Chapter

Health Care Associated Infections (HCAIs) a New Threat for World; U-Turn from Recovery to Death

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Abstract

Health care associated infections also termed as nosocomial infections are notable cause of morbidity and mortality especially in resource limited countries like Pakistan. Newborns and aged people have more probability of being infected by Health care associated infections because of immunosuppressant. Central line associated blood stream infections (CLABSI) are considered as one of the promising negotiator associated with Health Care associated infections. Improper health care setting and unaware medical staff play a championship protagonist in prevalence of health care associated infections. Standard hygienic measures should be adopted to reduce risk of Health care associated infections. So, there is a pressing need to take on control policies by Government to handle this dilemma. This chapter gives new intuition to healthcare associated microbes, infections and provides comprehensive detailed on ironic precaution to scientific community.

Keywords: Palindromic rheumatism, Rheumatoid arthritis, Environmental risk factors, Genetic risk factors, Therapies

1. Introduction

In health care safety issues, health care associated infections (HCAIs) are a significant cause of morbidity and mortality in developing countries specially in Pakistan. Environment of hospital favors certain infections during the period of admission patients, these are termed as Health care associated infections. Contaminated equipment's, unaware medical staff, unhealthy hospital environment and not satisfactory standard measures promote Hospital acquire infections, nosocomial infections/Health care associated infections (HCAIs). Prevalence of health care associated infection is high in developing countries due to unhealthy health care settings, where it affects more than 25–30% patients. Unhealthy Standard hygienic measures and risk of HCAIs are directly related which clearly address a pressing need to follow standard hygienic guidelines [1–3]. Prevalence of HCAIs is roughly about 10–30% in developing countries and 5–10% in developed countries [4].

