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Assessment of Essential Environmental Health Standards in some Health Care Settings in Alexandria, Egypt

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Abstract: Health-care-associated infections (HAI) cause severe loss in health sector resources worldwide. Application of appropriate environmental health standards within the health care setting (HCS) can significantly reduce the transmission of these infections. This study were conducted in Alexandria with the objective of assessing the environmental health standards in some HCS in order to identify the degree of compliance with the guidelines set by the World Health Organization (WHO) and with the infection control measures set by the Ministry of Health (MOH), for the purpose of identifying major areas that require improvement within the health care sector. Ten hospitals were randomly selected in Alexandria Governorate to constitute the study sample: five hospitals were belonging to the private sector and five were public ones. Data collection were conducted using an assessment checklist pre-designed by the WHO, in addition to the chemical and bacteriological analysis of 30 water samples collected from the 10 hospitals. Results of the study revealed the absence of a water quality monitoring system within the HCS, poor maintenance in the plumbing system, lack of sufficient handwashing facilities, absence of suitable puncture-proof containers for sharp waste collection, inadequate laundry and catering services, absence of a High Efficiency Particulate Air (HEPA) filter, and a pressure gradient in all operating theaters and poor vector control especially in public hospitals. According to the WHO checklist, scores for hospital water supply (quality and quantity), water facilities, excreta disposal, health care waste management, laundry, food storage and preparation, vector control and the HCS construction and management were 69%, 62.5%, 63%, 72%, 64%, 89%, 78%, 63% and 44%, respectively. It is worth mentioning that at 95% level of significance, there was no statistical difference between the scores obtained by private hospitals and those obtained by public ones. Consequently, the study concluded that improvement is required in all hospitals and recommended some corrective measures.

Key words: *Environmental Health Standards; Excreta Disposal; Health-Care-Associated Infections (HAI); Health Care Setting (HCS); Health Care Waste Management; High Efficiency Particulate Air (HEPA) Filter; Infection Control; Laundry; Vector Control; Water Supply.*

INTRODUCTION

Health care settings (HCS), including hospitals, present a type of environment with a high prevalence of infectious agents. Health-care-associated infections (HAI) affect between 5% and 30% of patients yearly and cause severe loss in

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health sector resources worldwide. In addition, staff and visitors are also at great risk from acquiring some types of these infections.[1]

Examples of HAI include airborne infections such as Tuberculosis and Aspergillosis. They have been associated with contamination or malfunctioning of the hospital Heating, Ventilation, and Air Conditioning (HVAC) system.[2] Concerning waterborne HAI, 43 hospital outbreaks and an estimated 1400 deaths occur each year in the United States (US) as a result of water-borne pneumonias caused by *Pseudomonas aeruginosa* alone.[3] In addition, water-borne outbreaks of Legionnaire's disease have also been reported, and hot water distribution system in hospitals was implicated as the source of infection.[4,5] Besides, nosocomial food-borne outbreak of *Salmonella enterica* in a University hospital in Greece raised the necessity of establishing Hazard Analysis and Critical Control Points (HACCP) system in hospital catering service.[6] As for blood-borne infections such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV), they constitute a major risk to health care workers. Occupational exposure to the virus occurs through needlestick injuries or as a result of the absence of a safe health care waste management system.[7] Regarding vector-borne HAI, isolation of *Pseudomonas aeruginosa, Enterococcus faecalis*, viridans streptococci, and *Staphylococcus aureus* from the housefly *Musca domestica* collected in the surgical ward of the India Institute of Medical Sciences Hospital proved that the flies may act as vectors of potentially pathogenic bacteria in a hospital environment, and highlighted the importance of vector control within the health care setting.[8] Finally, failure in sterilization technique within the health care setting has been

considered as the leading cause of postoperative wound sepsis, accounting for 24% of all HAI in the US.[9]

According to the World Health Organization (WHO), such problem of diseases from unsafe health care settings is growing worse due to an increasing proportion of patients being immuno-compromised, and hence more susceptible to HAI. Without effective action, the situation is likely to deteriorate. Application of appropriate environmental health standards within the HCS can significantly reduce the transmission of these infections. Consequently, the WHO has set 11 guidelines to be followed in order to achieve these standards. They include water supply (water quality and quantity), excreta disposal, health-care waste management, cleaning and laundry, food storage and preparation, control of vector-borne disease, building design (including ventilation), construction and management of the HCS, and hygiene promotion.[10]

Meanwhile, in Egypt, the Ministry of Health (MOH) has put standard precautions to be followed in HCS as infection control measures.[11] In addition, the infection control program (ICP) in the MOH has also issued policies to be established in every department within the HCS for the purpose of infection control. Many of these precautions and policies are related to environmental health within the health care facility. Examples include presence of water facilities for routine hand washing, appropriate isolation system, proper sterilization of equipment, adequate laundry and catering services, cleaning of hospital environment, and management of health care waste.[12] Furthermore, any HCS that is seeking to be accredited by the MOH should comply with the accreditation standards including – but not limited to – such infection control measures.[13]

In Alexandria, no one hospital has yet been accredited. Therefore, this study was

conducted with the objective of assessing the environmental health standards in some health care settings in order to identify the degree of compliance with the guidelines set by the WHO and with the infection control measures set by the MOH, for the purpose of identifying major areas that require improvement within the health care sector.

MATERIAL AND METHODS

Ten hospitals were randomly selected in Alexandria Governorate to constitute the study sample: five hospitals were belonging to the private sector and five were public ones. Public hospitals were presenting the University Hospitals sector by 2 hospitals, Health Insurance sector by 2 hospitals and MOH sector by one hospital.

Data collection was conducted using an assessment checklist pre-designed by the WHO. The checklist included 120 questions concerning 11 environmental health guidelines: water quality (16 questions) and quantity (4 questions), water facilities and access to water (8 questions), excreta disposal (17 questions), wastewater disposal (7 questions), health-care waste management (9 questions), cleaning and laundry (15 questions), food storage and preparation (14 questions), control of vector-borne disease (10 questions), building design, construction, and management (10 questions), and hygiene promotion (10 questions).[10] Questions could be answered with a "yes", a "no", or "not applicable (NA)". A "yes" answer was assigned the score of 1, while a "no" answer was assigned the score of zero. A score was given to every HCS as regards every guideline using the following equation:

$$\text{Score as \%} = \frac{\text{Number of "Yes" answers} \times 100}{\text{Total number of question} - \text{Number of questions that got "Not applicable" answers.}}$$

Finally, an average score was calculated for every guideline.

