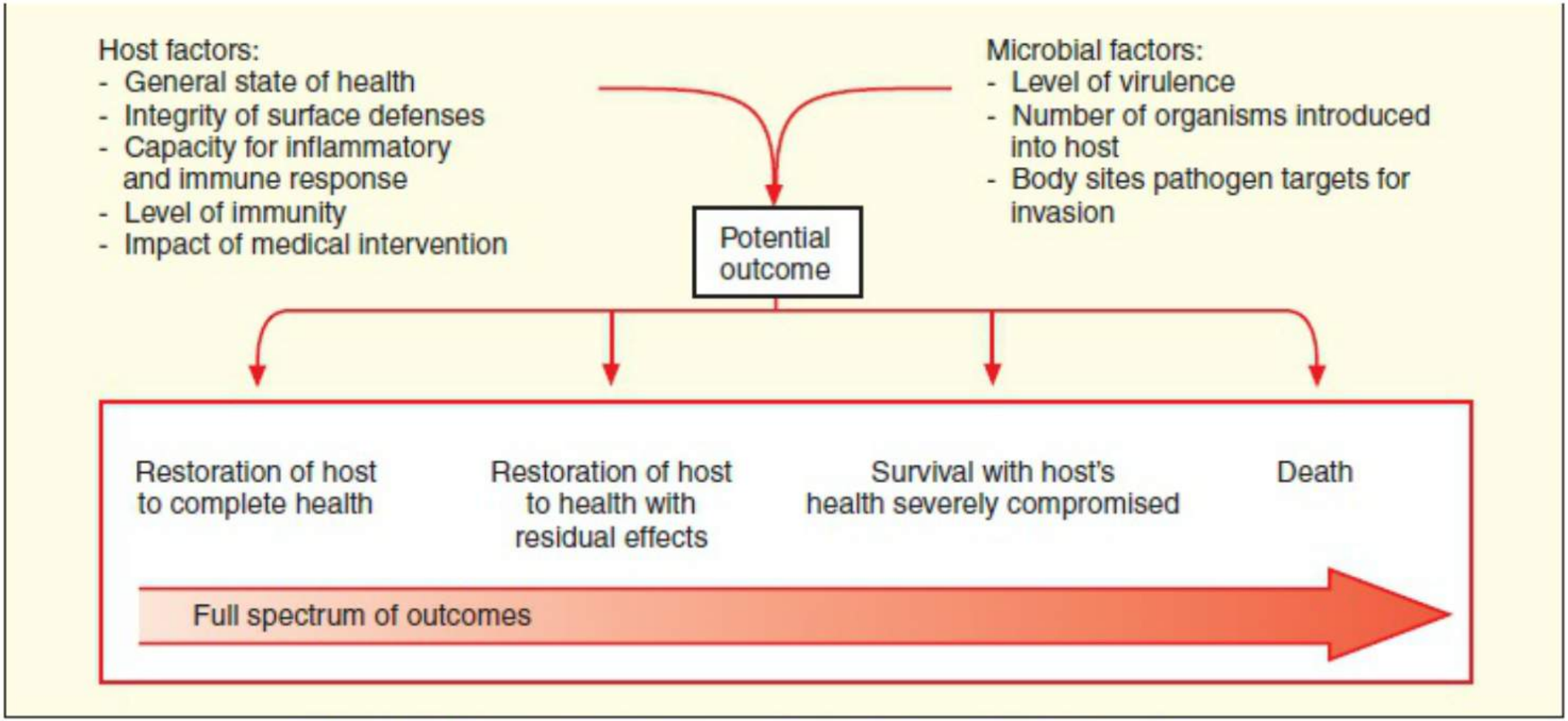


Figure 3-11 Possible outcomes of infections and infectious diseases.

