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Sustainability: **Waste – what happens to it?**

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Contents

Module Learning Outcomes

- Waste regulations summarised, including specifics for pharmaceuticals disposal.
- Department for Environment, Food and Rural Affairs' waste hierarchy.
- Waste streams, including specialist recycling.
- Waste segregation (benefits and pitfalls).
- How we can reduce our waste.

Management of healthcare waste is essential in ensuring healthcare activities do not pose a risk to others or the environment. In 2016/17, the NHS produced 590,000 tonnes of waste (2% of all commercial waste in England)[1]. With such a vast amount and wide variety of waste being produced in the healthcare sector there are a number of important regulations and legislations in waste management, including how we manage and segregate waste to ensure that we fulfil our legal obligations as to its disposal.

Environmental legislation and waste regulations

European Union Waste Framework Directive (EWFD)[2]

First described in 1975, it sets out the basic ideas and definitions of waste, the risks of each waste category and the targets for reduction and recycling - limiting incineration and landfilling. The directive aimed to transform the European Union and its member states into a recycling and re-using society.

The Environmental Protection Act 1990[3]

Fulfils the EWFD by defining the structure and authority for waste management and emissions for the United Kingdom. Every producer of waste has a duty of care to prevent any unauthorised storage, treatment, disposal or transfer of waste and sets out the criminal sanctions that apply. It also states that the organisations below control the limits set on emissions and any process or substance.

- The Department of Environment, Food and Rural Affairs (DEFRA)
- Environment Agency (in England & Wales)
- Scottish Environment Protection Agency (SEPA)
- Department of the Environment for Northern Ireland (now the Department of Agriculture, Environment and Rural Affairs - DAERA)

The Hazardous Waste (England & Wales) Regulations 2005[4]

States that waste should be recovered or disposed of without:-

- Endangering human health
- Using processing methods that could harm the environment, in particular water, air, soil, plants and animals
- Causing nuisance through noise or odours
- Adversely affecting the countryside or places of special interest.

The Lists of Wastes 2005[5]

Based on the European Waste Catalogue, it classifies waste by the properties which render it hazardous. See table 1 below;

Hazardous Property Code	Property	Example
HP1 Explosive	Unstable, may cause fire, blast or projection	Hydrogen peroxide
HP2 Oxidising	Exhibits highly exothermic reactions. May cause or intensify fire.	Nitric acid
HP3 Flammable	Extremely flammable substance. May catch fire spontaneously with or without air or with heat.	Metal hydrides/phosphides
HP4 Irritant	Can cause skin/eye damage	Extreme acid/alkaline substances, azathioprine
HP5 Harmful	May cause damage to internal organds, potentially fatal if swallowed	Oxytocin
HP6 Toxic	Harmful/toxic/fatal if inhaled/swallowed/contact with skin	Ergometrine, mitomycin, finasteride
HP7 Carcinogenic	May cause cancer	Chloramphenicol, azathioprine, mitomycin
HP8 Corrosive	Causes skin corrosion on application	Azathioprine
HP9 Infectious	Contains viable micro-organisms, or their toxins, believed to cause disease in man or other living organisms	Wastes from natal care, research, diagnosis, treatment or prevention of disease
HP10 Toxic for reproduction	May cause damage to fertility or unborn child	Chloramphenicol, ganciclovir
HP11 Mutagenic	May cause genetic defects	Azathioprine, bleomycin
HP12 Produces toxic gases	Contact with water may liberate toxic gases	Metal sulphides/phosphides, hypochlorite compounds, cyanide
HP13 Sensitising	May cause an allergic skin reaction or asthma symptoms	
HP14 Ecotoxic	May be toxic to aquatic life (with long term effects), may destroy the ozone.	Finasteride
HP15 Hazardous property not listed above	May cause mass explosions when dry/under confinement,	

Table 1: Properties (with codes) that render waste hazardous[6]

The England & Wales Waste Regulation 2011[7]

Industries are required to apply the waste hierarchy, segregate waste where technically, environmentally and economically practicable and declare as such with written consignment notes when transferring waste.

The Northern Ireland Waste Regulations 2011[8]

Comparable to the England & Wales Waste Regulation 2011, it however sets specific waste management strategies for Northern Ireland overseen by the Department of Agriculture, Environment and Rural Affairs (DAERA) and the Northern Ireland Environment Agency.

The Controlled Waste (England & Wales) Regulations 2012[9]

Classifies waste as household, industrial and commercial (healthcare) waste, as well as defining:

- Clinical waste – waste from a healthcare activity that contains viable micro-organisms, or their toxins. It may contain or is contaminated with a biologically active pharmaceutical agent, body fluid or other dangerous substance and includes sharps and bodily fluids which are contaminated in such a manner as described.

- Offensive waste – which is not clinical waste but contains body fluids, secretions or excretions.

Health Technical Memorandum 07-01: Safe management of healthcare waste[10]

A comprehensive guide created to help fulfil the healthcare industry's legal obligations to waste management. It provides practical advice on the design, installation and operation of waste management for healthcare organisations. It complies with the above waste legislature and implements the European Union Waste Framework Directive.

