Mansoura university
Faculty of Medicine
Clinical Pathology Department

Updated Microbiological Diagnosis of Nosocomial Infections

BY

Mayssa El-Said Zaki Mostafa

Assistant Lecturer Of Clinical Pathology Department

Faculty of Medicine - Mansoura University

Thesis

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Supervisors

Prof. Dr.
Amina Mostafa Abd El-Aal
Prof. of Clinical Pathology
Faculty of Medicine
Mansoura University

Prof. Dr.
Adel Abd El-Ghaffar El Sayed
Prof. of Community Medicine Department
Faculty of Medicine
Mansoura University

Dr.
Salah Abd El-Fatah Agha
Assitant Prof. of Clinical Pathology
Faculty of Medicine
Mansoura University

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Abbreviation

AIDs	Aquired immune defeciency syndrome
ANI	Anaerobes identification
B.	Bacteroid
C.	Candida
CDC	Centre of Disease control
Ch.	Chromogen
Citr.	Citrobacter
Con.	Coagulase negative
Clost.	Clostridium
E. coli	Escherichia coli
ELISA	Enzyme linked immunosorbant assay
Epid.	Epidermidis
Fig.	Figure
GEC	Gastroenterology centre
GIT	Gastrointestinal tract
GNI	Gram negative identification
GNS	Gram negative sensitivity
GPI	Gram positive identification
GPS	Gram positive sensitivity
H. pylori	Helicobacter pylori
Haem.	Haemolyticus
HIV	Human immunodefeciency virus
ICP	Infection control practitioner
ICU	Intensive care unit
LRTI	Lower Respiratory tract infection
NICU	Neonate intensive care unit
Pseud	Pseudomonas
Perf.	Perferinges
Sap.	Saprophyticas
Staph.	Staphylococcus
Simu.	Simulans
Pseudotrop.	Pseudotropicalis
Spp.	Species
URTI	Upper Respiratory tract infection
USA	Unisted states of America
UTI	Urinary tract infection
WHO	World health organization
YBC	Yeast biochemical cards

Introduction and aim of the work

Nosocomial infection is the infection acquired in hospital. It is one of the major problems all over the world concerning the patients and every member in hospital. Unless epidemic occurs in hospital, these infections are of minor or moderate clinical importance (Davies et al., 1992).

The causative organisms are mainly bacterial in origin, while viruses, fungus and protozoae are much less commonly reported as causative agents (Hierholzer and Zervos, 1991). The diagnosis and treatment of infections depends on rapid identification and antibiotic susceptibility testing provided by clinical microbiological laboratory (O'hara et al., 1990).

Bacterial identification can be performed by detecting their utilization of different substrates as source of carbon and nitrogen through the use of conventional tube method. Nevertheless, this method is slow and difficult technique (Ewing, 1986). Manual identification systems such as API are available with easier manipulation than conventional tube method. However, this method does not provide same day results (York et al., 1992). Therefore automated microbiological systems have been developed for rapid identification and antibiotic sensitivity (Stager and Davis 1992).

The aim of this study is to identify types of microorganisms causing nosocomial infections with evaluation of the environmental role on its occurrence at Mansoura University Hospitals. In addition, a comparative study is carried out between automated system "Vitek" and manual methods.

Epidemiology of Nosocomial Infections

Nosocomial infection is a serious medical problem that gives rise to increase hopsital costs and morbidity (Haley et al., 1981). Many of these infections are unavoidable but some are preventable (Schiefman and Palmer, 1985).

Advances of modern medicine including cancer chemotherapy, organ transplantation and immunosuppression have produced a large population who are particularly susceptible to infections (Emori and Gaynes, 1993).

This infection is defined as one with no evidence of its presence or incubation at time of hospital admission. It can be determined either by clinical criteria or by laboratory results (Garner et al., 1988).

Regarding investigations of hospital infections, they must follow the basic epidemiologic principles determining the host, source of infection and pathogenic agents. All the three links are influenced by the environment (Brachman, 1982).

I- Patient (Host of nosocomial infections):

Hospitalized patients are at high risk of infection for various reasons. They tend to be more susceptible to infection because their underlying diseases, but their risk may be increased by certain factors. These include

extremes of age, presence of malignancy and chemotherapy intake (Gross, 1991).

Another group of patients with high risk are those acutely ill in intensive care units either adults or prematures. This is a result of severity of the patient's illness and exposure to life saving invasive procedures such as peripheral venous catheter, endotracheal tube, oral tube and urethera catheter (Laforce, 1982).

Also patients exposed to surgical operations and the life saving invasive devices are affected more frequently by nosocomial infection (Craven et al., 1991).

The knowledge of patients with high exposure is useful to protect patients from nosocomial infections (Gross, 1991).

II- Sources of Nosocomial infection :

Sources of nosocomial infection include inanimate environment, instruments and hospital personnels (Mallison and Haley 1981).

1- Inanimate Environment :-

Inanimate environment is considered to be one source of nosocomial infections. Water, air and food are among the traditional sources of infection but they are less important in modern hospitals. Infections with environmental pathogens is more likely to occur when hospital personnel

fail to follow good hygeinic policy when performing patient care (Beck et al., 1992).

However, environmental cultures including personnel cultures, are done only when epidemiologic evidence indicates environmental source of pathogens. Also such sampling may be applied for certain patient care supplies to be sure of its sterility as respiratory or anaesthetic equipment (Emori and Gaynes, 1993).

The common pathogens usually are isolated from environment include Enterobacteriacae, Pseudomonas, Acinetobacter species, Staphylococcus aureus and Candida species (Maki et al., 1982).

2- Instruments :

Medical instruments provide a pathway for microorganisms from the environment to the body, facilitate the transfer of pathogens from one part of the patient's body to another and act as inanimate foci where pathogens can proliferate protected from the patient's immune defenses (Stamm, 1991).

Instruments such as endoscopes and cystoscopes have emerged as important sources of nosocomial infections (Kaezmarek et al., 1992). The risk for transmitting infections via endoscopes depends on exposure to organisms; cleaning and disinfection procedures. Depending on the origin of contaminating organisms, transmission of infections can be categorized either patient to patient or environmental to patient (Spach et al., 1993).

Organisms transmitted by endoscopes include Pseudomonas aeruginosa, Enterobacter aerogenes, Serratia marscens, Staphylococcus species and Trichosporon. In addition Helicobacter pylori has been reported to be transmitted by endoscopes (Langenberg et al., 1990). Among viral agents, there was only single documented case of hepatitis B virus infection. Neverthless, it may be difficult to link the transmission of this infection, with long incubation peroid, to a procedure done weeks or months before (Spash et al., 1993).

For prevention of the transmission of infections via the endoscopes, the most important step is good manual cleaning of endoscopes, then to be immersed in warm water and detergents. The disinfection should be done after that by soaking endoscopes for at least 5 to 10 minutes in 2% gluteraldehyde. Periodic check up of sterility of machines by culturing is important to prevent infections acquired by them (Axon, 1991).

Another important sources of infection in hospitals, include suction equipments, humidifiers, ventilators, wet bad pans or urinals (Shanson, 1989).

Also it should be taken in mind that antiseptic solution is susceptible to bacterial contamination. This has been found previousely in survey that certain strains of Pseudomonas aeruginosa were contaminating antispetic solution. Guidelines for production and use of these solutions must be reassessed to take this possibility into account (Parrott et al., 1982).

3- Hospital personnel :-

Reports had suggested that the hands of the hospital personnel may be important for transmission of organisms. Organisms isolated are Gram negative bacilli such as Klebsiella, Enterobacter and Serratia species (Weil et al., 1984).

In addition to Gram negative pathogens, it has been suggested that certain epidemic strains of Staph. aureus have a special ability to colonize both patients and staff (Cookson et al., 1989).

Washing of hands by water and soap or antiseptic solution is considered the most important practice in sterilization of hands. Also wearing of gloves is important while nursing patients with staphylococcal infections, taking care with urinary catheter and intravenous line (Weinstein, 1991).

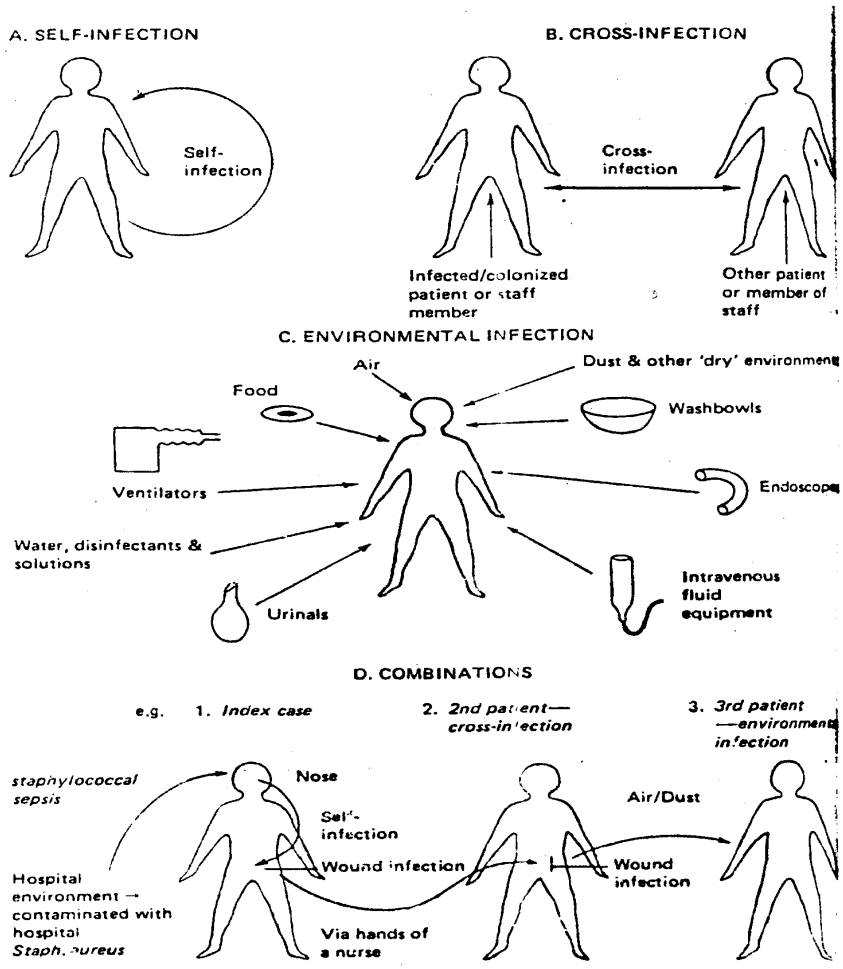
III- Pathogenic Agents :

Bacterial agents are reported to cause ninety percent of nosocomial infections. Viruses, fungus and protozoae are less frequently isolated from these infections (Hierholzer and Zervos, 1991). The commonest reported organisms are E. coli and Staphylococcus aureus. Other organisms have increasing importance such as Staphylococci coagulase negative, Enterococcus, Enterobacter and Pseudomonas aeruginosa (Emori and Gaynes, 1993).

It is clear that nosocomial pathogens possess the ability to acquire resistance for antimicrobial agents. Moreover a recent review reported that mortality and length of hospital stay are at least two fold higher among patients infected with resistant pathogens (Holmberg et al., 1987).

The tracing of organism causing nosocomial infections to its source to determine modes of transmission, needs laboratory confirmation. Therefore if the pathogen is epidemiologically important, it must be identifed to species level. Identification is carried by several techniques as biotyping, antimicrobial agents susceptibility testing, phage typing and molecular typing technique (Miller, 1993).

The key factor in deciding which method to use, is the discrimination power of the method. Surprisingly, some of the simplest, least expensive and most available typing methods may be the best as antimicrobial agent susceptibility profiles (McGowan, 1991).



Photograph (1): Sources of nosocomial infections coated from Shanson (1989): Nosocomial Infection. In Clinical Microbiology Practice. p 463-493. John Wright and sons. England.

Common Sites of Nosocomial Infections

The incidence of nosocomial infections varies by body site and is determined to a large extent by the underlying disease conditions in the patients. The most common are urinary tract infections, followed by pneumonias, surgical site infections and primary blood stream infections. A variety of infections in other sites are found but to a lesser extent as bone and joint infections, central nervous system infections, gastrointestinal infections and cardiovascular system infections (Banerjee et al., 1991).

However the distribution of infection sites is considerably different in each of the major hospital services.The differences can be explained by variations in exposure to high risk devices or procedures. This illustrates the importance of grouping patients with similar risks before attempting to compare distributions of infection rates (National Nosocomial Infection Surveillance system, 1991).

1- Urinary tract infections (UTI) :

Urinary tract is one of the most frequent site of infection (Sramova et al., 1988). Its infection includes symptomatic urinary tract infection, asymptomatic bacteriuria and other infections of the urinary tract as surrounding retroperitoneal or perinephric spaces (Garner et al., 1988).

Nearly all nosocomial urinary tract infections are associated with catheterization. However this infections may be reduced by application of sterile closed drainage system and the use of antiseptic ointment around the catheter (Pollock, 1988).

The causative organisms usually include E. coli, Enterococci Enterobacter species, Pseudomonas aeruginosa and Candida species (Jarvis and Martone, 1992). Infection with Candida species is difficult to interpret, therefore clinical correlation is essential in interpreting the results (Jones, 1990). Infections with these organisms is acquired either by autogenous route from patients flora or by exogenous route from patients in adjacent bed (Gordon et al., 1992).

2.Pneumonia and lower respiratory tract infections :

Nosocomial pneumonia occurs in 11% of hospitalized patients and is considered as one of the commonest hospital acquired infection (Rodriguez, 1993).

Lower respiratory tract infections (LRTI) include infections such as bronchitis, tracheobronchitis, bronchiolitis, lung abscess and empyema. While pneumonia diagnosis involve various combinations of clinical radiographic and laboratory evidence of infection. Other respiratory tract infections may be diagnosed by clinical or/and laboratory data. As regard the mechanism by which pneumonia occurs aspiration is considered to be important especially in the intensive care unit (Garner et al., 1988).

Oropharyngeal secretions become contaminated by pathogenic Gram negative pathogens within a few days of admission. This is preceeded by colonization of the stomach by gram negative pathogens after the use of gastric alkanization medicals to prevent development of stress ulcer (Kappstein et al., 1991).

Another source of this infection, is the contamination of environment with organisms such as Klebsiella and Pseudomonas aeruginosa (Pollock, 1988).

Regarding laboratory diagnosis of lower respiratory tract infections and pneumonia samples such as sputum, bronchoalveolar lavage and protected specimen brush may be used (Chauncey et al., 1990, Pugin et al., 1991, Wunderink et al., 1991).

These infections are caused by Staph. aureus and various species of Gram-negative bacilli (Rodriguez, 1993). Other organisms such as Brahamella catarrhalis and Neisseria cinerea species may be the cause but to much less extent (Boyce et al., 1985). Also Candida species is reported to cause this infections (Jones, 1990).

Viral agents causing respiratory infections include influenza, para influenza, respiratory syncytial viruses, adenoviruses and rhinoviruses. Spread of these viruses, occur through contact transmission (Valenti et al., 1980).

As for prophylaxis of bronchopulmonary infections this depends partly on the encouragement of cough and maintainance of sterility of respiratory equipments and attendant hands. Another strategy used with success in intubated patients is a combination of oropharyngeal hygiene, selective decontamination of gut and prophylactic parenteral antibiotic such as cefotaxime and tobramycin (Pollock, 1988).

3. Wound Infections :

Surgical wounds infections continue to be the most important cause of complication after surgical operations despite the development of powerful antimicrobial drugs. It is accepted that infection can occur only when pathogens invade tissues in sufficient numbers . Ability of the host to resist infection could be reduced by gross malnutrition and tissue destruction (Olson and Lee, 1990).

However not all patients are at equal risk for infections. Factors that might contribute for developing of infections are anatomic location of surgery, seeding of surgical site with patient's own flora, the contamination level of environment, and the presence of foreign body left in site of operation (Barrett, 1992).

The commonest causative organisms are Staphylococcus aureus, Escherichia coli, Staphylococcus epidermidis, Pseudomonas aeruginosa, Enterobacter species, Proteus species and Klebsiella (Twum et al., 1992).

As regard anaerobes, members of Bacteroid fragilis are most frequently recovered. They are usually cultured from the infection involving inoculation of a sterile site by colonic flora. This might occur as a result of contamination following abdominal surgery, ruptured appendicitis, bowel ischaemia, infected ulcer, colonic cancer and abdominal trauma (Cuchural et al., 1988).

Another important causative agent of wound infections is Candida species. High frequency of isolation has been attributed to several factors such as prolonged physiologic support, broad spectrum antibiotics, parenteral hyperalimentation and indewelling catheters. It has been suggested that broad spectrum antibiotics promote Candida proliferation because of suppression of the normal bacterial flora (Eubanks et al., 1993).

For prevention of wound infections, instruments should be sterilized by heat and disposable ones by gamma irradiation, exposure to ethylene oxide gas or by immersion in activated gluteraldehyde. Disinfection of surgeon's hands should be achieved by two minutes wash with chlorhexidine detergents followed by application of chlorhexidive cream (Nichols, 1991).

Normal skin flora of patients should be reduced by preoperative showers with chlorhexidine detergents and shaving of the skin at the operative site the day before the operation (Twum et al., 1992).

In addition to above measures, surgeons have to minimize the contamination from spillage from opened viscus and to reduce the number of contaminating bacteria with preoperative antibiotics (Ojiegbe et al., 1990).

4. Septicaemia :

This term includes laboraory confirmed blood stream infection and clinical sepsis. The definition of clinical sepsis is intended primarily for infants and neonates (Garner et al., 1988). The clinical spectrum of bacteremia is extremely wide, ranging from a self-limited septic event after trauma or manipulation of colonized mucosal surfaces to overwhelming and often fatal infections (Washington and Ilstrup, 1986).

Apparently the magnitude of bacteremia is in correlation with mortality rate. However because bacteremia usually results from break down of defense mechanisms that control infection, underlying debilitating diseases appear to be important factor (Yagupsky and Nolte, 1990).

Escherichia coli is generally reported to be the commonest isolate as it cause 20-27% of all bacteremia and 11-19% from cases of nosocomial bacteremia (McGowan, 1985).

Susceptibility testing of E.coli to antimicrobial agents has shown that it is resistant to ampicillin while gentamicin resistance is unusual (Phillips et al., 1990).

Another important organisms causing bacteremia are coagulase negative Staph. species. They are isolated from prosthetic heart valves, prosthetic joints, neurosurgical ventricualr shunts and from infants in intensive care units (Fidalgo et al., 1990).

They are associated with significant mortality and morbidity in hospitalized patients and no longer regarded as only contaminants (Yagupsky and Nolte, 1990).

Staphylococcus epidermidis is the most commonly isolated species from Staph. coagulase negative (Martin et al., 1989). It is usually affecting immunocompromised patients and it is the cause of speticaemia which has been associated with wounds and catheters or other devices (Stillman et al., 1987). A feature of Staph. epidermidis is the high rate of multiple resistant of to antibiotics as penicillin G and oxacillin but is effectively killed in vitro by cephalothin and vancomycin (Fidalgo et al., 1988).

Other species of Staph. coagulase negative have emerged in recent years as important nosocomial pathogens such as Staph. warneri, Staph. simulans and others (Males et al., 1985 and Kamath et al., 1992).

Staph. aureus is still an important cause of septicaemia and it is responsible for about 12% of bacteremia (Stamm et al., 1981).

Regarding antibiotic drugs, Beta-lactam agents are superior to vancomycin therapy for Staph. aureus infections. Vancomycin therapy

should be limited to strains resistant to B lactamase resistant penicillins or with allergies to these agents (Hartstein et al., 1992).

Another Gram-positive cocci causing bacteremia are Enterococci species. These cocci are catalase negative belonging to Lancefield group D. They are normal inhabitant of human gastrointestinal tract and are frequently found in genitourinary tracts of men and women (Hall et al., 1992). Infections either occur through autogenous or exogenous routes (Chenoweth and Schaberg, 1990).

Proper antibiotic treatment is carried out using synergistic combinations of a cell wall active agents plus aminoglycosides (Louie et al., 1992).

Recently Enterobacter Gram negative bacilli has emerged as an important pathogen particularly in hospitalized patients. This genus is composed of five species E. cloacae, E. aerogenes, E. agglomerans, E. sakazaki and E. gergoviae. Enterobacter cloacae is the species most frequently isolated is human diseases followed by E. aerogenes and E. agglomerans (Ristuccia and Cunha, 1985).

The respiratory tract is the commonest portal of entery, followed by the skin and the urinary tract (Wantana and Weber, 1989). In fact, prolonged hospitalization, preceeding antibiotic therapy and underlying diseases have been shown to contribute for colonization of the respiratory tract and skin with Enterobacter (Ristuccia and Cunha, 1985).

Regarding antibiotic sensitivity, Enterobacter species generally are sensitive to aminoglycosides and third generation of cephalosporins. They are usually resistant to penicillin, erythromycine, vancomycin, clindamycin, sulfonamides and first generation of cephalosporins (Gallagher, 1990).

Outbreaks of sepsis caused by Pseudomonas aeruginosa have been described in different wards such as surgical services, adults or paediatric intensive care units and neonatal nursery (Richet et al., 1989). Predisposing factors for infection include presence of a malignant tumour (Mallolas et al., 1990).

The sources of Pseudomonas aeruginosa usually come from environment such as sinks , hands, towels racks or bars of soap. Thus the attention of physicians dealing with clusters of P. aeruginosa infections or colonization is often focused on the environment (Ricket et al., 1989).

For antibiotic therapy Pseudomonas aeruginosa is found to be sensitive to aztreonam, ceftazidime, amikacin, azlocillin, ciprofloxacin, imipenem and piperacillin (Mallolas et al., 1990).

Serratia marscens another Gram negative bacilli, cause bacteremia especially among patients in a cardiac care unit and in infants (Banerjee et al., 1991). Infection either results from prior colonization of

gastrointestinal tract or spreading from contaminated pressure transducers (Villarino et al., 1989).

Unusual organisms are often opportunistic pathogens in immunocompromised patients. From these pathogens is Achromobacter which is oxidase positive organism. It is susceptible to gentamicin, amikacin, tetracycline, trimeth-sulfamethoxazole and colistin (Kish et al., 1984).