In addition to the assessment via the interviewing observation checklist, water samples were collected from taps present in the water closet (WC), the kitchen and the nursing station in every HCS so as to make a total of 30 samples. These samples were analyzed for residual chlorine, turbidity, and fecal coliform according to the Standard Methods for the Examination of Water and Wastewater. [14]

RESULTS AND DISCUSSION

Water quality:

Table (1) presents results of assessment of water quality within the 10 hospitals under study. In this regard, the WHO states that "Water for drinking, cooking, personal hygiene, medical activities, cleaning, and laundry must be safe for the purpose intended."[10] Nothing was mentioned about water quality among the infection control measures set by the MOH.[11,12]

Results of the study showed that all the HCS under study were obtaining their water supply from a safe source, which is Alexandria Water Authority. In 9 HCS, water was protected from contamination as proved by a free residual chlorine concentration ≥0.5 mg/l, and turbidity less than 1 NTU in water samples collected from these hospitals. Results of these analyses are shown in Table (2). In addition, water samples collected from these hospitals were all free from any fecal contamination. As for the tenth hospital E, residual chlorine was ranging between 0.07 and 0.11 mg/l in the water samples collected. This might be due to a biofim in the water distribution system carrying potable water to the hospital. Nevertheless, fecal coliform were also absent in the three water samples collected from this hospital. These results were in agreement with two previous studies carried out in Egypt in 2005 and 2008. The first concluded that

water supplying the hospitals was complying with the Egyptian Drinking Water Standards set by the MOH, while the latter found that water samples in one University Hospital was complying with WHO guidelines as regards residual chlorine and fecal coliform.[15,16]

Concerning water storage, this was found to take place in 7 HCS. Monthly cleaning and disinfection of the storage tanks has been reported in 4 HCS namely E, G, H and I, and weekly tank disinfection was reported in hospital F. This was contrarily to a study carried out in 5 Egyptian hospitals that proved that water tanks were not well-maintained leading to deterioration in the water quality from the tank in comparison to that of the main feeders.[15] As for the sixth and seventh hospitals possessing water tanks, these tanks were kept empty and were used only in emergencies such as water rupture.

As for water treatment within the HCS, this was encountered in 7 hospitals, owing to the presence of a dialysis unit in these hospitals. Treatment was consisting of a sand filter, a bacterial filter 25 µ, a carbon filter, a bacterial filter 10 µ, a softener, a reverse osmosis unit, a bacterial filter 0.2 µ and a UV disinfection lamp. This was found to be in agreement with the design of dialysis water treatment system recommended by the Centers of Disease Control and Prevention (CDC).[17] In hospital E, there was an ion exchange resin for nitrite removal prior to the softener. Effective operation of the treatment process, presence of sufficient supplies and adequately trained staff, regular monitoring of the treated water and the treatment process were found to take place in 6 out of the 7 hospitals. This was proved by the results of analyses of treated water carried out daily by the nursing staff (for only residual chlorine and dissolved solids), and monthly by the MOH

representatives. Biweekly visit of maintenance staff from the company that installed the treatment unit was found to take place. In addition, call for maintenance was the policy adopted by the HCS when failure to comply with any standard in the treated water occurs. In the seventh hospital (I), neither regular monitoring system nor trained staff could be found, and no policy was adopted in case of failure in the treatment system.

Water smell, taste, and appearance were found to be acceptable in all HCS. However, a minor complaint from the odour of residual chlorine that increases in summer season was reported from half of the respondents.

It is obvious from Table (1) that the major areas of deficiency in 90% of the HCS under study were absence of a water quality monitoring system and absence of any measure to avoid overexposure of susceptible patients to chemical contaminants that might be present in water. Both deficiencies were found in 9 HCS while in one private hospital (F), water samples were collected and analyzed every 6 months, and the HCS was installing a water treatment unit downstream the roof storage tanks consisting of a sand filter, a carbon filter, a reverse osmosis unit and an ultraviolet lamp.

Regarding the first deficiency, which is water quality monitoring, the WHO recommends that the environmental health department in the HCS should work with the infection control committee to monitor the microbiological quality of the water in the HCS, as part of a routine surveillance and control programme.[10] On the contrary, according to the Centers for Disease Control and Prevention (CDC), routine testing of water in a health-care facility is usually not indicated except for dialysis fluid that should be tested at least monthly, but sampling in support of outbreak investigations can help determine

appropriate infection control measures.[17] However, in 1995, the Health Department in Pennsylvania initiated some guidelines for the prevention and control of health care associated Legionnaires disease that differed from that of the CDC by recommending routine environmental testing of the hospital water distribution system even when cases had never been identified. A significant decrease in the number of cases from 33% to 9% was thus achieved.[18]

Legionnaire's disease is a well-established risk associated with health-care facilities, with an average proportion of HAI close to 10%. It is a lung infection clinically manifested as pneumonia. Persons with severe immunosuppression from organ transplantation or chronic underlying illnesses (e.g., hematologic malignancy or end-stage renal disease) are at markedly increased risk. Inhalation of aerosols of water contaminated with *Legionella* species is believed to be the primary mechanism of entry of these microorganisms into a patient's respiratory tract. In order to minimize the proliferation of *Legionella*, water pipes should be as short as practical to reduce the potential for water stagnation. Besides, periodic increasing of the water temperature at the faucets and the showers to at least 66˚C, and flushing the water distribution system of the health care setting with chlorine are recommended.[19] A study was conducted in 1999 to investigate the risk factors associated with nosocomial transmission of Legionnaires disease in 16 large hospitals in Texas. It was found that hospitals in municipalities where the water treatment plant used monochloramine as a residual disinfectant were *Legionella*-free, while the hot-water systems of the other hospitals containing free chlorine as a residual disinfectant were colonized with *Legionella*.[20]

Other water-borne microorganisms present in potable water in the HCS include

the gram-negative *Pseudomonas aeruginosa*. Medical conditions associated with this bacterium range from colonization of the respiratory and urinary tracts to deep, disseminated infections that can result in pneumonia and bloodstream bacteremia. Although both *Legionella* and *Pseudomonas* lead to respiratory infections, infection control measures intended to prevent health-care-associated cases focus on the quality of water, the principal reservoir for the organisms.(21)

Regarding the absence of an additional treatment of potable water - the second deficiency determined in the surveyed hospitals - a study in Leeds Teaching Hospitals in the United Kingdom concluded that additional water filters were an optimal way to provide drinking water to immuno-compromised patients, because of their high susceptibility to infection.(22) The WHO, by its turn, recommends particular care to ensure that safe drinking water is supplied to these patients, and proposes the provision of boiled water in such cases.(10)

As presented in Table (3) showing the results of assessment of the 11 guidelines set by the WHO, the scores obtained by the hospitals concerning water quality were ranging from 50% to 100% with a general mean of 69%. No statistical difference could be observed between public and private hospitals that obtained a mean score of 67.6% and 70%, respectively at 95% level of significance (t=0.8).