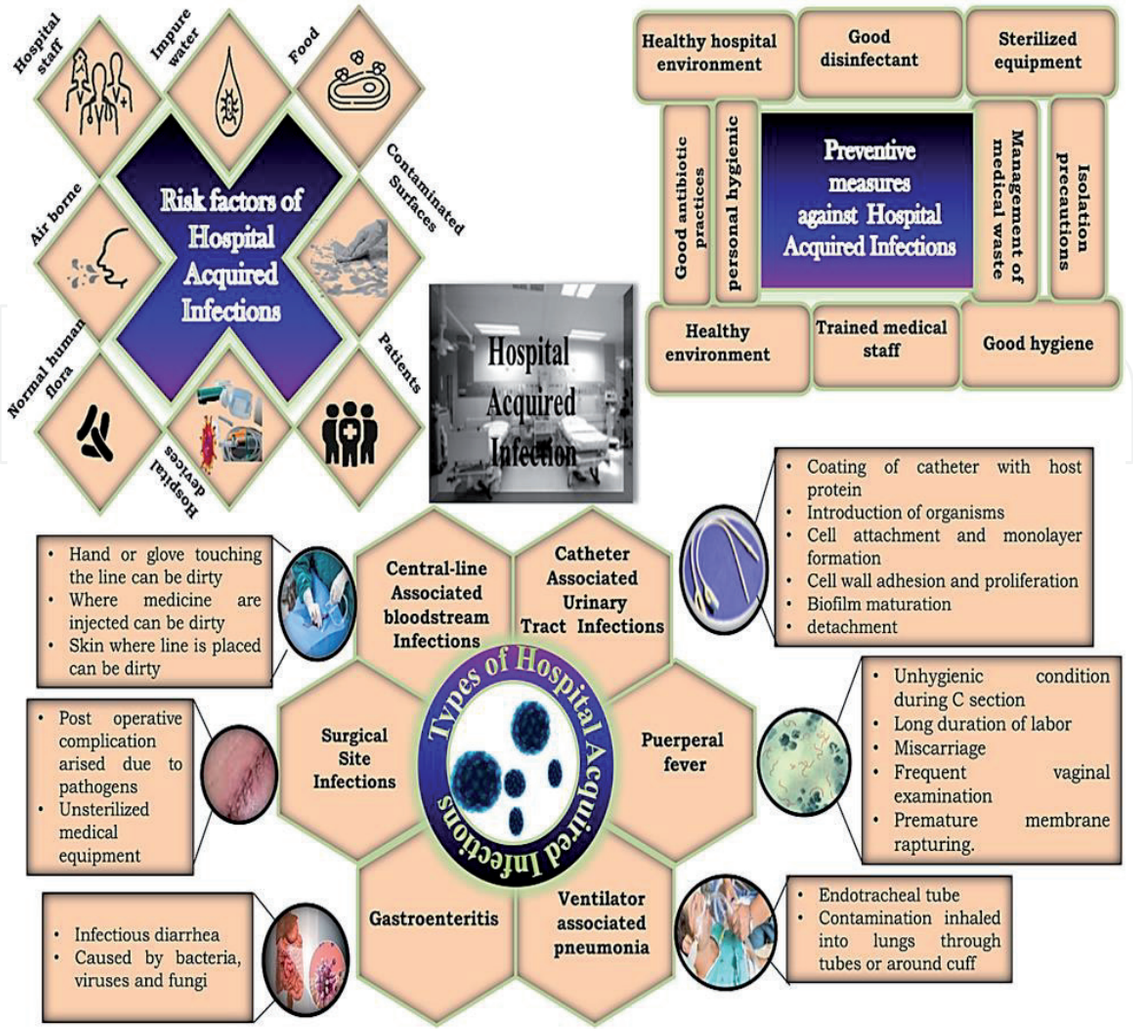

Figure 1.
Overview of hospital acquired infections.

Of all hospitalized patients about 15% are infected by HCAIs. In developing countries ten in every hundred acquire HCAIs. Neonates, patients of organ transplant, patients of burn surgery and patients at Intensive Care Unit (ICU) are more prone to HCAIs. High rate of infection is observed in ICU ward. HCAIs not only down health of patients who are already ill with other diseases but also impose socio economic burden for developing countries by increasing health care cost [5, 6]. This review article not only addresses endemic threat for patients but also covers counter measures to handle this problem as shown in **Figure 1**.

Role of medicines in treatment of diseases is understood by many of us but in recent years awareness about communication of diseases through health care is increased [7]. Ignaz Phillip Semmelweis was medical doctor who realized communication of puerperal sepsis through hospitals. He found increased rate of women death in clinic. To reduce rate of maternal deaths Semmelweis introduced chlorinated lime for hand washing. It is estimated that about 100,000 people are killing in world through HCAIs [8].

This review paper provides us advances knowledge about hospital infections and provide instruction to government for the improvement of medical conditions. In this paper, we have summarized the various health care associated infections by which patients are more vulnerable ultimately conditions will be severe.

2. Types of HCAIs

2.1 Central line-associated bloodstream infections (CLABSI)

Central line-association bloodstream infections are the infections of central venous catheter (CVC) by which catheter tube is only route for microorganisms to enter patient body and central line is required for infections progression within 48 hour [9]. There are two major routes which are adopted by microorganism, intraluminal and extraluminal but intraluminal route is important in the sense of causing severity through catheter hub [10]. In above luminal routes, biofilms are formed due catheter hub infection, composed of bacteria which is formed mostly extracellular matrix within 24 hour of catheter insertion [11]. CLABS-infections leads to cancers and other neurodegenerative diseases in those patients which are immunosuppressant [12], agonize chemotherapy and confess in ICU. Central-Line Insertion [13] is best method to control CLABSIs in ICU patients, but it is very cost effective.

CLABSIs effect the neonatal life, in the form of sepsis which cause the 20–36% [14] due to CVCs. In most cases, the babies which are premature, exposed to CLABSIs, have poor growth [15], high death rate and neurodegenerative diseases. Fever, hypothermia, apnea and bradycardia are most disastrous indicators which are appeared in the 1 year < age children [16]. CLABSIs also effect the adult life, the proportion of gram-negative bacteria including *Klebsiella pneumoniae, E. coli, and Enterobacter cloacae,* exceeded [17] due to translocation from gastrointestinal tract which enhances the bowel wall infections and mucosa infections. All these microorganisms enter the human to mutate the normal body functioning.

The potential pathway for source of microorganism are following catheter insertion site, hands of healthcare worker, contaminated disinfected, patient skin flora during catheter hub operation, contaminated drugs or fluids, catheter infections and hematogenous dissemination as a secondary infections [18]. Through these routes, microorganism enters in body and form biofilm at insertion site. Biofilms contains colony of bacteria which is formed firstly extracellular at catheter site but with a passage of time, move towards intracellular matrix [19]. The pathophysiological features are low metabolic rate, tiniest inhibitory concentration, less vulnerable to antibiotics and high penetrance rate to antibiotic, adapted by microorganism to spread the infections [20].