Another opportunistic organism is Flavobacterium species. Infections with this organism have been reported especially in hemodialyzed patients. This organism is susceptible to erythromycine, tetracycline, chloramphenical, vancomycin, gentamiin and sulfonamied (Potvliege et al., 1984).

The progress achieved by antibacterial drugs leads to increase in nosocomial fungal infections. Classic cases of histoplasmosis, sporotrichosis or blastomycosis may occur in apparently healthy hosts but are less common than opportunistic mycoses in immunodeficients hosts such as cryptococcosis, asperigellosis and candidiasis seen in patients with AIDs or surgical patients (Perfect et al., 1991). For diagnosis of candidiasis, culture is one method beside detection of Candida antigen by methods as ELISA or radioimmunoassay (Walsh et al., 1991).

5. Upper Respiratory tract infections (URTI) :

These infections include pharyngitis, laryngitis and epiglottis (Garner et al., 1988). They usually follow surgical procedures which allow true pathogens and members of normal flora to establish heavy growth (Lundberg, 1988). Also colonization by hospital pathogens, of the oropharynx in hospitalized patients play an important rule in URTIs. (Bamberger 1988). This colonization usually occur by Gram-negative bacilli such as Enterobacter species and Pseudomonas aeruginosa (Bonten et al., 1994).

Prophylaxis may be done by prevention of secretion accumulation and antibiotics intake if needed. Treatment is carried out by effective antibiotic based on results of bacteriological analysis (Lundberg, 1988).

6. Occupational Risks of Infections :

Members of the health care team have lived with threat of infections hazards. Hepatitis has been a major risk especially hepatitis B (Fry, 1993). For in patients the risk of acquiring hepatitis B infection is reduced by screening blood donor for hepatitis infections (Alter et al., 1989).

Fortunately safe and effective recent hepatitis B vaccines are presently available with complete protection (Zajac et al., 1986). Surgeons with high exposure risk may require booster dose every 5-10 years after successful vaccination (Hadler et al., 1986).

However another risk appears with recent identification of hepatitis C virus which is considered to be a real occupational risk. Unfortunately no vaccine exists to provide protection for health care workers (Alter et al., 1989).

Human immunodeficiency virus, another risk, has been recognized as clinical problem for the last 10 years. It is usually transmitted by percutaneous exposure of host to infected blood or body fluids from infected individuals (Fry, 1993).

Nererthless, considerable evidence indicates that the risk of becoming infected with HIV is activally small (Marcus, 1988).

Another risk to medical staff will be the acquiring of infection with tuberculosis. This is also aproblem especially with the evolution of multiresistant tuberculosis strains. This may be prevented by vaccination and periodic chick up of the medical staff (Bech et al., 1992).

Infection Control Programs

I. Historical Back ground :-

Nosocomial infections are infections acquired in hospital. The majority of hospital acquired infections are of minor or moderate clinical importance but may cause distressing morbidity, lengthen hospital stay and increase costs (Shanson, 1989).

For control of these infections, infection control committee is found in hospitals. This was introduced into hospitals in 1950 after severe Staphylococcus aureus pandemic which occured in USA hospitals. This committee included at first epidemiologist and a physician (Patterson, 1989).

However, because of the growing numbers of drug resistant pathogens, increasing the use of high risk medical interventions and the use of immunosuppressive agents, hospitals began to realize that a committee alone cannot adequately deal with the problem of hospital acquired infections . For this reason, a new health care professional called the infection control practitioner (ICP) was introduced (Bjerke et al., 1993).

II- Components of Infection control Programs :

The effective programs for prevention of nosocomial infections will include personnels and activities (Haley et al., 1985).

A. Personnels :

Persons in a hospital control programs are the hospital epidemiologist, the infection control practitioner and the microbiologist (Kazlauskas and Nadzam, 1992).

1- Hospital Epidemiologist :

The physician epidemiologist functions as a source of technical information on infection control practices, a policy formulator, a teacher and as diplomatic liaison with the professional staff. Clearly, the individual should have a special interest in infectious diseases control and antimicrobial agents (Doebbeling, 1992).

2. Infection control practitioner (ICP):

Infection control practitioners have been traditionally employed to provide day to day coordination of surveillance and control measures. Practitioners may be laboratory technician, nurse or respiratory therapist (Bjerke et al., 1993).

Their duties have included collection and analysis of surveillance data, assisting in development of infection control procedures and providing education to other hospital personnel (Haley et al., 1985).

The ICP should have, knowledge about clinical patient care, epidemiology and microbiology. This is done by taking specific courses in infection control and individuals who meet certain time and practice qualifications can be certified as infection control (Shands et al., 1981).

3- Microbiologist :

His rule will be to provide a training on the basic microbiology to the control program staff to interpert the results of cultures. Also to make laboratory test results available in easy manner and to monitor the laboratory results for unusual findings (Miller, 1993).

An important rule of the microbiologist is to use environmental culture judiciously. Such culturing must be coordinated with the infection control program to ensure that it is performed only when indicated and that the specimens are processed appropriately (Goldmann, 1987).

Environmental cultures, including personnel cultures, should not be done unless epidemiologic evidence clearly indicates an environmental source of the pathogen. Otherwise they may be performed to be sure of the effectiveness of the sterilization process (McGowan, 1991).

B. Activities :

The activities of infections control committee include surveillance, isolation of patients with communicable diseases, control of hospital environment and guidelines for use of medical instruments to minimize their risks (Mullan et al., 1990).

I. Surveillance system of Infection :

Surveillance is defined as systemic collection, analysis and interpretation of health data essential to the planning, implementation and

evaluation of public health practice. It provides data to identify infected patients to determine the site of infection and the factors that contribute to it (Jarvis et al., 1991).

Data are collected for four surveillance components that target different population of in patients. These include all patients in the hospital, patients in ICUs, patients in high risk nursery and patients who undergo operative procedures (Emori et al., 1991).

The case finding methods used to detect infected patients depend on the sources of information available in the hospital. In most hospitals the microbiology laboratory reports are the most usefull source. Other sources include nursing plan cards, antibiotic order in the pharmacy, radiological reports, autopsies and verbal reports from patient care personnel (French et al., 1989).

Surveillance data should be analysed carefully and the resulting analyses should be reported to members of the hospital staff. (Haley et al., 1985).

Hospitals use data to assess their quality of care by comparing their infection rates over time in their own hospitals. Many hospitals assume that any difference in the rate represents the success or failure of the patient care staff or institutional practices in preventing nosocomial infections (Gross, 1991).

2- Isolation measures :

The isolation measures can be classified into two categories either disease specific or category specific precautions (Eickhoff, 1982).

For disease-specific precautions, each infectious disease will be considered individually, and only the specific precautions indicated to interrupt transmission of that disease will be recommended. Thus the disease specific precautions necessary could simply be a private room, use of masks, use of gowns and gloves (Mullan et al., 1990).

While, category specific precautions mean that infectious diseases with similar isolation requirements will be grouped together in specific categories (Eickhoff, 1982).

This will include contact isolation precautions with a recommendation of a private room, masks for those who get close to patients, gowns if soiling with secretions is likely and the use of gloves for direct contact with the infected area. These prescautions will be used for infections with multiple resistant bacteria as Staphylococcus aureus, respiratory tract infections and pneumonia in young children and tuberculosis (Nauseef and Maki, 1981).

Another example of category specific precautions include the blood precautions. This requires only that blood specimens be appropriately labelled and that gloves be used in direct contact with blood. This includes patients with viral hepatitis infections and AIDs patients (Rutala, 1990).

3- Control of Hospital Environment :

Control of hospital environment includes environmental sanitation with good solid waste disposal, house keeping practices and kitchen sanitation (Schaffner, 1982).

In addition there must be effective sterilization and disinfection process. Sterilization and disinfection are used to remove microorganisms from surfaces. Appropriate use of these methods is based on proper indications. (Rutala, 1990). Defective application of disinfection results in contamination of medical instruments and infections in patients. While personnel over use causes inconvenience, increase in work load, intoxication and waste of money (Danchaivijitr et al., 1995).

The methods of sterilization and disinfection used vary according to the type of item to be sterilized. Steam sterilization is usually used for surgical instruments which are tolerable to heat. The surgical packs sterilized in steam should have been proven to be sterile for at least 8 weeks (Kobayashi, 1989). Items intolerable to heat sterilization are sterilized by ethylene oxide. However it is toxic gas and explosive, close monitoring and extraprecautions are needed. There are ethylene oxide chambers which are able to keep gas concentration at 650 mg/L and humidity at 65 percent during the entire process of sterilization (Rutala, 1990).

Antiseptic and disinfectants solutions are widely used. There are many factors affecting the efficacy of these agents such as microbial types, strains, inoculum size, contact time, pH, temperature, electrolytes concentration and presence of organic matter (Anderson et al., 1991). Actually, preparation by pharmacists in the pharmacy department for these solution is more reliable than that by unskilled personnel in hospitals wards (Kobayashi, 1989).

Hexachlorophene is effective mainly on Gram positive bacteria but can be contaminated by Gram negative bacteria, it is also toxic if applied in large quantities. For Gram negative, bacteria, yeasts and viruses chlorhexidine and hypochlorite are effective (Kanjanahareutai et al., 1995). Also formaldehyde vapour is effective for bacteria, yeast, viruses and suitable for surgical theatres disinfection. (Gross, 1991).

4- Guidelines for use of common medical procedures :

The higher rates of nosocomial infections are most likely related to the use of medical devices such as intravascular lines devices, urinary catheters and respiratory equipments. Policies and procedures to ensure that these devices are used appropriately and safely must be readily available to the patient care staff (Bjerke et al., 1993).

The use of intravascular fluid equipments is usually associated with many complications both systemic and at the site of delievering (Maki and Ringer, 1991).

To avoid these complications, intravenous fluid and medications are given only when there are clear indications. Good antiseptic solution must be applied to skin before administration such as povidone iodine for ½ -1 minutes. In addition, the medical personnel must wash hands with soap and water and wear gloves. The site of the puncture has to be examined daily for appearance of any signs of infection, if this occur remove the needle, cannula or catheter at once. The cannula and catheter have to be removed every 3 days (Danchaivijitr et al., 1995).

Another medical process which carries the risk of nosocomial infection is urinary catheterization. It is revealed that 64% of nosocomial urinary tract infection occurred in patients with uretheral catheter. This procedure must be avoided as much as possible and removed early when it is no longer needed. There has to be complete aseptic technique in its insertion with good nursing practice. Moreover, it has been shown that instillation of disinfectants into the drainage bag reduces the incidence of catheter associated urinary tract infections. The antiseptic solution used is usually 5% chlorhexidine (Mayo-White et al., 1988).

Regarding respiratory equipments such as humidifiers, nebulizers, oxygen hoods or tents and suction equipments they are considered major source of respiratory tract infections in hospitals. They must be sterilized before use with solutions such as chlorehexidine and changed frequently every 8-24 hours according to its type. If there is economic availability it is preferable to be changed with every patient (Gross, 1991).

However, this method does not provide same day results. Few systems which do provide results in 5 to 8 hours by either automated or semiautomated methods have emerged (York et al., 1992).

2. Semiautomated Systems :

Semiautomated systems were produced to solve the problem of the high cost of automated systems. These instruments usually require manual addition of reagents and off line incubation. Then it will read automatically and report the results. It is capable of identifying narrow spectrum of organisms and interpreting break point or minimal inhibitory tests of antibiotic sensitivity on both Gram positive and Gram negative bacteria. The results will be available within 18-24 hours of incubation (Chambers et al., 1990).

Examples of such instruments are Autosceptor, Uniscept, API reader and ATB. However the disadvantages of these instruments are off line incubation of panels, manual addition of reagents and identification of limited number of organisms (Stager and Davis 1992; Tritz et al., 1990).

3. Fully Automated Systems :

A. Vitek system :

It is an automated computerized system that can be used for the identification and antimicrobial susceptibility testing of rapidly growing aerobic or facultative anaerobic organisms. In addition it is capable of identification of yeasts and anaerobic organisms (Horn et al., 1984).

This system is based on bacterial growth in microwells of thin plastic cards. The results of identification may be available within 6-18 hours and antibiotic sensitivity could be reported for Gram negative and Gram positive organisms within 4 to 8 hours (Plorde et al., 1986, Stager and Davis, 1992).

Vitek depends on the use of enzymatic profiling of microorganisms which change chromogenic substrates. This method takes the advantage of the presence of preformed bacterial enzymes leading to rapid identification. It also has the ability to discriminate between bacterial isolates (D'amato et al., 1991, Kampfer et al., 1992).

B. Sensititre :

This system represents another advance of automation in microbiology by the use of fluorogenic substrates which allows a more rapid approach for organisms identification. It is coupled with fluorescence autoreader, computer, and multicopy printer (Lyznicki et al., 1991). Sensititre identifies aerobes in either 5 or 18 hours. As for antibiotic sensitivity, it is also available for both Gram negative and Gram positive cocci with the use of 54 antimicrobial agents (Stager and Davis, 1992).

Limitations of Sensititre system include the requirement for off line incubation of panels, the necessity of performing additional rapid tests for some isolates and the necessity of reincubation of the others. Moreover it lacks the ability of identification of yeasts and anaerobes (Lyznicki et al., 1991).

C. Walk away (W/A) system :

This system provides rapid identification of organisms with antibiotic sensitivity. The results could be interpreted within 7 hours. It depends on flourogenic substrates utilization, which is detected 100 times more sensitive than colorometric detection (York et al., 1992).

The system is provided with computer robotics which permit incubation, reading and interpretation of the tests without additional manipulation (O'hara and Miller, 1992).

It can identify Gram negative, Gram positive bacteria, fastidious organisms, anaerobes and yeast. Antibiotic sensitivity can be performed for both aerobes and anaerobes. However comparison of Walkaway system and Vitek showed that W/A system correctly identify 95% of the tested strains (Pfaller et al., 1991).

D- Biology System :

This system mainly depends on carbon source utilization profile with indicator. The microplate used in this system contains 96 wells dehydrated panels containing tetrazolium violet, buffered nutrient media and a different carbon source for each well. The change of tetrazolium violet colour to purpule means that bacteria use this carbon source. The resulting purple wells yield a sort of metabolic finger print. This finger print will be analysed by computer and the results are available within 4 hours or

overnight incubation according to rate of organism growth (Bochner, 1989).

This system is capable of identification of Gram negative and Gram positive bacteria. But, this system does not have the ability to identify anaerobes, yeast. It has no ability to perform antibiotic sensitivity (Mauchline and Keevil, 1991).

E- Gas chromatography :

In principle, this technique depends on identification of fatty acids in cell walls and membranes of bacteria. These fatty acids are very stable genetic trait (Morgan, 1984).

MIDI system is an example of such instruments. It could identify yeasts, anaerobes, aerobes and Mycobacteria (Welch, 1991). It is fully automated, computerized, high resolution gas chromatography system that can analyze more than 300 fatty acids (Wallace et al., 1988).

F- Automated Blood culture system :

The initial conventional blood culture depends on using two bottles system which requires subcultures and timed interval for detection of organisms (Daley et al., 1990).

For these reasons, many automated systems have been developed for rapid recovery of organisms from blood. These systems are usually composed of incubator, shaker and detector for Co_2 produced by

organisms cultured in bottles. The principle of these detectors vary from one system to another. So one is to use radiometric detector as in Bactec system (Daley et al., 1990, Thorpe et al., 1990).

Another system is to use simple manometry for detection of the produced Co_2 by organisms as with Oxoid system (Wenistein et al., 1988). Several studies have shown that Bactec blood culture system is preferable than Oxoid system for both the yield and speed of detection.

On the other hand oxoid system is easy to use in the laboratory with no need for radioactive materials (Wenistein et al 1989, Daley et al., 1990).

4- DNA Based Methods :

Another advance in microbial identification is the use of DNA based methods for diagnosis and epidemiologic analysis of infectious diseases. The ability to assess the pathogen's genotype directly without cultivation is important especially with fastidious organisms (Ludlan et al., 1989).

In addition genotypic methods enhanced epidemiologic studies with great discrepancy ability. However, phenotypic methods will remain important especially with organisms easy to culture (Versalovic et al., 1993).

A- Restriction Endonuclease Analysis (REA):

Chromosomal DNA is isolated from organisms and digested with frequent cutting restriction enzymes. Electrophoresis with agarose gel will separates DNA fragments according to size and results in a series of bands that constitute finger print (Reagan et al., 1990). A limitation of this process is the large number of bands generated that can migrate similarly in agarose gel and results in patterns that are difficult to distinguish (Versalovic et al., 1993).

B. REA with pulsed field gel electrophoresis :

With this method chromosomal DNA is digested with cutting restriction endonuclease and large DNA fragments migrate through an agarose gel within electrical field of varying polarity. The advantage is the smaller number of discrete products which are produced and are easy to interpret. This technique was applied to investigations of outbreaks involving Staph. aureus (Schlichting et al., 1993).

C. Hybridization method :

In this method restriction endonuclease analysis is enhanced by the application of specific nucleic acid probes in hybridization method that highlight discrete DNA fragments (Ogle et al., 1987).

Genomic DNA is digested with restriction enzymes and hybridized with radioisotopic probes followed by autoradiography of specific DNA band patterns of finger prints which will distinguish strains (Versalovic et al., 1993).

D. Ribotyping Method :

Ribotyping refers to application of ribosomal RNA (rRNA) probes for DNA finger printing. Ribosomal RNA genes are clustered operons that are repeated along DNA. These genes represent excellent targets because they are conserved in all bacterial species. Universal probes either DNA or RNA can be used and yield distinct finger prints (Dijkshoorn et al., 1993).

Examples for environmental study were taken from neonate intensive care unit and Gastroenterology centre.

From NICU, 100 samples were taken and distributed as the following:-

* 8 samples from suction equipments .
* 8 samples from air.
* 10 samples from waste containers.
* 10 samples from babies formula of feed.
* 10 samples from babies milk feed bottles.
* 34 samples from furnitures and bed linen .
* 10 samples from antiseptic solution .
* 10 samples from intravenous fluid bottles.

From Gastroenterology centre, 580 samples were taken and distributed as the following :

* 20 samples from air in surgical theatres after sterilization with formaldehyde gass.
* 100 samples from surgical furnitures and suction equipments.
* 40 samples from clothes and bed linen .
* 20 samples from antiseptic solution.
* 400 samples from flexible gastroduodenal endoscopes 200 before and 200 after disinfection with cetridine solution.

III- Nurses Samples :-

Nurses samples were composed of 35 nurses, distributed as the following:-

* 10 samples from nurses in NICU.
* 25 samples from nurses in GEC.

Methods :

A- Clinical History :-

Thorough history taking was done including age, sex, catheterization and type of wounds .

B- Samples collection and Transport :-

I- Patients samples :-

Samples from patients were collected according to site of infections. Pus or exuduate from wounds were collected with sterile swabs or syringes for aerobic culture. Sterile swabs were also used for collecting samples from throat and ear in patients with upper respiratory tract infections. For anaerobic culture, thioglycate broth was used as a transport medim.

Urine samples were collected from patients with urinary tract infections either mid stream samples or catheter samples from catheterized patients. Sputum samples were collected in sterile containers. For blood samples, 5-10 ml volume were collected for aerobic and anaerobic cultures from patients with septicaemia under aseptic conditions .

II- Environmental Samples :

Air samples were subjected to study by exposure of blood agar plates at various sites for 60 minutes within 1 metre above floor (Senior, 1989).

Samples from suction equipments, furnitures, waste containers, endoscopes, babies formula of feed and milk bottles were collected by rubbing a moistened swabs over surfaces.

Textiles and bed linen were sampled by pressing them over blood agar plates.

III- Nurses Samples :-

Samples were collected by rubbing of anterior nares and hands with moistened sterile swabs.

C- Laboratory Tests :

The following laboratory tests were performed :

I- Culture.

II- Identification :

1- Primary Identification :-

- Stained films with Gram's stain for aerobes and anaerobes.
- Lactophenol blue stain for fungus.

2- Biotyping :

Biotyping for all isolated organisms were performed by :

1- Manual system (API) :

* API 20E for Gram negative bacilli.
* API Staph. for Staph. species.

* APIC for Candida species.
* API ANI for anaerobes.

2- Automated system (Vitek) :
* GNI cards for Gram negative bacilli
* GPI cards for Gram positive cocci.
* YBC cards for yeast.
* ANI cards for anaerobes.

III- Antibiogram :

Antibiotic sensitivity was carried out for organisms isolated from patients by the following methods :
* Disk diffusion for aerobes and anaerobes.
* Vitek system for aerobes.
* Candifast for Candida .

I. Culture :

Samples from patients and nurses were cultured on MacConkey and blood agar plates , incubated at 37°C for 24-48 hours aerobically and with 5-10 % Co_2 for blood agar plates .

Aerobic blood cultures were performed by the use of Hemoline performance diphasic (*biomerieux) media at 37°C for up to 7 days. While aerobic blood cultures were carried out by using Hemoline performance anaerobie (biomerieux) media.

Anaerobic cultures for other samples were done by using Columbia blood agar plates in anaerobic station (bioMerieux) at 37.8°C up to 7 days.

Fungal cultures were carried out by culturing samples on Sabauroud's agar plates at 37°C for 24-48 hours.

As for environmental cultures the aerobic and fungal cultures were done as described above .

In addition, swabs from endoscopes were cultured also on Skirrow's media and incubated under microaerophilic conditions in anaerobic jar with Co_2 bags (release 5-10% Co_2) without catalyst at 37°C for 5-7 days (Duguid and Porter, 1989).

Antiseptic solutions were cultured by adding 1 ml from each one to 9 ml of nutrient broth. Few drops from nutrient broth were cultured on two agar plates, one was incubated at 37°C and the other at room temperature for 24-72 hours (for saprophytes).

The appearance of less than 5 colonies was considered negative (Shanson, 1989).

* bioMerieux:- SA au capital de 45068400F/1m prime en france /RCSLyon B673620399.

II- Identification :-

1- Primary Idenification :

Primary identifications were carried out by Gram's stained films which were done for aerobes, anaerobes and for growth on Skirrow's media (microaerophilic). Lactophenol blue stains were applied for fungal growth.