Water quantity:

As concerns water quantity, the WHO states that "Sufficient water must be available at all times for drinking, food preparation, personal hygiene, medical activities, cleaning, and laundry."(10) Nothing was mentioned about water quantity among the infection control measures set by the MOH.(11,12)

It could be noticed from the survey

that no deficiency in the provision of the hospital water quantity requirements was detected. Even during water tank disinfection, water was made available in the HCS as follows: Hospital E was constructed with two ground tanks, each of 200 cubic meters capacity, to be used alternatively. Hospital F was found to possess three roof tanks. Cleaning and disinfection took place 3 days a week; each day was dedicated to one of the three tanks leaving the other two in use. In the other hospitals possessing water roof tanks, disinfection of these tanks was used to take place on Fridays due to low water consumption on holidays.

According to the WHO, the minimum water quantities required by a HCS is supposed to be 5L/examination in outpatient clinics, 50 L/patient/day in inpatients, 100L/intervention in operating theatre, and 100L/patient/day in severe acute respiratory disease isolation centre.[10]

Based on such secure water supply, no other alternative supply was reported in 90% of the surveyed hospitals. As for the tenth hospital (B), a policy was adopted to call the fire extinguishing service of the City to fill up the roof tank in case of need.

Nevertheless, scores obtained by the HCS as regards to water quantity was ranging between 50% and 75%, with a general mean of 62.5 (Table 3). Mean scores for public versus private hospitals were 55% versus 70% respectively. Main area of deficiency observed in all public hospital as well as in one private hospital J was found to be a poor maintenance of the plumbing system in the hospital; leading to water wastage and sometimes to algal growth in the water closets. Reasons reported by the nursing staff in all hospitals were low patient awareness about the importance of maintaining the hospital in good condition, and lack of necessary fund to repair the broken and stolen items. This was found to be in agreement with

previous studies conducted in many Egyptian hospitals. These studies reported leakage from water taps and from the wastewater plumbing system in toilets of many hospitals. [15,16]

Similarly to water quality, there was no statistical difference between the scores of public and private hospitals as regards water quantity (t= 0.07) at 95% level of significance.

Water facilities and access to water:

Table (4) presents results of assessment of water facilities within the 10 hospitals under study. In this regard, the WHO states that "Sufficient water-collection points and water-use facilities must be available in the health-care setting to allow convenient access to, and use of, water for medical activities, drinking, personal hygiene, food preparation, laundry and cleaning." [10] Similarly, among the infection control measures set by the MOH, handwashing was given a priority. Handwashing facilities provided with soap or detergent and drying tool have to be available in all inpatient wards (1 facility per 4 patients), and wherever needed before and following different medical interventions, food preparation and distribution, wearing or taking off gloves, and notably after toilet use. In case of using liquid detergent (which is preferable), its container should always be covered, and whenever empty, it should be washed and disinfected prior to refilling. [11]

In this respect, the main area of deficiency in 90% of the HCS under study was the absence of drinking water points. WHO recommends that drinking water should be provided separately from water provided for handwashing and other purposes, even if it is from the same supply.[10] This was only found in hospital F where two water coolers were provided in the area of the outpatient clinics.

Hand washing is the simplest and most cost-effective way to reduce HAI.

Compliance with handwashing is, however, suboptimal in HCS. A study carried out in the Netherlands found that compliance with handwashing was 46% for hospital staff and 75% for members of the public. [23] Such low compliance could be due to many factors including low staff to patient ratio, the time required, insufficient knowledge and lack of facilities. [24] This lack of handwashing facilities was encountered in more than half of the surveyed hospitals where no handwashing facilities were available in wards (5 hospitals), consulting rooms (4 hospitals), laundry (2 hospitals) and waste zone (4 hospitals). As shown in was not found in four public hospitals since they were usually taken by the patients. This has led the HCS administration to ask every patient to bring his own soap and towel or drying tissue. Surprisingly, such trend was also found in one private hospital (J).

Fortunately, showers were found to be sufficient in all surveyed hospitals, according to the WHO recommendation of installing at least one shower for 40 users in inpatient settings. [10]

It was clear from table (3) that the scores obtained by the surveyed hospitals as concerns water facilities ranged between 29% and 100%, with a general mean of 63%. Public hospitals got a mean score of 52% while private ones got 74%. However, no statistical difference could be observed between both types of hospitals at 95% level of significance (t=0.15).

Excreta disposal:

Table (5) presents results of assessment of excreta disposal within the hospitals under study. In this regard, the WHO states that "Adequate, accessible and appropriate toilets should be provided for patients, staff and carers." [10] Nothing was mentioned about excreta disposal among the infection control measures set by the MOH. [11,12]

Results of the present study revealed that water closets were insufficient in all hospitals under study. Although the

recommended ratio of one toilet per twenty persons was found in inpatient settings in all hospitals, the outpatient settings were lacking some toilets in all surveyed hospitals. According to the WHO, a suitable arrangement for outpatient setting is often as follows: two toilets for male and female staff, one toilet for male patients, one toilet for female patients, and one child's toilet. In addition, toilets should be clearly signposted to help users find them. (10)

Another deficiency found in all the surveyed public hospitals and in one private hospital (J), was related to the toilet bad smell and dirtiness. This was attributed to the absence of a toilet cleaning and maintenance routine in these hospitals, although a cleaning plan was present. This plan was following the WHO recommendations of cleaning toilets whenever they are dirty, and at least twice per day with a disinfectant. (10) In 2004, a survey of adult in-patients was conducted in United Kingdom and reported that over half of the patients felt that their ward was very clean, but 1 in 8 felt that bathrooms and toilets were not very clean or not clean at all.(25) Besides, in 4 public hospitals and in a private one, soap was not available in the handwashing facilities at the exit of the toilets.