The clues that an infection is occurring are known as the signs and symptoms of disease and result from host responses (e.g., inflammatory and immune responses) to the action of microbial virulence factors (Box 3-10). The signs and symptoms reflect the stages of infection

BOX 3-10 Signs and Symptoms of Infection and Infectious Diseases

General or localized aches and pains
Headache
Fever
Swollen lymph nodes
Rashes
Redness and swelling
Cough and sneezes
Congestion of nasal and sinus passages
Sore throat
Nausea and vomiting
Diarrhea

The treatment of an infection is often difficult and not always successful. Because much of the damage is already done before appropriate medical intervention is begun, the microorganisms gain too much of a "head start." Another strategy for combating infectious diseases is to stop infections before they even start (i.e., disease prevention).

Strategies to prevent disease involve interrupting encounters or minimizing the risk of infection when encounters do occur.

BOX 3-11 Strategies for Prevention of Infectious Diseases

PREVENTING TRANSMISSION: Avoid direct contact with infected persons or take protective measures when direct contact is going to occur (e.g., wear gloves, wear condoms)

Block spread of airborne microorganisms by wearing masks or isolating persons with infections transmitted by air

Use sterile medical techniques

CONTROLLING MICROBIAL RESERVOIRS: Sanitation and disinfection

Sewage treatment

Food preservation

Water treatment

Control of pests and insect vector populations

MINIMIZING RISK BEFORE OR SHORTLY AFTER EXPOSURE: Immunization

Cleansing and use of antiseptics

Prophylactic use of antimicrobial agents

Immunodiagnostics

Immunodiagnostics is a diagnostic methodology that uses an antigen-antibody reaction as their primary means of detection.

Many tests based on the interactions of antibodies and antigens have been developed to determine the presence of antibodies or antigens in a patient.

These tests require both specificity and sensitivity of the antibodies. Sensitivity is the ability to recognize and bind to the antigen, specificity is the characteristic of binding only to one antigen and no others.

-Precipitation Reaction tests:

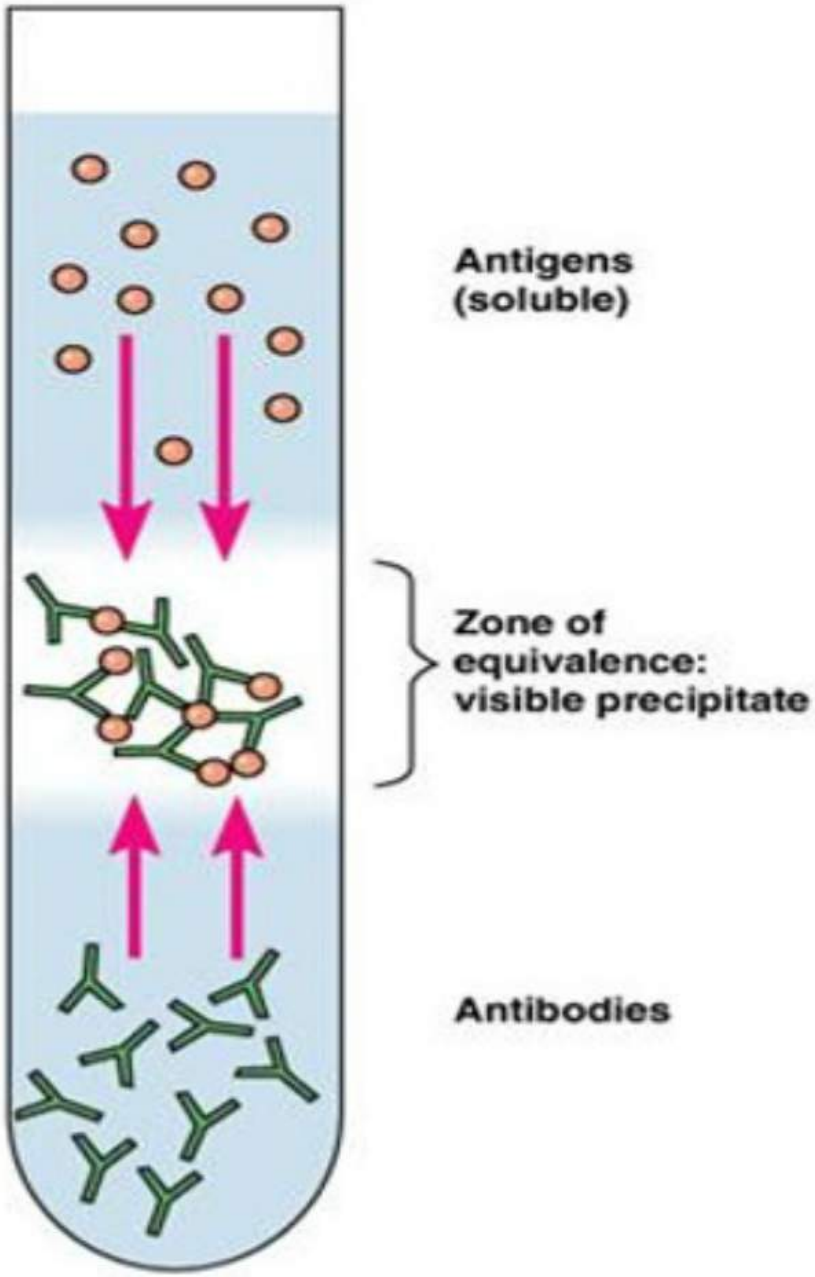
Precipitation is any antibody which reacts with antigen to form a precipitate.

