



Review

Awareness to Handle Research and Healthcare Waste (RHCW) in Teaching and Research Institutes; A Comprehensive Review

Naveed Munir^{a*}, Muhammad Naveed Afza^{1a}, Zahed Mahmood^b, Umar Bacha^c, Syeda Saira Iqbal^a, Qurat ul Ain^d, Awais Imdad Khan^e, Amber Yaseen^e

^a Department of Medical Laboratory Sciences, School of Health Sciences, Health Sciences Campus, University of Management and Technology, Lahore-Pakistan

^b Department of Biochemistry, Government College University, Faisalabad-Pakistan

^c Department of Nutritional Sciences, School of Health Sciences, Health Sciences Campus, University of Management and Technology, Lahore-Pakistan

^d Department of Medical Imaging Technology, School of Health Sciences, Health Sciences Campus, University of Management and Technology, Lahore-Pakistan

^e Department of Basic Medical Sciences, School of Health Sciences, Health Sciences Campus, University of Management and Technology, Lahore-Pakistan

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Abstract

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Correspondence:
naveedmunir215@gmail.com

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Environmental pollution has become the major challenge not only for developing countries but also for developed ones Worldwide. In addition to the pharmaceutical, leather, chemicals, food and paper industries teaching, research and healthcare institutions are also the significant sources of different types of Non-hazardous as well as hazardous wastes. Therefore, a simple and implementable guideline for cleaning and waste disposal services in such institutions require strict adherence to applicable policies and procedures. Research and healthcare waste (RHCW) management is a joint effort among Research Laboratory Personnel, Healthcare Facilitator, Building Services Personnel and Local Environmental Health and Safety Personnel. As Pakistan is among the developing countries situated in South Asia therefore most of the institutes including teaching, research and healthcare try to follow the WHO guidance or try to manage hazardous as well as non-hazardous wastes at self-planned strategies. The major goal of this comprehensive review is to compile the reference data regarding the different types of waste generated in teaching, research and healthcare institutes, and specific strategy to manage such wastes. Although, most of the local Government bodies and Institutional bodies are trying to handle the wastes at their own levels by following different protocols but introducing a protocol at National level is the need of current era to fight against environmental pollutants.

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Introduction

The strategies to handle Medical Waste (MW) also known as infectious waste are among the big challenge for developing countries due to their severe consequences for human health and the environment [1]. Moreover, significant increase in environmental pollution has been getting attention in developing countries and developed ones worldwide from the last few decades [2]. In addition to the pharmaceutical, leather, chemicals, food and paper industries; teaching, research and healthcare institutions are also the significant sources of different types of Non-hazardous as well as hazardous wastes. Such pollutants and the climate changes have posed not only the human and animal survival at risk but whole food systems may be at risk under such unpredictable changes in the environment [3]. Moreover, the poor management of hazardous waste generated particularly in patients care has aroused the concern Worldwide mainly focusing on the long-term effects on human, health and the environment [4].

World Health Organization (WHO) has established advisory guidelines that provide procedural information for Laboratory Workers to follow when disposing of laboratory waste. Therefore, a simple and implementable guideline for cleaning and waste disposal services in such institutions requires strict adherence to applicable policies and procedures. Research and healthcare waste (RHCW) management is a joint effort among Research Laboratory Personnel, Healthcare Facilitator, Building Services Personnel and Local Environmental Health and Safety Personnel [2]. The guidelines should be read in conjunction with the given references for Hazardous Waste Disposal at the end in order to minimize risks associated with the disposal of laboratory waste [5]. The major goal is to provide cleaning and waste disposal guidelines for RHCW management is particularly all over Pakistan. These will provide the guidelines apply to all Researchers, Clinicians, Workers, Students and Visitors who work within a laboratory environment that generate only and/or dispose of any type of waste.

General Principles in the Management of RHCW

All potential waste streams that emerge from Research facility activities should be surveyed, and a proper removal course chose before squander being created. Waste should be gathered in a reasonable holder and named as portrayed underneath in applicable segment for each. Supporting the Institutional Waste supervisory group and Neighborhood State run administrations in the execution of satisfactory methods to limit the general dangers related with Research and healthcare waste (RHCW) the executives stay the earlier level-headed of this original copy. Squander the executives and treatment choices should initially safeguard the analysts, medical care laborers, understudies and everyone, and Limit circuitous effects from natural openings to RHCW [6]. WHO and other waste administration systems involved the accompanying fundamental phrasings for thought in an RHC establishment:

Minimize waste and do not accumulate large amounts in the Laboratory.