2- Biotyping :

Gram negative bacilli were subjected to oxidase test using disk (bioMerieux). Gram positive cocci were subjected to coagulase test tube method and catalase test described by Collee and Miles (1989).

Growth on Skirrow's was identified as Helicobacter pylori, according to colony appearance (water droplets), Gram stained films (Gram negative bacilli slender shape), positive urease (performed on Christensen's medium), catalase and oxidase tests (Duguid and Porter, 1989).

For fungal growth on Sabaraud's germ tube test was performed as described by Milne (1989).

Anaerobic growth was subjected to spot indole test. This test was done by picking few colonies from growth on tip of a cotton swab and saturating it with indole reagent. Positive result was reported with development of blue colour within 2 minutes.

After that, suspensions from all orgainsms were done by using either suspension vials for API (Obtained from bioMerieux) or by 0.45% sterile saline for Vitek system. The concentration was adjuseted by the use of McFarland standard, then these suspensions were used for API and Vitek system (biomerieux).

1- API :

In brief, the test system consists of 20 microtubes containing dehydrated substrates. These tests reagents were inoculated with the bacterial suspension which reconstitutes the media. The strips were incubated for 24 hours at 37°C. During incubation, metabolism of growing bacteria produce colour changes spontaneously or after addition of required reagents. The results were read and interpreted with reference to the infromation contained with provided tables. The identification was obtained by referring to the analytical profile index.

2- Vitek system (automated system) :

Inocula were automatically transferred to cards via transfer tubes during the vacum cycle of the filling module.

GNI and GPI cards were placed in the reader/incubator of Vitek after marking GNI cards if oxidase test was positive. GPI cards were labelled for type of haemolysis on blood agar, coagulase and catalase reactions.

Photography (2) : Vitek system.

a- Incubator / reader

b- Computer component

c- Printer

As for ANI cards, incubation was done for 4 hours at 37°C off line i.e in ordinary incubator. The positive and negative wells were determined with reference to information contained with provided tables. The results were then entered into Vitek system along with the results Gram stain and indole.

YBC cards were incubated off line at 30°C for 24 hours . After that they were placed in the reader/incubator for a single reading. If a message, reincubate was printed, the definitive identification requires another 24 hours incubation and the result would be available.

Final identification for all cards would be reported using the biochemical patterns, which were analyzed by Vitek computer.

III- Antibiogram :

1- Disk Diffusion Method:

A series of antibiotic disks **(Becton) were used according to site of infection and the type of isolated organisms.

Becton Dickinson obtained from kemet : 39, Beirut Heliopolis Cairo 11341.
Tel: 2904965-2917529-2909942.
2914728. Fax. 2908917.

For Gram negative bacilli that were isolated from urine ampicillin, cefazolin, ceftazidime, ceftriaxone, cefuroxime, ciprofloxacin, gentamicin, nitrofurantoin, ticarcillin, tobramycin and trimethsulfa were used.

For Gram positive cocci isolated from urine, cephalothin, ampicillin chloramphenicol, clindamycin, eryhromycin, nitrofurantoin, penicillin G, tetracycline, vancomycin, gentamicin, streptomycin and norfloxacin were used.

Gram negative bacilli isolated from sites other than UT1s, were subjected to antibiotic sensitivity by the use of amikacin, ampicillin, carbenicillin, cefamandole, cefoxitin, cephalothin, chloramphenicol gentamyicin, tetracycline, tobramycin and trimethsulfa.

Gram positive cocci isolated from sites other than UTI, were subjected to antibiotic sensitivity by the use of ampicillin/ sulbactam, cephalothin, ciprofloxacin, clindamycin, erythromycin, oxacillin, penicillin G, tetracycline, trimethsulfa and vancomycin.

For anaerobes, metronidazole, chloramphenicol, piperacillin, cefoxitin, clindamycin, imipenem, ceftazidime, cefotaxime, tetracycline and ciprofloxacin were used.

The sensitivity of aerobes and anaerobes by disk diffusion was reported according to WHO (1977).

2- Automated system (Vitek):

The principle of sensitivity cards adopted by Vitek is based on microdilution minimum inhibitory concentration technique reported by MacLowry and Marsh (1968) and Gerlach (1974). These cards were filled by the same suspension used for identification cards and by the same method.

The used cards were two types for UTI, GNS-GA for Gram negative bacilli and GPS-TA for Gram psoitive cocci. They included the same types of antibiotics used as disks in UTI.

The other two types were GNS used for Gram negative bacilli and GPS-SA used for Gram positive cocci. they were used with bacterial isolates from infections other than UTIs and contained the same antibiotics used in disk diffusion method.

3- Antifungal sensitivity:

The antifungal sensitivity was carried out by the use of Candifast **(International Mycoplasma). This method is based on enzymatic activity of the fungus in the presence of antifungal agents. The enzymatic activity may be observed by appearance of turbidity and/or colour change of the medium which are signs of fungal growth and hence the resistance to antifungal agents.

**Internationl Mycoplasma BP 705-83030 Towlon Cedex 0 Ph. Int. + 3394328181/ Fax. 94328484.

The antifungal agents included were amphotericine B, 5-fluorocytosine, miconazole, fluconazole, ketoconazole, nystatin and econazol.

Statistical analysis

The following formulae were used for statistical analysis of the results :

**** Chi Square Test (X^2):***

For comparison of frequencies of occurrence of an event.

$$X^2 = \Sigma \frac{(O - E)^2}{E}$$ (Pipkin,1984).

Where

O = observed frequency

E = expected frequency

Σ = summation

**** Z Test :***

For comparison of percentages of occurrence of an event in two samples.

$$Z = \frac{P_1 - P_2}{\sqrt{\frac{P_1 q_1}{n_1} + \frac{P_2 q_2}{n_2}}}$$ (Knapp and Miller, 1984)

Where

P_1= percentage of an event in sample 1
P_2= Percentage of an event in sample 2
q_1= 100 - P_1
q_2= 100 - P_2
n_1= number of samples 1
n_2= number of samples 2
$P<0.05$ if $z \geq 1.96$

$$*\text{Sensitivity} = \frac{\text{True positive results}}{\text{True positive} + \text{False negative}}$$

$$*\text{Specificity} = \frac{\text{True negative}}{\text{True negative} + \text{False positive}}$$

$$*\text{Accuracy} = \frac{\text{True positive} + \text{True negative}}{\text{All results}}$$

**** Correlation coefficient :***

$$r = 1 - \frac{6 \Sigma d^2}{n(n^2 - 1)}$$

Where

r = Correlation coefficient
n = number
Σ= summation
d^2= squar frank difference

Results

The results of this study are tabulated in the following tables :

Table (1) shows classification of samples. A total number of 1180 samples were studied. Patients samples were 465 cases (39.41%), environmental smaples were 680 (57.63%) and nurses samples were 35 (2.97%).

Patients samples were distributed as 186 with wound infections (40%), 152 with UTI (32.7%), 94 with septicaemia (20.21%), 20 with URTI (4.3%) and 13 with LRTI (2.79%).

Environmental samples were classified as 100 samples (14.7%) from neonate intensive care unit (NICU) and 580 samples (85.3%) from GEC.

Nurses samples were 35 distributed as 10 nurses (28.6%) from NICU and 25 nurses (71.4%) from GEC.

Table (2) shows age distribution of patients in different types of infections. In wound infections the mean age was 39.43 ±9.614, in UTI the mean age was 34.87±17.309 , in septicaemia the mean age was 20.88± 13.46, in URTI the mean age was 23.89± 11.75 and in LRTI the mean age was 43.154 ± 7.15. The mean age of the total infected cases was 35.844± 12.781. Infected prematures were 16.34% from total patients.

Table (1) : Classification of samples

Sample	No.	%	% from total
Patient samples	**465**		39.41
* Wound	186	40.0	
* UTI	152	32.7	
* Septicaemia	94	20.21	
* URTI	20	4.3	
* LRTI	13	2.79	
Environmental samples	**680**		57.63
* NICU	100	14.7	
* GEC	580	85.3	
Nurses's samples	**35**		2.97
* Nurses in NICU	10	28.6	
* Nurses in GEC	25	71.4	
Total	1180		100

Table (2) : Age distribution of patients in different types of infections.

Group / Age	Wound (186)		UTI (152)		Septicaemia (94)		URTI (20)		LRTI (13)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Premature	1	0.54	6	3.95	68	72.34	1	5.0	0	0	76	16.34
< 10	0	0	17	11.18	2	2.13	0	0	0	0	19	4.09
10 - 20	9	4.84	21	13.81	15	15.96	9	45.0	0	0	54	11.61
20 - 30	11	5.91	6	3.95	0	0	1	5.0	0	0	18	3.87
30 - 40	53	28.49	20	13.16	3	3.19	5	25.0	3	23.07	84	18.06
40 - 50	89	47.84	54	35.52	6	6.38	4	20.0	7	53.84	160	34.41
50 - 60	21	11.29	19	12.50	0	0	0	0	3	23.07	43	9.25
60 +	2	1.08	9	5.92	0	0	0	0	0	0	11	2.36
Total	186	100.0	152	100	94	100	20	100	13	100	465	100
Mean±SD	39.43±9.614		34.87±17.309		20.88±13.46		23.89±11.75		43.154±7.15		35.844±12.781	

Table (3) shows sex distribution of patients in different types of infections. Males had a higher prevalence of infections (63.01%) than females (36.99%). There was statistically insignificant difference in distribution of infections (Wound, UTI, septicaemia, URTI and LRTI) between males and females (P>0.05).

Table (4) shows isolated bacteria in different sites of infections . The distribution of the following organisms between sites of infections were statistically significant (P≤0.001, ≤0.01). Staph. aureus was the commonest organism isolated from LRTI (61.55%), wound infections (36.02%) and URTI (35%). Enterobacter species were the commonest isolated organisms from septicaemia (35.1%) E. coli and Staph. coagulase negative spp. were the commonest isolated organisms from UTI (26.32%, 23.02% respectively).

Bacteroid and Clostriduim species were isolated form wound infections only (6.45%, 2.15% respectively).

Photograph (3) shows API20E for identification of Gram negative bacilli, uninoculated strip.

Table (5) shows distribution of infections in wards. There was statistically significant difference in distribution of types of infections between wards (P≤0.001). Wound infections were the commonest infections in surgical wards (68.9%) . UTIs were the commonest infections

in medical wards (72.5%), paediatric wards (56.2%) and oncology unit (60.6%).

Septicaemia was the commonest infection in NICU (89.5%) and surgical ICU (54.5%). LRTIs and URTIs were common in surgical ICU (27.3%, 18.2% respectively). LRTIs were the commonest infections in medical ICU (66.7%).

Table (6) shows organisms distribution in different types of surgical wounds. Among 186 cases, 129 were contaminated clean (69.35%), 30 were infected (16.13%) and 27 were clean (14.5%).

In contaminated clean wounds, there was statistically significant high prevalence of Staph. aureus (23.65%), E.coli (13.44%), Enterobacter spp. (11.83%), and Staph. coagulase negative spp. (6.45%), $P<0.05$.

In clean wounds, there was statistically significant high prevalence of Staph. aureus (8.6%), $P\leq0.05$. In infected wounds the high isolation rate was for psedomonas aeruginosa (5.4%).

Bacteroid and Clostriduim species were only isolated from contaminated clean wounds (3.22%, 0.54% respectively) and infected wounds (3.22%, 1.6% respectively).

Photograph (4): shows API 20 E for identification of Gram-negative bacilli

a. E.coli.

b. Pseudomonas aeruginosa.

c- Enterobacter cloacae.

Photograph (5): Shows API20A for anaerobes identification, B. fragilis.

Table (7) shows prevalence of organisms in UTI with relation to catheterization. Among 152 cases, catheterized patients were 110 (72.4%) and non catheterized patients were 42 (27.6%). Staph. aureus was isolated with statistically significant prevalence in non catheterized patients (19.05%, $P<0.05$). E. coli, Staph. coagulase negative species, Enterobacter species, Klebsiella spp., Pseudomonas aeruginosa, Citrobacter spp., Proteus spp., Serratia spp. and Candida spp. were isolated with insignificant difference between patients, $P>0.05$.

Table (8) shows prevalence of organisms in different wards. In surgical wards the commonest organisms were Staph. aureus (27.9%), E. coli (18.3%) and Staph. con. spp. (15.5%). In surgical ICU the commonest organisms were Staph. aureus (54.5%) and Enterobacter spp. (18.2%). In medical wards the commonest organisms were Staph. aureus (20%), Enterobacter spp. and E. coli each 15%. In medical ICU the commonest organism was Staph. aureus (50%). In pediatric ward the commonest organisms were Staph. aureus (31.2%) E.coli (22.9%) and

Staph. con. spp. (14.6%). In NICU the commonest organisms were Enterobacter spp. (42.1%), E. coli (15.8%) and Staph. con. spp. (14.5%). In oncology unit the commonest organisms were Enterobacter spp. (33.3%) and E. coli (27.3%).

So, Staph. aureus shows statistically significant higher prevalence in surgical ICU (54.5%), medical ICU (50%), paediatric wards (31.2%), surgical wards (27.9%) and medical wards (20%) $P \leq 0.001$. While Enterobacter spp. had statistically significant higher prevalence in NICU (42.1%) and in oncology unit (33.3%) $P \leq 0.001$.

Table (3) : Sex distribution of patients in different types of infections.

Sex / Group	Male		Female	
	No.	%	No.	%
Wound (186)	125	67.2	61	32.8
UTI (152)	91	59.9	61	40.1
Septicaemia (94)	58	61.7	36	38.3
URTI (20)	13	65.0	7	35.0
LRTI (13)	6	46.2	7	53.8
Total	293	63.01	172	36.99

$X^2 = 3.755$ $P > 0.05$

Table (4) : Isolated bacteria in different sites of infections

Site / Organism	Wound		UTI		Septicaemia		URTI		LRTI		x^2	P
	No.	%	No.	%	No.	%	No.	%	No.	%		
Staph. aureus	67	36.02	11	7.24	16	17.02	7	35	8	61.55	56.5	≤ .001
Staph. con. spp.	13	6.99	35	23.02	17	18.1	0	0	0	0	24.6	≤ .001
Enterobacter spp.	27	14.52	25	16.45	33	35.1	1	5	1	7.69	22.8	≤ .001
E. coli	28	15.05	40	26.32	10	10.64	6	30	1	7.69	16.1	≤ .01
Pseudomonas spp.	18	9.67	7	4.6	2	2.13	1	5	1	7.69	7.27	> 0.05
Klebsiella spp.	7	3.76	13	8.55	5	5.32	1	5	1	7.69	3.6	> 0.05
Citrobacter spp.	1	0.54	6	3.95	2	2.13	0	0	0	0	5.82	> 0.05
Proteus spp.	3	1.61	6	3.95	2	2.13	4	20	0	0	20.63	≤ .001
Serratia spp.	2	1.08	4	2.63	6	6.38	0	0	1	7.69	8.21	> 0.05
Bacteroid spp.	12	6.45	0	0	0	0	0	0	0	0		
Clostridium spp.	4	2.15	0	0	0	0	0	0	0	0		
Candida spp.	4	2.15	5	3.29	1	1.07	0	0	0	0	2.14	> 0.05
Total	186	100	152	100	94	100	20	100	13	100		

Photograph (3) API20E for identification of Gram negative bacilli, uninoculated strip.

Photograph (4): API 20 E for identification of Gram-negative bacilli
a. E.coli.
b. Pseudomonas aeruginosa.
c- Enterobacter cloacae.

Table (5) : Distribution of infections in wards

Ward / Infection	No.	Surgical		Surgical ICU		Medical		Medical ICU		Paediatric		Neonate ICU		Oncology		X^2	P
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Wound	186	173	68.9	0	0	3	7.5	0	0	1	2.1	1	1.3	8	24.2	195.9	≤ .001
UTI	152	68	27.1	0	0	29	72.5	2	33.3	27	56.2	6	7.9	20	60.6	82.8	≤ .001
Septicaemia	94	1	0.4	6	54.5	2	5	0	0	12	25	68	89.5	5	15.2	303.6	≤ .001
URTI	20	8	3.19	2	18.2	1	2.5	0	0	8	16.7	1	1.3	0	0	27.4	≤ .001
LRTI	13	1	0.4	3	27.3	5	12.5	4	66.7	0	0	0	0	0	0	133.01	≤ .001
Total	465	251	100	11	100	40	100	6	100	48	100	76	100	33	100		

Table (6) : Organisms distribution in different types of surgical wounds (n=186)

Organism	Clean		Contami-nated		Infected		Z	P
	No.	%	No.	%	No.	%		
Staph. aureus	16	8.6	44	23.65	7	3.8		
E. coli	3	1.6	25	13.44	0	0	3.0729	< 0.05
Enterobacter spp.	5	2.7	22	11.83	0	0	2.163	< 0.05
Staph. coagulase negative spp.	1	0.54	12	6.45	0	0	2.291	< 0.05
Pseudomonas aeruginosa	0	0	8	4.3	10	5.4	0.245	> 0.05
Klebsiella spp.	0	0	4	2.15	3	1.6	0.21	> 0.05
Citrobacter spp.	0	0	1	0.54	0	0		
Proteus spp.	0	0	3	1.6	0	0		
Serratia spp.	1	0.54	1	0.54	0	0		
Bacteroid spp.	0	0	6	3.22	6	3.22		
Clostriduim spp.	0	0	1	0.54	3	1.6	0.995	> 0.05
Candida spp.	1	0.54	2	1.1	1	0.54		
Total	27	14.5	129	69.35	30	16.13		

$X^2 = 8.627$ P < 0.05 (Staph. aureus)

$X^2 = 0.730$ P > 0.05 (Candida. spp.)

Photograph (5): API20 A for anaerobes identification, B. fragilis.

Table (7) : Prevalence of organisms in UTI with relation to catheterization

Patient / Organism	Catheterized (n = 110) % of total = 72.4%		non Catheterized (n = 42) % of total = 27.6%		Z	P
	No.	%	No.	%		
E. coli	30	27.3	10	23.8	0.45	> 0.05
Staph. coagulase negative	25	22.7	10	23.8	0.26	> 0.05
Enterobacter spp.	21	19.1	4	9.5	1.63	> 0.05
Staph. aureus	3	2.7	8	19.05	2.62	< 0.05
Klebsiella spp.	10	9.1	3	7.1	0.41	> 0.05
Pseudomonas aeruginosa	6	5.5	1	2.4	0.9	> 0.05
Citrobacter spp.	4	3.6	2	4.8	0.32	> 0.05
Proteus spp.	4	3.6	2	4.8	0.32	> 0.05
Serratia spp.	3	2.7	1	2.4	0.11	> 0.05
Candida spp.	4	3.6	1	2.4	0.41	> 0.05
Total	110	100	42	100		

Table (8) : Prevalence of organisms in different wards

Ward / Organism	Surgical		Surgical ICU		Medical		Medical ICU		Paediatric		NICU		Oncology		X^2	P
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Staph. aureus	70	27.9	6	54.5	8	20	3	50	15	31.2	6	7.9	1	3.03	30.8	≤ 0.001
Staph. con. spp.	39	15.5	0	0	5	12.5	0	0	7	14.6	11	14.5	3	9.1	4.03	> 0.05
E. coli.	46	18.3	0	0	6	15	1	16.7	11	22.9	12	15.8	9	27.3	4.911	> 0.05
Klebsiella spp.	9	3.6	1	9.1	4	10	0	0	4	8.3	7	9.2	2	6.1	6.311	> 0.05
Enterobacter spp.	32	12.7	2	18.2	6	15	0	0	4	8.3	32	42.1	11	33.3	42.99	≤ 0.001
Citrobacter spp.	2	0.8	0	0	0	0	0	0	3	6.2	1	1.3	3	9.1	16.6	≤ 0.01
Pseudomonas spp.	22	8.8	1	9.1	4	10	1	16.7	0	0	1	1.3	0	0	13.5	≤ 0.05
Proteus spp.	5	1.99	0	0	3	7.5	0	0	2	4.2	2	2.6	3	9.1	7.44	> 0.05
Serratia spp.	4	1.6	1	9.1	2	5	1	16.7	0	0	4	5.3	1	3.03	10.94	> 0.05
Bacteroid spp.	12	4.8	0	0	0	0	0	0	0	0	0	0	0	0		
Clostriduim spp.	4	1.6	0	0	0	0	0	0	0	0	0	0	0	0		
Candida spp.	6	2.4	0	0	2	5	0	0	2	4.2	0	0	0	0	5.308	> 0.05
Total	251	100	11	100	40	100	6	100	48	100	76	100	33	100		

Photograph (6) shows API for Staph. spp. identification :-

a- Uninoculated strip.

b- Staph. aureus.

Table (9) Shows environmental culture from NICU (n=100). Samples with no growth were 80% and samples with growth were 20%. All samples from formula of feed (10%), furniture and bed linen (34%), intravenous fluid and antiseptic solution each (10%) had no growth. While samples from suction equipment (2%), air (8%) and waste container (10%) had growth.

Table (10), Fig. (1) show correlation between organisms isolated from premaure infections (n=76) and their environment (n = 20). Organisms isolated form environment were Enterobacter cloacae (50%), from waste containers, Staph. aureus 30% and Klebsiella oxytoca 10% from air and Pseudomonas aeruginosa (10%) from suction equipment.

From prematures, Enterobacter cloacae was isolated from 42.1% , Staph. aureus from 7.89%, Pseudomonas aeruginosa from 1.37% and Klebsiella oxytoca from 9.21%.

There was significant positive correlation between organisms isolated from environment and from prematures ($r = 0.741$ - $P \leq 0.001$). There were no organisms isolated from nurses.

Table (11), Fig. (2) show correlation between organisms isolated from patients and nurses in GEC. Staph. aureus was isolated from nurses (20%) and from patients (30.1%) with significant positive correlation (r=0.7679-P≤0.001). There were no organisms isolated from surgical theatres.

Table (12) shows organisms isolated from gastroduodenal endoscopes before and after disinfection. Orgainsms isolated before disinfection were Staph. aureus (10%), Staph. epidermidis (11%), Staph. saprophyticus (0.5%), E.coli (4%), Psuedomonas aeruginosa (7.5%) Enterobacter cloacae (1%) and H. pylori (14%). Cases with no growth were 52%.

