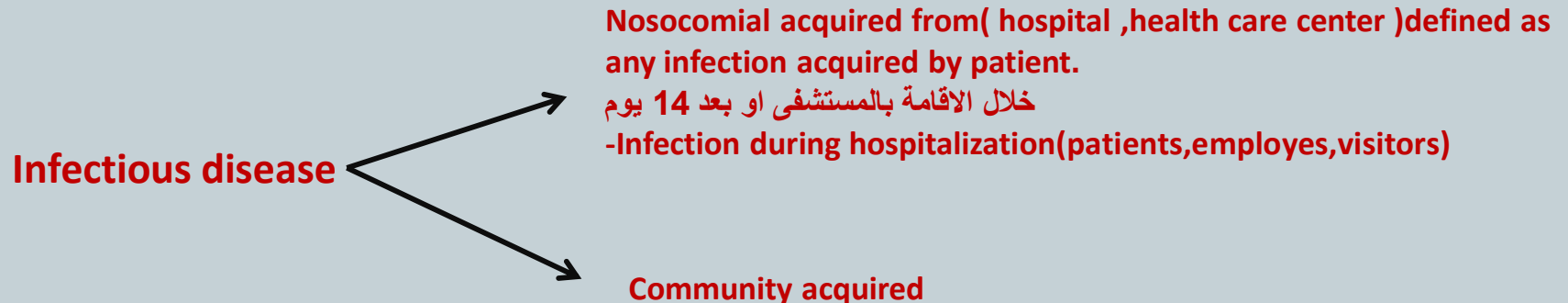


Microbiology in health care facilities



HEALTH CARE ASSOCIATED INFECTIONS (HAI)

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Healthcare epidemiology can be defined as the study of the occurrence, determinants, and distribution of health and disease within healthcare settings

Healthcare-Associated Infections



Infectious diseases can be divided into 2 categories

1. Hospital acquired infections (nosocomial infections) **Not induced(transmitted) by regular transmission modes**



The term “healthcare-associated infection” should not be confused with the term “iatrogenic infection” (iatrogenic literally meaning “physician- induced”).

Infection caused by medical error(اخطاء طبية)

2. Community acquired infections

**Transmitted between
population
Ex. influenza**

- Iatrogenic infection are those result from medical or surgical treatment

Frequency of HAIs (Prevalence)

In the United States, approximately 5% of hospitalized Patients develop HAIs.



من كل 20 مريض او زائر دخل المستشفى واحد بطلع معه

Among the leading causes of preventable death in U.S.

Hospital acquired infection (HAI)

1 in 20 hospitalized patients affected

1.7 million infections/99,000 deaths

Pathogens Most Often Involved in HAIs

The hospital environment harbors many pathogens and potential pathogens.

كيف ينتقل ال HAIs

1. Some live on and in healthcare professionals,

2. Other hospital employees  **nurses**
اكثر التصاق بالمريض + اكثر تفاعل
((close contact+ higher frequency))

3. Visitors to the hospital,



threats

4. Patients themselves (**coughing , sneezing**)

Pathogens most often involved in nosocomial infections

- Gram positive cocci (S. aureus, Coagulase negative staphylococci, enterococci)
- Gram negative bacilli (E. coli, P. aeruginosa, Enterobacter spp., Klebsiella spp)

The reason: presence of antimicrobial drugs in hospitals so more common to develop drug resistance.

هون الكارثة

70% of nosocomial infections involve drug resistant bacteria.

Nosocomial infection **في كل مرحلة من المراحل بيطلع organism جديد بسبب**

****Ex. acinetobacter “kind of bacteria” cause most common isolated bacteria from ICU.**

****all microbes can develop resistant .**

Bacteria are not the only pathogens that have become drug resistant, however.

Viruses (such as human immunodeficiency virus [HIV]), fungi (such as various *Candida spp.*), and protozoa (such as malarial parasites) have also developed drug resistance.

Transmission mode



Ways for transmission of infection

- Airborne
- Droplet
- Contact
 - direct
 - Indirect

Most common types of nosocomial infections



- Urinary tract infections (UTI) represent about 32% of all HAIs and cause about 13% of the deaths associated with HAIs

 **Mortality rate**

Post surgical infection
Post operative infection

- Surgical wound infections (بعد العملية الجراحية)

which represent about 22% of all HAIs and cause about 8% of the deaths associated with HAIs

Mortality rate

Surgical Site Infections:

hysterectomy (abdominal and vaginal), knee and hip arthroplasty, coronary artery bypass graft

اسبابها:

1-نقص الهايجيين

2-نقص ال disinfection

3-نقص المناعة

- LRT infections (pneumonia)

lower respiratory tract infections (primarily pneumonia), which represent about 15% of HAIs and cause about 36% of the deaths associated with HAIs

 **Mortality rate**

****Pneumonia that happened due to nosocomial tract infection is dangerous.**

- Bloodstream infections

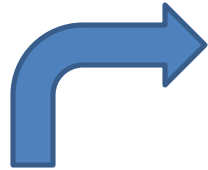
Is very dangerous
**cause sepsis

Represent about 14% of HAIs and cause about 31% of the deaths associated with HAIs

↓
Mortality
rate

Central Line Associated Blood Stream Infections

“The CDC defines a CLABSI as recovery of a pathogen from a blood culture (a single blood culture for organisms not commonly present on the skin and two or more blood cultures for organisms commonly present on the skin) in a patient who had a central line at the time of infection or within the 48-hour period before development of infection”



Main reason: contamination of food and drinks

Other common HAIs are the gastrointestinal diseases caused by *Clostridium difficile*, which are referred to as *C.difficile*- associated diseases. *C. difficile* (often referred to as “C. diff”) is an anaerobic, spore-forming, Gram-positive bacillus



Main causative agent pseudomembranous colitis which caused by

1-contamination

2-drug abuse

normal flora in gastrointestinal **لما ما يكون فيه استجابة بصيروا يعطوا المريض IV وهذا يؤدي الى**
العلاج
+(excessive/intensive treatments)



Will die

Patients most likely to develop HAI



- Immunosuppressed patients, whose immune systems have been weakened by age, disease, medical or surgical treatment **((diabetic/pregnant))**
- The highest infection rate in intensive care unit patients
- HAI rates are three times higher in adult and pediatric ICUs than elsewhere in the hospital



Ideal place for nosocomial infection

Justifying: ICU patients are immunosuppressed

So as we say previously that the pathogens with drug resistance

- Most vulnerable patients are elderly people, women in labor, premature infants and newborns, surgical and burn patients, patients under steroid treatment, anticancer drugs, radiation



**All of them are
immunosuppressed patients**

Major factors contributing to HAI

Lead doctors to search about herbal antibacterial rather than synthetic ones



So any simple infection can lead to death
But natural ones ; bacterium can't resist

- Increasing number of drug resistant pathogens
- Failure of health care personnel to follow infection control guidelines

كل العاملين بالمستشفى يجب ان يتبعوا guidelines وفي حال ما اتبعوها ال nosocomial infections يزيدوا ال

- Increased number of immunocompromised patients

**Because of immune system diseases due to drugs
So more susceptible for infections.**

→ Chemotherapy
(cancer patients)

↘ corticosteroids

**Drug abuse or misuse or over dose of antimicrobials lead to resistant bacteria
(92% of antimicrobes)**

- **The indiscriminate use of antimicrobial agents**

a false sense of security about antimicrobial agents,
leading to a neglect of aseptic techniques and other
infection control procedures

- **lengthy, more complicated types of surgery**

****كل ما تطور الطب، يتطلب من المريض يظل مدة اطول في المستشفى و هذا يتناقض مع**

Infection control committee

****كل ما كانت نسبة الإقامة قليلة بنقل احتمالية الإصابة ب Nosocomial infection**

كل ما كانت المؤسسات الطبية

Much easier infection transmission

- Overcrowding of hospitals and other healthcare facilities as well as shortages of staff
- Increased use of less-highly trained healthcare workers, who are often unaware of infection control procedures

**نقص الكادر الطبي:
1- الاطباء 2- الممرضين

بساعد على انتشار المرض

Recently graduated/untrained**
ممکن يساهموا بانتشار المرض لانه
ما عندهم علم بال guidelines ممکن

All medications that are used by patient

lead to

So more probability of inflammation disease

- Increased use of anti-inflammatory and immunosuppressant agents, such as radiation, steroids, anticancer chemotherapy, and antilymphocyte serum
- Overuse and improper use of indwelling medical devices.

Caused by developing of medical treatment

How we can reduce HAI



- Strict compliance with infection control guidelines

اهم خطوة

Hand higeen

- Handwashing is the single most important measure to the risk of transmitting pathogens from one patient to another

Good reduction for HAI

***Chain of infection that contain 6 compartments; if we want to control it, we just break the chain between 2 compartments (to control infection)**

Other means of reducing the incidence of HAIs include disinfection and sterilization techniques, air filtration, use of ultraviolet lights, isolation of especially infectious patients, and wearing gloves, masks, and gowns whenever appropriate.