Segregate to separate waste residues in suitable color-coded containers if you generate a large amount of waste.

Compatibility ensures the waste container is compatible with the waste you are collecting.

Label the waste residue container with the appropriate waste label and symbol.

Storage waste in a suitable area before collection. For example, chemicals and solvents

Leakage ensure container is not leaking and no spillage on the exterior of the container on storing hazardous material.

Handle waste only if you are aware of the hazards associated with the waste and appropriate risk controls are used.

Dispose-off waste as per relevant guidelines.

Regular disposal from the Laboratories must be part of a RHCW management program.

Record all disposals on Waste Tracking Logbook to ensure evidence of correct waste management.

Some Basic Definitions

Meanings of Perilous Waste Qualities embraced from Various Waste administration acts are given beneath [7, 8, 5, 9]. About 72 images are utilized to demonstrate different unsafe wastes; however, the most ordinarily utilized images are given underneath:

3.1 Flammability

Combustible squanders will make fires under specific circumstances, may be suddenly combust, and have a blazing point under 60 °C (140 °F). Models incorporate excess ethanol, methanol, hexane, acidic corrosive and CH₃CO. It ought to be named as (Figure 1A)

3.2 Corrosivity

Destructive squanders are acids or bases with a pH not exactly or equivalent to 2, or more noteworthy than or equivalent to 12.5. They are equipped for eroding metal holders, for example, capacity tanks, drums, and barrels. Models incorporate utilized acidic corrosive and sodium hydroxide. It ought to be named as (Figure 1B).

3.3 Reactivity

Responsive squanders are temperamental under "ordinary" conditions. They can cause blasts and responsive gases or fumes when warmed, packed, or blended in with water. Models incorporate picric corrosive waste (that has been permitted to solidify), sodium azide, old tetrahydrofuran and old ethyl ether. It ought to be named as Figure 1C.

3.4 Toxicity

Harmful materials are destructive or deadly when ingested or consumed (e.g., pesticides, metals like mercury or lead, and poisonous synthetic substances like nicotine, benzene, formaldehyde, chloroform, and so forth) Whenever harmful materials are land arranged, impurities might get away and contaminate the air or groundwater. It ought to be named as addressed in Figure 1D.

Fundamentals of Research and Health Care Waste Management (RHCWM)

This segment gives general data on RHCW and key components of the executive's methodology that are fundamental before fostering a RHCWM plan. It incorporates the accompanying:

The requirement for the improvement of oversight and the executives' structures [6,9]:

- A show of the dangers related to RHCW

- A definition and an arrangement of RHCW (depicted previously)
- The base recognition that ought to be regarded for RHCWM
- A direction for the particular administration of unsafe and irresistible RHCW
- Signs for the advancement of defensive measures for Exploration and Medical services Help (RHCF) staff and the climate.

4.1. Supervision and Management Structures for Research and Health Care Waste (RHCW)

RHCWM is most importantly an administration issue before being a specialized one and relies upon the responsibility of the whole staff inside RHCFs. This devotion might be conceivable assuming individuals are appropriately prepared and made mindful of the dangers that this specific kind of waste postures. It is along these lines essential to ensure the educational programs of scientists, clinicians and aiding/advantageous staff incorporates this significant general medical problem [7]. (I) When another staff part or understudy is locked in, it is enthusiastically suggested that a particular condition regarding the protected administration of RHCW be remembered for the agreement, to make the newcomers completely mindful of the significance of this piece of his/her work and made at risk in this regard. (ii) To ensure RHCW is appropriately overseen in the long haul, it is vital to consistently direct the acts of the staff. This ought to be performed by the RHCWM official and individuals from a RHCWM council inside each RHCF (contingent upon the size of the office). Individuals from such a council are normally equivalent to those responsible for nosocomial contaminations. (iii) Proper on-going preparation and mindfulness meetings should be coordinated to keep rehearses at the most ideal principles. (iv) To help the RHCWM official as well as these RHCWM boards of trustees, provincial and public help ought to be given. These territorial and public supervisory groups are there to supply the RHCF level with the essential specialized backstopping to both guarantee standard and blended systems are applied and work with the everyday work of the RHCWM official and individuals from the RHCWM boards of trustees [7, 8,10].

