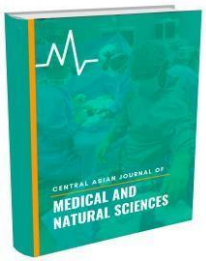

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Article

Medical Instrumentation Technical Engineering Environment Health and Safety Plan in Iraqi Hospitals

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Abstract: This project highlights about health and safety in Iraqi hospitals. Every day, health institutions and clinics, especially large hospitals received large numbers of patients. Transmission of infections and radiations that use diagnostic and therapeutic medical devices, and all the risks that affect the health of auditors and doctors. Therefore, safety and environment are very essential factor in hospital concerned with preserving environmental health and safety inside the hospital. In order to preserve their health and safety, it is one of the most important duties of the health institution. In this work, our research is focused in Medical City Department and Baghdad Teaching Hospital, which is the largest hospital in Ministry of Health Baghdad.

Keywords: Environmental Health and Safety, Iraqi Hospitals, Infection Control, Radiation Risk, Medical Waste Management, Patient Safety

1. Introduction

Safety in hospitals

The comprehensive quality standards in hospitals: Safety of hospital visitors. In addition to choosing gifts that are suitable for the condition of the injured person and that do not affect his health condition, and making sure of the hospital regarding the safety of these gifts; Some departments prohibit the entry of flowers, plants, and food, in addition to the need to avoid emotion and talk to staff and other patients in an inappropriate manner in the event of feeling pain towards a dear person who suffers from physical fatigue, and in this

regard, hospitals employ Hospitals must employ security staff and establish comprehensive arrangements to protect all patients and hospital personnel, ensuring their safety. Health services enforce a code of conduct that outlines proper procedures for employees to handle such cases. Figure 1-1 illustrates the safety plan diagram for hospitals [1].

Patient safety in the hospital Many deaths in the world occur due to failure to provide adequate and appropriate care to patients, and in fact this reason is one of the top ten causes of death and disability globally. Every year, (134) million accidents occur in hospitals, injuring the injured, and resulting in (2.6) deaths. One million injured, and two-thirds of these cases are caused by unsafe care, One of the most critical aspects of patient safety is ensuring accurate tracking of medications administered to patients. Medications pass through multiple stages, beginning with the prescribing physician, followed by the

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pharmacy, and finally the nurse who administers the medication. Any error or breakdown in this process can compromise patient safety. Medication errors, in particular, are a leading cause of preventable harm in healthcare settings . Preventable worldwide Here are some facts about poor patient safety: Symptomatic infection affects about (7) in every (100) hospital residents [2].

Radiation Risks Health And Environment In Hospitals

Radiation Risks to Health and the Environment in Hospitals X-ray risks to patients and workers In general, all aspects of life involve a balance of risks and benefits, and the use of X-rays is no exception. While X-rays are a valuable diagnostic tool, the ionizing radiation used in these examinations has the potential to damage the body's genetic material (DNA). Figure (2-1) as shown cautions X-ray [3].

1.1 X-ray risks are divided into two forms:

Risks to Patients:

The first section focuses on the risks of radiation exposure to patients. a common procedure that involves ionizing radiation.

Risks to Healthcare Workers:

The second section addresses the dangers of X-rays for doctors and technicians who work with this technology. These risks can be categorized into two types:

Local Injuries: Damage to specific areas of the body, such as skin or tissuesm [4].

General Injuries: Systemic effects that may impact overall health.

However, advancements in medical devices and improved safety protocols have significantly reduced the occurrence of such injuries over time.

1.2 X-ray risks are:

To the Skin:

Radiation-Induced Injuries

Skin Injuries:

Mild Lesions: Redness may appear 1–2 days after exposure.

Late Infections: Inflammatory lesions of the skin, subcutaneous tissue, or dermis may develop 2–4 weeks after exposure [5].

Very Late Effects: Atrophy and skin cancers may occur, often visible on radiographs.

Mucosal Lesions:

Similar to skin lesions, mucosal injuries typically appear within 13 days of exposure.