According recent researches there are 84,000-204,000 [21] people, infected by CLABSIs and 25,000 death. Death incidence rate of CLABSI is about 12–25%. Catheters are used for intravenous therapies, for delivery of specific medicine and specific treatment. Through contaminated infusion of catheter and unhealthy environment microbes gain access to bloodstream which cause CLABSI. Coagulase negative staphylococci for example *Staphylococcus epidermidis*is and *S. aureus* [22] which are most common cause of CLABSI in developing countries including south Korea [23]. According to a study of intensive care unit in Pakistan CLABSI has highest incidence rate in all HCAIs [24].

To overcome such rate, government and hospital admin should adopt following aliments, sterile barrier [25] are used during catheter insertion and use disinfectants in case of intravenous administration [26]. Government should also give priority the potent disinfectants including's, chlorhexidine, povidone iodine, iodophor and 70% alcohol but optimal timing is unclear yet [9]. Awareness in medical staff, PICC site assortment, CVC insertion and maintenance by intervention

bundles, applications skin antiseptics, In-line filters, umbilical catheter, catheter dressing, prophylactic antimicrobial and antimicrobial locks are the methods of preventions for CLABSI.

Awareness in medical staff Basic principle to control any disturbance, educate the people to specific issue. CLABSI incidence rate would be higher day by day than the responsibility of government and hospital admin to educate their staff [27]. Government should also publish proper set of rules and guidelines for maintained and insertion of catheter, insist the staff to follow these rules and do more practice [28]. The potential way to prevent CLABSI, to enrolled only skilled nurse for insertion and upheld of catheter and nurse-to-patient ratio should kept normal specifically in ICU [9].

PICC site assortment Upper and lower limb [29] considered as PICC site but the exact location is unknown yet. Subclavian and femoral vein [30] are the most suitable site for insertion as compare to jugular vein because it is more susceptible for infections and biofilms formation [28].

CVC insertion and maintenance by intervention bundles Intervention bundles (IBs) are widely used to control bloodstream infections and maintenance of CVC but before introducing the IBs, medical staff must be monitored checklist to reassure compliance and the recommendations. Recent health care report revealed that 40% CLABSI patient abridged by using intervention bundles in USA [31].

Applications of skin antiseptics Skin antiseptics stunt the growth of microorganisms on living tissues, 70% alcohol, tincture of iodine or alcoholic chlorhexidine gluconate (CHG)solutions are widely used before inserting catheter [32]. Researchers proved that there is no recommendation for preference or valuable any antiseptics among others but precautions for usage of antiseptic should be followed such as antiseptic must be dried up before inserting catheter and changing the dressing [33]. Most important thing, application of antiseptic (CUG Solution) on infants could lead to skin cancer and neurological disorder. Overindulge of iodine tincture metamorphose the functional veracity of thyroid gland which need iodine to release thyroxin [34, 35].

In-line filter, a device which is used to pour the material into body but not to prevent the CLABSI. According to reported data, there are two inline filters used such 0.2 μ and 1.2 μ used for liquid and large molecule insertion respectively. In-line filter basically reduced the mortality and morbidity in neonates [36].

Umbilical Catheter It is used for monitoring the sickness in neonates through arterial and venous umbilical catheter. So, before inserting the catheter on umbilical site, antiseptic must be applied to prevent complications. Despite of these, antibiotics especially low dose of heparin is also used to control CLABSIs. Optimal time period for catheter is 5 to 14 days either for venous or arteriosus [9].

Catheter dressing including gauze and transparent clothing are mostly used in CLABSI-site until used when the bleeding or oozing is not stunt. But researcher endorsed that antibiotic is not a helpful font to stop these type of infection because antibiotics induced the fungal infections and resist the bacterial at catheter insertion site [9].

Prophylactic antimicrobial is most effective agent to stunt the mortality rate in newborn and resist the microorganisms but the exact mechanism for usage of agent on CLABSI is not clear [37].

Antimicrobial locks including fusidic acid, vancomycin and amikacin are most effective agents to prevent the CLABSI specifically in newborn babies [38].