Include :
1- ring test
2- gel test (Immunodiffusion)

1-ring test

The ring test is a simple serological technique that illustrates the precipitin reaction in solution. This antigen-antibody reaction can be demonstrated by the formation of a visible precipitate, or granular turbidity, in the test fluid.

-Antiserum is introduced into a small diameter test tube, and the antigen is then carefully added to form a distinct upper layer
. After 4 hours incubation a ring of precipitate forms at the point of contact in the presence of antigen-antibody reaction. The rates at which the visible ring forms depends on the concentration of the antigen.


Antigens
(soluble)
Zone of
equivalence:
visible precipitate
Antibodies

(a)

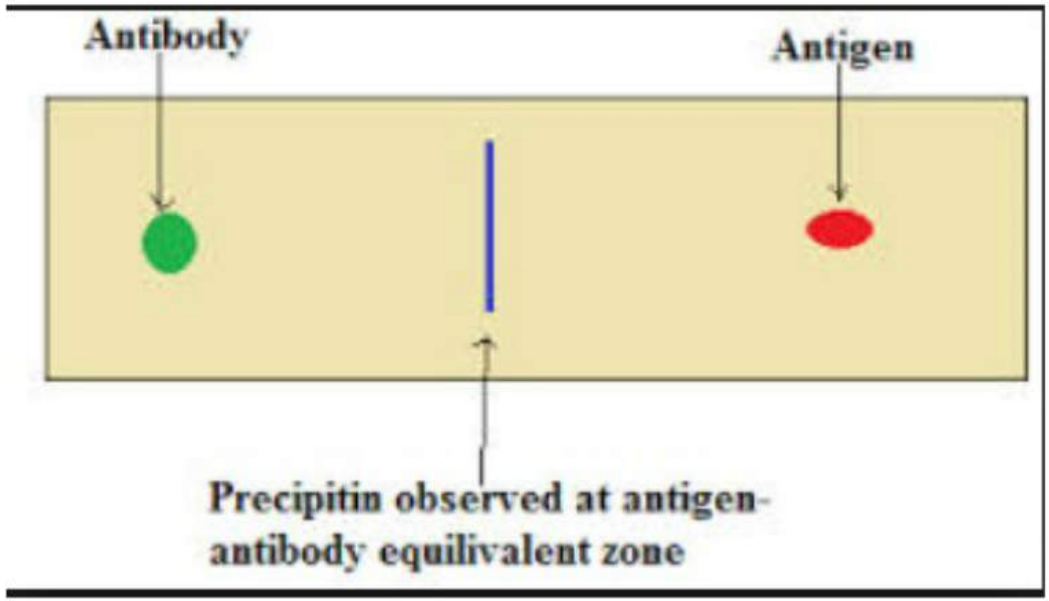
(b)