4.2 People at Dangers Related with RHCW

All people presented to unsafe RHCW are possibly in danger of being harmed or tainted. The populace could be separated into various individual gatherings that might be at high gamble to be tainted during various exercises, including research and clinical (Table 1) [5].

Different Types/Classes of Wastes

World Health organization (WHO) classified the different types of wastes into different categories depending upon the hazards associated with them and the nature of the waste produced given below [6,5].

5.1 Non-Hazardous RHCW

Non-risk RHCW incorporates all the waste that has not been contaminated like general office waste, bundling or left-over food. They are like typical family or metropolitan waste and can be overseen by the civil waste administrations. They address somewhere in the range of 75% and 90% of the aggregate sum of RHCW produced

by examination and clinical foundations. Three gatherings can be laid out [5]:

5.1.1 Recyclable waste

It incorporates paper, cardboard, non-defiled plastic or metal, jars or glass that can be reused assuming any reusing industry exists in the country.

5.1.2 Biodegradable RHCW

This classification of waste involves extra food or nursery squander that can be treated the soil.

5.1.3 Other non-risk squander

This incorporates all the non-risk squander that don't have a place with classifications 5.1.1 and 5.1.2.

5.1.4 Disposal of Non-Dangerous RHCW

Ensure irresistible and dangerous RHCW are appropriately isolated from general waste to lessen removal expenses and increment materials for reuse. For Non-Perilous On location WHO suggested dark shading compartments with proper naming for General waste and Recyclable waste as addressed in Figure 2 A1-A2 [5].

5.2 Hazardous RHCW

5.2.1 Infectious solid wastes

Irresistible waste incorporates organic waste, societies stocks and related squanders, obsessive waste, and sharps. Every one of these classes has a legitimate removal technique [6]. Following are the various kinds and sources to create strong bio-dangerous squanders as classified by [7,11,12]:

- Organic fluid squanders mean endlessly blood items, discharges, exudates, emissions, suctioning, and other body liquids including fluid squander from renal dialysis.
- Obsessive squanders mean every human tissue and physical part, including human hatchling remains, which exudes from a medical procedure, obstetrical methodology, examination and research center systems.
- Culture and supplies of etiologic specialists and related natural endlessly wastes from creation of organic and serums societies.
- Lab squanders mean those squanders which have interacted with pathogenic life forms or blood or body liquids. Such squanders incorporate, yet are not restricted to, dispensable materials; culture dishes; gadgets used to move, immunize, and blend societies; paper and fabric which has interacted with examples of societies which have not been sanitized or delivered non-irresistible; or research facility squanders, including societies of etiologic specialists, which represent a significant danger to wellbeing because of their volume and destructiveness.
- Creature tissue, bedding and different squander from creatures known or thought to be tainted with a microorganism which likewise causes human sickness, given that overarching proof demonstrates that such tissue, bedding or other waste might go about as a vehicle of transmission to people.
- Human dialysis squander materials include bloodlines and dialysate layers.
- Disposed of drug squander implies serums and antibodies delivered by drug organizations for human or veterinary use. These items might be disposed of in light of a terrible assembling parcel (i.e., off-detail material that doesn't pass quality control or that is reviewed), out-dating or expulsion of the item from the market or different reasons. On account of the conceivable presence of etiologic specialists in these items, the disposed of

material establishes irresistible waste. (h) Other irresistible squanders mean any build-up or polluted soil, water, or other garbage coming about because of the tidy up of a spill of any irresistible waste [7, 11,12].