DEFRA's waste hierarchy

The waste hierarchy was produced by DEFRA and the Environment Agency in response to The England & Wales Waste Regulations 2011.[6] It ranks waste management options in order of what is best for the environment. These options are based on current scientific research e.g. climate change, air and water quality. New technologies may emerge which improve the efficiency of waste management and therefore the hierarchy. See figure 1. Every industry has a legal duty of care to take all reasonable steps to apply the hierarchy to all waste produced from top to bottom.

Figure 1: Waste hierarchy [*Gasification – reaction of waste with oxygen and/or steam, resulting in the production of carbon monoxide, carbon dioxide, and hydrogen. Pyrolysis – process of heating organic substances to above decomposition temperatures resulting in production of char and eventually ash. Backfilling – reclaiming excavated areas for landscaping purposes using non-hazardous waste as a substitute for non-waste materials.[11]

Waste streams

Globally 85% of total healthcare waste is classified as general waste, the remaining 15% is considered hazardous, infectious, toxic or radioactive[13]. Each operating theatre in the UK produces on average 2300kg of anaesthetic waste per annum, 40% of this waste could potentially be reclassified as domestic or recyclable waste with huge potential for financial and environmental benefits.[1]

A waste stream refers to the flow of a precise type of waste from source to recovery, recycling or disposal. Each specific waste stream has been developed from the legislation discussed previously, taking into account its hazardous properties, treatment methods, recovery and recycling possibilities.

Waste is segregated in healthcare using UN approved receptacles – either rigid containers with coloured lids, coloured bags, or sharps bins with coloured lids. Colours are based on nationalised colour codes. Although there is no specific legislation with regards to colour, national guidelines are based on historical precedence but may still differ between individual nations. Examples of different waste streams used in healthcare are summarised in table 2. The Association of Anaesthetists is currently developing a waste segregation flowchart, outlining streams to be used for anaesthetic and theatre waste.

Colour Code	Description	Disposal Method
	Yellow stream – infectious waste/sharps, includes chemical or medicinal samples contaminated with Category A pathogens. (Category A pathogens can cause fatality or permanent disability to humans or animals and include anthrax, Ebola, smallpox and other pox viruses).	Incineration
	Red stream - anatomical waste	Incineration
	Orange stream – infectious waste, known or suspected to be contaminated with Category B pathogens (pathogens which do not meet criteria of Category A, including but not limited to E Coli, Salmonella, Shigella, Listeria, Cryptosporidium, Toxoplasma, Tuberculosis, Influenza and HIV).	Treated to be rendered safe prior to disposal OR Incineration
	Blue stream - Non-cytotoxic/cytostatic waste consisting of medicines or sharps contaminated with such medicines. Separate containers for solids and liquids. Outer packaging should be placed in recycling if possible. Blister packs/syringes should not be opened/expelled. Syringes containing controlled drugs should be expelled, other forms of controlled drugs should be rendered irretrievable using denature kits	Incineration
	Purple stream – Cytotoxic/cytostatic Waste/sharps contaminated with such drugs	Incineration
	Yellow & black (Tiger) stream – Offensive/hygiene waste, contaminated with bodily fluids that are not considered infectious e.g. incontinence pads, catheter bags	Landfill; Energy recovery; Incineration
	Black/clear stream - domestic/municipal waste e.g. flowers, food, tissues. If possible, food should be segregated for composting (usually but not always in green bags). Aluminium, glass, paper and plastic should be segregated, and are recycled to produce base materials for re-use in new products	Landfill; Composting; Recycling
	Radioactive waste stream – healthcare waste contaminated with radioactive material	Incineration in specialised hazardous waste facility

Table 2: Summary of waste streams by type and colour coding of containers (bags, rigid containers with coloured lids, and sharps bins) and their eventual disposal methods. [Cytotoxic/cytostatic waste is defined as any drug with hazardous property codes HP 6 toxic, HP 7 carcinogenic or HP 10 toxic for reproduction. These are not limited to drugs labelled as cytotoxic in the British National Formulary]. [12]

Hospital wastewater and sewage systems do not undergo any special treatment before joining the municipal sewage system. Drugs and their metabolites can enter the aquatic

environment if disposed of into the sink or sluice. All unused drugs must be disposed of into the appropriate containers for incineration.[14]

Recycling

General recyclable waste is separated at waste facilities, any non-recyclable waste is removed by hand.[15]

- Paper is separated by quality and compressed into bales before being transported to paper mills where it is mixed with water and turned into pulp. Ink is removed by washing. On drying, the pulp begins to resemble paper before it is further compressed with rollers to form new sheets of paper. Confidential waste is transported in locked containers and shredded but otherwise undergoes the same processes as non-confidential paper. Confidential waste is only recycled into tissues/hand towels.

- Glass waste (from general households and industries other than healthcare) is separated by colour and crushed to form new glass or stone aggregates to build new roads. Glass from the healthcare industry (especially that which is contaminated with medicinal waste) is incinerated.