As for the scores presented in Table (3) regarding excreta disposal, they were ranging between 35% and 94% with a general mean of 72%. Public hospitals had a mean of 66% compared to 78% got by private hospitals, and no statistical difference could be observed between both types of hospitals at 95% level of significance (t=0.36).

Wastewater disposal:

Regarding wastewater disposal, the WHO states that "Wastewater should be disposed of rapidly and safely". (10) As for the Egyptian MOH, nothing was stated about wastewater disposal neither in the infection control precautions nor in the

policies. [11,12] However, safety of the environment inside and outside the HCS is among the requirements for HCS accreditation. [13]

In this context, all the surveyed hospitals got 100%: They were found to be connected to the sewerage system of Alexandria Governorate. This was found to be in accordance to the WHO guidelines stating that "the most appropriate wastewater disposal option is connecting the health-care setting to a properly built and functioning sewer system, which is, in turn, connected to an adequate treatment plant." [10] In fact, this system has sufficient capacity in the zones where the selected hospitals exist. It is well designed, operated and maintained. Nevertheless, in other zones in Alexandria, the system capacity is not enough and flooding occurs outside HCS. This was not the case in the present study.

Health-care solid waste disposal:

Concerning health-care solid waste disposal in the surveyed hospital, results of its assessment are shown in Table (6). The WHO states that "Health-care waste should be segregated, collected, transported, treated and disposed safely." [10] As for the Egyptian MOH, precautions for segregation, in-site storage, in-site and off-site transport, treatment and disposal of health-care waste are described among the infection control measures that should be adopted by HCS. [11] In addition, a policy for waste segregation is also provided to HCS. [12]

Health care waste includes all the waste generated as result of any health care activity. They are classified into sharps, infectious waste, pathological waste, chemical waste, radio-active waste, pharmaceutical waste, genotoxic waste, pressurized containers and domestic non-hazardous waste. [26] Proper health care waste management must be consistent from cradle to grave. It should go through the following steps: waste minimization,

segregation at the point of generation, internal transport (in the HCS), in-site storage, external transport, treatment and final disposal.[27]

As presented in Table (6), all the hospitals under study were found to segregate health care waste at the point of generation although 60% of them did not possess suitable sharp resistant container in the place of waste generation. In these hospitals, sharps were segregated in the kidney-shaped tray carried by the nurse while giving the prescribed medication to the patients. At the nurse station, segregated sharps were transferred manually by the nurse from the kidney-shaped tray to a large safety box, unpractical to be taken with her in wards. This would certainly expose the nursing staff to the risk of needle stick injuries. Furthermore, as shown in Table (6), no reporting system about waste-related injuries was encountered in 50% of the surveyed hospitals. According to the CDC, following an occupational needlestick injury, the injury or cut should be immediately washed with soap and water, and then reported to the infection control department in the HCS. Prompt reporting is essential because post-exposure treatment should be started as soon as possible. No treatment exists for HCV or HIV. However, concerning HBV, if the injured staff has not been vaccinated yet, then hepatitis B vaccination is recommended regardless of the source person's HBV status. [28]

In addition to the lack of facilities for segregation and the absence of injury reporting system, health care waste was found to be segregated into three categories: sharps in puncture-proof containers, infectious, chemical, pharmaceutical and genotoxic waste in red plastic bags and domestic waste in black bags. Such method of segregation was found to be in agreement with the policy set by the Egyptian MOH.[12] The WHO, by its turn, recommends that segregation

should be done into 4 major categories: sharps, infectious waste, domestic waste and hazardous waste. The latter includes expired drugs, laboratory reagents, genotoxic waste and radioactive waste.[10] However, a good improvement in health care waste management could be observed from the findings of the present study. They are in contrast to a study carried out in 16 hospitals in Alexandria during 1997, which found that health care waste segregation was not practiced in any hospital. [29] Such difference could be attributed to the continuous efforts of the MOH to reduce the risks associated with health care waste.

Following segregation, red bags and puncture-proof containers were transported to a waste zone in 8 out of the 10 surveyed hospitals. Among the 8 hospitals that were allocating a special zone for health care waste storage, Hospitals B, G, H and I were not adhering to the requirements of such zone. Such requirements include a limited access to authorized personnel, ease of cleaning, the presence of a water source with soap or detergent, connection to sewer system for wastewater disposal, protection from rodents and insects, good ventilation and lighting, in addition to being far from food stores and food preparation areas. [27]

Hospitals A and J were devoid of a waste zone. In the first, waste containers were stored in one of the hospital corridors next to the patients and visitors. In the second, containers were stored in the garage of the hospital. In this way, contaminated needles and syringes would present great threat to the community because they can be scavenged from waste containers, and reused. [10] In addition, examination of a random selection of clinical waste carts at nine hospitals across London revealed external soiling in all of the carts. Sixty percent of the carts were also soiled on the inner surfaces, with evidence of bloodstains and

free fluids in the base. *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* were recovered from the lids and wheels of carts. Two carts were heavily contaminated with *Aspergillus*. The study concluded that pathogens originating from clinical wastes may be transferred from contaminated bulk waste carts to the wider hospital environment. It recommended keeping waste carts outside clinical areas, and preferably outside all hospital buildings. (30)

Finally, at the level of health care waste treatment and disposal, contracts were made between public hospitals and a licensed company operating a sterilization unit, while private hospitals were having contracts with another licensed company operating an incinerator. Both treatment methods are approved by the MOH (11) and the Egyptian Environmental Affairs Agency (EEAA). (31)

As obvious in Table (3), scores obtained by the hospitals under study were ranging between 14% and 100% with a general mean of 64%. In this respect, public hospitals were found to be better than private ones since they got 71% in comparison to 57% obtained by private hospitals. Nevertheless, no statistical difference could be observed between both types of hospitals at 95% level of significance (t=0.7).