Disposal Protocols for Infectious solid waste

Segregation and Packaging Requirements (On-Site)

Possibly irresistible strong squanders (other than sharps) should be isolated at the place of age (i.e., in the lab or other area) and gathered into at least one layers of biohazard sacks inside hard-sided, watertight optional holders of the suitable size with a fitted cover. A widespread biohazard image should be noticeable outwardly of the compartment (Figure 2 and Table 2). Compartments should stay shut except when waste is being added. Culture liquids and other fluid irresistible waste should be gathered into autoclave-capable holders and treated via autoclaving before disposal of. Irresistible squanders should either be burned or treated preceding removal [12]. After treatment, natural waste might be treated as expected squander. However, if waste is in red or orange biohazard packs, it should be set inside dark plastic sacks preceding disposal in institutional dumpsters. Societies and stocks should be treated similarly as organic waste. Obsessive waste should be burned. Neurotic, organic and culture/stock squanders should be dealt with or arranged in the span of 7 days of age, or in 30 days whenever refrigerated or frozen [5,12,13]. Continuously leave a proper space in the compartment (1/3rd) during assortment of irresistible waste (Don't pack). Irresistible waste packs or different compartments should be cautiously aired firmly shut in the Research facility or other place of age preceding vehicle for autoclave or other objective and should stay shut consistently during transport [7,6,12]. Assuming transportation is necessary by vehicle to Off-Site, the optional compartment should have a tight fixing top that stays shut during transport, and fitting spill remediation materials should go with the loss with obviously named [7].

Recommendations for storage facilities for healthcare waste

The capacity region should have an impervious, hard-standing floor with great waste; it should not be difficult to clean and sanitize with legitimate marking. There should be a water supply for cleaning. The capacity region should manage the cost of simple access for staff responsible for dealing with the waste. It should be feasible to lock the store to forestall access by unapproved people. Simple access for squander assortment vehicles is fundamental. There ought to be insurance from the sun. The capacity region ought to be out of reach for creatures, bugs, and birds. There should be great lighting and latent ventilation. The capacity region ought not be arranged nearby new food stores or food planning regions. A stock of cleaning gear, defensive attire, and waste packs or compartments should be found advantageously near the capacity region [3,6]. WHO suggested involving yellow shaded holders/sacks for the assortment and removal of irresistible strong squanders with image to show the irresistible specialists (Figure 2) [5,23].

5.2.2 Sharps or Broken Glasses

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The term sharp is often used for the pointed objects that can cause cuts, abrasion and puncture injuries to the skin. Like scalpel blades, razor blades, knives, infusion sets, hypodermic needles, broken glassware, i.e. broken pipette, beakers, etc. It was subdivided into two categories as (a) Scalpel blades, razor, needles and (b) Broken glassware (broken beakers) [10,11]. Following contemplations for sharps squanders should be taken to forestall injury and contamination during their care of inside and outside the RHCs.

- They must be gathered and overseen independently from different classes of RHCW
- When the wellbeing boxes are fixed, they can be discarded with the other irresistible waste contingent upon the kind of removal innovation that is chosen.
- Extraordinary arrangements for needles and needles should be made.
- Needles ought never to be recapped.
- What's more, by no means are utilized needles or well-being boxes discarded in typical trash or unloaded haphazardly without earlier treatment [10,11].

Special Treatments before disposal of Sharps

Two prospects right now exist to discard needles and needles: (A) They can be gathered in security boxes that are then discarded with the irresistible RHCW if the removal/treatment advancements are appropriate: burning or embodiment. This choice is positively the most secure since it limits the treatment of the needle and the needle. (B) Destroying and autoclaving; they can likewise be "treated on the spot". The treatment comprises either in obliterating the needle utilizing a needle destroyer or isolating the needle from the needle utilizing a gadget where the needle drops straightforwardly in a cut-resistant holder [10].

Handling and Disposal of Sharp Wastes

The canisters and holder utilized for the sharp squanders should be made of thick and hard plastic. The holder ought to be watertight and cut safe. WHO prescribed the yellow hued compartments to discard sharps (Figure 2). Holders should be in simple access in the research facility or any arrangement of the produces sharp waste. Compartments just are filled up to level of the stamping referenced on it. Try not to power or push additional sharp squanders in a compartment when it is topped off to the checking referenced on it as it might cause Injury. Whenever the compartment is filled once it ought to be fixed appropriately, assuming the sharps are tainted with blood and different synthetic substances. It should store in independent holders with name or signs referenced on it. Marking and signs on holder should be clear and discernible. Tainted sharps ought to be taken care of with incredible consideration and before removing it ought to be treated with a compound to clean them. It will be fixed and discarded when 3/4 is full [10,14,22].