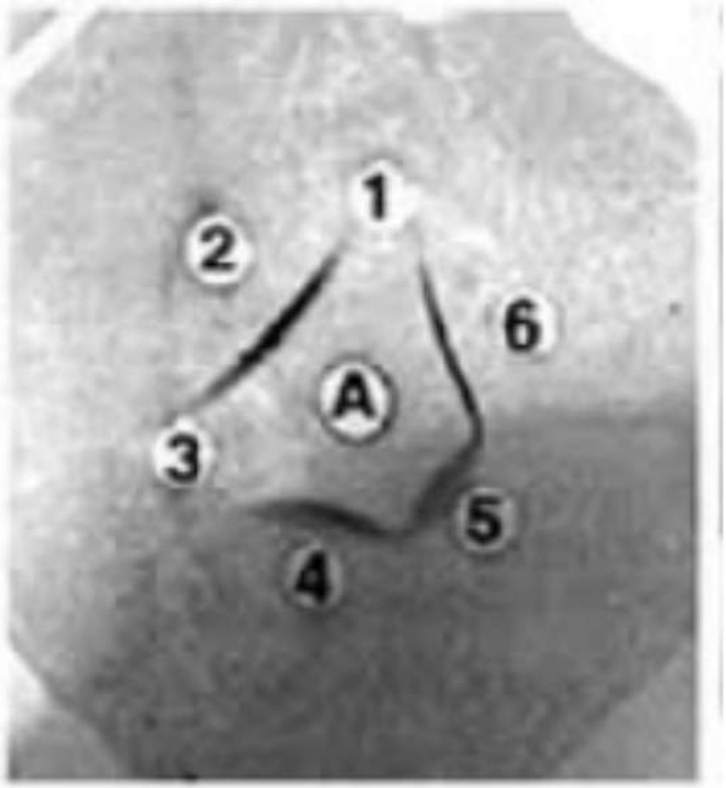
2-Immunodiffusion: Antigen-Antibody Precipitations Reactions in Gels

Antigen may link together by multiple antibodies and form an insoluble precipitate form. This form is visible to the naked eye.

A precipitate also indicates that antibody and antigen molecules are present at optimal proportions for the formation of larger complex.

In Immunodiffusion tests, antibodies and or soluble antigens are loaded into separate wells of a gel and are allowed to diffuse, each reagent moving radially into the gel. An immobile precipitate, visible as a band (precipitin line) in the gel, develops if specific antibody- antigen binding takes place, and if antibody-antigen components are present at optimal proportions.