Cleaning and laundry:

As regards cleaning and laundry, the WHO states that "Laundry and surfaces in the health care environment should be kept clean" (10) As for the MOH, cleaning of the hospital environment, equipment reprocessing by disinfection or sterilization and proper dealing with soiled and clean laundry have been highly recognized among the infection control precautions that should be adopted within HCS . Besides, guideline policies were established for these precautions. (11,12)

Methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant

enterococci (VRE) are capable of surviving for days to weeks on environmental surfaces in rooms of patients infected with MRSA or VRE. A number of studies have documented that healthcare workers may contaminate their hands or gloves by touching contaminated environmental surfaces, and that hands or gloves become contaminated with numbers of organisms that are likely to be transmitted to other patients. Because the routine cleaning of equipment and other surfaces does not always remove pathogens from contaminated surfaces, improved methods of disinfecting the hospital environment are needed. (32)

Fortunately, this was found to take place in all the surveyed hospitals: Dry mopping and sweeping were the methods employed for cleaning hospital offices, while wet mopping with a detergent followed by disinfecting with dilute chlorine solution was the method employed for cleaning the remainder of the hospital. Blood spills cleaning requirements were well defined and were effectively used in case of spills. However, in three hospitals, walls were not made of washable materials and some surfaces were not visibly cleaned. The latter could be attributed to the lack of man-power within the HCS, as explained by the head of infection control committee. Similarly, in the UK, financial constraints have forced managers to re-evaluate domestic services and general cleaning has been reduced to the bare minimum. Services have been contracted out in some hospitals, and this has lead to lowered standards of hygiene. (33) Another study was carried out also in the UK for assessing the cleanliness of up to 113 environmental surfaces in an operating theatre and a hospital ward. Seventy-six percent of these sites were unacceptable after cleaning. Sites most likely to fail in the ward were in the toilet and kitchen, areas which are frequently implicated in the spread of infectious intestinal disease.

Among operating theatre sites, 61% would be considered unacceptable. The study concluded that the routine cleaning programmes used did not include a biocide and that cleaning using a hypochlorite based sanitizer would be more efficient. (34)

Viewing the importance of a clean environment in a HCS, another study called for bacteriological standards with which to assess clinical surface hygiene. The first standard concerns the finding of a specific 'indicator' organism, the presence of which suggests a requirement for increased cleaning. Indicators would include *Staphylococcus aureus*, including MRSA, *Clostridium difficile*, VRE and various Gram-negative bacilli. The second standard concerns a quantitative aerobic colony count of <5 cfu/cm^2 on frequent hand touch surfaces in hospitals. (35)

Regarding laundry facilities, they were found to be adequate in private hospitals. Soiled linen was immediately placed in bags and then properly washed and dried. It was transported separately from clean linen. However, in four private hospitals, only one lift was installed to be used by patients, staff, and health worker carrying food trays, clean or soiled linen or even waste bags. Only one private hospital was installing two lifts: one for soiled items and the other for clean ones. Among public hospitals, two were installing 2 lifts for separate transport of soiled and clean items.

Although linen was washed, dried and pressed in private hospitals, all of these hospitals were not following the specifications of the laundry service as put by the MOH and by the CDC. These specifications include good ventilation and lighting, the presence of a receiving and sorting area for the contaminated textile with a negative pressure compared with the clean area of the laundry, presence of handwashing facilities, supplying the workers with personal protective equipment especially heavy duty gloves to minimize

sharp injuries during sorting, presence of a safety box to get rid of sharps that reach the laundry in linen and ordering work in the laundry so as to decrease cross-traffic between clean and soiled operation. (11,17) This was found to be in accordance with a previous study conducted in Egypt, which revealed that laundry facilities in Egyptian hospitals got scores ranging between 0% and 21%. (15)

Evaluation of the hygienic state of a hospital laundry in Slovenia was carried out by evaluating the number and types of micro-organisms present throughout the whole laundering process, using agar plates. The initial examination showed that the sanitary condition of the laundry did not reach the required hygiene level. To prevent micro-organisms spreading into the entire clean working area, it was recommended to enforce sanitary measures such as cleaning/disinfecting of all working areas, installing technical equipment and storage shelves; and regular education sessions for laundry employees on proper hand hygiene. (36)

In public hospitals, one facility was operating a laundry with too old washing machines that were not properly functioning. In the second, the boiler was out of order making linen to be washed in cold water. The MOH infection control precautions suggest a washing cycle at 72° C for 25 minutes.(11)A third public hospital was not having a laundry service at all.

In all surveyed hospitals, mattresses were found to have water-proof covers. They were disinfected following each hospitalization and whenever soiled. In addition, medical equipment were found to be disinfected and sterilized effectively in properly operated sterilization units.

Consequently, as the WHO did not include laundry specification among the indicators of environmental health in HCS, the mean score for cleaning and laundry was found to be 89% as listed in Table (3). Public hospitals got 83% and private ones

got 96%. Similarly to the previous standards, no statistical difference could be observed between both types of hospitals at 95% level of significance (t=0.15).

Food storage and preparation:

Table (7) presents the results of assessment of food storage and preparation within the hospitals under study. In this regard, the WHO states that "Food for patients, staff and carers should be stored and prepared so as to minimize the risk of disease transmission" [10] As for the MOH, it has set some policies to be followed in the health care kitchens: these policies concern hygiene of food handlers, kitchen cleanliness, food storage, preparation and distribution, and cleaning of utensils. [12]

It is clear from the table (3) that the scores obtained by the hospitals under study were ranging between 50% and 100% with an average of 78%. Kitchens in public hospitals were much better than those in private hospitals, as proved by a mean score of 90% for public hospital compared to 66% obtained by private hospitals, although no statistical difference could be observed between both of them at 95% level of significance (t=0.1).

As shown in Table (7), handwashing points were available in the food preparation area and in toilets used by food handlers in all the surveyed hospitals. In 4 public hospitals, kitchens were properly designed: They were easy to clean, separate places were provided for avoiding contact between raw and cooked foodstuffs, cooking facilities were adequate and sufficient, there were fridges for cooked and raw food and dry foods were stored appropriately. In 4 private hospitals, kitchens were not made of stainless-steel materials to be easily cleaned; and there were no facilities for the separation between cooked and raw foodstuffs. Consequently, kitchens in these private hospitals were not found to be clean at all. In addition, garbage generated from these

kitchens was collected in uncovered bins that were stored inside or closely to the kitchens. This could be a potential reservoir for bacteria and could attract insects and rodents.