5.2.3 Chemical Wastes

Synthetic waste comprises disposal of synthetics produced during sanitizing strategies or cleaning processes. Not every one of them are unsafe but rather

some have harmful, destructive, combustible, responsive, hazardous, shock delicate, cytotoxic or genotoxic properties. They should be utilized and discarded by the determinations furnished with each kind of substance [15]. Followings are the synthetic compounds/specialists that might have deadly outcomes as far as straightforwardly or by gas creation.

Ethanol, Methanol, Ethers: Solvents with combustibility utilized as sanitizers, solvents and in the protection of tissue areas. Hydrogen peroxide (H_2O_2): the receptive oxygen species disintegrates quickly within the sight of responsive mixtures in the research facilities. It isn't burnable yet it upgrades the ignition responses. Nitric corrosive: Cyclohexanol and nitric corrosive can respond at room temperature to shape a fiercely dangerous material. It is exceptionally combustible when responded with the metals, creating fire or poisonous vapor. Sulphuric corrosive: Sulphuric corrosive isn't combustible or unstable however when responded with metals and weakened water, it can produce hydrogen gas which gets moved in the bound lab spaces. Perchloric corrosive: It is the most responsive mineral corrosive and is exceptionally oxidative and drying out when interacts with wooden surfaces and garments and so forth hydrogen gas created by its warming response is profoundly poisonous to the specialists there. Piranha Engraving: The piranha arrangement is exceptionally destructive to the metals, and it develops the hydrogen gas that has the chance of blast or fire in the lab regions. Water Regia: It is the combination of nitric corrosive and HCL which can deliver exceptionally harmful nitrosyl chloride. The inward breath of these fumes can be deadly and destructive and can prompt breathing challenges moderate towards pneumonia [16,17,22].

General Guidelines using chemicals and for disposal

While dealing with held onto synthetic compounds, consistently use appropriate security gear. Never handle synthetic substances alone; consistently have a second individual to help. Peruse all names before taking care of or moving synthetics. When synthetic substances should be put away, store them by gatherings (for example acids, bases, volatiles, oxidizers, and so forth) Hold the base measure of synthetics expected for evidentiary purposes (with proper marking to keep up with the chain of authority). Never blend obscure synthetics and take unique consideration while opening holders, since dissolvable fumes might have developed huge tension inside particularly in warm environments [15,16]. There are various retentive materials accessible which are reasonable for use as compound permeable materials during the synthetic spills. It is suggested that while taking care of or shipping synthetic substances, a compound spill pack containing a spongy material ought to be conveyed consistently. These are the different permeable materials which might be appropriate in the removal of synthetic substances including business reused paper spongy (minimal expense), sand, diatomaceous earth (costly and not generally accessible), vermiculite (costly) and Zeolite [15]. Also, it is generally suggested to peruse the name and maker's data about the protected use of the retentive material before removing synthetics (Figure 3).

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5.2.4 Gaseous Wastes

Oxides of carbon, Sulphur, nitrogen, hydrocarbons, aerosols, carbon monoxide, methane, and chlorofluorocarbon (CFC) etc. are the gaseous waste of the laboratories in certain research institutions. Gases can be the hazardous flammable that evolved from mixing certain chemical agents [18].

Storage Instructions for gaseous chemicals and gas cylinders

- Gas storage areas shall be heated through indirect methods, such as air, steam, hot water, etc.
- Cylinders should be stored in unenclosed areas with proper ventilation.
- Hazardous chemicals that can evolve toxic fumes and are ignitable should be stored in a segregated place far from the lab area.
- Oxidizing agents should be stored separately from the flammable gases.
- Cylinders containing oxidizers, e.g., nitric oxide, etc., should not be stored with the flammable liquids, reactive metals surfaces, wooden surfaces, etc.
- There should be at least 20 feet between the gas cylinders and flammable gaseous agents under the same room/building.

General Guidelines to handle gaseous wastes

WHO recommended that the staff involved in handling wastes should be trained properly how to use the equipment in the laboratory. There should be proper labelling and handling for the gas cylinders. Alarm systems and carbon monoxide detectors should be installed in every laboratory. Laboratories should be inspected properly. Make a record keeping for the regular maintenance of the laboratories. Areas of the laboratories, pipes, vehicles having direct contact with the gases should be marked properly. Breathing operators should be functional in the laboratories. Medical treatment protocols should be present [5].