Bone Injuries:

The most significant bone injury is radial osteonecrosis, particularly in demineralized bones. This condition is caused by secondary radiation and often becomes apparent weeks or months after exposure. The jawbone is a common site for such injuries [6].

Ophthalmic Injuries:

The most notable eye injury is cataracts, which may develop months after radiation exposure.

Reproductive Injuries:

Radiation can damage sex cells, leading to infertility in both males and females. It can also affect gene transfer to embryos, resulting in structural abnormalities and fetal deformities.

1.3 The Waste Inside Hospitals.

1. There is Types of waste inside hospitals.

Pharmaceutical waste is sorted into blue bags

It is sorted by a specialist pharmacist or an experienced person [7].

Non-hazardous pharmaceutical waste (creams - crisis medications)

2. Sharps are sorted into special containers that are puncture-resistant. Safe box.

Containers should be sturdy, made of plastic and eco-rated materials that are non-leaking.

The appropriate size and place to place the box are selected.

The date is written on the safe box at the beginning of its use. In the event that the required size is not available, the box is used for a maximum period of 7 days, because it may constitute a suitable environment for the growth of bacteria [8].

3. The safe box is placed in a place far from the ground, at an appropriate height from the ground, and away from the hands of children, the elderly, or people with intellectual disabilities.

4. The safe box must be sealed and replaced with another when it is about full, and it must be recorded from which section it came from. Genotoxic waste sorting: Chemo Genotoxic waste is excreted in blue plastic bags. It is forbidden to dispose of it by using landfill and burial or pouring it into the sewage system, and it must be returned to the source (Department of Pharmacy).

Sorting radioactive waste:

These wastes must be collected in containers specially prepared for this purpose, with specifications determined by the competent authorities, made of lead or surrounded by tightly closed lead, with the presence of the international radiation logo [9].

The waste treatment :

Waste Handling Procedures:

a. Waste sorting

Medical waste must be sorted according to its classification directly at the place of its generation according to the color coding guide as follows:

Regular (semi-domestic) waste is sorted into black plastic bags Infectious waste is sorted into yellow plastic bags.

Highly infectious waste is sorted into red colored plastic bags.

1.3.1 Initial processing must be carried out within the department using the following methods:

Contaminated blood units are dealt with in one of the following ways:

Either the blood bag is placed inside a thermal bag and placed inside the sterilizer under (121) degrees Celsius for (20) minutes. Or add 605 ml of chlorine to the blood unit for (30) minutes so that the total chlorine per unit is (10,000 ppm). The blood is then disposed of in the sewer [10].

Blood bags are treated as infectious waste:

Medical waste management program inside and outside health institutions:

Each health institution, especially the Infection Control Committee, must form a committee to manage medical waste within it, and it shall consist of the following:

1 . Head of the health institution.

2 . Administrative affairs officer, member.

3 . Waste management officer, member

4 . Infection control officer, member.

5 . Dental Officer member.

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4 . Infection control officer, member.

5 . Dental Officer member.

6. Doctors responsible member.

7 . Nursing official member.

8 . The laboratory official is a member.

Tasks of this committee: Develop a medical waste management plan within the institution in line with the approved medical waste management guide and supervise its implementation. Develop a plan to train all employees of the institution on the safe management of medical waste. Training the employees of the institution on the policies and procedures for the disposal of medical waste. Monitoring the occupational health of workers and vaccinating them, ensuring that the necessary personal protective equipment is provided. . Ensure that bags and containers are in line with the color guide. . Ensure that waste is separated according to its classification directly from the place of its generation. . Supervising the process of separating, collecting, transporting and storing medical waste.

Preparing reports on achievements and obstacles and submitting them to senior management.[11]

8. Strategic foundations of the medical waste management program Preventive support for the health institution in all aspects, including the safe disposal of medical waste and taking all necessary measures to deal with this waste in all its stages using known scientific methods.

9.Effective management of medical waste involves disposing of it through appropriate and scientifically validated methods to minimize its impact on both human health and the environment. Additionally, adopting strategies to reduce the generation of medical waste is essential for sustainable healthcare practices.