2.2 Catheter associated urinary tract infections (CAUTI)

Catheterization is a process of introducing urinary catheter into urinary bladder which functions both as therapeutic tool and diagnostic tool. In health care facilities catheter associated urinary tract infections (UTIs) are most common infection. Infection can occur during insertion of catheter and cleaning of catheter if process is done inadvertently. For number of reasons about 25% of all hospitalized patients need catheter and risk of catheter associated urinary tract infection is much higher in Intensive Care Unit (ICU). Among all HCAIs catheter associated urinary tract infection account for about 40% [39, 40], catheter related UTIs 70% and 95% UTIs in intensive care units [41]. To reduce risk of catheter associated urinary tract infections there is a pressing need to follow standard measures during catheterization process and safe maintenance of catheterization. If Catheter associated urinary tract infections are ignored for long time serious kidney disorders may arise [42, 43].

Pandemic nature of CAUTIs, 150 million affect the people annually which show following symptoms such as somber sequelae, recurrences, pyelonephritis with sepsis, blood with urine, catheter obstruction and renal damage [44]. Accounted symptoms are the result of severe complex metabolic reactions due to overdose of antibiotic, frequently usage of antimicrobial drugs such as *Clostridium difficile* colitis.3 [45]. There are two major category of UTIs, complicated UTIs and Uncomplicated UTIs based on pathophysiological complication [46]. In case of uncomplicated UTIs are also known as community-onset-cystitis [47] in which patient remain healthy, not develop any neurological problems of urinary system [48]. These types of complications mostly recorded in female, but infant or older men could be exposed for UTIs [49, 50].

Recent discoveries proved that complicated UTIs totally dependent on physiological pools of patients [51]. If a person has weak immune defense system, renal failure, renal stones, urodynamics and indwelling catherization (IC), are major indicator for UTIS but the IC is most communal agents to progress the infections [52].

E. coli is most common cause of CAUTIs but other are listed in graph:1. These microorganisms progress the infections after 24–48 hours of catheter insertion. Entrance of microorganisms form the biofilms inside the catheter-site, which prevent the action of antibiotics but permit the microorganism to inside the patient body [52]. Microbes divide rapidly to develop infections, patient suffered 3–7% microbes daily after catheter-insertion [53]. These microbes mostly gram-negative bacteria which cause CAUTIs, enter the urinary system via crossing periurethral area [44]. The gram-negative bacteria are potential reservoir of infections, patients of CAUTIs are epidemic in nature so these gram-negative bacteria have efficient resistant again antimicrobial therapies [54]. If a patient remains untreated than this disease become acute [53].

This infection can be diagnosed by urinalysis test which address the presence of leucocytes and nitrites in urine but not detach these compound. The presence of leucocytes and nitrites signpost that a person is suffered from CAUTIs and progression of infections. Leucocytes in urine are the result of, activation of leucocytes esterase (LE), which is immune system product, triggering the malformed and break down of normal WBCs through the action of microorganisms. But the presence of nitrites, developed curiosity in nitrogen-feeding bacterial colony reside inside the catheter site, which break the nitrogen wastes [55].

The most effective way to prevent the CAUTIs, give proper guidance to medical staff and insist the nurse to do more practice [56]. In United Kingdom [57] developed the set rules in the name of "epic3 Guidelines "which based one scientific literature and expertise of medical staff. This booklet proposed that application catheter insertion must be done when there is no alternative because catheter insertion exceed the chance of urinary tract infections [58]. Catheter dressing, sterile catheter bag, length of catheter accordance to patient, gloves and aprons are properly used during catheter-insertion. One most important point to change the urinary drainage bag after every 7 days [55].