After disinfection there was disappearance of Staph. saprophyticus, E. coli, Pseudomonas aeruginosa and Enterobacter cloacae, with significant decrease in Staph. aureus (3%) and H. pylori (1%), P ≤ 0.05, P≤0.001 respectively. Also cases with no growth were significantly increased (90%, P ≤0.001).

Photograph (6) : API for Staph. spp. identification :-

a- Uninoculated strip.

b- Staph. aureus.

Table (9) : Environmental culture from NICU (n = 100)

Cuture / Sample	No growth		Growth	
	No.	%	No.	%
Suction equipment	6	6	2	2
Air	0	0	8	8
Waste container	0	0	10	10
Feed formula	10	10	0	0
Milk bottles	10	10	0	0
Furniture bed linen	34	34	0	0
Intravenous fluid	10	10	0	0
Antiseptic solution	10	10	0	0
Total	80	80	20	20

Table (10): Correlation between organisms from premature's infections (n=76) and their environment (n=20).

Organism	Patient (n=76)		Environment (n=20)						Nurse (n=10)
			Suctiona-equipment		Air.		Waste container		
	No.	%	No.	%	No.	%	No.	%	
Enterobacter cloacae	32	42.1	0	0	0	0	10	50	No Growth
E. coli	12	15.79	0	0	0	0	0	0	
Staph. coagulase negative	11	14.47	0	0	0	0	0	0	
Staph. aureus	6	7.89	0	0	6	30	0	0	
Pseudomonas aeruginosa	1	1.37	2	10	0	0	0	0	
Klebsiella oxytoca	7	9.21	0	0	2	10	0	0	
Proteus mirabilis	2	2.6	0	0	0	0	0	0	
Citrobacter freundii	1	1.32	0	0	0	0	0	0	
Serratia	4	5.26	0	0	0	0	0	0	

$r = 0.741$

$P \leq 0.001$

Fig. (1): Correlation between organisms isolated from premature infections (n=76) and their environment (n=20).

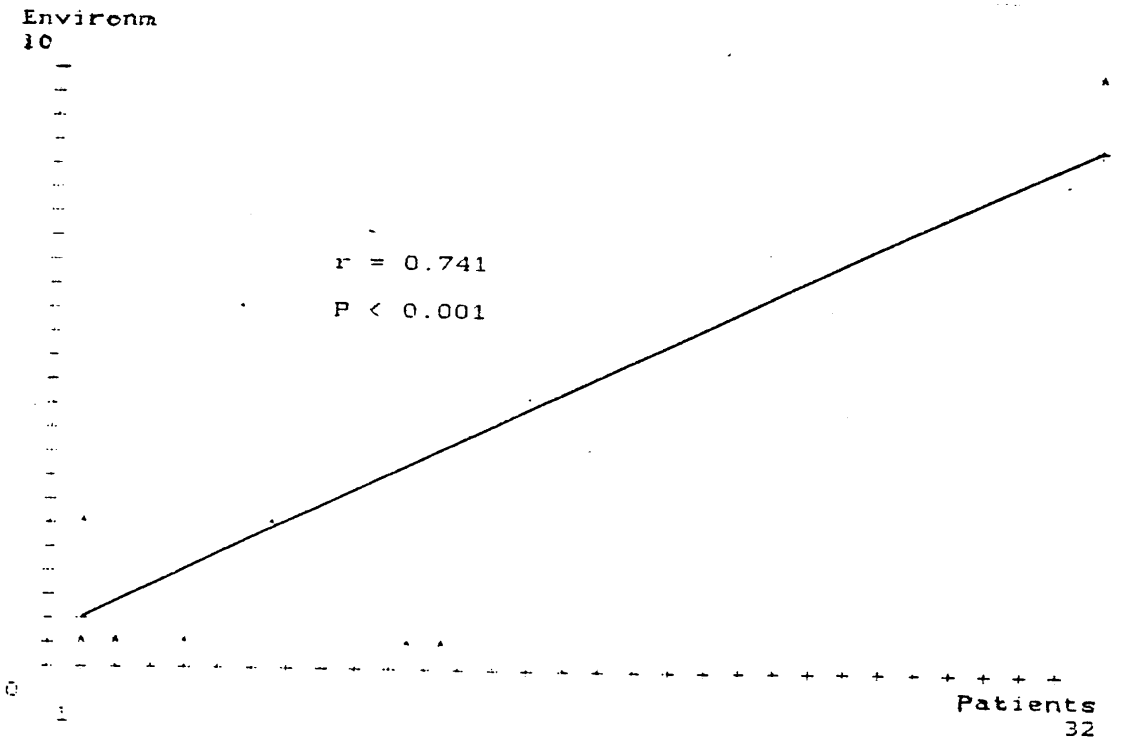


Table (11) : Correlation between organisms isolated from patients and nurses in GEC

Organism	Patient (n = 173)		nurses (n = 25)		Environment in surgical theatre (n=180)
	No.	%	No.	%	
Staph aureus	52	30.1	5	20	No growth
Staph. coagulase negative	24	13.9	0	0	
Enterobacter spp.	24	13.9	0	0	
E. coli	32	18.49	0	0	
Pseudomonas aeruginosa	9	5.2	0	0	
Klebsiella spp.	7	4.04	0	0	
Proteus spp.	4	2.3	0	0	
Serratia spp.	2	1.15	0	0	
Bacteroid spp.	10	5.78	0	0	
Clostridium spp.	3	1.73	0	0	
Candida spp.	6	3.47	0	0	

r= 0.7679

P≤0.001

Fig. (2): Correlation between organisms isolated from patients and nurses in GEC:

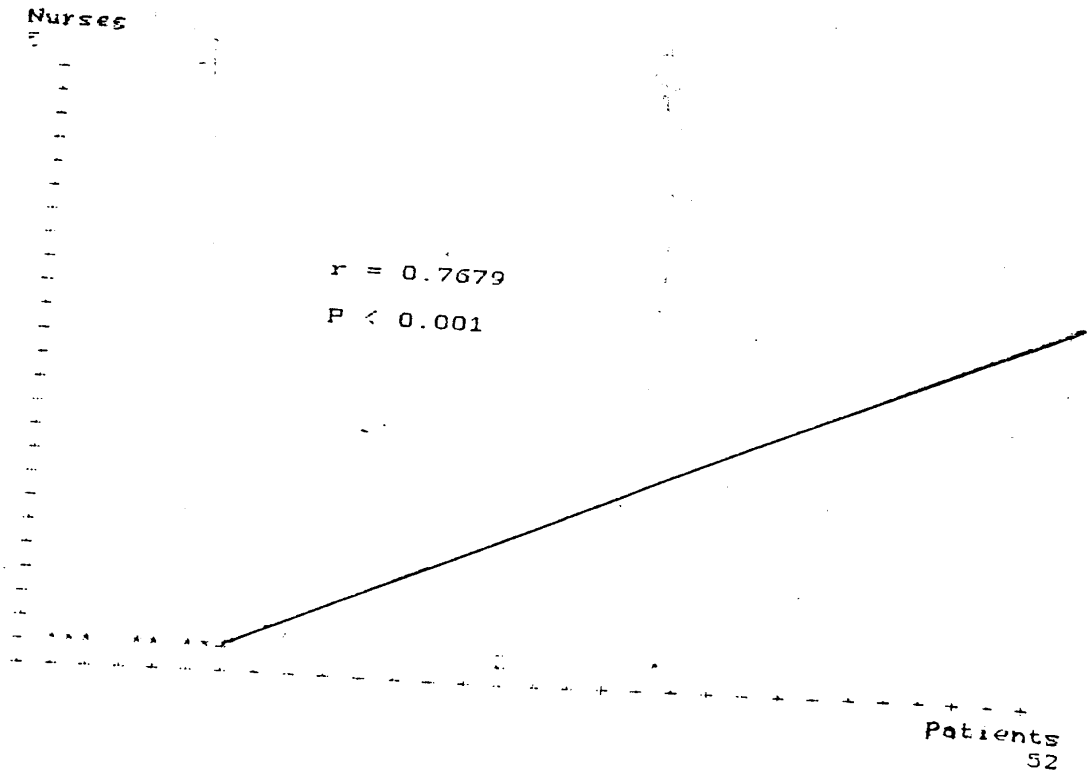


Table (12) : Organisms isolated from gastroduodenal endoscopes before and after disinfection.

Group / Organism	Before Disinfection (n = 200)		After Disinfection (n = 200)		Z	P
	No.	%	No.	%		
Staph. aureus	20	10	6	3	2.28	≤ 0.05
Staph. epidermidis	22	11	12	6	1.48	> 0.05
Staph. saprophyticus	1	0.5	0	0	1.004	> 0.05
E. coli	8	4.0	0	0	2.878	≤ 0.01
Pseudomonas aeruginosa	15	7.5	0	0	4.032	≤ 0.01
Enterobacter cloacae	2	1.0	0	0	1.42	> 0.05
H. pylori	28	14	2	1	5.306	≤ 0.001
No growth	104	52.0	180	90	8.314	≤ 0.001
Total	200	100	200	100		

Photograph (7) Shows H. pylori growth on Skirrow's media, like droplets of water.

Photograph (8) shows urease test on Christensen's media for H. pyloir.

a- Control tube.

b- Positive tube.

Table (13) : shows antibiogram for isolated Gram negative bacilli (in sites other than UTI) , Vitek versus disk diffusion method. Enterobacter spp. were sensitive to amikacin (95.2%), tobramycin (91.9%) and gentamicin (87.1%). E. coli was sensitive to tobramycin (95.6%), amikacin (93.3%) and gentamicin (91.1%). Pseudomonas spp. were sensitive to tobramycin (95.6%), amikacin (90.9%) and gentamicin (81.8%).

Collectively, Gram negative bacilli were sensitive to amikacin (92.7%), tobramycin (92.1%) and gentamicin (87.2%). But, they were resistant to ampicillin (81.6%), tetracycline (81.8%) and cephalothin (80.6%).

Table (14) shows antibiogram for isolated Gram negative bacilli (in UTI), Vitek versus disk diffusion method. Enterobacter spp. were sensitive to nitrofurantoin (92%), to each of ciprofloxacin and tobramycin (88%) and to each of ceftazidime and gentamicin (84%). E. coli was sensitive to tobramycin (92.5%) and to each of ceftazidime, ciprofloxacin and nitrofurantoin (90%). Klebsiella spp. were sensitive to nitrofurantoin

(100%) and to each of ceftazidime and ciprofloxacin (92.3%) and tobramycin (84.6%).

Gram negative bacilli were sensitive to ciprofloxacin (91.1%), ceftazidime (88.1%) nitrofurantoin (87.1%), tobromycin (85.1%). While they were resistant to ampicillin (85.2%), trimeth-sulfa (78.2%) and ticarcillin (77.3%).

Photograph (9) shows cards used in automated system (Vitek) for identification and antibiotic sensitivity.

Table (15) shows antibiogram for Staph. species (in sites other than UTI), Vitek versus disk diffusion method. Staph aureus was sensitive to ciprofloxacin (94.9%), oxacillin (93.9%), clindamycin (91%) and vancomycin (89.8%), while it was resistant to penicillin G (97.9%) and tetracycline (94.9%) .

Staph. con. species were sensitive to each of ciprofloxacin and clindamycin (93.3%), oxacillin (83.3%) and vancomycin (80%). They were resistant to penicillin (96.7%).

Table (16) shows antibiogram for Staph. spp. (in UTI) Vitek versus disk diffusion. Staph. aureus was sensitive to each of nitrofurantoin, norfloxacin, gentamicin (90.9%), vancomycin (81.8%) and clindamycin (72.7%). It was resitant to penicillin G (90.9%) , erythromycin (90.9%) and cephalothin (84.6%).

Staph. con. spp. were sensitive to gentamicin (91.4%), norfloxacin (88.6%), nitrofurantoin (85.7%), each of vancomycin and clindamycin (74.3%). They were resistant to penicillin G (94.3%) each of erythromycin and tetracycline (88.6%).

Collectively Staph. spp., were sensitive to clindamycin, vancomycin and were resistant to pericillin G .

There was insignificant difference of antibiogram pattern between Vitek and antibiotic disk diffusion method for all isolates; P>0.05 (Tables 13,14,15,16).

Table (17) shows antibiogram for anaerobes by disk diffusion (n=16) method. Anaerobes were sensitive to each of metronidazole and chloramphenicol (100%) followed by imipenem (81.3%), piperacillin and cefoxitin (62.5%). They were resistant to tetracycline (81.3%), ciprofloxacin (68.8%) and ceftazidime (62.5%).

Table (18) shows sensitivity for isolated Candida by Candifast (n=10). 30% of isolated Candida were sensitive to nystatin, while 20% were sensitive for each of amphotericine B and ketoconazole.

Photograph (10) : API20 C for Candida spp. identication
a- Uninoculated Strip.
b- Candida albicons.

Photograph (7): H. pylori growth on Skirrow's media , like droplets of water.

Photograph (8): Urease test on Christensen's media for H. pylori.

a- Control tube.
b- Positive tube.

Table (13) : Antibiogram for isolated Gram negative bacilli (in sites other than U.T.I) , Vitek versus disk diffusion.

Organism		Amikacin			Gentamicin			Tobramycin			Cefamandole			Cefoxitin			Cephalothin			Chloramphenicol			Tetracyline			Ampicillin			Carbenicillin			Trimeth - sulfa		
		S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Enterobacter	No.																																	
Vitek	62	96.8	0	3.2	82.3	4.8	12.9	88.7	4.8	6.5	19.4	0	80.6	79.03	1.6	19.4	17.7	1.6	80.7	70.9	0	29.04	17.7	1.6	80.6	16.1	4.8	79.03	25.8	0	74.2	58.1	0	41.9
Disk		95.2	0	4.8	87.1	3.2	9.7	91.9	0	8.1	17.7	0	82.3	74.2	0	25.8	20.9	4.8	74.2	69.4	0	30.6	19.3	3.2	77.4	17.7	0	82.3	22.6	0	77.4	53.2	0	46.8
E.coli	45																																	
Vitek		91.1	0	8.9	88.9	2.2	8.9	93.3	0	6.7	17.7	6.7	75.6	82.2	0	17.8	15.6	2.2	82.2	71.1	0	18.9	13.3	0	86.7	11.1	0	88.9	26.7	2.2	71.1	60	0	40
Disk		93.3	0	6.7	91.1	0	8.9	95.6	0	4.4	15.5	0	84.5	80.0	0	20	17.8	2.2	80	71.1	0	18.9	8.9	2.2	88.9	8.9	0	91.1	24.4	4.4	71.1	57.8	2.2	40
Citrobacter	3																																	
Vitek		100	0	0	100	0	0	66.7	0	33.3	0	33.3	66.7	66.7	0	33.3	0	0	100	66.7	0	33.3	66.7	0	33.3	33.3	0	66.7	33.3	0	66.7	33.3	33.3	33.3
Disk		100	0	0	100	0	0	66.7	0	33.3	0	0	100	33.3	33.3	33.3	0	0	100	66.7	0	33.3	33.3	0	66.7	0	33.3	66.7	33.3	0	66.7	33.3	0	66.7
Klebsiella	14																																	
Vitek		92.9	0	7.1	78.6	14.3	7.1	92.9	0	7.1	21.4	14.3	64.3	71.4	21.4	7.1	14.3	0	85.7	64.3	21.4	14.3	14.3	7.1	78.6	14.3	7.1	78.6	21.4	0	78.6	50	0	50
Disk		85.7	7.1	7.1	78.6	0	21.4	92.9	0	7.1	28.6	7.1	64.3	57.1	14.3	28.6	7.1	21.4	71.4	57.1	14.3	28.6	21.4	0	78.6	21.4	0	78.6	21.4	0	78.6	57.1	0	42.9
Pseudomonas	22																																	
Vitek		90.9	4.5	4.5	86.4	4.5	9.1	90.1	0	9.1	27.3	4.5	68.2	63.6	0	36.4	13.6	4.5	81.6	63.6	0	36.4	13.6	4.5	81.8	13.6	4.5	81.8	28.7	4.5	72.7	31.8	9.1	59.1
Disk		90.9	4.5	4.5	81.8	4.5	13.6	95.6	0	4.5	31.8	0	68.2	63.6	0	36.4	9.1	0	90.9	59.1	9.1	31.8	18.2	13.6	68.2	18.2	0	81.8	18.1	9.1	72.7	31.8	9.1	59.1
Proteus	9																																	
Vitek		88.9	0	11.1	88.9	0	11.1	88.9	0	11.1	22.2	0	77.8	77.8	0	22.2	11.1	0	88.9	77.8	0	22.2	11.1	11.1	77.8	11.1	22.2	66.7	22.2	11.1	66.7	22.2	0	77.9
Disk		88.9	0	11.1	77.8	0	22.2	88.9	0	11.1	22.2	0	77.8	66.7	11.1	22.2	11.1	0	88.9	77.8	0	22.2	11.1	0	88.9	11.1	0	88.9	33.3	11.1	55.6	22.2	0	77.9
Serratia	9																																	
Vitek		88.9	11.1	0	88.9	11.1	0	88.9	0	11.1	22.2	0	77.8	77.8	0	22.2	11.1	11.1	77.8	77.8	0	22.2	11.1	0	88.9	11.1	11.1	77.8	11.1	0	88.9	33.3	0	66.7
Disk		88.9	0	11.1	88.9	0	11.1	88.9	0	11.1	22.2	0	77.8	66.7	0	33.3	11.1	22.2	66.7	77.8	0	22.2	11.1	11.1	77.8	11.1	22.2	66.7	22.2	11.1	66.7	33.3	0	66.7
Total	164																																	
Vitek		93.3	6.1	0.6	85.4	4.9	9.7	90.2	8	1.8	20.1	3.6	76.3	76.8	1.8	21.4	15.2	2.4	82.4	70.1	1.8	28.1	15.9	1.2	82.9	14.02	4.9	81.08	24.4	1.8	73.8	50.6	1.8	47.6
Disk		92.7	5.5	1.8	87.2	1.8	11.0	92.1	7.9	0	20.1	0.6	79.3	71.3	1.8	26.9	15.8	3.6	80.6	68.3	2.4	29.3	15.8	2.4	81.8	14.6	1.8	81.6	23.2	3.7	26.9	48.8	1.8	49.4

P > 0.05

Table (14) : Antibiogram for isolated Gram neative bacilli (in U.T.I), Vitek versus disk diffusion.

Orgarism		Ampicillin			Ticarcillin			Cefazolin			Ceftazidime			Ceftriaxone			Cefuroxime			Ciprofloxacin			Gentamicin			Tobramycin			Nitrofurantoin			Trimethsulfa		
		S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Enterobacter	No																																	
Vitek	25	8	4	88	24	4	72	36	0	64	88	0	12	76	4	20	68	0	32	92	0	8	84	0	16	88	4	8	88	0	12	24	0	76
Disk.		12	0	88	20	0	80	36	4	60	84	4	12	76	4	20	64	4	32	88	0	12	84	0	16	88	4	8	92	0	8	20	4	76
E.coli	40																																	
Vitek		10	0	90	20	2.5	77.5	35	0	65	90	0	10	75	6	25	65	5	30	90	5	5	85	0	15	90	0	10	90	5	5	20	0	75
Disk.		10	0	90	20	2.5	77.5	30	0	70	90	0	10	75	5	20	60	5	35	90	5	5	85	0	15	92.5	0	7.5	90	0	10	22.5	2.5	75
Klebsiella	13																																	
Vitek		15.4	0	84.62	23.1	0	76.9	53.9	0	46.2	92.3	0	7.7	76.9	0	23.1	53.9	15.4	30.8	92.3	0	7.7	84.6	0	15.4	84.6	0	15.4	92.3	0	7.7	15.4	0	84.6
Disk.		23.1	0	76.9	23.1	0	76.9	46.2	0	53.8	92.3	0	7.7	68.2	0	30.8	61.5	0	38.5	92.3	0	7.7	76.9	7.7	15.4	84.6	0	15.4	100	0	0	15.4	0	84.6
Citrobacter	6																																	
Vitek		16.6	16.6	66.7	16.7	0	83.3	33.3	0	66.7	83.3	0	16.7	66.7	0	33.3	33.3	0	66.7	100	0	0	83.3	0	16.7	83.3	0	16.7	83.3	0	16.7	16.7	0	83.3
Disk.		16.7	33.3	50	16.7	0	83.3	16.7	0	83.3	83.3	0	16.7	50	16.7	33.3	33.3	0	66.7	100	0	0	83.3	0	16.7	83.3	0	16.7	83.3	16.7	0	16.7	0	83.3
Pseudomonas	7																																	
Vitek		6	14.3	85.7	28.6	0	71.4	14.3	0	85.7	85.7	0	14.3	71.4	14.3	14.3	28.6	28.6	42.8	85.7	0	14.3	71.4	14.3	14.3	71.4	0	18.6	57.1	0	42.9	14.3	0	85.7
Disk.		0	0	100	14.3	14.3	71.4	14.3	0	85.7	85.7	14.3	0	57.1	14.3	28.6	28.6	14.3	57.1	85.7	0	14.3	57.1	0	42.9	71.4	0	18.6	57.1	0	42.9	14.3	0	85.7
Proteus	6																																	
Vitek		16.7	0	83.3	16.7	16.7	66.7	16.7	16.7	56.7	83.3	16.7	0	50	16.7	33.3	33.3	0	66.7	100	0	0	83.3	0	16.7	83.3	0	16.7	66.7	0	33.3	0	16.7	83.3
Disk.		16.7	0	83.3	16.7	0	83.3	33.3	0	66.7	83.3	0	16.7	66.7	16.7	16.7	16.7	0	83.3	100	0	0	83.3	0	16.7	83.3	0	16.7	66.7	16.7	16.60	0	16.7	83.3
Serratia	4																																	
Vitek		25	25	50	25	25	50	25	0	75	100	0	0	50	0	50	25	25	50	100	0	0	75	0	25	75	25	0	75	25	0	25	0	75
Disc.		25	0	75	50	25	25	25	0	75	100	0	0	50	25	25	25	25	50	100	0	0	50	25	25	50	25	25	75	0	25	0	25	75
Total	101																																	
Vitek		10.9	2.9	86.2	20.8	3.96	75.4	34.7	1.9	63.4	89.1	0.99	10	72.3	2.97	24.7	56.4	4.9	38.7	92.1	1.98	5.9	83.2	0.99	15.8	86.1	1.98	11.9	85.1	2.97	11.9	20.8	1.98	77.2
Disk.		12.9	1.9	85.2	19.8	2.97	77.3	31.7	0.99	67.3	88.1	1.98	10	70.3	6.9	22.8	56.4	4.9	38.7	91.1	1.98	6.2	80.2	1.98	17.8	85.1	1.98	12.9	87.1	0.99	12	17.8	3.96	78.2

P > 0.05

Table (15) : Antibiogram for Staph species (in sites other than U.T.I) , Vitek versus disk diffusion.