Infection control



Measures taken to prevent HAI

- Infection control measures are designed to break various links in the chain of infection.
- Asepsis (without infection) include any actions taken to prevent infection or break the chain of infection

Asepsis (two types)

- (1) Medical asepsis include all measures used to prevent direct transfer of pathogens from person to person and indirect transfer of pathogens through the air or on instruments, bedding, equipments (handwash, proper cleaning of supplies and equipments, disinfection, proper disposal of needles, contaminated materials, infectious waste).

**Even the transmission is direct (with patients)
Or indirect (by employees , surgical equipment)**

Sterilizing of objects: killing all the microorganisms



- (2) Surgical asepsis include practices used to render and keep objects and areas sterile, it is practiced in operating rooms, labor and delivery areas
- Surgical asepsis is a sterile technique. Its goal is to exclude all microbes.

Organisms free **غرفة العمليات بتكون

**How to kill pathogens in hospital?
through sterilization we use auto claves for killing**

Chemical sterilants: kill bacterial spores with prolonged exposure times (3–12 hours)

3 levels of chemicals sterilants:

High-level disinfectants((sterile equipment))

kill all microbes (including viruses), except large numbers of bacterial spores.



For intermediate equipment

Intermediate-level disinfectants

might kill mycobacteria, vegetative bacteria, most viruses, and most fungi, but do not necessarily kill bacterial spores.

Low-level disinfectants

kill most vegetative bacteria, some fungi, and some viruses within 10 minutes of exposure

We don't use high level disinfectant for low level bacteria ;to prevent resistance

low & intermediate بتتعود على High و بتبطل تستجيب لل

Spaulding System for Classification of Instruments and Items for Patient Care.

Critical items.

must be sterile.

Critical items include:

surgical instruments, cardiac and urinary catheters, implants, and ultrasound probes used in sterile body cavities.

Semicritical items.

contact mucous membranes or non intact skin

require high-level disinfection.

These include respiratory therapy and anesthesia equipment, some endoscopes, laryngoscope blades, esophageal manometry probes, cytosopes, anorectal manometry catheters, and diaphragm fitting rings.

They minimally require high-level disinfection peroxide.

Noncritical items.

Come in contact with intact skin, but not mucous membranes.

Such items are divided into two subcategories:

1. Noncritical patient-care items (e.g., bedpans, blood pressure cuffs, crutches, computers)

2. Noncritical environmental surfaces (e.g., bed rails, some food utensils, bedside tables, patient furniture, floors).

Low-level disinfectants may be used for noncritical items.

70% to 90% ethyl or isopropyl alcohol, sodium hypochlorite

Regulations Pertaining to Healthcare Epidemiology and Infection Control

Exposure Control Plan

This plan is designed to eliminate or minimize
employee exposure to pathogens

Standard precautions



1. Handwash

2. Gloves

3. Masks, Eye protection equipments

4. Patient care

5. Environmental control

6. Linens

7. Occupational health and bloodborne pathogens

8. Patients placement

Vaccinations

healthcare personnel should receive the following vaccines:

- Hepatitis B vaccine
- Influenza (annually)
- Measles–mumps–rubella (MMR)
- Varicella (chickenpox)
- Tetanus–diphtheria–pertussis (TDP)
- Meningococcal vaccine (for microbiologists who are routinely exposed to isolates of *Neisseria meningitidis*)

Personal Protective Equipment

Gloves.

Isolation Gowns

Masks

Eye Protection

Respiratory Protection

Patient-Care Equipment

Organic material (e.g., blood, body fluids, secretions, excretions) must be removed from medical equipment, instruments, and devices prior to high-level disinfection and sterilization because residual proteinaceous material reduces the effectiveness of disinfection and sterilization processes.

All such equipment and devices must be handled in a manner that will protect healthcare workers and the environment from potentially infectious material.

Environmental Control

The hospital must have, and employees must comply with, adequate procedures for the routine care, cleaning, and disinfection of environmental surfaces such as bedrails, bedside tables, commodes, doorknobs, sinks, and any other surfaces and equipment in close proximity to patients.

Linens, Disposal of Sharps

All contaminated needles, lancets, scalpel blades, and other sharps must be disposed of immediately after use, by placing them in special containers known as sharps containers



Sharps containers are rigid, puncture resistant, leak proof, disposable, and clearly marked with a biohazard label



Sharps containers must be easily accessible to all personnel needing them and must be located in all areas where needles are commonly used, as in areas where blood is drawn, including patient rooms, emergency rooms, ICUs, and surgical suites.