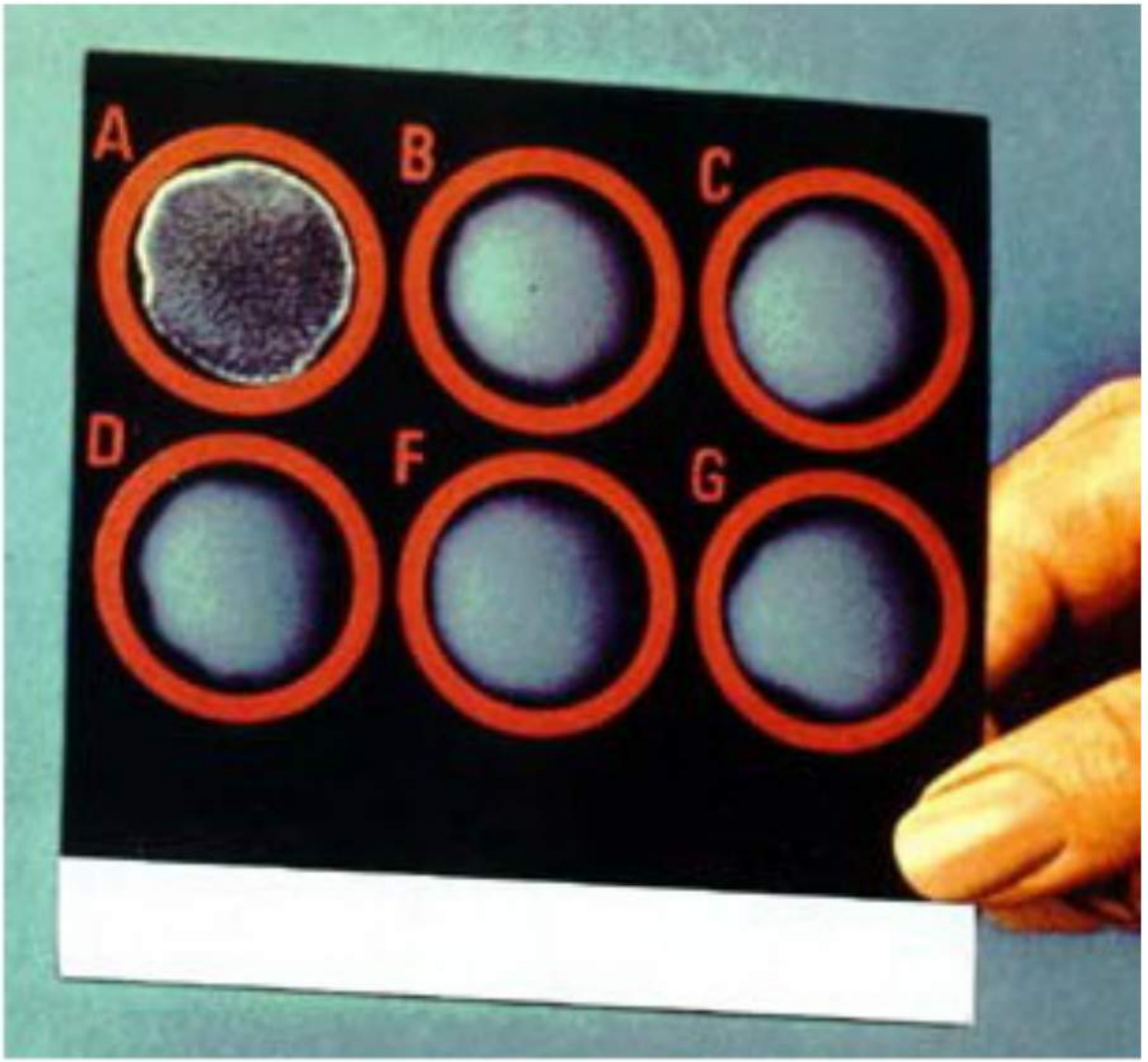

Antibody
Antigen
Precipitin observed at antigen-antibody equilivalent zone


1
2
6
A
3
5
4

-Serologic Investigation of Microorganims

Serologic technique may allow rapid and highly specific identification of microorganisms. This involve antibodies and antigen reaction. Antibodies and antigen may react in certain visible ways in vitro.

For example, agglutinins are antibodies that produce agglutination, a reaction that occurs when bacterial cells or other particles are visibily clumped by antibody combined with antigens on the cell surfaces. Percipitins are antibodies that produce precipitation of soluble antigen (free in solution and unassociated with cells).