2.3 Surgical site infections

After urinary tract infections surgical site infections are most common HCAIs. According to a study about 13% of patients who undergo surgery become infected with Surgical Site Infections and SSI account for about 20% of all Health care associated infections and account for 77% deaths of surgical patients. SSI adopt the pandemic nature; overdose of antibiotic and hospital stay cause the recorded cases in Spain (26.1%) and Europe (19.6%). Reported data shown that SSIs are most common in china, but major microbes associated with SSIs are *E. coli* (25.9%), *S. aureus* (14.3%) and *P. aeruginosa* (11.9%) [25, 59]. Adverse outcomes of SSI include failure of wound healing, increase hospital stay, increase health care cost and mortality. Surgical site infection can occur after days and year of exposure. Center of Disease Control and Prevention (CDC's) classified the SSIs into three major group on the basis of site of infection such as superficial incisional (Skin infection), Deep incisional (Muscle infections) and Organ or Space (any part of body except skin and muscle) [60]. According to WHO resource limited countries like have no more data about surgical site infections. According to an observation study conducted in Pakistan about 6.5% patients who undergoes surgery develop surgical site infections and *Staphylococcus aureus* is most common bacteria that cause SSI. However,*Klebsiellapneumonia*, *Pseudomonas aeruginosa*, *Escherichia coli, Acinetobacter* and *Proteus mirabilis* can play significant role in SSI. Time duration of surgery is directly related to infection rate. Caesarian section surgery that last for more than 1.5 hours increases the risk of SSI Infection. Patients with gastrointestinal surgery and wound contamination have high incidence of SSI [61]. Duration of surgery, age of patients, co morbidity and obesity are risk factors for developing surgical site associated infections. Control measures, proper antibiotics prophylaxis, patients' hygienic conditions and good surgery setting can reduce risk of SSI. In ICU Skin and soft tissue infections are most common condition with fatality rate of about 1.3–7.2%. Among 2 million nosocomial infection (20–25%) [62] that occurs every year they account one quarter of these infections [63–65].

A recent study shows that Patients with neurosurgery have evidences of meningitides mostly caused by *Staphylococcus aureus.* Per year number of cases of CHD (Coronary heart disease) is greater which need surgery. Surgery results in many postoperative infections which cause morbidity and mortality of children with CHD. Complexity of surgery, age and contaminations are risk factors for nosocomial infections [64, 66, 67].

Despite of pathophysiological feature of SSIs, government and medical staff should be recommended the preoperative and intraoperative measures to control infections.

*Balanced Diet*plays a critical role in healing of wound if proper nutrient would not take, then it could alter the physiological nature of wound [68]. Proper nutrition

boosts up immune response for infection, if a patient should be used "immune-nutrition" [69], it increases the anti-inflammatory response to infection and healing of wound would be rapidly recovered in immunosuppressant patients which suffer with major surgery [70].

Refinement _ Nasal Mupirocin It is a monocarboxylic acid antibacterial agent which is used to stunt the growth of methicillin-resistant *Staphylococcus aureus* (MRSA) [71] specifically in cardiac surgery [72] infections [68, 73].

Immunomodulatory Therapies Inflammatory diseases, Transplant patients and preoperative discontinuations are the risk factor to progression of SSIs [74]. Despite of these factor, scientists are crucial to overcome these limitation in these patient by the application anti-inflammatory drug, methotrexate, which is continuously supplied to patient at preoperative period [75–77].

Bathing/Shower For proper disinfection of skin, chlorhexidine soap [78] and povidone-iodine soap [79] best non-pharmacological soap to eradicate the bacteria but timing, types of soap and number of applications are also mandatory with respect of location such as axilla, groin and skin folds [80].

Oral Antibiotics Consortia of oral antibiotic and bowel [81] is efficient method to reduce the risk of SSIs approximately 4%, specifically in colon surgery [82] which face the exposure of *Clostridium difficile* [83]. This type of antibiotic is very workable on gram-negative bacteria and anaerobes which mutate the surgical complication into severe problem in organs except skin and muscles [84, 85].

*Antibiotic Prophylaxis*β-lactams is a prophylaxis antibiotic which is used to reduce the chances of SSI in therapeutic tissue [86]. But timing, dosage and indication are the optimal factors to insert in therapeutic tissue. Disproportionate use of antibiotic, which increase toxicity, resistance of bacteria and cost of antibiotics.

Hair Removal from surgical site also enhances the chances of SSIs that's why scientists not recommended hair removal during surgery. But the instrument, which is used to remove hair, really matter for the progression of surgical site infections. Electric shaver, razor blades and depilatory creams are widely used for vigilant hair removal on surgical site [87].

2.4 Ventilator associated pneumonia (VAP)

Ventilator associated pneumonia is one of significant health care issue among health care associated infections. 9–27% patients on ventilators have Ventilator associated pneumonia. 86% of nosocomial pneumonia is ventilator associated. Patients at Intensive Care Unit are more prone to VAP. In Asian countries especially in developing countries incidence of VAP is higher than European countries where poor implementation of standard measures make ICU a major transmitter of Pathogens.