In case of kitchens having windows (70% of the hospitals), windows were equipped with screens. In the remainder 30%, kitchens were lacking windows and food handlers were working in very bad conditions as concerns temperature and ventilation. This was in agreement with the finding of a study carried out in Damanhour and in Shebin El-Kom Hospitals that reported that temperature in hospital kitchens was 8°C higher than outside the hospitals. This may lead to food spoilage and heat stroke to food handlers. (15)

Cooking facilities and fridges were found to be adequate in 90% of the hospital kitchens. As for the preparation of infant formula, this was not carried out in the hospital kitchens. Instead it was carried out in the new born unit in a specially designated area and according to the WHO guidelines. (37)

Although the order of the work flow in kitchens was not among the indicators set by the WHO, it is one of those set by the MOH. Such work flow was not respected in 80% of the surveyed hospitals. This could lead to the contamination of prepared food. In U.S., a HACCP system was implemented for the quality assurance of preparation, storage and delivery of food to patients in hospitals. When hazards were identified and corrective measures were applied, bacterial count in food preparations was reduced.(38,39)

Building design, construction and management:

The results of assessment of building design, construction and management within the hospitals under study are shown in the same table (8). In this regard, the WHO states that "Buildings should be designed, constructed and managed to provide a healthy and comfortable

environment for patients, staff and carers".[10] As for the MOH, it has established precautionary measures to create healthy environment in the HCS. These measures include the presence of isolation rooms in order to minimize the spread of airborne or droplet infections. Such rooms should be under negative pressure, be preceded by an anteroom and be equipped with a handwashing facility and a separate toilet. Regular handwashing, using personal protective equipment and treating waste generated from these rooms as infectious hazardous waste were also among the precautionary measures. [12]

Results of the present study revealed that the main areas of deficiency in the design of 60% of the hospitals were the absence of special corridors and a special lift designated for dirty items such as soiled linen and health care waste. Moreover, Hospital A had a lift for dirty items in its design but this lift has been out of order since many years. This was in agreement with findings of a previous study that concluded the absence of these special corridors in all the surveyed hospitals. [15]

Concerning hospital HVAC system, it was not properly constructed nor managed within all the surveyed hospitals. This was proved by the absence of a positive pressure and a functioning HEPA filter in the operating theaters of all hospitals. According to the WHO and the CDC, high-risk areas such as operating rooms, critical care units and transplant units require special ventilation systems with high efficiency particulate air (HEPA) filters. For the operating room, the critical parameters for air quality include frequent maintenance of the filters, pressure gradient across the filter bed and in the operation theatre, a minimum of 15 air changes per hour. Besides, temperature should be maintained between 20°C and 22°C and humidity between 30% and 60% to inhibit

bacterial multiplication.[17,24]

Filters should be inspected regularly and cleaned or changed as required, because biofilms may build up and become breeding places for microorganisms.[10] Following an outbreak of MRSA in a hospital in US, the ventilation grilles in the hospital were found to be harboring the organism. Daily shutdown of the HVAC system created a negative pressure, sucking air from the ward to be blown back into the ward when the system was started. [40] Therefore, the American Institute of Architects prohibits hospitals and surgical centers from completely shutting down their HVAC systems except in the case of routine maintenance or filter change. Even in such situations, a required pressure must be maintained. [41]

In 100% of the hospitals, lighting system was found to be sufficient. This was found to be contrarily to a study carried out in one hospital in Alexandria that found fair illumination in most of the hospital departments. The study added that poor levels of illumination were encountered in the inpatient ward that was free of charge due to insufficient windows, and in the chemotherapy unit, the kitchen and the laundry that were all located in the underground floor of the hospital away from daylight. [16]

Third area of deficiency as regards the building design and management was the absence of a negative-pressure isolation room as specified by the MOH for contagious airborne diseases such as influenza, measles, and tuberculosis within all the surveyed hospitals. This was in agreement with a previous study covering 5 hospitals in 5 Egyptian Governorates that revealed that none of the hospitals under study included an isolation room although some patients with infectious diseases were present in the hospitals during the study period.[15]

Finally, all the surveyed hospitals were easily accessed by patients with physical handicaps.

As shown in Table (3), the mean score obtained by the hospitals under study as regards building design, construction and management was 44%. Public hospitals had a mean score of 48% while private ones had 40%. No statistical difference could be observed between both types of hospitals at 95% level of significance (t=0.35).

Control of vector-borne disease:

In this aspect, the WHO states that "Patients, staff and carers should be protected from disease vectors." [10] Nothing was mentioned about vector control among the infection control measures set by the MOH. [11,12]

It was clear from Table (3) that the general score for vector control within the HCS under study was ranging between 0% and 100 % with a general mean of 63%. No statistical difference could be observed between the scores obtained by public and private hospitals at 95% level of significance (t=0.3). Nonetheless, public hospitals got a mean score of 53% compared to 74% got by private ones. This was due to the fact that all private hospitals were environmentally protected from disease vector such as flies, mosquitoes and rodents by being sited in clean areas while 3 public hospitals were not: They were sited in areas where garbage was everywhere in the streets surrounding the buildings thus creating breeding sites for insects and rodents. This was found to be in accordance with a previous study that reported donkey carts and solid waste heaps around Abou-Kir Hospital in Alexandria.[15]

Another area of deficiency was found and is related to window screens: They were found in only six hospitals (three public hospitals and three private ones). Cockroaches, flies, ants, mosquitoes and mice are among the typical pest

populations found in health-care facilities. Insects can serve as agents for the mechanical transmission of microorganisms, or as vector in disease transmission process. [42] Consequently, windows in all HCS should be equipped with screens.[10]

As for the use of repellents for vector control, an insect ultra sonic repellent was found to be used in one private hospital (I). In three public hospitals (A, C and E), a paste especially designed as cockroach repellent was found to be prepared by nurses and put in different corners of the hospitals. This paste consists of powdered milk, boric acid, sugar and flour. In addition, as a general way to control insects, spraying insecticides in the HCS especially the basement floor (where the storage areas exist) was found to be done regularly in 8 hospitals by pest control specialists.

Hygiene promotion:

In this regard, the WHO states that "Correct use of environmental health facilities should be encouraged by hygiene promotion and by management of staff, patients and carers." [10] As for the MOH, hygiene promotion has started with an infection control program (ICP) that is well-established in all health care facilities in Egypt. The plan to be followed in order to implement this program is explained in details. This plan includes assessment of the actual situation in every HCS, staff training, upgrading all services necessary for infection control such as handwashing facilities, laundry, sterilization and waste disposal, and regular monitoring of the outcomes of the plan. [12]

Therefore, and due to this ICP, the mean score obtained in hygiene promotion in the hospitals under study

was 86%. Public hospitals had a mean score of 88% and private ones had 83%. No statistical difference could be observed between both of them at 95% level of significance (t=0.7).