10. Continued coordination and work of regional and international organizations in this regard.

Transportation of medical waste :

The waste be collected in special grommets or containers which shall meet the following specifications:

15. Easy loading and unloading Smooth surfaces for easy cleaning and disinfectionAbsence of sharp corners that lead to rupture or damage to bags or packages

16. It is made of a material against corrosion due to solutions, chemicals and cleaning materials

17. Waste must be transported from its places of production to storage at appropriate and predetermined periodic times within a specific route

18. A new bag should be placed directly in place of the full one

19. The transport vehicle must be cleaned and disinfected immediately after unloading and in the event of any spills

20. A vehicle must be designated for transporting waste outside the health facility.

21. Temporary storage of medical waste

22. Waste must be stored in a special storage room, provided that it meets the following specifications.

23. The storage location is separate fr smooth and polished om the rest of the departments.The walls are.

24. Smooth and impermeable surfaces for easy cleaning and disinfection. Good lighting and ventilation

25. Ease of entry for workers in charge of transporting and treating waste.

Enterprise. Easy entry for waste transport vehicles outside

26. Protected from sunlight and weather factors.

27. The presence of a source of running water and sanitation. Airtight.

28. Anti-spreading of insects, rodents and birds, with a wire mesh on the windows.

29. Suitable disinfectants and cleaning tools are available size and area should be commensurate with the volume of waste produced.

Arranging the waste within the storage site in a manner that guarantees the safety of the stored waste

31. It is preferable to arrange waste bags in the storage room so that each color is separate

32. To write clearly on the door of the room (store for medical waste)

33. Available for storage at any time, with the guarantee of periodic waste transfer to it

34. Sealing the storage room, identifying the persons who have the keys to the site, and preventing the entry of those who have no work

35. Storage should be in intact containe

Infection transmission in hospitals

Infection transmitted by tuoch:

Contact isolation precautions are followed when a patient with infections spread by . Direct and indirect touch that is transmitted as a result of touching the surfaces in the patient's surrounding environment. Infection includes antibiotic-resistant bacteria and other microbes transmitted through the environment (eg MRSA, VRE, MDR Pseudomonas aeruginosa, MDR Acinetobacter baumannii C. difficile, noroviruses and other intestinal tract pathogens; RSV [12].

Contact isolation precautions should be followed if the patient has severe diarrhea or abscesses. Accompanied by a large discharge or a lot of secretions can lead to contamination of the surrounding environment and thus the spread of infection 1Droplet transmission [13]:

Aerosol isolation precautions are applied if the patient is known or suspected to have a transmissible infection. Respiratory droplets are small amounts of fluid expelled from the lungs or nose with a diameter greater than or equal to 5 microns that are expelled into the air by coughing Contaminated droplets spread through the air for short distances of no more than one or two metres. Examples of microbes transmitted through droplets are:

53. Whooping cough

54. COVID 19

55. German measles

56. Meningococcal meningitis

57. Influenzae

Place A single room containing a toilet must be provided (air pressure is not required to be negative

58. If a separate room is not available: Patients infected with the same microbe (similar group) are isolated in one place with a physical barrier between them, curtains (for example), after consultation with the infection control officer. In multi-bed rooms, a minimum of 3 feet of separation between patients is recommended.

59. When there is a shortage of single rooms: Priority should be given to isolation in a single room for patients with excessive sputum secretion and coughing. Patients are congregated in one area if they have the same infection and if it is appropriate for their health condition.

60. Tools must be allocated to the patient, disinfection and sterilization of reusable tools after each use. It is preferable to use single-use equipment if possible.

61. A sign must be placed on the door of the room indicating the presence of spray insulation. The door of the room must be kept closed

Hand hygiene:

a. Patient caregivers must clean hands before entering and after leaving the isolation room.
b. completely using paper towels or rubbing hands with an alcohol-based disinfectant
c. according to the five moments when dealing with the patient. Refer to the hand-washing policy.
d. Encouraging the patient to observe personal hygiene, including hand hygiene.

1.4 Environmental cleanliness:

The accuracy of the environment is emphasized, especially the most touching surfaces such as door handles, bed frames, light sockets, and others.

a. The place must be cleaned and disinfected by an approved cleaner and disinfectant in the institution
b. A surgical mask, clean gown and gloves must be worn by the cleaner before entering the isolation room and must be disposed of upon departure.