- Metals are separated using magnets or current separators and compressed into bales. Cans are shredded, cleaned, melted, cooled and eventually rolled into new aluminium sheets.

- Plastics are separated depending on their different polymer make up[16]. Bales of plastic are then shredded, cleaned, melted, and filtered. Small filtered strands can be spun into fibres making fleeces, jackets and sleeping bags. Larger items are compressed into pellets to be moulded into new plastic items.

Specialist recycling of healthcare-specific waste can be provided by contractors that specialise in medical waste management, although the decision to employ these services lie with individual healthcare trusts.

Examples of recycling of healthcare-specific waste include:

- PVC Recycling -High quality PVC in oxygen masks, tubing, nasal cannulae and anaesthetic masks can be down-cycled and repurposed to use in the horticultural industry e.g. tree ties. Non-PVC items such as straps are removed from facemasks at the site of use, the PVC is collected and then relocated to centres for further hand sorting before they are shredded, melted and repurposed.[17]

- Sterile surgical wraps can be melted into briquettes of base element – polypropylene, using the process of “Sterimelt”. This can be used to manufacture various household products including buckets, rope and stationery.[18]

- Medical Equipment[19] – CT, MRI, ultrasound and mobile surgical equipment can be refurbished. Minimal complication rates have been demonstrated from the re-use of implantable ICD devices after sterilisation.[20]

- High-cost single-use surgical devices (arthroscopic wands, laparoscopic instruments and trocars) can be “re-processed”. They are collected, disassembled, and individually inspected and tested for function, then sterilised and repackaged for clinical re-use.[21] These services are more popular in mainland Europe and North America and would require equipment to be shipped from the UK to other parts of the world including the US (increasing the carbon footprint and potentially offsetting any gain from reprocessing).

- Metals in healthcare such as single-use equipment (laryngoscope blades, Magill’s forceps and surgical scissors) can be recovered, mechanically treated (cut, sheared, shredded or granulated; sorted, separated, cleaned, de-polluted and emptied)[22] and recycled but do not re-enter the healthcare system.[23, 24]

Waste segregation

Benefits and Pitfalls

There are a number of benefits (and pitfalls) to waste segregation listed below in Table 3.

Benefits	Pitfalls
Segregating waste can reduce the cost of disposal by incineration if these products can be treated appropriately via another stream.	Staff require training to avoid using clinical waste bins as default.
Some waste can be recycled to base materials which can supply other industries and generate income – e.g. platinum and silver for used endocardial leads.	Appropriately coloured and UN approved waste containers must be available and require dedicated storage areas.
Batteries contain toxins which can affect the health of humans and animals. Segregating batteries ensures appropriate treatment and disposal therefore preventing toxins entering the environment	Incorrectly segregated waste results in contamination of entire waste containers usually resulting in their incineration.
Diverting waste to appropriate waste streams avoids the use of landfill reducing the consumption of land resources.	
Appropriate segregation of waste prevents exposure of hazardous waste to staff.	

Table 3: Benefits and pitfalls of waste segregation

How we can reduce our waste

A proportion of waste in healthcare is unavoidable but applying the principles of the waste hierarchy[11] can reduce its impact on the environment around us. There is a distinction between waste and *wasteful* practice which includes those actions and behaviours that create unnecessary waste, these can be managed using the 5R approach listed below.

The 5R Approach – REDUCE, REUSE, RECYCLE, RETHINK & RESEARCH.[25]
Working with our colleagues in theatre we can:

Reduce

- Use paperless anaesthetics records.
- Use refillable ink cartridges and rechargeable batteries.
- Use oral rather than IV drug preparations to reduce plastic/PVC waste associated with IV administration.
- Ensure sharps bins are used *only* for the disposal of sharps and are full (to the line) prior to their disposal.
- Change breathing circuits weekly instead of daily (unless recommended otherwise by manufacturer).
- Only open packaging and drugs when necessary.
- Only use equipment when clinically indicated e.g. calf compression boots.
- Turn off electrical equipment when not in use e.g. scavenging systems, anaesthetic machines, (except in those areas used for emergencies).

Reuse

- Reuse materials that are allocated for use in the same patient and in the same encounter where clinically appropriate e.g. tourniquets, TCI syringes, facemasks.
- Prioritise the procurement of reusable equipment preferentially to single-use equipment where possible e.g. laryngoscopy handles, plastic drawing up trays.
- Avoid the use of disposable plates, cutlery and cups and replace with reusable forms.

Recycle

- Ensure the correct segregation of waste to the appropriate streams in order to avoid unnecessary incineration and landfill use.
- Consult with waste management contractors to discuss the possibilities of specialist recycling schemes and which items can be accepted into general recycling streams.

Rethink

- Increase access to recycling bins and place in strategic locations (in anaesthetic rooms, theatres and communal break areas) making it easier to recycle rather than to dispose.

- Regularly train staff in waste management.

Research

- Promote audit and quality improvement in sustainability and greener anaesthetic practices.[26] More information can be found in the '*Sustainable Healthcare*' emodule in this series.

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