Organism		*Ampicillin/ sulbactam*			*Cephalothin*			*Ciprofloxacine*			*Clindamycin*			*Erythromycin*			*Oxacillin*			*Penicillin G*			*Tetracycline*			*Trimethsulfa*			*Vancomycin*		
		S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Staph. aureus	No																														
Vitek.	98	25.5	0	74.5	15.3	3.1	81.6	94.9	0	5.1	90.8	2.04	7.2	25.5	0	74.5	92.3	1.02	6.7	2.04	0	97.96	8.2	2.04	89.8	7.1	0	92.9	84.7	1.02	14.3
Disk.		23.5	0	76.5	10.2	3.1	86.7	94.9	1.02	4.1	91	1..02	7.98	24	0	76	93.9	0	6.1	2.04	0	97.96	3.1	2.04	94.9	7.1	0	92.9	89.8	1.02	9.2
Staph coagulase negative	30																														
Vitek.		16.7	0	83.3	14.3	3.3	82.4	93.3	0	6.7	90	0	10	20	0	80	90	0	10	3.3	0	96.7	16.7	0	83.3	6.7	0	93.3	80	0	20
Disk.		16.7	0	83.3	14.3	3.3	82.4	93.3	3.3	3.4	93.3	0	6.7	20	0	80	83.3	0	16.7	3.3	0	96.7	13.3	0	86.7	3.3	0	96.7	80	0	20

P > 0.05

Table (16) : Antibiogram for staph species (in U.T.I) , Vitek versus disk diffusion.

Organism		*Ampicillin*	*Cephalothin*	*Clindamycin*	*Erythromycin*	*Nitrofurantion*	*Norfloxacin*	*Penicillin G*	*Tetracycline*	*Vancomycin*	*Gentamicin*	*Streptomycin*	*Chloramphenicol*
		S I R	S I R	S I R	S I R	S I R	S I R	S I R	S I R	S I R	S I R	S I R	S I R
Staph aureus	No												
Vitek	11	18.2 9.1 72.7	23.1 0 76.9	72.7 0 27.3	18.2 9.1 72.7	81.8 0 18.2	90.9 9.1 0	9.1 9.1 81.8	18.2 18.2 63.6	90.9 0 9.1	81.8 9.1 9.1	54.5 0 45.5	27.3 18.2 54.5
Disk		18.2 0 81.8	15.4 0 84.6	72.7 0 27.3	9.1 0 90.9	90.9 0 9.1	90.9 0 9.1	9.1 0 90.9	9.1 27.3 63.6	81.8 0 18.2	90.9 0 9.1	63.6 0 36.4	36.4 0 63.6
Staph coagulase negative	35												
Vitek		11.4 2.9 85.7	25.7 0 74.3	74.3 22.9 2.9	14.3 2.9 82.8	88.6 0 11.4	91.4 0 9.6	8.6 2.9 88.5	11.4 0 88.6	77.1 0 22.6	91.4 0 8.6	57.1 0 42.9	28.6 0 71.4
Disk		14.3 2.9 82.8	22.9 0 74.3	74.3 22.9 2.9	11.4 0 88.6	85.7 0 14.3	88.6 0 11.4	5.7 0 94.3	11.4 0 88.6	74.3 0 25.7	91.4 0 8.6	54.3 0 45.7	25.7 0 74.3

$P > 0.05$

Table (17) : Antibiogram for anaerobes by disk diffusion.

Organism		Cefoxitin			Piperacillin			Chloramphenicol			Metronidazole			Clindamycin			Imipenem			Ceftazidime			Cefotaxime			Tetracycline			Ciprofloxacin		
		S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Bacteroid fragilis	7										7	0	0																		
No.		5	0	2	5	1	1	7	0	0	100	0	0	3	1	3	6	0	1	2	1	4	2	0	5	1	0	6	2	1	4
%		71.4	0	28.6	71.4	14.3	14.3	100	0	0				42.8	14.4	42.8	85.7	0	14.3	28.6	14.3	57.1	28.6	0	71.4	14.3	0	85.7	28.6	14.3	57.1
Bacteroid vulgatis	2																														
No.		1	0	1	1	1	0	2	0	0	2	0	0	1	0	1	2	0	0	0	0	2	1	0	1	0	0	2	0	0	2
%		50	0	50	50	50	-	100	0	0	100	0	0	50	0	50	100	0	0	0	0	100	50	0	50	0	0	100	0	0	100
Bacteroid distasonis	3																														
No.		2	0	1	2	0	1	3	0	0	3	0	0	2	1	0	2	0	1	1	1	1	1	0	2	1	0	2	2	0	1
%		66.7	0	33.3	66.7	0	33.3	100	0	0	100	0	0	66.7	33.3	0	66.7	0	66.7	33.3	33.3	33.3	33.3	0	66.7	33.3	0	66.7	66.7	0	33.3
Clostridium difficile	2																														
No.		1	0	1	1	0	1	2	0	0	2	0	0	1	0	1	1	1	0	1	0	1	1	0	1	0	0	2	0	0	2
%		50	0	50	50	0	50	100	0	0	100	0	0	50	0	50	50	50	0	50	0	50	50	0	50	0	0	100	0	0	100
Clostridium perferigenis	2																														
No.		1	1	0	1	0	1	2	0	0	2	0	0	0	1	1	2	0	0	0	0	2	1	0	1	1	0	1	0	0	2
%		50	50	50	50	0	50	100	0	0	100	0	0	0	50	50	100	0	0	0	0	100	50	0	50	50	0	50	0	0	100
Total	16																														
No.		10	1	5	10	2	4	16	0	0	16	0	0	7	3	6	13	1	2	4	2	10	6	0	10	3	0	13	4	1	11
%		62.5	6.2	31.3	62.5	12.5	25	100	0	0	100	0	0	43.8	18.7	37.5	81.3	6.2	12.5	25	12.5	62.5	37.5	0	62.5	18.7	0	81.3	25	6.2	68.8

Photograph (9): Cards used in automated system "Vitek" for identification and antibiotic sensitivity.

Table (18) : Sensitivity of isolated Candida by Candifast

Antifungal	Sensitive	Intermediate sensitivity	Resistant
Amphotericine B	20%	70	10
Nystatin	30%	60	10
5-Fluorocytosine	٥	50	50
Econazol	٤	40	60
Fluconazol	٣	30	70
Ketoconazol	20	50	30
Miconazole	0	20	80

٥ = [illegible]

Photograph (10): API20C for Candida spp. identification.
a- Uninoculated strip.
b- Candida albicans.

Table (19), Fig. (3) show Gram negative bacilli identification by automated system in comparison with API (n=304). The sensitivity of automated system was 90.9% for Enterobacter spp., 93.5% for E.coli, 100% for Citrobacter spp., 93.1 % for Klebsiella spp. , 91.1% for Peudomonas spp., 93.3% for Proteus spp., and 92.3% for Serratia spp.

The specificity of automated system was 95.1% for Enterobacter spp., 95.7% for E.coli, 99.3% for Citrobacter spp., 100% for Klebsiella spp., 98.8% for Pseudomonas spp., and 100% for each of Proteus and Serratia spp.

The accuracy of automated system was 93.7% for Enterobacter spp., 95.1% for E.coli, 99.3% for each Citrobacter spp. and Klebsiella spp., 97.4% for Pseudomonas spp. and 99.7% for each Proteus and Serratia spp.

Collectively, for identification of Gram negative bacilli, sensitivity of automated system compared with API was ranging from 90.9% to 100%, specificity was from 95.1% to 100% and accuracy was from 93.7% to 99.7%.

Table (20), Fig (4) shows Staph. spp. identification by automated system in comparison with API (n=246). The sensitivity, specificity and accuracy of automated system were 100% for identification of Staph. aureus and Staph. epidermidis.

For other Staph. spp., the sensitivity of automated system was 80% for Staph. haemolyticus, 57.1% for Staph. saprophyticus, 75% for Staph. warneri and Staph. lentus, 66.7% for Staph. simulans, 50% for Staph. capitis, 100% for Staph. hominis and 0% for Staph. chromogen.

The specificity of automated system was 99.1% for Staph. haemolyticus, 99.6% for each of Staph. saprophyicus, Staph. warneri, Staph. simulans and Staph. capitis, 99.2% for Staph. lentus and Staph. hominis and 100% Staph. chromogen.

The accuracy of automated system was 98.4% for each of Staph. haemolyticus, and Staph. saprophyticus, 98.8% for Staph. lentus, 99.2% for each of Staph. warneri, Staph. simulans, Staph. capitis and Staph. hominis, 99.6% for Staph. chromogen.

So, automated system when compared with API for Staph. species identification, sensitivity, specificity and accuracy were 100% for identification of staph aureus and Staph. epidermidis.

For identification of other Staph. species sensitivity of automated system compared with API was ranging from 0% to 100%, specificity was from 99.1% to 100 % and accuracy was from 98.4% to 100%.

Table (21), Fig. (5) shows anaerobic bacilli identification by automated system in comparison with API (n=16). The sensitivity, specificity and accuracy of automated system were 100% for each of

Bacteroid fragilis, Bacteroid vulgatis and Clostridium perferinges. For B. distasonis sensitivity, specificity and accuracy were 66.7% , 100% and 93.7% respectively. For Clost. difficile identification, sensitivity, specificity and accuracy were 100%, 92.8% and 93.7% respectively.

Table (22), Fig. (6) shows Candida spp. identification by automated system in comparison with API (n=10). The sensitivity, specificity and accuracy of automated system were 100% for Candida tropicalis and Candida guilliermondii. For C. albicans, sensitivity of automated system was 80%, specificity 100% and accuracy 90%. For C. pseudotropicalis, sensitivity was 100%, specificity 87.5% and accuracy 90%.

Table (19) : Gram negative bacilli identification by automated system in comparison with API (n=304)

Organism	Method				Sensitivity	Specificity	Accuracy
	API		Automation				
	No	%	No	%			
Enterobacter spp.	99	32.56	100	32.89	90.9	95.1	93.7
E. coli.	93	30.6	96	31.58	93.5	95.7	95.1
Citrobacter spp.	9	2.96	11	3.62	100	99.3	99.3
Klebsiella spp.	29	9.54	27	8.88	93.1	100	99.3
Pseudomonas spp.	46	15.13	44	14.47	91.1	98.8	97.4
Proteus spp.	15	4.93	14	4.60	93.3	100	99.7
Serratia spp.	13	4.28	12	3.95	92.3	100	99.7
Total	304	100	304	100			

Fig. (3) : Gram negative bacilli identification by automated system in comparison with API

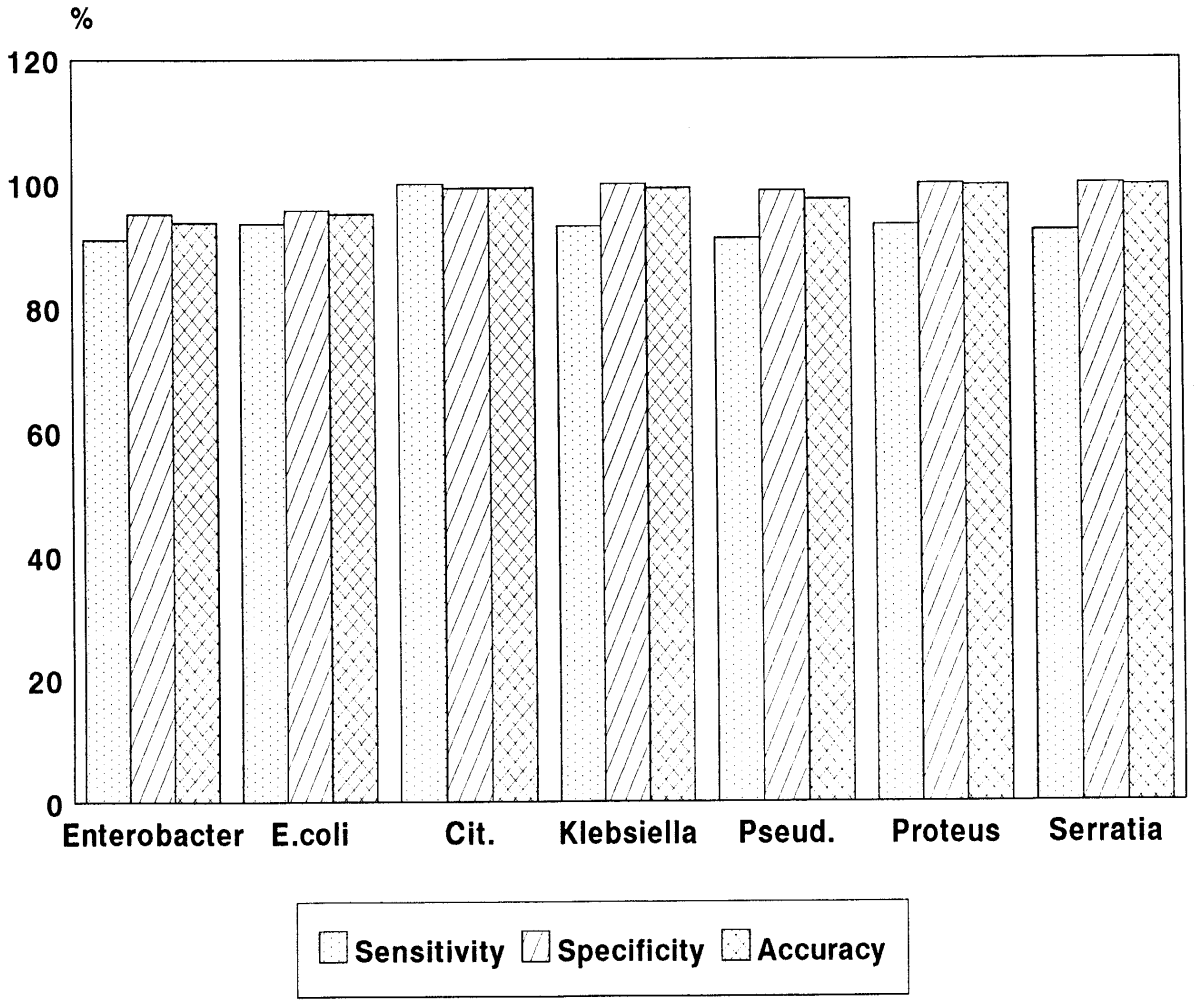


Table (20) : Staph. spp. identification by automated system in comparison with API (n=246).

Organism	Methods				Sensitivity	Specificity	Accuracy
	API		Automation				
	No	%	No	%			
Staph. aureus	146	59.35	146	59.35	100	100	100
Staph epidermidis	68	27.64	68	27.64	100	100	100
Staph. haemolyticus	10	4.1	10	4.1	80	99.1	98.4
Staph. saprophyticus	7	2.84	5	2.03	57.1	99.6	98.4
Staph. warneri	4	1.63	4	1.63	75	99.6	99.2
Staph. lentus	4	1.63	5	2.03	75	99.2	98.8
Staph. simulans	3	1.22	3	1.22	66.7	99.6	99.2
Staph. capitis	2	0.81	2	0.81	50	99.6	99.2
Staph. hominis	1	0.41	3	1.22	100	99.2	99.2
Staph. chromogen	1	0.41	0	0	0	100	99.6
Toatl	246	100	246	100			

Fig. (4) : Staph. spp. identification by automated system in comparison with API

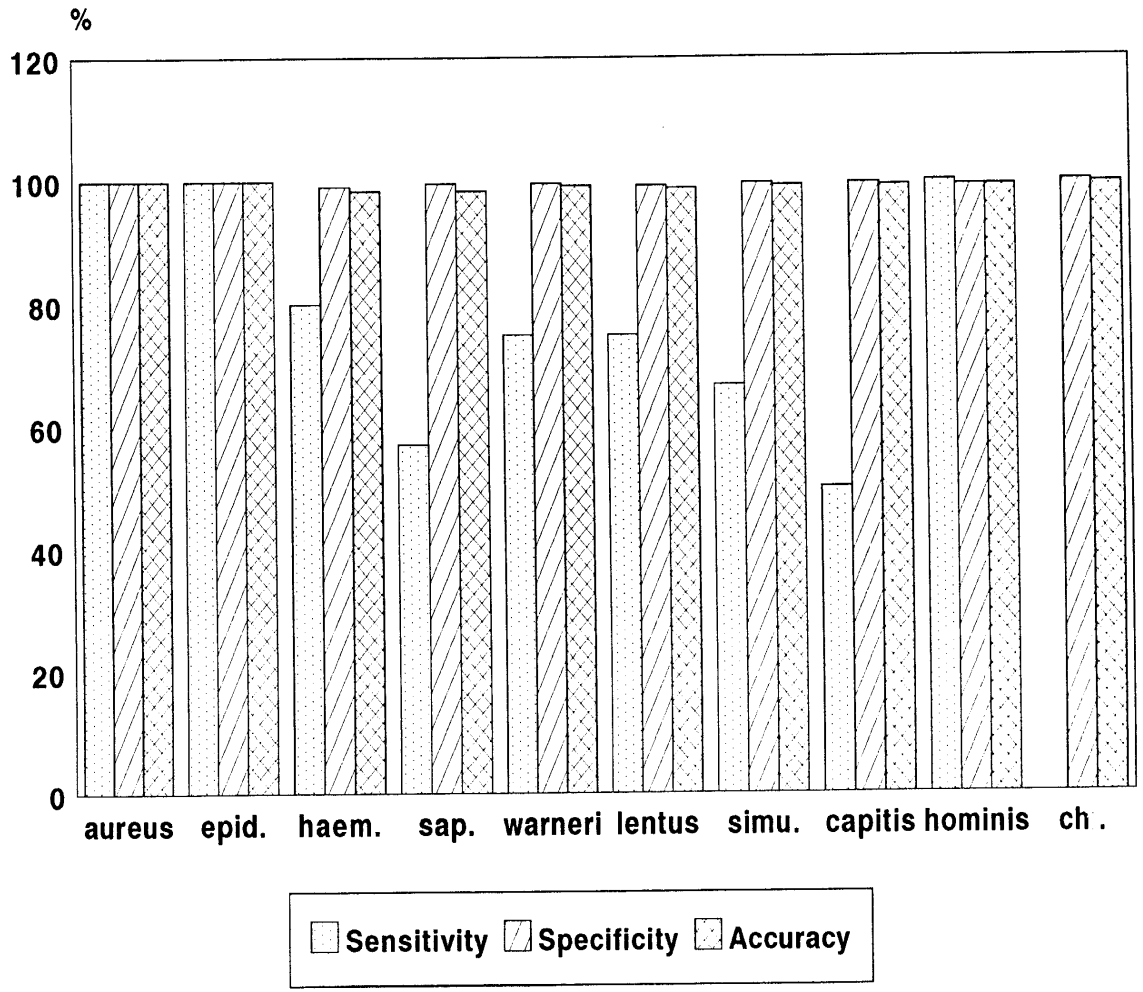


Table (21) : Anaerobic bacilli Identification by automated system in comparison with API (n=16).