Hands must be cleaned before entering and after leaving the isolation room.

2. Materials and Methods

As part of its research methodology, this study used a qualitative descriptive approach to conduct this study that encompasses the environmental health and safety (EHS) practices in Iraqi hospitals, particularly in the Medical City Department and Baghdad Teaching Hospital which are in the list of the two largest hospitals in Baghdad Iraq. Data collection was made through direct observations, reports of the institutional, expert consultations in hospital departments to assess current safety processes, infection control measures, radiation exposure practices and medical waste management systems. The frequency and the quality of hygiene practices and use of personal protective equipment and the rate of compliance of hospitals with Infection Protection guidelines were monitored by the research team. Radiation safety was evaluated using information on the handling and monitoring of diagnostic equipment, protection measures for both population and patient healthcare personnel, as well as staff's awareness on risk of radiation. Likewise, the method was to review on-site procedures for storage and disposal of hazardous medical waste and check how it aligns with the national and international guidelines for genotoxic, radioactive and pharmaceutical materials. Another part of the study involved informal interviews with staff members such as nurses, technicians and administrators to understand how safety measures are being implemented as a practical matter and what systemic failures already exist in this. This methodological design permitted the researchers to triangulate findings to other sources that would enhance the reliability and importance of the data collection in the critical issues found. This focused to the real hospital environments thus the study could have been used to reflect the actual conditions under which these health risks occur and to propose practical ways and measures by which hospitals could enhance the safety and well being of both patients and healthcare workers.

3. Results and Discussion

3.1 Nuclear medicine or ionizing radiation treatment in hospital

Key Facts About Ionizing Radiation Definition: Ionizing radiation is a form of energy emitted by certain atoms in the form of electromagnetic waves or particles.

Sources of Exposure: People are exposed to ionizing radiation from natural sources (e.g., soil, water, and plants) and man-made sources (e.g., X-ray machines and medical devices).

Applications: Ionizing radiation has numerous beneficial applications in fields such as medicine, industry, agriculture, and research.

Health Risks: Improper use or containment of ionizing radiation increases the risk of adverse health effects. High doses can cause severe conditions such as skin burns or acute radiation syndrome, while prolonged exposure to low doses may lead to long-term effects like cancer.

Types of Radiation Exposure

Internal Exposure:

Occurs when radionuclides enter the body through inhalation, ingestion, or injection (e.g., via wounds).

Internal exposure ends when the body eliminates these radionuclides naturally (e.g., through waste) or through medical treatment.

External Contamination:

Happens when radioactive materials (e.g., dust, liquids, or aerosols) adhere to the skin or clothing.

This type of contamination can often be removed by washing.

External Irradiation:

Results from exposure to external radiation sources, such as X-rays in medical facilities.

Exposure ceases when the radiation source is shielded or the individual moves away from the radiation field [13].

Health Effects of Ionizing Radiation Mechanism of Damage:

The extent of damage to tissues and organs depends on the absorbed dose, measured in gray (Gy).

The type of damage varies based on the radiation type and the sensitivity of the affected tissues or organs [14].

Effective Dose Measurement:

The sievert (Sv) is the unit used to measure the effective dose of ionizing radiation, accounting for the type of radiation and tissue sensitivity.

Cellular Repair and Long-Term Effects:

Cells are more likely to repair themselves if radiation exposure is spread over a long period (low dose rate).

However, errors in cellular repair can lead to mutations, potentially causing cancer years or even decades later [15].

The likelihood of long-term effects increases with higher radiation doses.

Vulnerable Populations:

Children and adolescents are more sensitive to radiation exposure than adults, making them a high-risk group.

Epidemiological Evidence

Cancer Risk:

Studies on populations exposed to high radiation doses (e.g., atomic bomb survivors or radiation therapy patients) show a significantly increased risk of cancer at doses above 100 millisieverts (mSv).

Prenatal Exposure:

Exposure to ionizing radiation during pregnancy can cause fetal brain damage, particularly at doses exceeding 100 mSv between weeks 8–15 and 200 mSv between weeks 16–25 of gestation.