Disposal Guidelines for gaseous waste

Gas Recycling: The gas should be compressed until it becomes cryogenic liquid and is disposed of to the recovery containers.

Disposal of Gases by Absorption/Adsorption/Reaction: Disposal of certain reactive gases can be achieved by absorption/reaction in a liquid (scrubbing) or by adsorption in a solid-state medium. The resultant solution and/or suspension or other absorption product should be less harmful and more conveniently disposed of than the original waste gas.

Direct Discharge into Simple Scrubber: The gas to be disposed of is fed directly into the absorbent chemical. Under certain circumstances, liquefied gas may be fed into the scrubber in the liquid phase following a risk assessment.

Disposal of Gases by Burning and Direct Combustion: Gases which to be disposed of can be fed directly into the chamber having oxidant (usually air).

Incineration-Gas Phase: The waste gas is incinerated in a separately fueled flame [10,18,23].

5.3 Other Hazardous RHCW

5.3.1 Radioactive Health-care waste

Radioactive waste includes liquids, gases and solids contaminated with radionuclides whose ionizing radiations have genotoxic effects. The ionizing radiations of interest in medicine include X-rays and γ -rays as well as α - and β - particles. An important difference between these types of radiations is that X-rays are emitted from X-ray tubes only when generating equipment is switched on. In contrast, γ -rays, α - and β - particles emit radiations continuously.

The radioactive material used in health-care facilities results in low level radioactive waste. It concerns mainly therapeutic and imaging investigation activities where Cobalt (^{60}Co), Technetium ($^{99\text{m}}\text{Tc}$), Iodine (^{131}I) and Iridium (^{192}Ir) are most used [9].

Basic rules to Discard Radioactive waste

Radioactive waste joins solid, liquid and vaporous waste debased with radionuclides delivered from in vitro assessment of body tissue and fluid, in vivo body organ imaging and malignant growth localization, and adroit and accommodating technique [18].

- With the detectable unique instance of Cobalt (^{60}Co), their half-life is reasonably short (6 hours for $^{99\text{m}}\text{Tc}$, 8 days for ^{131}I and 74 days for ^{192}Ir) and the obsessions used stay low. An authentic accumulating with a fitting upkeep time is satisfactory enough to allow decay to the establishment level.
- Radioactive wastes should be placed in tremendous compartments or drums and named with the radiation picture showing the radionuclide activity on a given date and the required hour of limit.
- Compartments or tanks with radioactive waste that has not yet spoiled to establishment level, should be taken care of in an unequivocally stepped room with thick significant dividers (least 25 cm).
- Non-overpowering radioactive waste, spoiled to establishment level, should follow the non-hazardous RHCW stream. In contrast, Overwhelming radioactive waste, which has decayed to establishment level, should follow the powerful RHCW stream.
- Liquid radioactive waste should be delivered into the sewerage system or a septic tank exclusively after it has decayed to establishment level in support tanks.

Common Symbols in the Labs for Radioactive Gaseous hazards

Radioactive RHCW should be set in yellow holders, fixed, stepped, and exhibited with the worldwide radioactive picture (Figure 2 (F1-F2)).

5.3.2 Cytotoxic Drugs and Related Waste

Cytotoxic medications/drug squanders can emerge by use (organization to patients), production and arrangement of drugs with a cytotoxic (antineoplastic) impact. These squanders normally emerge at focal areas, for example in drug stores and Research facilities, and they are likewise regularly found where the prepared to-utilize cytotoxic arrangements are ready. These compound substances can be partitioned into six primary gatherings: (I) Alkylated substances, (ii)

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Antimetabolites, (iii) Anti-microbials, (iv) Plant alkaloids, (v) Chemicals, and (vi) others. A potential wellbeing hazard to people who handle cytotoxic drugs results from the mutagenic, cancer-causing and teratogenic properties of these substances. Thus, these squanders represent a danger, and the actions to be taken should likewise incorporate those expected by word related wellbeing and security arrangements [5,12].