Organism	Method				Sensitivity	Specificity	Accuracy
	API		Automation				
	No	%	No	%			
Bacteroid fragilis	7	43.75	7	43.75	100	100	100
Bacteroid distasonis	3	18.75	2	12.5	66.7	100	93.7
Bacteroid vulgatis	2	12.5	2	12.5	100	100	100
Clostriduim perferinges	2	12.5	2	12.5	100	100	100
Clostridium difficile	2	12.5	3	18.75	100	92.8	93.7
Total	16	100	16	100			

Fig. (5) : Anaerobic bacilli identification by automated system in comparison with API

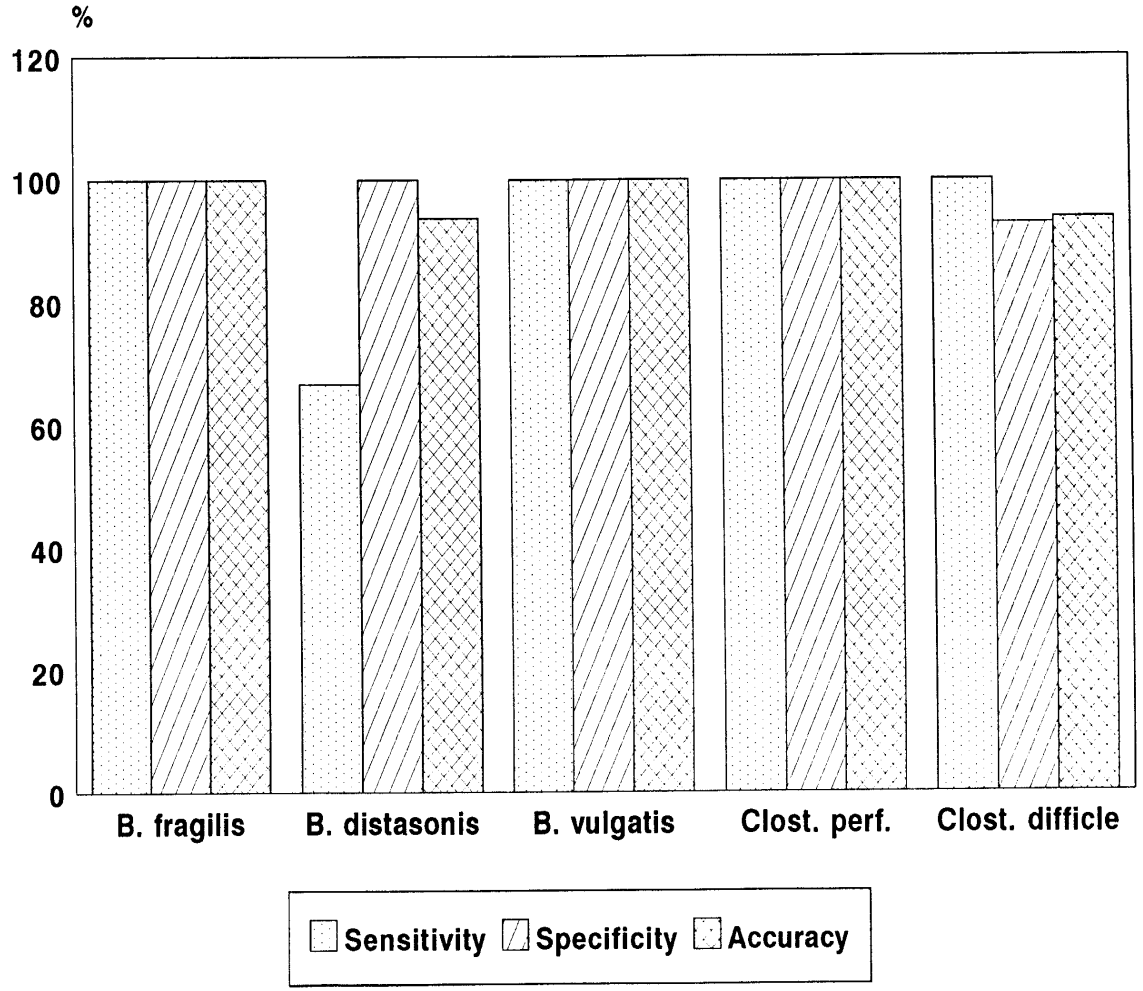
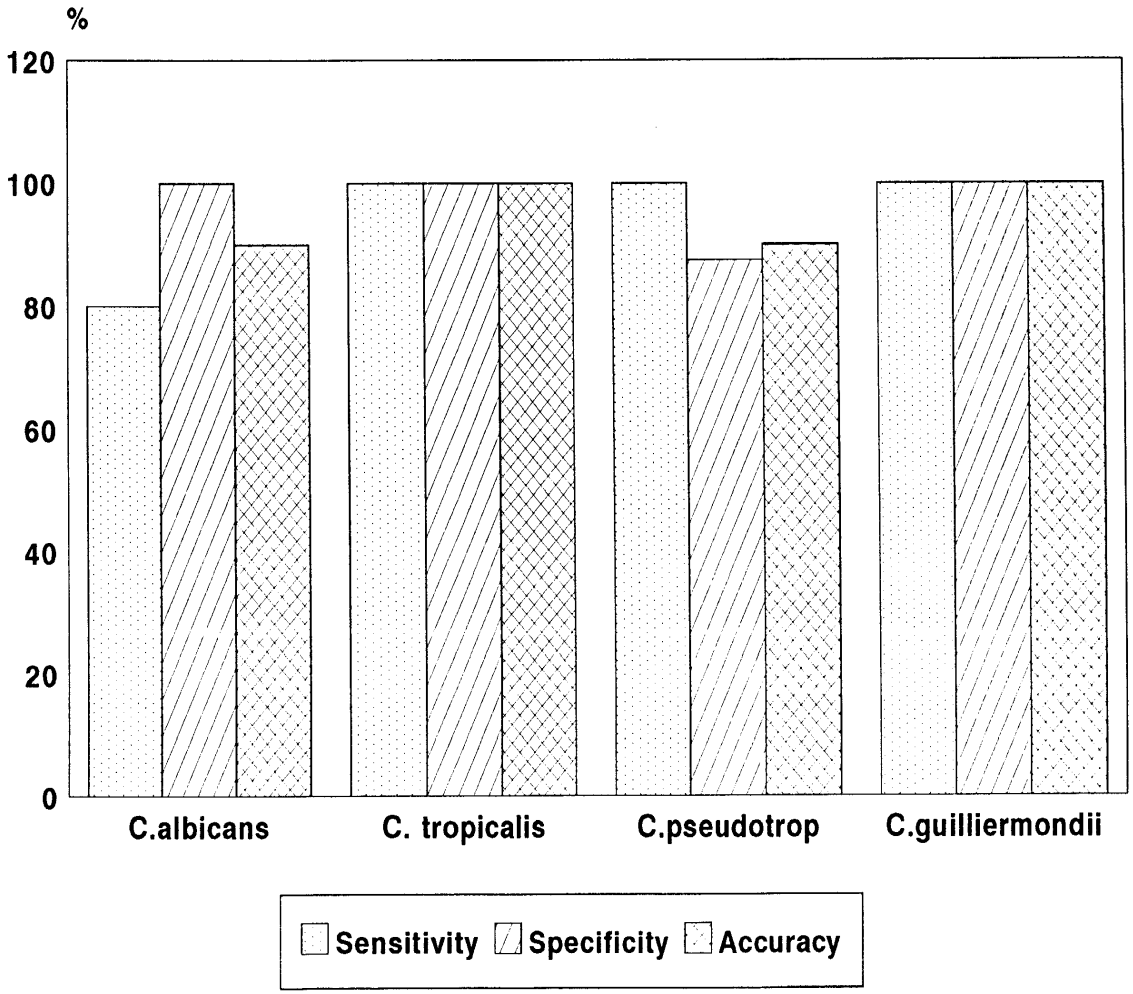


Table (22) : Candida spp. Identification by automated system in comparison with API (n=10).

Organism	Method				Sensitivity	Specificity	Accuracy
	API		Automation				
	No	%	No	%			
Candida albicans	5	50	4	40	80	100	90
Candida tropicalis	1	10	1	10	100	100	100
Candid pseudotropicalis	2	20	3	30	100	87.5	90
Candida guilliermondii	2	20	2	20	100	100	100
Total	10	100	10	100			

Fig. (6) : Candida spp. identification by automated system in comparison with API



Discussion

Nosocomial infection is the infection acquired in hospital. The majority of these infections are of minor or moderate clinical importance but may cause distressing morbidity, lengthen hospital stay and increase costs. They are one of the major problems all over the world concerning the patients and every member in hospital. When epidemic occurs in hospital, strict typing methods for organisms causing this outbreak are needed (Davies et al., 1992).

The causative organisms are mainly bacterial in origin; while viruses; fungus and protozoae are much less commonly reported as causative agents (Hierholzer and Zervos, 1991). The sources of these organisms may come from patient own flora, environment and from other patients (Shanson, 1989).

Bacterial identification can be performed by detecting their utilization of different substrates as source of carbon and nitrogen through the use of conventional tube method. Manual identification systems as API are also available with easier manipulation but does not provide the same day results (York et al., 1992). Therefore rapid automated systems have been developed for rapid identification and antibiotic sensitivity within few hours for wide range of aerobes, anaerobes and yeasts (Stager and Davis, 1992).

The aim of this study is to identify types of microorganisms causing nosocomial infections with evaluation of environmental role on its occurrence at Mansoura University Hospitals. In addition, a comparative study is carried out between the automated system "Vitek" and manual methods.

Therefore a total of 1180 samples were collected from December 1993 to August 1995. They were classified into 465 from patients, 680 from environment and 35 from nurses. Patients and nurses samples were subjected to aerobic culture on MacConkey and blood agar plates . Anaerobic culture was carried out on Columbia agar plates in anaerobic station. Fungal culture was performed on Sabauroud's media.

Samples from environment were 100 from neonate intensive care unit (NICU) and 580 from Gastroenterology centre (GEC). They were cultured aerobically on MacConkey and blood agar plates. Fungal culture was done on Sabauroud's media. Also swabs from endoscopes before and after disinfection were cultured on Skirrow's media.

Identification of isolated microbes was done by automated system "Vitek" and API for aerobes, anaerobes and yeasts. Helicobacter pylori was identified by colony appearance on Skirrow's media, urease, catalase and oxidase tests.

Antibiogram was carried out for isolated microbes from patients by disk diffusion and Vitek for aerobes, Candifast for Candida and disk diffusion only for anaerobes.

In this study surgical wound infection was the commonest (40%) followed by urinary tract infection (32.7%), septicaemia (20.21%), upper respiratory tract infection (4.3%) and lower respiratory tract infection (2.79%), table 1.

In Assiut University Hospital, wound sepsis was the commonest infection followed by UTI, chest infections and bacteremia (Ahmed et al., 1993). Also in Mauritius, Jepsen et al., (1993) reported that surgical wound infections were the commonest (8.2%) and UTI (8%).

Controversally in Prague, Sramova et al., (1988) reported that UTI was the commonest (25%) followed by surgical wounds (15%) and URTI (13%).

The distribution of nosocomial infections rates varies according to the specific services, body sites and exposure to invasive techniques, such as surgical operations and catheterization.

In the present study the mean age was 39.43±9.614 for wound infections, 34.87±17.309 for UTI, 20.88±13.46 for septicaemia, 23.89 ± 11.75 for URTI and 43.154±7.15 for LRTI (Table 2).

Similar age distribution was reported by Emori et al (1991). It is observed that the oldest mean age was for patients with LRTI (43.154± 7.15). These infections were common among elderly patients in intensive care unit (ICU).

The frequency of infections between males (63.01%) and females (36.99%) regarding sites of infections was insignificantly different ($P>0.05$), table 3. This may be explained by exposure of both males and females to the same environmental sources causing nosocomial infection.

Biotyping study of the isolated organisms in different sites of infections shows that Staph. aureus had the significantly high prevalence in LRTI (61.55%), wound infection (36.02%) and URTI (35%), $P\leq0.001$. Enterobacter spp. had the significantly high prevalence in septicaemia (35.1%), $P\leq0.001$. E. Coli and Staph. coagulase negative spp. had significantly high prevalence in UTI (26.32%, 23.02% & $P\leq0.01$, $P\leq0.001$ respectively), table 4.

Similarly, Jarvis and Martone (1992) in USA stated that Staph. aureus was isolated at high rate from wound infections, URTI and LRTI, while E. coli and Staph. coagulase negative species were the frequent causative organisms of UTI. On the other hand they found that E.coli was the commonest organism causing septicaemia. Also, in Assiut University Hospital Staph. aureus was the common isolates of wound, chest infections and bacteremia, while Klebsiella, Pseudomonas aeruginosa and Staph. aureus were the common isolates in UTI (Ahmed et al., 1993).

Zaghloul (1993) at Mansoura University Hospital, isolated Staph. aureus in 13.2% from total isolates of wound infection. The changes of the isolation rate of staph. aureus between this study and the previous one could be explained by change of pathogens from time to time.

The high prevalence of Enterobacter spp. may be due to the included a large number of prematures in this study in whom this organism is a major pathogen of them.

In this study, there was statistically significant difference in the distribution of infections between wards, $P \leq 0.001$. In surgical wards the commonest infection was wound infection (68.9%). In medical, paediatric and oncology wards, UTI was the commonest with prevalence rates 72.5%, 56.2% and 60.6% respectively. In surgical ICU, septicemia, LRTI and URTI were the major infections (54.5%, 27.3%, 18.2% respectively). In medical ICU, the major infection was LRTI (66.7%). In neonate intensive care unit, septicaemia was the commonest infection (89.5%), table 5.

Also USA hospitals Hughes and Jarvies (1985), Davies et al., (1992) and Emori and Gaynes (1993) reported that UTI was a common site for nosocomial infection in paediatric and medical wards. Pizzo and Meyer (1989) stated also that UTI was common among cancer patients due to chemotherapy which leads to inflammation of mucous membrane and reduce its effectiveness as a barrier to infections.

Patients in ICUs are at high risk of developing nosocomial infections, due to the severity of the patients illness and exposure to life saving procedures. In addition prematures are vulenerable group for infections, which might be due to the altered immune status of the low birth weight prematures.

Septicaemia is considered an important cause of morbidity and mortality among prematures and adults in ICUs. This was found also by Jolley (1993), Pegues et al (1994) and Tralow (1994).

In addition, respiratory tract infections either upper or lower is common among patients in ICUs. These infections may be attributed to the use of suction equipments, ventilators and long recumbancy of patients.

It is to be noticed that septicaemia was the major infection in NICU and surgical ICU at Mansoura University Hospital. This might be attributed to the frequent use of intravenous catheter, however this infection could be reduced by limitation of use this practice and changing the catheter more frequently.

The intact skin is normally a barrier to the entry of organisms. This barrier is mainly a mechanical one but other factors such as local immunoglobulin A, fatty acids and lysozyme may also contribute to an effective local barrier against infection. When the skin is breached as in surgical operations, infection often results. Factors which may play a rule for developing wound infections include the type of surgical operations

and the degree of microbial contamination of the operative site. Surgical wounds are classified according to these factors into clean wounds which does not involve incision through site with normal flora apart from skin, contaminated clean wound with surgical sites in GIT and infected wounds with incision through infected sites as abscess.

In this study, surgical wounds were contaminated clean (69:35%), infected (16.13%) and clean. (14.5%), table 6.

The high prevalence of contaminated clean wounds was due to the included greater numbers of patients undergoing gastrointestinal operation. These types of operations carry high risk of infections with gastrointestinal flora.

In Saudi Arabi, Twum et al (1992) stated more or less similarly that infection rate was 5.9% in clean wounds , 37.4% in contaminated and 30.2% in infected wounds. In contrary, in Sydney hospitals, McLaws et al., (1988) stated that highest infection rate was for infected wounds (15.0%) , followed by clean wounds (4.8%) then contaminated clean wounds (2.9%).

In contaminated clean wounds, there was statistically significant high isolation rates of Stap. aureus, E. coli, Enterobacter spp. and Staph. coagulase negative spp. (23.65 %, 13.44%, 11.83%, 6.45% respectively, $P \leq 0.05$). In clean wounds Staph. aureus was the common isolate (8.6%).

In infected wounds, Pseudomonas aeruginosa was isolated at a rate of 5.4%. (Table 6).

In fact, the anatomic location of the surgery may leads to the seeding of the surgical site with normal flora such as that from GIT. This would explain the high prevalence of E. coli, Enterobacter spp. and Staph. coagulase negative spp. in contaminated clean wounds. This finding was also shown by Barrett (1992) and by Siegman et al. (1993).

Also the presence of a foreign body which might occur in wounds favour the infection with Pseudomonas aeruginosa (Barrett 1992). Staph. aureus is considered as major pathogen for wound infection and this may explain its significant increase in contaminated and clean wounds.

Among anaerobes, Bacteroid and Clostriduim spp. were isolated from contaminated clean (3.22%, 0.54% respectively) and infected wounds, (3.22%, 1.6% respectively). Table (6).

This is in agreement with previous study at Mansoura University Hospital, which stated that Bacteroid spp. were 8.96% and Clostridium spp. were 1.44% (Zaghloul 1993). Also in India Brook (1989) stated that anaerobes were responsible for 12% of wound infections.

However Arora et al (1990) found that anaerobes were isolated at rate of 17.8% of wound infections. The difference in isolation of anaerobes

may be explained by the difference in types of wounds between this study and the others.

Urinary tract infections were found in 152 patients, 72.4% of them were catheterized. E. coli, Staph. coagulase. negative species, Enterobacter species, Klebsiella spp., Pseudomonas aeruginosa, Citrobacter spp., Proteus spp., Serratia spp. and Candida spp. were isolated with insignificant difference between catheterized and non catheterized patients, $P>0.05$. While Staph. aureus was isolated in statistically significant prevalence in non catheterized patients (19.05%, $P>0.05$). Table (7).

Generally, catheterization is considered to be a major risk factor for UTI as it provides a pathway for microorganisms from the environment to eneter the body and facilitates the transfer of pathogens from one part of the patient's body to another, also it acts as inanimate foci where pathogens can proliferate.

On line, Macfarlane (1985) found that catheterization was the major risk factor in 75% of patients with UTI. However, good nursing practice including antiseptic solution instillation such as chirohexidine 5% in the catheterization system is associated with drop of infection rate to 44% as stated by Mulhal et al., (1988).

The significant increase of Staph. aureus in non catheterized patients noticed in this study might be due to colonization of these patients by

Staph. aureus which is a common nosocomial pathogen. This is in agreement with Sanderson (1996).

The major pathogens causing nosocomial infections are more or less the same in different hospitals. But if the hospital had special care units as NICU or oncology unit opportunistic organisms are usually isolated from these infections. In this study Staph. aureus had statistically significant higher prevalence in surgical ICU (54.5%) , medical ICU (50%), paediatric wards (31.2%), surgical wards (27.9%) and medical wards (20%) $P \leq 0.001$. But, Enterobacter spp. had statistically significant higher prevalence in NICU (42.1%) and in oncology unit (33.3%) $P \leq 0.001$. Table (8).

Similarly Jarvis and Martone (1992) and Emori and Gaynes (1993) stated that Staph. aureus was the commonest nosocomial pathogen in USA hospitals. Also, in Assiut University Ahmed et al., (1993) found that Staph aureus was the major pathogen causing nosocomial infections. However Enterobacter species may be considered as an opportunistic organism causing infections in prematures and in patient with malignancy. This is accepted by Pizzo and Meyers (1989) and Gallagher (1990).

In paediatric ward the commonest organisms were Staph. aureus (31.2%), E. coli (22.9%) and Staph. con. (14.6%). While in NICU the commonest organisms were Enterobacter spp. (42.1%), E. coli (15.8%) and Staph. coagulase negative spp. (14.5%). Table (8).

Inspite that NICU is a sector from paediatric word, it is to be noticed that the commonest organism causing paediatric infection was Staph. aureus while the commonest organism causing premature infection was Enterobacter spp. This may denotes active isolation measures between them.

Aiming at tracing the source of infection in environment, two examples were studied at NICU and GEC.

From NICU 100 samples were taken. Samples which revealed growth were 20% while 80% of samples were sterile. Samples with no growth were from formula of feed, feeding bottles, furnitures and bed linen, intravenous fluid bottles and antiseptic solution, table (9). The absence of growth from these samples gives attention that other environmental sources may be the cause of prematures infections.

Organisms isolated from NICU environment were Enterobacter cloacae (50%) from waste containers , Staph. aureus (30%) and Klebsiella oxytoca (10%) from air and Pseudomonas aeruginosa (10%) from suction equipment. There was significant correlation between organisms isolated from prematures (n=76) and from environment (n=20), ($r = 0.741$- $P \leq 0.001$). Culture from hands and noses of nurses yield no growth. Table (10).

Similarly in a study done by Larson et al., (1985) and Grundmann et al., (1993) , Pseudomonas aeruginosa was isolated from suction equipment

and Klebsiella spp. from air in old crowded nursery. Isolation of Enterobacter cloacae in this study might be attributed to the presence of disposable napkins of prematures in the unit. Also, Staph. aureus isolation from air may be related to the visitors of the unit.

Positive correlation between organisms isolated from prematures and their environment, might be due to colonization of babies by organisms found in nursery environment. Over crowding in NICU assist in occurrence of this colonization. So the rate of prematures infections may be reduced with good spacing of the babies and reducing visitors of this unit to a minimal level.

The absence of organisms from nurses may be due to the practice of hand washing and good general hygienic conditions with absence of dermatological diseases. This is accepted also by Ayliffe et al., (1988).

The second example of environmental study were done in GEC. Samples were collected from GEC surgical theaters after sterilization with formaldehyde vapour, yield no growth (Table 11).This denotes effective sterilization performed in this centre.

For nurses, 20% of them were carriers of Staph. aureus in their hands. There was positive significant correlation between the rates of Staph. aureus isolation from them and that isolated from patients (30.1 %), $r = -0.7679$, $P \leq 0.001$. (Table 11).

This is in agreement with Akonai et al. (1992) who reported isolation rate 17% for Staph. aureus from surgical staff and this may be the cause of post operative wound infections with this organism. Nevertheless, higher isolation rate of Staph. aureus was found by Cookson et al., (1989) which was 50%.

This rate of Staph. aureus carriage in nurses may be either true carriage state or following nursing of infected patients. So, effective hand washing practice with water, soap and chlorhexidine solution must be taken into consideration after nursing of patients with Staph. aureus infections.

In this study the effect of disinfection of gastroduodenal endoscopes by cetridine solution (3% cetrimide, 0.3% chlorhexidine gluconate) was evaluated.

The isolated organisms before disinfection were Staph. aureus (10%), Staph. epidermidis (11%), Staph. saprophyticus (0.5%), E.coli (4%), Pseudomonas aeruginosa (7.5%), Enterobacter cloacae (1%) and H. Pylori (14%). (Table 12) .

On line Langenberg et al (1990) reported similar finding that major organisms contaminating endoscopes were Pseudomonas aeruginosa, E. coli, Staph. aureus and H. pylori.

After disinfection by cetridine there was disappearance of Staph. saprophyticus, Pseudomonas aeruginosa, E. coli and Enterobacter cloacae. While there was significant decrease in Staph. aureus (3%), and H. pylori (1%), ($P \leq 0.05$, $P \leq 0.001$ respectively). Also cases with no growth were significantly increased (90%, $P \leq 0.001$).

It is noticed that cetridine solution had the greatest activity against Gram negative bacilli and to a less extent Gram positive cocci. However in the effective disinfection technique there must be total absence of living organisms (El-Battawi, 1983). Various antiseptic solutions are used in hospitals according to the type of organisms to be eradicated such as chlorhexidine and hypochlorite for Gram negative bacilli, yeasts and viruses. But, for endoscopes the prefered antiseptic solution is gluteraldehyde 2% for 10-15 minutes because of its wide spectrum activity against bacteria, yeasts and viruses inspite of its irritating smell as reported by Langenberg et al (1990).

Antimicrobial agents have a profound effect on the character of nosocomial infections. The morbidity and the length of hospital stay are higher among patients infected with resistant pathogens than among patients infected with susceptible pathogens. In addition eradication of susceptible organisms is easier than that of resistant types.

From antibiogram study for Gram negative bacilli (in sites other than UTI), Enterobacter spp. were sensitive to amikacin (95.2%), tobramycin (91.9%), and gentamcin (87.1%). E. coli was sensitive to tobramycin

(95.6%), amikacin (93.3%) and gentamicin (91.1%). Pseudomonas spp. were sensitive to tobramycin (95.6%), amikacin (90.9%) and gentamicin (81.8%).

So, collectively Gram negative bacilli (in sites other than UTI), were sensitive to amikacin (92.7%), tobramycin (92.1%) and gentamicin (87.2%). They were resistant to ampicillin (81.6%), tetracycline (81.8%) and cephalothin (80.6%). Table 13.