No significant effects on fetal brain development were observed before week 8 or after week 25 of pregnancy, see Figure 1.

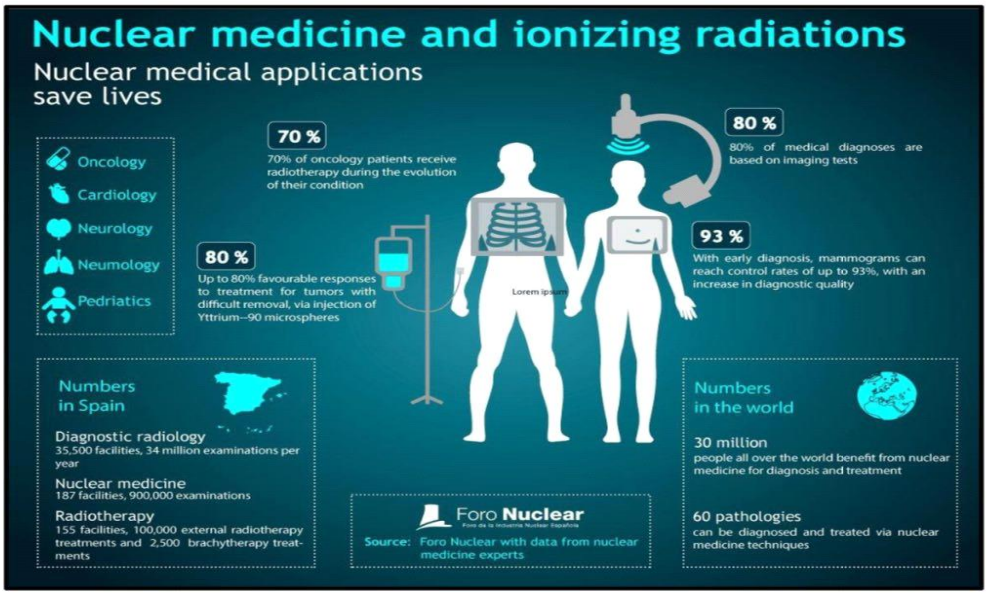

Figure 1. Nuclear medicine and ionizing radiations.

4. Conclusion

Providing environmental health safety inside the hospital is one of the most important duties of the health institution. The institution must provide technological capabilities and advanced expertise to protect the health institution from dangers such as pollutants and infections transmitted inside the hospital, and provide advanced capabilities in dealing with errors that most hospitals face. Some of which end the life of the patient, so it is necessary to take advantage of the experiences and develop the health and technical cadres through courses and planets of development and the use of foreign expertise and advanced health devices in dealing with problems and cases within the institution.

Radiation Hazards to Hospital Environmental Health In light of the technical development in the field of medical devices, especially radiological devices, and the effectiveness of their safety on patients and workers, the institution must emphasize the setting of specific doses that the patient receives from radiation, so as not to cause any side effect that threatens the life and health of the patient, and to pay attention to the workers inside the radiation rooms Because they are not exposed to injuries or complications to which they are exposed to radiation, and this must be done for them a periodic examination to ensure their safety and to provide them with the best factors of protection and prevention from radiation.

The waste inside hospitals. Increasing awareness of health hazards related to healthcare waste, appropriate training on proper waste management, increasing waste

management and disposal systems, increasing financial and human resources, and increasing the level of priority given to the subject.

Infection transmission in hospitals Contribute to the provision of the highest quality healthcare, by promoting safety and reducing the risk of infection and transmission among patients, visitors, healthcare workers and support staff in hospital facilities.

Nuclear medicine or ionizing radiation treatment in hospitals After studying this topic, I pointed out some basic things that must be taken into account in order to prevent and preserve people's lives, because small things may not appear directly, but over time and accumulation will begin to aggravate and lead to disasters. Therefore, patients and staff should be careful about radiation exposure and not overexposure. This should be done when necessary and at that time the staff should be equipped with a radiation counter kit. Radiation hazards lie in a long period of time and are exposed almost continuously. It will be distorted in the DNA and negatively affect his health.

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