Pseudomonas aeruginosa, Staphylococcus aureus, Acinetobacter and enterococcus are most common causative agents of VAP in Asian countries. Chronic obstructive pulmonary diseases increase incidence of Ventilator associated pneumonia. Old Age, co morbidity, gender and severity of illness are significant risk factors for VAP. Among mechanically ventilated patients in Intensive Care Unit VAP is second most common infection [88].Studies have shown that critically ill patients on ventilator can also develop nosocomial sinusitis [89].

2.5 Gastroentirites

Inflammation of Gastrointestinal tract is termed as infectious diarrhea or Gastroenteritis. In 2015 globally 1.3 million deaths were reported due to gastroenteritis.

In developing countries prevalence of gastroenteritis is most. Most common causative agent is virus (rotavirus, norovirus, astrovirus and adenovirus) however bacteria, parasites and fungi can also cause gastroenteritis. Most studies in literature show that most of nosocomial gastroenteritis infections were caused by rotavirus and mostly effects children under age of five [90, 91]. According to a study conducted in Pakistan in 2015 about 80% of hospitalized children have viral infections and about 95% were positive for rotavirus in addition to others [92].

2.6 Puerperal fever

During childbirth and after childbirth or miscarriage women get infected with puerperal sepsis. Annually about 75,000 women die worldwide due to puerperal sepsis and developing countries have more death annually than developed countries. Puerperal sepsis is a leading cause of maternal mortality in developing countries like Pakistan due to multiple reasons. Most common causative agent of puerperal fever is bacteria. Data from developing countries as Pakistan shows that more than half of women do not get hospital facilities during delivery. Unhygienic conditions during delivery, long duration of labour, miscarriage, frequent vaginal examination, malnutrition, premature membrane rupturing, and anemia are risk factors for puerperal fever [92]. Most common infection that cause postpartum is endometritis and mostly occur in women who gave birth by cesarean section [93].

3. Causative agents

Bacteria, viruses, and fungus parasites are causative agent responsible for nosocomial infections however most common causative agents are bacteria. In bacteria *Enterobacteria, Staphylococcus and Pseudomonas and Legionella* are more common cause of HCAIs.

80–87% of HCAIs are caused by 12–17 microorganisms *P. aeruginosa, A. baumannii, Enterobacter species, Proteus species, Candida species (eg, albicans, glabrata), K. pneumoniae and Klebsiella oxytoca, E. coli, coagulase-negative Staphylococci, Enterococcus species,* Yeast NOS, Bacteroides species and others. In these 16–20% is multidrug resistance and most of these are gram negative organisms. However causative agents and resistance varies throughout world [94–96]. Bacteria are most common pathogen for HCAIs. Actinobacteria constitutes about 80% infections. Contaminated hands and wounds are mostly affected by Methicillin-resistant *S. aureus* (MRSA) and cause pneumonia and cause surgical site infection [5]. Like bacteria viruses also cause HCAIs. Common viruses causing nosocomial infections are herpes simplex virus, rota virus, influenza, HIV and hepatitis. Fungus such as *Aspergillus sp, Candida albicans, and Cryptococcus neoformans* can cause HCAIs [97].In addition to bacteria and viruses, fungus (*Aspergillus* and *Candida*), prions and plasmodium can also cause nosocomial infections [98]. Summary of causative agents is shown in **Table 1**.

3.1 Risk factors

Unhealthy hospital environment (poor hygienic conditions, poor medical waste management), unaware medical staff (improper use of invasive devices and medical devices) and susceptibility of patient are risk factors for Health care associated infections (HCAIs).

As these risk factors are mostly associated with poverty so resource limited countries are at more risk to develop HCAIs due to impropriate control policies [98].