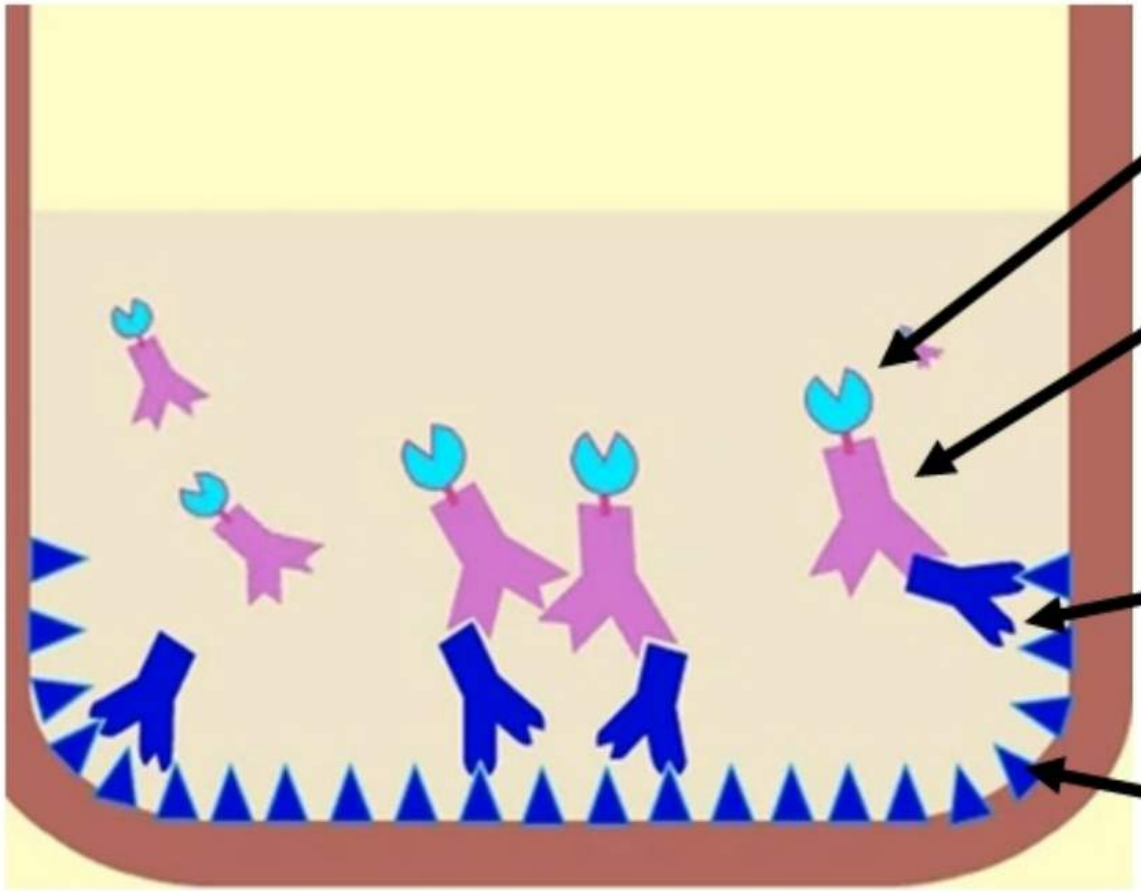

A
B
C
D
F
G

The ELISA test(enzyme-linked immunosorbent assay):

The ELISA (sometimes also called an EIA) is a sensitive, inexpensive assay technique involving the use of antibodies coupled with indicators such, enzymes to detect the presence of specific substances, usually an antigen in a liquid sample or wet sample.
ELISA tests are generally simple and accurate tests that determine how much antibody is in a sample, or how much protein is bound by an antibody.

ELISAs are performed in plate which has 96-wells . The bottom of each well is coated with a protein to which will bind the antibody you want to measure.

+ substrat (last step)



ELISA test color maker

Animal antibody to recognize patient antibody

Patient's antibody

Single type of antigen covered vessel

An ELISA test may be used to diagnose diseases such as:

- **HIV (the virus that causes AIDS)**
- **Hepatitis**
- **syphilis**
- **varicella zoster virus (which causes chicken pox and shingles)**