Similar patterns of antibiotic sensitivity for Gram negative bacilli were reported by Chan et al (1993) who found that aminoglycosides are still the most active agents against Gram negative infections while Bérézin et al. (1993) reported their resistance to ampicillin, tetracycline and cephalothin.

Gram-negative bacilli species that were isolated in UTI, Enterobacter spp. were sensitive to nitrofurantion (92%), tobramycin and ciprofloxacin (88%) for each, ceftazidime and gentamicin (84%) for each. E. coli was sensitive to tobramycin (92.5%), ciprofloxacin, ceftazidime and nitrofuratoin (90%) for each. Klebsiella species were sensitive to nitrofurantoin (100%), ceftazidime and ciprofloxacin each 92.3% and tobramycin (84.6%).

Collectively, Gram negative bacilli species that were isolated in UTI were sensitive to ciprofloxacin (91.1%), ceftazidime (88.1%),

nitrofurantoin (87.1%), and tobramycin (85.1%). They were resistant to ampicillin (85.2%), trimethsulfa (78.2%) and ticarcillin (77.3%). Table 14

This pattern of sensitivity was accepted by Giamarellou et al (1984) and Berezin et al (1993) who reported sensitivity of Gram negative bacilli species to members of 3rd generation cephalosporines, quinolones and urinary antiseptic such as nitrofurantoin.

It is to be noticed that homogenous pattern of antibiotic sensitivity of Gram negative bacilli species might denote similarity of the isolated strains from different species.

Regarding antibiogram for Staph. species (in sites other than UTI), Staph. aureus was sensitive to ciprofloxacin (94.9%), oxacillin (93.9%), clindamycin (91%) and vancomycin (89.8%), while it was resistant to penicillin G (97.9%).

In UTI, Staph. aureus was sensitive to each of nitrofurantoin, norfloxacin, gentamicin (90.9%), vancomycin (81.8%) and clindamycin (72.7%). It was resistant to penicillin G (90.9%), erythromycin (90.9%) and cephalothin (84.6%).

Staph. con. species (in sites other than UTI) were sensitive to ciprofloxacin and clindamycin (93.3%), for each oxacillin (83.3%) and vancomycin (80%). They were resistant to penicillin (96.7%). While in UTI they were sensitive to gentamicin (91.4%), norfloxacin (88.6%),

nitrofurantoin (85.7%), each of vancomycin and clindamycin (74.3%). They were resistant to penicillin G (94.3%) and each of erythromycin and tetracycline (88.6%). Tables 15,16.

Collectively Staph. spp. were sensitive to clindamycin, vancomycin and were resistant to penicillin G.

Similarly, Berezin et al (1993) reported that Staph. species were sensitive to quinolone, clindamycin, vancomycin and gentamicin, while resistant to penicillin, erythromycin and first cephalosporine generation was common.

This pattern of antibiogram for Staph. species may denote similarity in isolated strains.

Anaerobes, were sensitive to metronidazole and chloramphenicol (100%), followed by imipenem (81.3%) piperacillin and cefoxitin each (62.5%). Table 17

This was noticed also by Cuchural et al., (1988) who they found that chloramphenicol and metronidazole are the most active drugs in treatment anaerobes. In addition, imipenem, piperacillin and cefoxitin are effective agents in treatment of anaerobic infections.

It is to be noticed that a combination of amikacin or tobramycin and ciprofloxacin may be used as effective prophylactic regimens in preventing

wound infections especially in the liable wounds (contaminated and infected wounds) and for prevention of occurrence of UTI in catheterized patients.

On the other hand empirical use of amikacin or tobramycin and oxacillin in treatment of septicaemia may be effective especially for prematures.

As regard antifungal agents, 30% of isolated Candida were sensitive to nystatin, while 20% were sensitive to amphotericine B and ketoconazol. Table 18.

This is in agreement with Rodriquez (1992) who also reported that nystatin is the first drug of choice against Candida, it is highly sensitive in 39% of cases followed by amphotericine B (20%).

A comparative study between automated system "Vitk" and API was carried out for identification of Gram negative bacilli, the sensitivity of automated system was ranging from 90.9% to 100%, specificity from 95.1 to 100% and accuracy from 93.7 to 99.7% in comparison with API. (Table 19)

This was in agreement with Pfaller et al (1986) and Colonne et al (1990) who stated that accuracy of this system was 97.9% and 94.7% for Gram negative bacilli identification as compared with API .

Staph. species, identification by automated system showed sensitivity specificity and accuracy 100% for identification of Staph. aureus and Staph. epidermidis as compared with API. (Table 20).

Similarly Mathews et al (1990) reported that Staph. aureus and Staph. epidermidis were correctly identified by this automated system in 100%.

For identification of other Staph. species, this system showed specificity from 99.1% to 100% and accuracy from 98.4% to 100%. (Table 20)

Almeida et al (1983) found that automated system had accuracy of 85% for identification Staph. species other than Staph. aureus and Staph. epidermidis.

As regard anaerobes, the sensitivity, specificity and accuracy of automated system were 100% for the identification of Bacteroid fragilis, Bacteroid vulgatis and Clostridium perferinges. While for C. difficile, sensitivity was 100%, specificity 92.8% and accuracy 93.7%. For B. distasonis, sensitivity was 66.7%, specificity 100% and accuracy 93.7%. (Table 21).

Similarly Schreckenberger et al., (1988) reported accuracy of automated system 100% in identification of Bacteroid fragilis and Clostridium perfergenis and accurracy in range of 70.5% to 83.9% for other anaerobes.

The improved accuracy of identification of anaerobes may be due to updating of data base of automated system computer as the previous studies was done before this improvement.

In identification of Candida species, the sensitivity, specificity and accuracy were 100% of automated system for identification of Candida tropicalis and Candida gieulliermondii, while for identification of other Candida species sensitivity ranged from 80% to 100%, specificity from 87.5% to 100% and accuracy from 90% to 100% as compared with APIC. (Table 22)

El-Zaatari et al., (1990) and Riddle et al., (1994) stated similarly that accuracy was 85% and 97.2% respectively for identification of Candida species.

Regarding the comparative study between automated system and disk diffusion for antibiotic sensitivity of Gram negative bacilli and Gram-positive cocci, there was statistically insignificant difference ($P>0.05$). Tables 13,14,15,16.

Nauschuetz and Juchau (1985) reported similarly that there was insignificant difference in reporting antibiotic sensitivity between Vitek system and disk diffusion method for staph. species. However, automated system is superior to disk diffusion when there is a need for rapid

sensitivity measurements within few hours, but it lacks the ability to perform antibiotic sensitivity for anaerobes and yeasts.

It seems from this study, that automated system with its computer capabilities is valuable in rapid identification of wide range of organisms (aerobes, anaerobes and yeast). Moreover it may be life saving as it gives rapid antibiotic determination for the isolated organism (within few heurs). Also it has the capacity to expand its data base and identify new species.

Summary and Conclusion

Nosocomial infection is the infection acquired in hospital. It is one of the major problems all over the world concerning the patients and every member in the hospital. Unless epidemic occurs in hospital, these infections are of minor or moderate clinical importance.

Laboratory identification of the causative bacteria can be performed by detecting their utilization of carbon and nitrogen through conventional tube method. Manual identification systems as API may be used with easier manipulation than tube method, but it does not provide the same day results. Therefore the use of automated systems are encouraged in many laboratories for rapid organisms identification and antibiotic sensitivity.

The aim of this work is to identify types of organisms causing nosocomial infections with evaluation of environmental role in its occurrence at Mansoura University Hospitals. In addition a comparative study is carried out between the automated system "Vitek" and manual methods.

A total of 1180 samples were collected. They were classified as 465 from patients, 680 from environment and 35 from nurses.

All samples were cultured aerobically on MacConkey and blood agar plates. Fungal culture was performed on Sabauroud's media. Anaerobic culture was done for patients samples on Columbia blood agar. In addition

microaerophilic culture on Skirrew's media was done for swabs from gastroduodenal endoscopes.

Identification was done for aerobes, anaerobes and yeasts by the use of automated system "Vitek" and manual "API". Colonies which developed on Skirrow's media were considered H. pylori by colonies appearance as "water droplets", positive oxidase, urease and catalase tests. Antibiogram was carried out for organisms isolated from patients by disk diffusion and Vitek for aerobes, Gram negative curved bacilli, Candifast for Candida and disk diffusion for anaerobes.

The major infections in this study were surgical wound infections (40%) followed by UTI (32.7%), septicaemia (20.21%) then URTI (4.3%) and LRTI (2.79%). The rates of nosocomial infections vary according to the specific services, body sites and exposure to invasive techniques.

The mean age for wound infection was 39.43±9.614, for UTI 34.87± 17.309 for septicaemia 20.88±13.46 for URTI 23.89±11.75 and for LRTI 43.154±7.15. It is observed that the oldest mean age was for LRTI which was common infection in intensive care unit.

Inspite of high prevalence of males (63.01%) than females (36.99%), there was insignificant difference regarding sites of infections between them, $P>0.05$. This may be due to the same exposure to the environmental sources causing nosocomial infections.

From biotyping study of isolated organisms in different sites of infections, Staph. aureus was the commonest in LRTI (61.55%), wound infection (36.02%) and URTI (35%). Enterobacter spp. were the commonest in septicaemia (35.1%), E. coli and Staph. coagulase negative spp. were the commonest in UTI (26.32%, 23.02% respectively). The high prevalence of Enterobacter spp. may be due to the included a large number of prematures in this study in whom this organism was a major pathogen of them.

There was statistically significant difference in distribution of infections between wards, $P \leq 0.001$.

In surgical wards, wound infection was the commonest (68.9%).

In medical, paediatric and oncology wards, UTI was the commonest (72.5%, 56.2%, 60.6% respectively).

In surgical ICU, septicaemia, LRTI and URTI were the commonest (54.5%, 27.3%, 18.2% respectively).

In medical ICU, LRTI was the commonest (66.7%).

In NICU, septicaemia was the commonest (89.5%).

The sites of infections vary according to the service offered by the wards. In surgical wards wound infections was common as the skin was breached in surgical operation. The intact skin is normally a barrier to

infection by its mechanical action, local immunoglobulin A, fatty acids and lysozyme.

Urinary tract infection was a common infection in medical services either for adults or paediatric. Urinary tract infection was common in cancer patients due to chemotherapy leading to inflammation of mucous membrane reducing its effectiveness as a barrier to infection.

Patients in ICUs were at high risk of developing septicaemia and respiratory infections due to severity of underlying illness, exposure to life saving procedures such as intravenous catheter, ventilators and respiratory suction. Prematures were also vulenerable group due to their low birth weight which affect immunity.

In this study surgical wounds were , contaminated clean wounds in surgical sites of GIT (69.35%). There was statistically high prevalence of Staph. aureus (23.65%), E. coli (13.44%), Enterobacter spp. (11.83%) and Staph. coagulase negative spp. (6.45%), $P<0.05$. Anaerobes isolated were Bacteroid spp. (3.22%) and Clostridium spp. (0.54%) The high rate of contaminated clean wounds might be due to great numbers of patients included in this study undergoing operations in GIT with seeding of wounds with gastrointestinal flora.

Infected wounds with incision through infected sites as abscess were (16.13%). Pseudomonas aeruginosa was isolated at high rate (5.4%). Bacteroid spp. were isolated in 3.22% and Clostridium spp. were 1.6%.

Clean wounds which does not involve incision through sites with normal flora apart from skin were 14.5%. There was statistically significant high prevalence of Staph. aureus (8.6%, P≤0.05).

Among 152 cases with UTI, 72.4% of them were catheterized, E. coli, Staph. coagulase negative species, Enterobacter spp., Klebsiella spp., Pseudomonas aeruginosa, Citrobacter spp., Proteus spp., Serratia spp. and Candida spp. were isolated with insignificant difference between catheterized and non catheterized patients, P>0.05. While Staph. aureus was isolated with statistically significant higher prevalence in non catheterized patients (19.05%, P<0.05).

Catheterization represented risk factor for UTI which might be reduced with good nursing practice, instillation of antiseptic solution such as 5% chlorehexidine in the drainage bag and removal of the catheter system early as possible.

In this study, Staph. aureus was the commonest organism isolated in statistically significant rates from surgical ICU (54.5%), medical ICU (50%), paediatric ward (31.2%), surgical wards (27.9%) and medical wards (20%), P≤0.001. Enterobacter spp. had statistically significant high isolation rates from NICU (42.1%) and from oncology unit (33.3%) , P≤ 0.001, it was considered as opportunistic organism.

In paediatric ward the commonest organisms were Staph. aureus (31.2%), E. coli (22.9%) and Staph. con. (14.6%). While in NICU the

commonest organisms were Enterobacter spp. (42.1%), E. coli (15.8%) and Staph con. spp. (14.5%). Inspite that NICU is a sector from the paediatric ward, it is observed that the commonest organism in pediatric infections was Staph. aureus while it was Enterobacter spp. in premature infections denoting active isolation measures between both.

Aiming of tracing the source of infections in environment, two examples were studied at NICU and GEC.

From NICU, 100 samples were taken. samples show no growth were 80%, they were from formula of feed, milk bottles, furnitures and bed linen, intravenous fluid bottles and antiseptic solution.

Samples show growth were 20%. Organisms isolated were (50%) Enterobacter cloacae from waste containers, (30%) Staph. aureus and (10%) Klebsiella oxytoca from air, (10%) Pseudomonas aeruginosa from suction equipment. There was significant positive correlation between organisms isolated from environment and those from premature infections ($r=0.741$-$P\leq 0.001$).

Isolation of Enterobacter cloacae in this study might be attributed to presence of disposable napkines of premature in the unit. Staph. aureus isolation from air may be related to the visitors of the unit. The presence of organisms in the environment may leads to colonization of premature by these organisms and over crowding in NICU help this colonization. The

rate of infections in prematures may be reduced with good spacing of bobies and reducing visitors of this unit to a minimal level.

There was no organisms isolated from nurses in NICU. This may be attributed to good practice of frequent hand washing and absence of dermatological disease.

At GEC, 580 samples were taken : There was no organisms isolated from surgical theatres after sterilization with formaldehyde vapour which means effective sterilization.

Another example for the disinfection process was that used for endoscopes by use of cetridine solution. Culture from endoscopes before disinfection yield growth of Staph. aureus (10%), Staph. epidermidis (11%), Staph. saprophyticus (0.5%), E. coli (4%), Pseudomonas aeruginosa (7.5%), Enterobacter cloacae (1%)and H. Pylori (14%). Cases with no growth were (52%). After disinfection there was disappearance of Staph. saprophyticus, E. coli, Pseudomonas aeruginosa and Enterobacter cloacae. Also there was significant decrease of Staph. aureus (3%, $P \leq 0.05$) and H. pylori (1%, $P \leq 0.01$). Cases with no growth show statistically significant increase (90%, $P \leq 0.001$).

It seems that cetridine solution was more or less effective against Gram negative bacilli and to less extent Gram positive cocci. However for effective disinfection of endoscopes, gluteraldehyde solution 2% is good

and has wide spectrum activity against bacteria, fungus and viruses inspite of its irritant smell.

Antibiogram shows that Gram negative bacilli in sites other than UTI were sensitive to amikacin (92.7%), tobramycin (92.1%) and gentamicin (87.2%). They were resistant to ampicillin (81.6%), tetracycline (81.8%), and cephalothin (80.6%). Gram negative bacilli species in UTI were sensitive to ceftazidime (88.1%), nitrofurantion (87.1%) and tobramycin (85.1%). While they were resistant to ampicillin (85.2%), trimeth-sulfa (78.2%) and ticarcillin (77.3%).

Antibiogram for Staph. species shows that Staph. aureus in sites other than UTI, was sensitive to ciprofloxacin (94.4%), oxacillin (93.9%) clindamycin (91%) and vancomycin (89.8%). While it was resistant to penicillin (97.9%). Staph. con. species were sensitive to ciprofloxacin and clindamycin each (93.3%), oxacillin (83.3%) and vancomycin (80%). They were resistant to penicillin G (96.7%).

In UTI, Staph. aureus was sensitive to nitrofurantoin, norfloxacin gentamicin (90.9% for each), vancomycin (81.8%) and clindamycin (72.7%). It was resistant to penicillin G (90.9%), erythromycine (90.9%)and cephalothin (84.6%). Staph. con. spp. were sensitive to gentamicin (91.4%), norfloxacin (88.6%), nitrofurantoin (85.7%), each of vancomycin and clindamycin (74.3%). They were resistant to penicillin G (94.3%) and each of erythromycin and tetracycline (88.6%).

This homogenous pattern of antibiogram for Gram negative bacilli and Staph. species denote similarity of isolated strains. The antibiotics which were found effective against aerobes such as tobramycin and amikacin for Gram negative bacilli and ciprofloxacin for Staph. species may be used in combination for prophylactic regimens in prevention of wound infections especially liable wounds (contaminated and infected) and for prevention of UTI especially in catheterized patients. In prematures combination of amikacin and oxacillin may be used as empirical antibiotic therapy for septicaemia.

Anaerobes were sensitive to metronidazole and chloramphenicol each (100%), followed by imipenem (81.3%), piperacillin and cefoxitin each (62.5%). For Candida, 30% of isolates were sensitive to nystatin followed by 20% to amphotericine B and ketaconazoles.

Comparative study for organisms identification by automated system "Vitek" and manual "API", for Gram negative bacilli species the sensitivity of Vitek was ranging from 90% to 100%, specificity was from 95.2% to 100% and accuracy was from 93.7% to 99.7%.

For identification of Staph. aureus and Staph epidermidis, the sensitivity, specificity and accuracy of automated system were 100%. For identification of other Staph. species specificity was from 99.1% to 100% and accuracy was from 98.4% to 100%.

For identification of anaerobes, the sensitivity, specificity and accuracy of automated system were 100% for Bacteroid fragilis, Bacteroid vulgatis and Clostridium perferinges. For Bacteroid distasonis the sensitivity, specificity and accuracy were 66.7%, 100% and 93.7% respectively. For C. difficele, the sensitivity, specificity and accuracy were 100%, 92.8% and 93.7% respectively.

For identification of Candida the sensitivity, specificity and accuracy of automated system were 100% for C. tropicalis and C. guillermondii. For C. albicans the sensitivity was 80%, specificity 100% and accuracy 90%. For C. pseudotropicalis, the sensitivity was 100, specificity 87.5% and accuracy 90%.

From the comparative study between automated system "Vitek" and disk diffusion method for antibiogram determination, there was insignificant difference between both, $P>0.05$. However the antibiotic sensitivity reports were available within few hours (6-18 hours) by the automated system, but this system lack the ability to perform antibiotic sensitivity for anaerobes and yeasts.

It seems from this study, that automated system with its computer capabilities is valuable in identification of aerobes, anaerobes and yeasts with rapid antibotic determination for aerobes within few hours. Also it has the capacity to expand its data base and identify new species.

Conclusion

From this study it could be concluded that :-

* The major nosocomial infections at Mansoura University Hospitals were in the following order; surgical wound infection, urinary tract infection, septicaemia, upper and lower respiratory tract infections.

* Staph. aureus was the commonest organism isolated from wound, upper and lower respiratory tract infections. Enterobacter spp. were the commonest isolated organisms from septicaemia. E. coli and Staph. coagulase negative species were the commonest isolated from urinary tract infection.

* In wards:
  - The commonest infections were :
    - Wound infection in surgical wards.
    - urinary tract infection in medical, paediatric and oncology wards.
    - Septicaemia upper and lower respiratory tract infections in surgical ICU.
    - Lower respiratory tract infection in medical ICU.
    - Septicaemia in neonate intensive care unit.

  - The commonest organism was :
  * Staph aureus in surgical, medical, paediatric, surgical and medical ICUs. While Enterobacter spp. were the commonest in NICU and oncology unit.

* Inspite that NICU is a sector from paediatric ward, the commonest organism in paediatric infections was Staph. aureus, while it was Enterobacter in prematures denoting active isolation between both.
* The Study of hospital environment yields that :

- at NICU;

* Samples showed growth were from waste containers (Enterobacter cloacae), air (Klebsiella oxytoca) and suction equipment (Pseudomonas aeruginosa) and there was a significant correlation with their isolation rates from neonates.

- at GEC :

* Effective sterilization of surgical theaters with formaldehyde vapour leads to absence of organisms.
* Inspite the use of cetridine solution as disinfectant for gastroduodenal endoscopes, there was a growth of Staph. aureus and H. pylori after disinfection. This denotes that either the type or the time should be changed.
* There was a significant correlation between isolated Staph. aureus from nurses at GEC and patients. So, frequent checking up is required to diagnose carrier state for proper control of nosocomial infections.
* Gram negative bacilli were sensitive to aminoglycosides and Staph. spp. to quinolones and oxacillin in addition to nitrofurantoin to isolates from UTI. Anaerobes were sensitive to metronidazole and

chloramphenical. Candida species were sensitive to nystatin, ketoconazole and amphotericine B.

* The automated system was proved to be accurate and specific in identification of aerobes, anaerobes and yeasts also in determination of antibiotic sensitivity for aerobes as early as 6 hours.

Recommendation :

1- prophylactic use of amikacin and ciprofloxacin in combination could effectively reduce post operative wound infection. In addition amikacin and oxacillin could be used as empirical therapy to start with in neonatal septicaemia.

2- Cetridine solution could be used to prevent Pseudomonas aeruginosa contamination of suction equipments at NICU.

3- Further studies should be carried out to identify mycobacteria, viruses, yeasts and protozoae as causative agents of nosocomial infections. Molecular biological techniques should be introduced for the epidemiological study.

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الملخص العربى

تعتبر العدوى بالمستشفيات من المشاكل التى تهم المرضى وكل أفراد المستشفى وخاصه عند حدوث وباء .

ويعتمد التشخيص المعملى للميكروبات على الطريقة التقليدية بإستخدام التفاعلات الكيماوية فى الأنابيب وكذلك بالأنظمة اليدوية مثل "API" فهى أسهل لكنها لا تعطى نتيجة سريعه ، وحديثا تلاقى الأجهزة الأتوماتيكية تشجيعا فى معامل كثيرة حيث يمكن التعرف على الميكروبات وحساسيتها للمضادات الحيوية خلال ساعات.