When full, sharps containers are properly disposed of as biohazardous waste

Transmission-Based Precautions

Contact Precautions

Droplet Precautions

Airborne Precautions

Patient Placement



Isolation

Source isolation

- Patients with contagious diseases are isolated in special rooms to protect other people from becoming infected.
- The isolation rooms are under negative pressure

Protective isolation

- Patients who are susceptible to infections are isolated in special rooms under positive pressure to protect them from getting infections from others

Handling food and eating utensils

- Provide an excellent environment for the growth of pathogens

Handling fomites

Non living objects that may transmit microbes

Examples of fomites in healthcare settings are patients' gowns, bedding, towels, and eating and drinking utensils; and hospital equipment such as bedpans, stethoscopes, latex gloves, electronic thermometers, and electrocardiographic electrodes

Transmission by fomites can be prevented by



- Using disposable equipments
- Disinfect or sterilize equipment after use
- Use individual equipment for each patient
- Empty bedpans and wash them soon
- Use electronic thermometer, with disposable cover for single use

Medical waste disposal



medical wastes must be disposed of properly. These standards include the following:

- Any receptacle used for decomposable solid or liquid waste or refuse must be constructed so that it does not leak and must be maintained in a sanitary condition.

- All sweepings, solid or liquid wastes, refuse, and garbage shall be removed to avoid creating a menace to health and shall be removed as often as necessary to maintain the place of employment in a sanitary condition.
- The medical facility's infection control program must address the handling and disposal of potentially contaminated items.

Infection Control in Dental Healthcare Settings

Infection control guidelines applicable to dental healthcare settings

Preventing transmission of **bloodborne pathogens**, including HBV vaccination and preventing exposures to blood and other potentially infectious materials

- Hand hygiene
- Contact dermatitis and latex hypersensitivity
- Sterilization and disinfection of patient-care items
- Environmental infection control, including use of disinfectants, housekeeping services, spills of blood or body substances, and medical waste
- Special considerations, such as dental handpieces, dental radiology, aseptic technique for parenteral medications, oral-surgical procedures

Infection Control Committees and Infection Control Professionals

A hospital's infection control program is usually under the jurisdiction of the hospital's ICC or Epidemiology Service.

The ICC is composed of representatives from most of the hospital's departments, including medical and surgical services, pathology, nursing, hospital administration, risk management, pharmacy, housekeeping, food services, and central supply

The chairperson is usually an Infection Control Professional (ICP), such as a physician (e.g., an epidemiologist or infectious disease specialist), an infection control nurse, a microbiologist, or some other person knowledgeable about infection control.

The primary responsibilities of an ICP are as follows:

- Possess knowledge of infectious diseases processes, reservoirs, incubation periods, periods of communicability, and susceptibility of patients
- Conduct surveillance and epidemiologic investigations

- Prevent/control the transmission of pathogens to include strategies for hand hygiene, antisepsis, cleaning, disinfection, sterilization, patient-care settings, patient placement, medical waste disposal, and implementation of outbreak control measures

- Manage the facility's infection control program
- Communicate with the public, facility staff, and state and local health departments concerning infection control- related issues
- Evaluate new medical products that could be associated with increased infection risk

The ICC periodically reviews the hospital's infection control program and the incidence of HAIs.

It is a policymaking and review body that may take drastic action (e.g., instituting quarantine measures) when epidemiologic circumstances warrant.

Other ICC responsibilities include patient surveillance, environmental surveillance, investigation of outbreaks and epidemics, and education of the hospital staff regarding infection control.

Role of the microbiology laboratory in the hospital

CML personnel participate in healthcare epidemiology and infection control:

1. By monitoring the types and numbers of pathogens isolated from hospitalized patients.
2. By performing antimicrobial susceptibility testing, detecting emerging resistance patterns,
3. By notifying the appropriate ICP should an unusual pathogen or an unusually high number of isolates of a common pathogen be detected.

4. By processing environmental samples, including samples from hospital employees that have been collected from within the affected ward(s), with the goal of pinpointing the exact source of the pathogen that is causing the outbreak.

5. By performing biochemical, immunological, and molecular identification and typing procedures to compare various isolates of the same species.

Conclusion

- An HAI can add several weeks to a patient's hospital stay and may lead to serious complications and even death.
- From an economic viewpoint, insurance companies rarely reimburse hospitals and other healthcare facilities for the costs associated with HAIs.

- Cross-infections transmitted by hospital personnel, including physicians, are all too common; this is particularly true when hospitals and clinics are overcrowded and the staff is overworked.
- However, HAIs can be avoided through proper education and disciplined compliance with infection control practices.

- All healthcare workers must fully comprehend the problem of HAIs,
- Must be completely knowledgeable about infection control practices,
- Must personally do everything in their power to prevent HAIs from occurring.