Disposal Guidelines for Cytotoxic Drugs and Related Waste

Follow specific systems for cytotoxic squanders as:

- Isolate the Cytotoxic Medications and Related Squander from different squanders.
- The administration of these squanders, in covered and impermeable holders, should in this manner be completely controlled.
- Strong compartments should be utilized for assortment. The utilization of coded compartments is suggested.
- Assuming some other waste or material is blended or defiled, it should be treated as Cytotoxic Medications and Related Squander.
- As indicated by WHO place all Cytotoxic squanders in Brown/purple compartments or canisters that are set apart with the white Cytotoxic name
- If the cytotoxic waste is sharp, place squanders into Earthy coloured sharps compartment.
- Lock the purple wheelie container and spot it in a devoted region for assortment (Figure 2).
- Because of word-related well-being, cytotoxic drug squanders should be gathered independently from drug squander and discarded in an unsafe waste cremation plant [19,20].

5.3.3 Animal Waste and Their Tissues

The creature squander/tissues might be put away for a specific time frame before definite removal or assortment by the approved division. For capacity reason, a legitimate arrangement of rules might be observed including creature bodies and parts thereof should be kept refrigerated as expected until the hour of expulsion from site; creature litter, groceries and dung should be put away in a cool climate; the waste should be put away in an all-around ventilated, weather conditions safeguarded and secure region [1,19].

Disposal guidance for animal waste and their tissues

For capacity reason, an appropriate arrangement of rules might be kept as portrayed in strong irresistible garbage removal segment and incorporates rejection of non-viable materials and discard Creature Squander in dim green wheelie receptacles with lime green tops set apart as Creature Squander; don't pack material except if important and containers should not surpass 40kg in weight [19,20,21].

5.4 Future Perspective and Recommendations

As environmental pollution is the major change of the current era globally, all governments should recognize the critical role they could play. So, it is suggested that the waste management department should be shifted under the disaster management authority to

make plans and focus on the sources and handling of the generated waste. Moreover, the guidelines should be available in a flow chart or tabulated form at National level, ensuring that the persons responsible for the handling and management of RHCW are well educated and trained to minimize the risk associated with these. An optimized National policy is a key to the sustainable and successful health care waste management system. Instead of using desired color codes, internationally recommended color codes policy should be applied worldwide to segregate the hazardous from non-hazardous wastes.

In addition, latest biotechnology-based techniques including automated waste valorization processes like gasification, pyrolysis, hydrothermal carbonization etc. for the generation of valuable by products can be implemented to boost up the economy of developing countries. The strategies should be strictly adopted to maximally recycle the foods particles by composting in place of synthetic fertilizers which will be very beneficial for the producers and consumers. Furthermore, recyclable wastes should be properly utilized by making recycling units functional at district levels. A separate handsome budget for the safe management and handling of RHCW should be deputed to educate people through training workshops, seminars and informative awareness campaigns to change the human behavior towards this major hot issue.

Conclusion

Natural contamination has turned into the significant test for creating and concerning nations Around the world. As Pakistan is among the agricultural nations arranged in South Asia, the greater part of the organizations including educating, examination, and medical services attempt to follow the WHO direction or attempt to oversee dangerous and non-risky squanders at self-arranged systems. Squander the board and treatment choices should initially safeguard the analysts, medical services laborers, understudies and everyone, and Limit roundabout effects from ecological openings to RHCW. For Research facilities/focuses Building Administrations supplier will exhaust metropolitan junk, supply paper towels for hand washing regions, clear and vacuum floors, mop floors and restore floors when required. Each waste classification should be taken care of and oversaw by laid out systems. It is critical to practice unique watchfulness in the dealing with and the board of clinical waste to limit any peril to general wellbeing or hazard of contamination to the climate. Even though, we made an honest effort to aggregate far reaching information for RHCW the board, generally delivered during the exploration and clinical exercises at RHC. Still, more information or controlled investigations are expected in various areas of Pakistan to investigate the insufficient perspectives to deal with the ecological contamination.

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Conflict of Interest

Authors have not any type of conflict to be published this article.

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Table 1: Different individuals at high risk of different hazards associated with RHCW [5,11].