Sr. No	Type of HCAIs	Description	Causative agents	Preventions	References
1	Central line -associated bloodstream infections	Fever, tendered site of insertion of IV access of CVP catheter	*Acinetobacter, Candida sp, Citrobacter sp, Corynobacter, E. coli spp, Enterobacter spp, Enterococcus spp,Haemophiliusspp, Klebsiella spp, Proteus spp, Pseudomonas spp, Staphylococcus aureus spp, coagulase-negative staphylococci spp, Serratia spp, Stenotrophomonas, Streptococcus*	Hand hygienic, sterilizing techniques, appropriate setting of site, prefer upper extremities for catheter insertion, prefer ultrasound guided insertion, make sure sterile precaution during whole procedure of insertion	[99–102]
2	Catheter associated urinary tract infections	Fever, Lower abdominal pain, changes in urine characteristics	*Staphylococci spp,Alcaligenes denitrificans, Delftiatsuruhatensis, E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa. D. tsuruhatensi,Serratia marcescens*	Appropriate setting of catheter and site, hand hygienic, sterilizing techniques, sure closed drainage system,sure unobstructed urine flow,	[100–103]
3	Surgical site infections	Fever, wound healing problems, pain, redness	*Staphylococcus aureus*, *Pseudomonas aeruginosa, Klebsiella pneumonia, E. coli, Acinetobacter,* Coagulase-negative staphylococci	Sterilizing techniques, Safe operating theater, good quality surgical procedure	[104–106]
4	Ventilator associated pneumonia	Decreased intensity of breath sounds,fever, pleuritic chest pain, increase in rales	*Pseudomonas,lebsiella spp., E. coli, Proteus spp, Enterobacter spp, Serratia spp, Citrobacter spp, Streptococcus spp,Hemophilus spp, Acinetobacter spp,Neisseria spp,Stenotrophomonas maltophilia, Coagulase-negative staphylococcus, Corynebacterium, Moraxella, Enterococcus,Nocardia abscesses,* Respiratory syncytial virus,Adenoviruses, Rhinovirus, influenza virus, Herpes simplexvirus	Reduce patient time on ventilator,sterilizing techniques, avoid intubation, elevate head of bed, suction oro pharynx regularly, reduce ventilator circuit changes	[100, 107–110]
5	Gastroenteritis	Increase infrequency of stool, dehydration, fever	Norovirus, Astrovirus Rotavirus, Torovirus,*Adenovirus*, *Campylobacter,Clostridium difficile,* E.coli, salmonella spp., *Campylobacter jejuni, shigella spp,Staphylococcus aureus,Bacillus sp,Clostridium perfringens* type A, *Clostridium botulinum,Yersinia enterocolitica,Aeromonas spp*, *Cryptosporidium,Cyclospora cayatenensis,Entamoeba histolytica,Giardia lamblia.*	Use of Probiotics, sterilizing techniques, hand hygiene	[100, 111–118]
6	Puerperal fever	Fever, abdominal distension, wound infection, septicemia and disseminated intravascular coagulation.	*E. coli, Klebsiella pneumoniae, Klebsiella oxytoca, Morganella morganii, Pseudomonas aeruginosa, Coagulase negative staphylococcus, Staphylococcus aureus, Providencia, Corynebacterium sp, Enterobacter sp, Streptococcus pyogenes, Citrobacter freundii, Alcaligenes sp, Shigella sp, Yersinia sp, Streptococcus viridans), streptococcus agalactae, Salmonella sp, Kluyverasp*	Use of sterilized equipment and good health care setting, antiseptic shower after surgery	[119–121]

Table 1.
Summarized causative agents and preventions against different types of HCAIs.

4. Transmission of HAIs

4.1 Hospital environment

Unhealthy hospital setting serves as best source to transmit infections. Contaminated utensils, medical devices, air, food, beds, and windows can transmit pathogens. Supply of filtered air must be maintained in ICU [61, 98].

4.2 Medical staff

Medical staff plays a significant role in prevalence of nosocomial infection. Use of unsterilized medical equipment by unaware medical staff in healthcare delivery increases chances of infection of HCAIs. Improper handling and management of hazardous medical waste by unaware medical staff can act as significant reservoir of HCAIs. Most of studies in Pakistan show non satisfactory behavior of medical staff towards standard precautions [5] Micro flora of patient can also become source of infection if they effect surgical site or wounds [5].