A plan for hygiene promotion was found in 90% of the surveyed hospital, staff were aware of this plan, they were informed about changes in strategies adopted within the HCS and were following the new procedures. Staff were adequately trained in infection control procedures by attending infection control workshops organized either inside or outside the HCS. Posters were found in all hospitals about many topics such as steps of handwashing and preventive measures against swine flu. This was found to be in accordance to a previous study conducted in Abou Kir Hospital, Damanhour Hospital and in Shebin El-Kom Hospital that reported that training in infection control and occupational health and safety was performed regularly within these hospitals.[15] However, no training sessions were dedicated to the public including patients and visitors. This should be encouraged since posters were not enough as perceived by the nursing staff in the hospitals under study. They were always complaining about the low patient awareness as concerns simple hygiene measures.

CONCLUSIONS AND RECOMMENDATIONS:

Many HCS are far from achieving acceptable levels of environmental health, either because of lack of resources, or failure in the design and management of the HCS building. Major areas that require improvement within the health care sector include water supply, handwashing facilities, excreta disposal, health care waste

management, laundry, food storage and preparation, vector control and the HCS construction and management.

Recommended measures include:

- Installing HEPA filters in the operating theaters; and creating a positive pressure inside.
- Repairing the plumbing system in the water closets of the HCS, and cleaning and disinfecting them regularly.
- Provision of puncture-proof containers for the safe segregation of sharp health care waste.
- Adhering to the MOH specifications for laundry facility within the HCS.
- Implementing HACCP system in hospital catering.
- Regular monitoring of the water quality within the different departments of the HCS; and installing water filters for supplying water to immuno-compromised patients.
- Covering opening window with fly screens.
- Raising patient awareness as concerns essential hygiene measures and the importance of maintaining the hospital in good sanitary conditions.

Table (1): Assessment of the Water Quality in Ten Hospitals in Alexandria, 2009

Questions*	Hospital Answers **									
	Public Hospitals					Private Hospitals				
	A	B	C	D	E	F	G	H	I	J
Is water from a safe source (free from fecal contamination)?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is water protected from contamination in the HCS?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is the safety of water monitored regularly?	N	N	N	N	N	Y	N	N	N	N
Is the quality of water supplied monitored regularly?	N	N	N	N	N	Y	N	N	N	N
Are water storage and distribution adequately maintained?	NA	N	NA	N	Y	Y	Y	Y	Y	NA
If necessary, can water be treated at the HCS?	Y	NA	Y	Y	Y	Y	Y	NA	Y	NA
If water is treated, is the treatment process operated effectively?	Y	NA	Y	Y	Y	Y	Y	NA	N	NA
Are there sufficient supplies and adequately trained staff to carry out treatment?	Y	NA	Y	Y	Y	Y	Y	NA	N	NA
Is the quality of treated water monitored regularly?	Y	NA	Y	Y	Y	Y	Y	NA	Y	NA
Are treatment process monitored regularly?	Y	NA	Y	Y	Y	Y	Y	NA	N	NA
Does the water supply meet national chemical and radiological standards?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
If necessary, are measures in place to avoid overexposure to chemical contaminants?	N	N	N	N	N	Y	N	N	N	N
Is water acceptable (smell, taste, appearance)?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
If water is not acceptable, is there a safe alternative supply for drinking water?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Is low quality water identified as non-potable at all outlets?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Are procedures in place for keeping both water supplies identified?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hospital score (as a %)	75	50	75	69	70	100	77	62.5	54	57

*** WHO assessment checklist [(10)]**

**** Y = Yes, N = No, NA = Not applicable**

Table (2): Results of Analysis of Water Samples from 10 Hospitals in Alexandria, 2009

Hospital	Fecal Coliform MPN/100ml			Residual Chlorine Concentration (mg/l)			Turbidity (NTU)		
	Kitchen	Nursing Station	WC	Kitchen	Nursing Station	WC	Kitchen	Nursing Station	WC
A	ND	ND	ND	1	0.7	1	0.5	1	0.6
B	ND	ND	ND	1.5	1.5	1	0.74	0.46	0.53
C	ND	ND	ND	1.7	3	1.14	1	0.93	0.72
D	ND	ND	ND	1	0.8	0.9	0.4	0.7	0.3
E	ND	ND	ND	0.07	0.1	0.11	0.14	0.5	0.64
F	ND	ND	ND	0.6	0.75	0.8	0.6	0.5	0.4
G	ND	ND	ND	1	1	1	0.29	0.32	0.4
H	ND	ND	ND	0.58	0.69	0.5	0.78	0.98	0.66
I	ND	ND	ND	0.58	0.7	0.55	1	1	1
J	ND	ND	ND	0.8	0.7	1	0.65	0.7	0.5

MPN= Most Probable Number

ND= Not Detected

Table (3): Assessment of Environmental Health Standards in Ten Hospitals in Alexandria, 2009*

Questions	Hospital Scores as %												General mean as %
	Public Hospitals						Private Hospitals						
	A	B	C	D	E	Mean	F	G	H	I	J	Mean	
Water quality	75	50	75	69	77	67.6	100	77	62.5	54	57	70	69
Water quantity	50	75	50	50	50	55	75	75	75	75	50	70	62.5
Water facilities	86	29	43	43	57	51.6	100	86	57	86	43	74.4	63
Excreta disposal	88	35	76	65	65	66	94	71	88	88	47	77.6	71.7
Wastewater disposal	100	100	100	100	100	100	100	100	100	100	100	100	100
Health care waste disposal	71	14	75	69	77	71	100	77	62.5	54	43	57	64
Cleaning and laundry	93	57	93	71	100	83	100	93	100	93	93	96	89
Food storage and preparation	100	100	100	50	100	90	100	58	58	58	58	66	78
Building design, construction and management	50	30	60	40	60	48	60	40	40	30	30	40	44
Vector control	71	0	100	16	71	53.5	86	86	50	100	50	74.4	63
Hygiene promotion	100	60	100	80	100	88	100	100	80	80	56	83	86

* WHO assessment checklist [10]