SR #	Types of Individuals	Individuals at Risk Associated with RHCW
01	Researchers	All the Faculty members like teachers, teacher assistants, lab technicians etc., work on research projects, class practical's; and students.
02	Clinical staff	Includes Clinical instructors, Doctors, Technologists, nurses, supplementary/ helping staff like sweepers, Ayahs, and midwives.
03	In- and out-patients	Different patients receiving treatment in healthcare facilities as well as their attendants & visitors
04	Workers in support services	Includes the peoples linked to health-care facilities such as ambulances drivers, laundries, waste handling and transportation services
05	Workers	Workers in waste disposal facilities, including scavengers, sweepers, wastes segregators etc.
06	General public	The general public and more specifically the children playing with the items they can be found in the waste outside the healthcare facilities when directly accessible to them.

Table 2: WHO recommended color-coding for healthcare (infectious) waste [6].

Type of waste	Color of container and markings	Type of container
Highly infectious waste	Yellow, marked, "HIGHLY INFECTIOUS"	Strong, leak-proof plastic bag, or container capable of being autoclaved
Pathological and anatomical waste	Yellow	Leak-proof plastic bag, or container
General Health-care waste	Black	Plastic bag

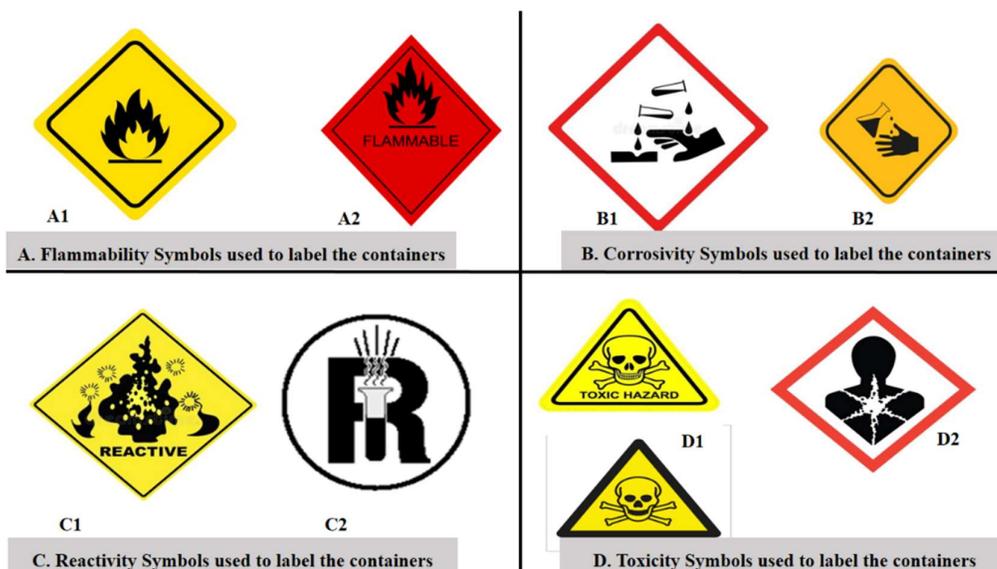


Figure 1: Internationally used symbols to represent the nature of different chemical hazardous wastes. (A1-A2) Symbols used to represent flammability; (B1-B2) Symbols used to represent Corrosivity; (C1-C2) Symbols used to represent Reactivity; (D1-D2) Symbols are used to represent the Toxicity.



Figure 2: (A1-A2) Containers used for the disposal of Non-Hazardous Material; (B1-B5) Trolleys may be used for transportation as well as to store the infectious wastes and Internationally symbols and Bins/ bags used for infectious waste; (C1-C3) International symbol and Bins/ bags used for Sharps (Needle/broken glasses); (D1) International common Symbols in the Labs for Chemical hazards; (E1) Common Symbols in the Labs for Gaseous hazards; (F1-F2) Common Symbols in the Labs for Radioactive Gaseous hazards; and (G1) International Common Symbol and color in the Labs for Cytotoxic biohazards

Code	Type of Chemical Hazards	Color
01	Flammable	Red
02	Toxics	Purple
03	Organic Acids	Yellow
04	Inorganic Acids	Orange
05	Oxidizing/ Special Handling Inorganic acids	Blue
06	Bases	Dark Green
07	Oxidizers	Light Green
08	General Chemicals	White

Figure 3: Recommended color-coding for chemical waste containers.