5. Preventions for HCAIs

5.1 Standard precautions

In health care unit medical staff should adopt proper standard hygienic measures (hand hygienic, sterilized equipment, use of gowns, gloves, respiratory

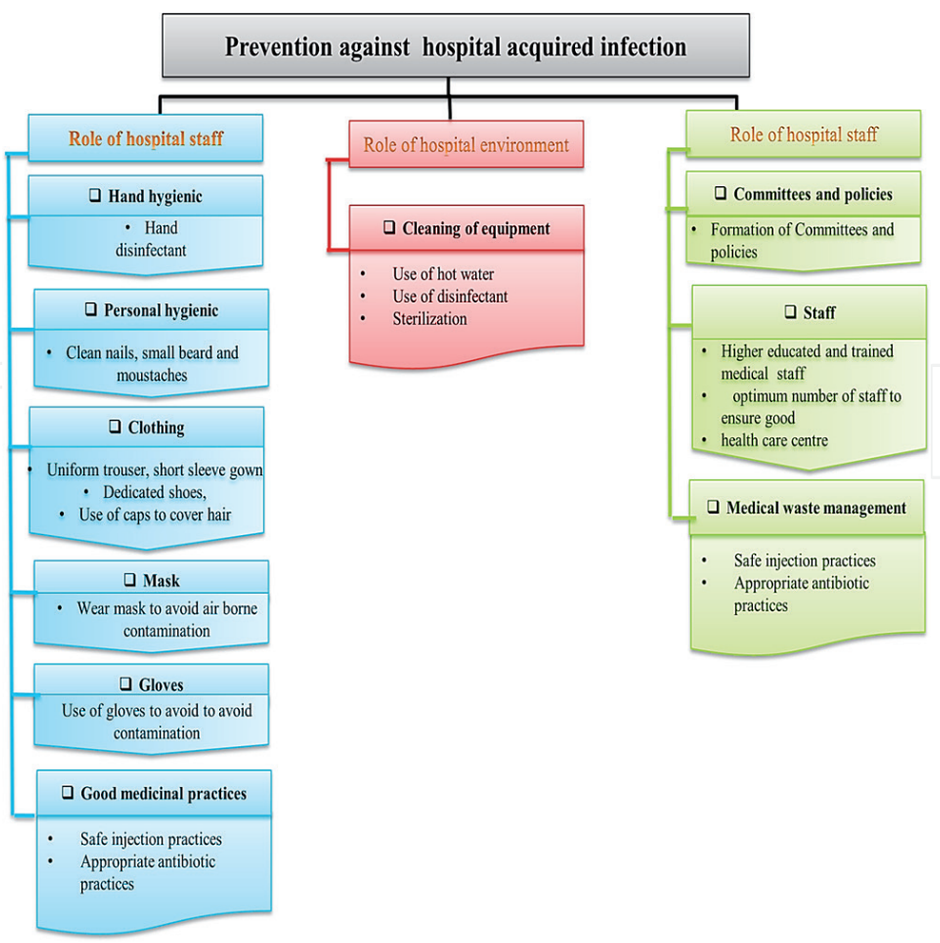

Figure 2.
Prevention against hospital acquired infections.

hygienic) to reduce chances of HCAIs. Medical staff should be trained for biosafety and hazardous waste management should also be maintained. Public should be aware about risk factors consequences of HCAIs as there are number of group of bacteria and viruses in health care centers. Medical staff must be aware with appropriate use of antibiotic to avoid antibiotic resistance which is a significant cause of death in south-East Asian countries where one child died in every five minutes due to antibiotic resistance [5, 97, 122–124]. Preventive measures are the best way to control these type of infections as shown in **Figure 2**.

5.2 Government policies

As HCAIs is leading cause of morbidity and mortality, health institute must plan efficient infection control programs to handle this problem. It is responsibility of government to promote safety of health care centers through availability of trained medical staff, appropriate use of medications and medical equipment and quality eye care. Workload and staff capacity of health care must be directed by government to encourage good health care settings. Government must plan control policies (awareness about HCAIs through media) to reduce risk of Health care associated infections [2].

6. Conclusion

HCAIS is posing serious threat to economy of world specially to developing countries. In resource limited countries infections control program are unsatisfactory. Surveillance for HCAIs mainly serves purpose of prevention interventions. Unhealthy hospital environment and unaware medical staff and susceptibility of patient mainly lead to HCAIs. Government must play its role by forming new policies and committees for modification in national guidelines and for hiring trained and educated staff to promote healthy health care setting. Government should promote implementation of standard strategies by providing resources and policies.

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