Table (4): Assessment of Water Facilities in Ten Hospitals in Alexandria, 2009

Questions*	Hospital Answers**									
	Public Hospitals					Private Hospitals				
	A	B	C	D	E	F	G	H	I	J
Are there sufficient clearly identified drinking water points?	N	N	N	N	N	Y	N	N	N	N
Are drinking water points properly used and adequately maintained?	NA	NA	NA	NA	NA	Y	NA	NA	NA	NA
Are there sufficient water points in the right place for all needs?	Y	N	N	N	Y	Y	Y	N	Y	N
Is water accessible where needed at all times?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are handwashing points available in all areas where health care is carried out?	Y	N	N	N	N	Y	Y	N	Y	N
Is there always soap or a suitable alternative at handwashing points?	Y	N	N	N	N	Y	Y	Y	Y	N
In inpatient HCS, are there sufficient showers?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are showers properly used and adequately maintained?	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Hospital score (as a %)	86	29	43	43	57	100	86	57	86	43

*** WHO assessment checklist [(10)]**

**** Y = Yes, N = No, NA = Not applicable**

Table (5): Assessment of Excreta Disposal in Ten Hospitals in Alexandria, 2009

Questions*	Hospital Answers**									
	Public Hospitals					Private Hospitals				
	A	B	C	D	E	F	G	H	I	J
Are there sufficient toilets in the HCS?	N	N	N	N	N	N	N	N	N	N
Are there sufficient toilets actually in use?	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Are toilets adapted to local maintenance systems?	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Are toilets affordable in short term and in long term?	Y	N	Y	N	Y	Y	Y	Y	Y	Y
Are toilets maintained and repaired in a timely effective way?	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Are toilets designed to suit local culture?	Y	Y	Y	N	N	Y	Y	Y	Y	Y
Do toilets provide privacy and security?	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Do patients, staff and carers find toilets appropriate?	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Are toilets used according to their design?	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
Are toilets hygienic to use and easy to clean?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are toilets clean and without smell?	N	N	N	N	N	Y	Y	Y	Y	N
Are there handwashing facilities close by toilets?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is there water and soap available all the time?	Y	N	N	N	N	Y	Y	Y	Y	N
Are toilets easily accessible for all users?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are access routes to toilets kept in good condition?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is there a cleaning and maintenance plan?	Y	N	Y	Y	Y	Y	Y	N	N	N
Is there an effective cleaning and maintenance routine in operation?	Y	N	N	N	N	Y	Y	Y	Y	N
Hospital score (as a %)	88	35	76	65	65	94	71	88	88	47

*** WHO assessment checklist [10]**

**** Y = Yes, N = No, NA = Not applicable**

Table (6): Assessment of Solid Waste Disposal in Ten Hospitals in Alexandria, 2009

Questions*	Hospital Answers**									
	Public Hospitals					Private Hospitals				
	A	B	C	D	E	F	G	H	I	J
Are there facilities in place for segregation at the point of generation?	Y	N	N	Y	Y	Y	N	N	N	N
Are segregation facilities used effectively?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are there sufficient waste containers in the right places?	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Are waste containers emptied, cleaned and replaced frequently enough?	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Are there appropriate treatment and disposal facilities in place?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Are treatment and disposal facilities correctly operated and maintained?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Are waste-related injuries correctly reported and acted on?	Y	N	Y	N	Y	Y	Y	N	N	N
Is there a specific waste disposal zone with the necessary facilities?	N	N	Y	Y	Y	Y	N	N	N	N
Is the waste disposal zone operated so as to prevent contamination?	N	N	Y	Y	Y	Y	N	N	N	N
Hospital score (as a %)	71	14	86	86	100	100	57	43	43	43

*** WHO assessment checklist [(10)]**

**** Y = Yes, N = No, NA = Not applicable**

Table (7): Assessment of Food Storage and Preparation in Ten Hospitals in Alexandria, 2009

Questions*	Hospital Answers**									
	Public Hospitals					Private Hospitals				
	A	B	C	D	E	F	G	H	I	J
Are there handwashing points in food preparation area and the toilets food handlers use?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Do food handlers wash their hands when necessary?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are food storage and prep areas designed so as to be easy to clean?	Y	Y	Y	N	Y	Y	N	N	N	N
Are food preparation areas kept clean and protected from rodents and insects?	Y	Y	Y	N	Y	Y	N	N	N	N
Are there facilities for preventing contact between raw and cooked foodstuffs?	Y	Y	Y	N	Y	Y	N	N	N	N
Is contact between raw and cooked foodstuffs prevented?	Y	Y	Y	N	Y	Y	N	N	N	N
Are cooking facilities adequate for heating food sufficiently?	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Is food cooked thoroughly?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is there a fridge?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is food kept at safe temperature?	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Is the store for dry food appropriate?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Are dry food stores kept clean and protected from rodents and insects?	Y	Y	Y	N	Y	Y	N	N	N	N
Do facilities exist for safe preparation, storage and handling of powdered infant formula?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Is powdered infant formula prepared according to WHO and FAO guidelines?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hospital score (as a %)	100	100	100	50	100	100	58	58	58	58

*** WHO assessment checklist [(10)]**

**** Y = Yes, N = No, NA = Not applicable**

Table (8): Assessment of Building Design, Construction and Management in Ten Hospitals in Alexandria, 2009

Questions*	Hospital Answers**									
	Public Hospitals					Private Hospitals				
	A	B	C	D	E	F	G	H	I	J
Is the HCS designed and built so as to provide comfortable and healthy conditions?	Y	N	Y	N	Y	Y	N	N	N	N
Are the HCS buildings managed so as to maintain comfortable and healthy conditions?	N	N	Y	N	Y	Y	N	N	N	N
Is the ventilation designed to minimize airborne disease transmission?	N	N	N	N	N	N	N	N	N	N
Is the ventilation appropriately managed?	N	N	N	N	N	N	N	N	N	N
Is the lighting system sufficient?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is the lighting system correctly operated and maintained?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Does the design respect national guidance to minimize contamination?	N	N	N	N	N	N	N	N	N	N
Are the HCS activities organized to minimize the spread of contamination?	N	N	N	N	N	N	N	N	N	N
Is the HCS easily accessible by people with physical handicaps?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Is space in HCS used in effective way for easy access and to minimize spread of contamination?	Y	N	Y	Y	Y	Y	Y	Y	N	N
Hospital score (as a %)	50	30	60	40	60	60	40	40	30	30

*** WHO assessment checklist [(10)]**

**** Y = Yes, N = No, NA = Not applicable**

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