والهدف من هذا العمل التعرف على أنواع الميكروبات المسببه للعدوى بمستشفيات المنصورة الجامعية وتقييم دور الوسط المحيط بالمرضى فى حدوثها بالإضافة الى مقارنة نتائج أنواع البكتيريا المعزولةوحساسيتها للمضادات الحيوية بإستخدام الجهاز الميكروبى الأوتوماتيكى والطرق اليدوية.

وقد تم تجميع ١١٨٠ عينه وقسموا إلى ٤٦٥ عينه من المرضى ، ٦٨٠ عينه من الوسط المحيط بالمرضى (١٠٠ عينه من وحدة العناية المركزة لحديثى الولادة ، ٥٨٠ عينه فى مركز الجهاز الهضمى) ، ٣٥ عينه من الممرضات.

تم زرع العينات هوائيا على مستنبتات الماكونكى والدم ومستنبتات سابارود للفطريات ، أما المزارع اللاهوائية فقد زرعت على مستنبت كولومبيا وزرعت مسحات من المناظير المعوية على مستنبتات سكيرو فى وجود ٥٪ أكسجين فقط.

تم التعرف على الميكروبات الهوائية ، اللاهوائية والفطريات بإستخدام الجهاز الأوتوماتيكى "Vitek" واليدوى "API". أما ميكروب الهليكوباكتر البطى النمو السريع الهلاك فقد تم التعرف عليه بمظهر المستعمرات على مستنبت سكيرو كقطرات الندى ، وبصبغة الجرام هو عصوى منحنى الشكل ، أيجابى التفاعل لليوريز ، الأوكسيديز والكاتاليز .

وقد عملت إختبارات حساسية للمضادات الحيوية للميكروبات الهوائية المعزوله من المرضى بطريقة أقراص الحساسية وكذلك "Vitek" والكانديفاست للكانديدا وأقراص الحساسية للميكروبات اللاهوائية ٠

وفى هذه الدراسة وجد أن العدوى الرئيسية كانت عدوى الجروح (٤٠٪) تليها عدوى الجهاز البولى (٧ر٣٢٪)، التسمم الدموى (٢١ر٢٠٪) ثم عدوى الجهاز التنفسى العلوى (٣ر٤٪) وعدوى الجهاز التنفسى السفلى (٧٩ر٢٪)٠ وتختلف نسبة عدوى المستشفيات تبعا للخدمات المقدمة فى الأقسام وأجزاء الجسم الأكثر تعرضا للعدوى٠

كان متوسط العمر لعدوى الجروح ٤٣ر٣٩ ±٦١٤ر٩ ، لعدوى الجهاز البولى ٨٧ر٣٤±٣٠٩ر١٧ ، للتسمم الدموى ٨٨ر٢٠ ± ٤٦ر١٣ ، لعدوى الجهاز التنفسى العلوى ٨٩ر٢٣ ±٧٥ر١١ ولعدوى الجهاز التنفسى السفلى ١٥٤ر٤٣ ± ١٥ر٧ ، ويلاحظ أن أكبر متوسط الأعمار كانت لعدوى الجهاز التنفسى السفلى لمرضى العناية المركزة ٠

على الرغم من أرتفاع إنتشار العدوى فى الذكور (٠١ر٦٣٪) عن الإناث (٩٩ر٣٦٪) ، فأنه لم يوجد إختلاف إحصائى بينهم ($P<0.05$) وذلك لتعرضهم لنفس مصادر العدوى بالمستشفيات ٠

فى دراسة أنواع الميكروبات المعزولة من أماكن العدوى المختلفة وجد أن الميكروب العنقودى الذهبى هو الأكثر شيوعا فى عدوى الجهاز التنفسى السفلى (٥٥ر٦١٪) / الجروح (٠٢ر٣٦٪) ، عدوى الجهاز التنفسى العلوى (٣٥٪)٠ وكان ميكروب الإنتروباكتر هو الشائع فى حالات التسمم الدموى (١ر٣٥٪)٠ أما ميكروبى أ٠ كولاى والميكروبات العنقودية سالبة التجلط فكانوا شائعين فى التهابات الجهاز البولى بنسبة ٣٢ر٢٦٪ ، ٠٢ر٢٣٪ على التوالى٠ ويعزى إنتشار ميكروب الإنتروباكتر فى هذه الدراسة إلى وجود عدد كبير من المبتسرين حتى كان الميكروب الرئيسى لهم ٠

وجد إختلاف ذو دلالة إحصائية فى توزيع العدوى بين أقسام المستشفى ($P\leq0.001$)٠

ففى أقسام الجراحه كانت العدوى السائدة هى عدوى الجروح (٩ر٦٨٪)، حيث أن قطع الجلد أثناء العمليات الجراحية يقلل من كفاءة الجلد كعامل لمنع العدوى.

فى أقسام الباطنه ، الأطفال والأورام كانت عدوى الجهاز البولى هى الأكثر شيوعا بنسبة ٥ر٧٢٪ ، ٢ر٥٦٪ ، ٦ر٦٠٪ على التوالى. ويرجع إنتشار عدوى الجهاز البولى فى مرضى الأورام للعلاج الكيماوى الذى يقلل كفاءة الغشاء المخاطى كعازل للعدوى.

فى العناية المركزة الجراحيه كانت عدوى التسمم الدموى ، عدوى الجهاز التنفسى العلوى والسفلى هى السائدة بنسبة ٥ر٥٤٪ ، ٣ر٢٧٪ ، ٢ر١٨٪ على التوالى ، فى العناية المركزة الباطنية كانت عدوى الجهاز التنفسى السفلى هى السائدة بنسبة ٧ر٦٦٪ . بينما فى العناية المركزة لحديثى الولادة كانت عدوى التسمم الدموى هى السائدة بنسبة ٥ر٨٩٪ .

ومرضى العناية المركزة معرضين للتسمم الدموى عدوى الجهاز التنفسى وذلك لحاجتهم لإستخدام أجهزة المحاليل وأجهزة الشفط من الجهاز التنفسى . كذلك فإن الميتسرين معرضين لتلك العدوى بسبب نقص أوزانهم التى قد تؤثر على مناعتهم.

فى هذه الدراسة قسمت الجروح الى :-

جروح ملوثه نظيفه كتلك التى فى الجهاز الهضمى بنسبة (٣٥ر٦٩٪) ويوجد بها زيادة إحصائية فى إنتشار الميكروب العنقودى الذهبى (٦٥ر٢٣٪) ، أ. كولاى (٤٤ر١٣٪) ، الإنتروباكتر (٨٣ر١١٪) والميكروبات العنقوديه سالبة التجلط (٤٥ر٦٪). أما الميكروبات اللاهوائية فكانت الباكتيرويد (٢٢ر٣٪) ، وميكروب الكلوستريديم (٥٤ر٪) . وترجع النسبة العالية لتلك النوعية من الجروح لوجود عدد كبير من مرضى جراحات الجهاز الهضمى وتأثرهم بالميكروبات الموجودة الطبيعية.

جروح ملوثه فى أماكن كالخراج وكانت نسبتها ١٣ر١٦٪ وعزل منها ميكروب السيدوموناس إيروجينوزا بنسبة (٤ر٥٪) ، الباكتيرويد بنسبة ٢٢ر٣٪ والكلوستيريديم بنسبة ٦ر١٪.

الجروح النظيفة التى لاتشمل أماكن ذات ميكروبات طبيعية ماعدا الجلد وكانت بنسبة ٥ر١٤٪ وعزل منها الميكروب العنقودى الذهبى بنسبة ذات دلالة احصائية (٦ر٨٪ ، P≤0.05).

فى ١٥٢ حالة من حالات عدوى الجهاز البولى ، وجد أن ٤ر٧٢٪ من المرضى يستخدمون قسطرة ، ولم يوجد إختلاف إحصائى بينهم وبين المرضى بدون قسطرة فى ميكروبات أ.كولاى ، العنقودية التجلط ، الإنتروباكتر ، الكليبسيلا ، السيدوموناس ايروجينوزا ، السيتروباكتر ، البروتيس ، السيريشيا والكانديدا ، بينما عزل الميكروب العنقودى الذهبى بنسبة ذات دلالة احصائية (٠٥ر١٩٪ ، P<0.05) فى المرضى بدون قسطرة. ومن الممكن خفض خطورة إستعمال القسطرة بالتمريض الجيد وبوضع ٥٪ كلورهكسيدين فى كيس تجميع البول وإزالة القسطرة مبكرا قدر الإستطاعة.

إختلف إنتشار الميكروبات بين مرضى الأقسام حيث كان ميكروب العنقودى الذهبى هو السائد بدلالة إحصائية فى حالات العناية المركزة الجراحية (٥ر٥٤٪) ، العناية المركزة الباطنية (٥٠٪) ، قسم الأطفال (٢١ر٣١٪) ، أقسام الجراحة (٩ر٢٧٪) ، اقسام الباطنة (٢٠٪). بينما كان ميكروب الإنتروباكتر والذى يعتبر ميكروب أنتهازى هو السائد بدلالة احصائية فى حالات وحدة العناية المركزة لحديثى الولادة (١ر٤٢٪) ، وفى وحدة الأورام (٣ر٣٣٪).

وبمقارنة الميكروبات فى مرضى وحدة العناية المركزة لحديثى الولادة بتلك المعزولة من مرضى الأطفال كانت الميكروبات الأكثر شيوعا فى المبتسرين هى الإنتروباكتر (١ر٤٢٪) ، أ.كولاى (٨ر١٥) العنقودية سالبة التجلط (٥ر١٤٪) ، بينما فى الأطفال كانت العنقودية الذهبية (٢ر٣١٪) ، أ.كولاى (٩ر٢٢٪) والعنقودية سالبة التجلط (٦ر١٤٪). وعلى

الرغم من أن وحدة العناية المركزة لحديثى الولادة جزء من قسم الأطفال فقد كان الميكروب العنقودى الذهبى هو السائد فى الأطفال بين كان الإنتروباكتر هو السائد فى المبتسرين مما يدل على كفاءة العزل السائد بين القسمين .

ولتتبع مصدر العدوى فى المستشفيات أخذت عينات من وحدة العناية المركزة لحديثى الولادة ومركز الجهاز الهضمى كمثلين للدراسة :

من وحدة العناية المركزة لحديثى الولادة ، أخذت ١٠٠ عينة :

وجد أن ٨٠٪ من العينات خالية من الميكروبات وكانت من غذاء المبتسرين ، زجاجات الرضاعة ، الأثاث والمفروشات ، زجاجات المحاليل وسوائل التعقيم.

وجدت ميكروبات فى ٢٠٪ من العينات ، وكانت الميكروبات المعزولة ٥٠٪ إنتروباكتر كلواكى من حاويات القمامة ، ٣٠٪ العنقودية الذهبية و ١٠٪ كليبسيلا أوكسيتوسا من الهواء ، ١٠٪ سيدوموناس إيروجينوزا من جهاز الشفط ، وقد وجدت علاقة إيجابية ملحوظة بين المعزولة من البيئة ومن تلك المعزولة من عدوى المبتسرين ($r=0.741$ - $P \leq 0.001$) ويعزى عزل الانتيروباكتر الى وجود الحفاضات المستخدمة فى حاويات القمامة بالوحدة ، كما أن عزل الميكروب العنقودى الذهبى من الهواء قد يكون له علاقة بالزائرين . ووجود هذة الميكروبات فى البيئة من الممكن أن تنتقل الى المبتسرين يساعد على ذلك كثرة عدد المبتسرين. لذلك من الممكن خفض العدوى بين المبتسرين بوجود مسافات كافية بينهم وتقليل عدد الزوار للحد الأدنى وقد يتوفر هذا فى مستشفى الأطفال الجديد .

بالنسبة للممرضات فى وحدة العناية المركزة لحديثى الولادة فلم يعزل أى ميكروب منهم، وقد يعزى هذا لتكرار غسل الأيدى وعدم وجود أمراض جلدية بينهم .

وفى مركز الجهاز الهضمى لم يعزل أى ميكروب من غرف العمليات الجراحية بعد استخدام غاز الفورمالديهيد ويدل هذا على كفاءة التعقيم .

أما بالنسبة لتعقيم المناظير المعوية بإستخدام محلول السيتريدين فقد أظهرت المسحات قبل التعقيم وجود الميكروب العنقودى الذهبى (١٠٪) ، العنقودى إبيديرميدز (١١٪) ، العنقودى سابروفيتيكس (٥ر٠٪) ، كولاى (٤٪) ، السيدوموناس إيريجينوزا (٥ر٧٪) ، انتيروباكتر كلواكى (١٪) وميكروب الهليكوباكتر (١٤٪) أما ٥٢٪ من المسحات فلم يكن فيها ميكروبات .

وبعد التعقيم إختفت ميكروبات العنقودية سابروفيتيكس ، أ.كولاى ، السيدوموناس إيروجينوزا والأنتروباكتر كلواكى ، وانخفضت انخفاض ملحوظ نسبة العنقودية الذهبية (٣٪ ، $P\leq0.05$) ، وميكروب الهليكوباكتر (١٪ $P\leq0.01$) ، وأرتفعت نسبة المسحات التى لم يكن فيها ميكروبات ارتفاعا احصائيا (٩٠٪ $P\leq0.001$) .

لذلك يمكن إستخدام محلول السيتريدين فى القضاء على السيدوموتاس وخاصة فى أجهزة الشفط فى المبتسرين . وينصح بإستخدام الجليوتيرلدهايد ٢٪ فى تعقيم المناظير حيث أنه فعال ضد البكتيريا ، الفطريات والفيروسات على الرغم من رائحتة النفاذة التى قد تحد من استعماله .

فى ممرضات مركز الجهاز الهضمى عزل الميكروب العنقودى الذهبى فى ٢٠٪ منهم مع وجود علاقة إيجابية ملحوظة بين نسبتها فى الممرضات ونسبتها فى مرضى مركز الجهاز الهضمى ($r=0.7676$ $P<0.001$) . ويمكن تلافى وجود هذا الميكروب فى الممرضات وإنتقاله الى المرضى بتكرار غسل الأيدى وإرتداء القفارات الطبية أثناء العناية بالمرضى .

فى دراسة الحساسية للمضادات الحيوية ، وجد أن العصوبات سالبة الجرام فى أماكن العدوى غير الجهاز البولى كانت حساسة للأميكاسين (٧ر٩٢٪)توبراميسين (١ر٩٢٪)، الجيننااميسين (٢ر٨٧٪) ، وكانوا مقاومين للأمبيسيللين (٦ر٨١٪) تتراسيكلين (٨ر٨١٪) ، والسيقالوثين (٦ر٨٠٪) . بينما فى عدوى الجهاز البولى فقد كانت العصويات حساسة

للسيفتازيديم (١ر٨٨٪) ، نيتروفيرانتوين (١ر٨٧٪)و التوبراميسين (١ر٨٥٪) بينما كانوا مقاومين للأمبيسيللين (٢ر٨٥٪) ، تريمنتلفا (٢ر٧٨٪)و التيكارسيللين (٣ر٧٧٪).

وبالنسبة لحساسية الستاف للمضادات الحيوية فى أماكن غير عدوى الجهاز البولى فقد ظهر أن الميكروب العنقودى الذهبى كان حساس للسيبروفلوكاسين (٩ر٩٤٪)، أوكساسيللين (٩ر٩٣٪)، كليندااميسين (٩١٪) ، والفانكوميسين (٨ر٨٩٪) بينما كانت مقاومة للبنسيللين (٩ر٩٧٪). أما الميكروبات العنقودية سالبة التجلط فكانت حساسة للسيبروفلوكاسين والكليندااميسين (٣ر٩٣٪ ولكل منهما)، أوكساسيللين (٣ر٨٣٪) والفانكوميسين (٨٠٪) وكانوا مقاومين للبنسيللين ج (٧ر٩٦٪).

فى عدوى الجهاز البولى كان الميكروب العنقودى الذهبى حساس لكل من نيتروفيرانتوين ، نورفلوكاسين (٩ر٩٠٪) ، وكان مقاوم للبنسيللين ج (٩ر٩٠٪)، أريثروميسين (٩ر٩٠٪) والسيقالوثين (٦ر٨٤٪)ز وكان الميكروب العنقودى سالب التجلط حساس للجنتاميسين (٤ر٩١٪) ، نورفلوكساسين (٦ر٨٨٪) ، نيتروفيرانتوين (٧ر٨٥٪) ولكل من فانكوميسين وكليندااميسين (٣ر٧٤٪) وكانو مقاومين للبنسيللين ج (٣ر٩٤٪) ولكل من الإريثروميسين والتتراسيكللين (٦ر٨٨٪) .

وهذا النمط المتجانس من الحساسية للعصويات سالبة الجرام للمضادات الحيوية ومجموعات الميكروبات العنقودية يدل على التشابة فى فصائل الميكروبات المعزولة ، ومن الممكن أستخدام المضادات الحيوية الفعاله ضد الميكروبات الهوائية كالتوبراميسين أوالأميكاسيللين والسيبروفلوكساسين فى مجموعة كنظام وقائى لمنع عدوى الجروح خاصه تلك المعرضه للعدوى مثل الجروح الملوثه النظيفة والجروح وأيضا لمنع عدوى الجهاز البولى وخاصه فى حالات أستعمال القسطرة . فى المبتسرين من الممكن أستخدام مجموعة من الأميكاسين والأوكساسيللين فى كعلاج سريع للتسمم الدموى.

كانت الميكروبات اللاهوائية حساسة للميترونيدازول والكلورامفينكول (١٠٠٪ لكلا منهم) وبعد ذلك إمبينيم (٣ر٨١٪) ، بيبراسيللين والسيفوكسيتين (٥ر٦٢٪)، لكل منهم ،

وبالنسبة للكانديدا فأن ٣٠٪ من المعزول كان حساس للنيستاتين و ٢٠٪ للأمفوتيريسين والكيتاكونازول٠

بمقارنة الجهاز الأوتوماتيكى "Vitek" واليدوى "API" وجد أن :-

فى تحديد أنواع العصويات سالبة الجرام فإن حساسية "Vitek" كانت تتراوح من ٩٠ ٪ الى ١٠٠٪ ، وخصوصيته من ١ر٩٥٪ الى ١٠٠٪ ودقته من ٧ر٩٣٪ الى ٧ر٩٩٪٠

الميكروب العنقودى الذهبى والعنقودى أبيديرميدز فإن حساسية وخصوصية ودقة الجهاز الأوتوماتيكى كانت ١٠٠٪ ، بينما فى باقى أنواع الميكروبات العنقودية فإن الخصوصية كانت من ١ر٩٩٪ الى ١٠٠٪ ، الدقة كانت من ٤ر٩٨٪ الى ١٠٠٪ ٠

وفى تحديد نوع الميكروبات اللاهوائية فأن حساسية ، خصوصية ودقة الجهاز الأتووماتيكى كانت ١٠٠٪ للباكتيرويد فراجيليز ، باكتيرويد فالجاتيس والكلوستيريديم بيرفيرجينيس ، للباكيترويد ديستاسونيس فإن الحساسية والخصوصية والدقة كانت ١٠٠٪ ، ٨ر٩٢٪ و ٧ر٩٣٪ على التوالى ٠

لتحديد نوع الكانديدا فإن الحساسية والخصوصية والدقة للجهاز الأوتوماتيكى كانت ١٠٠٪ للكانديدا تروبيكاليز والكانديدا جيلليرموندى ، وللكاندنيرا ألبيكانس فإن الحساسية كانت ٨٠٪ ، الخصوصية ١٠٠٪ والدقة ٩٠٪ وللكانديدا سيدوتروبيكاليز فإن الحساسية كانت ١٠٠٪ ، الخصوصية ٥ر٨٧ والدقة ٩٠٪ فى المقارنة بين الجهاز الأوتوماتيكى "Vitek" وأقراص المضادات الحيوية لإختبار حساسية الميكروبات للمضادات الحيوية فلم يوجد إختلاف إحصائى بين الطريقيتين ($P>0.05$) ، ولكن الجهاز الأوتوماتيكى تنقصه القدرة عمل الحساسية للميكروبات اللاهوائية والفطريات٠

ويبدو فى هذه الدراسة أن الجهاز الأوتوماتيكى والمزود بالكمبيوتر يعتبر ذو قيمة عالية فى تحديد نوع الميكروبات الهوائية ، اللاهوائية والفطريات كما يحدد الحاسية للمضادات

الحيوية خلال ساعات (٦-١٨ ساعة) للميكروبات الهوائية ، بالإضافة إلى قدرته على توسيع المجالات لتحديد أنواع جديدة من الميكروبات ومن الممكن توصيله بالأقسام عن طريق كمبيوتر مركزى لأبلاغ النتائج فور ظهورها.

ويوصى هذا البحث :-

باستخدام المضادات الحيوية الأميكاسين والسيبروفلوكاسين كنظام وقائى قبل العمليات الجراحية وفى المرضى الذين يستخدمون القسطرة بدلا من الإستخدام العشوائى للمضادات الأخرى وكذلك أستخدام الأميكاسين والأوسكاسيللين كعلاج مبدئى لحالات تسمم الدم فى المبتسرين . وباستخدام محلول السيتريدين لتعقيم أجهزة الشفط . باجراء دراسة مستقبلية تشتمل على الميكوباكتيريا الفيروسات والبروتوزوا كأسباب للعدوى بالمستشفيات.

كلية الطب
قسم الباثولوجيا الإكلينيكية

التشخيص الميكروبى الحديث للعدوى بالمستشفيات

رساله مقدمه من

ميساء السيد زكى مصطفى
مدرس مساعد بقسم الباثولوجيا الإكلينيكية

كجزء من المتطلبات للحصول على **درجة الدكتوراه**
فى الباثولوجيا الإكلينيكيه

المشرفون

الأستاذة الدكتورة
أمينة مصطفى عبدالعال
أستاذ الباثولوجيا الإكلينيكية
ورئيس وحدة الميكروبيولوجى والمناعة
كلية الطب – جامعة المنصورة

الأستاذ الدكتور
عادل عبدالغفار السيد
أستاذ طب المجتمع والصحة العامة
وكيل كلية الطب للدراسات العليا والبحوث
كلية الطب – جامعة المنصورة

الدكتور
صلاح عبدالفتاح محمد أغا
استاذ مساعد الباثولوجيا الإكلينيكية
كلية الطب – جامعة المنصورة

١٩٩٦