The Sustainable Management of National Health Service (NHS) Waste

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Abstract of Thesis

In line with the general waste management policy the United Kingdom (UK) Government and the European Commission are committed to the safe and sustainable management of health service waste. The Government's strategy for 'Our Healthier Nation' places responsibility for the success of the health strategy with the National Health Service (NHS). The strategy includes demonstrating a commitment to health and safety and addressing the potential environmental impact of NHS practice on the local communities and the environment.

The sustainable management of health service waste, therefore, will be determined by the successful integration of safety, health and environmental concerns into the process of managing the waste streams from production to end disposal.

This thesis describes the development of a framework for waste management in NHS hospitals, which integrates the health, safety and environment protection issues relating to hospital waste management.

Initial reconnaissance visits seeking information on the current situation in order to identify strengths and weaknesses of current practice were made to six hospitals and criteria were developed to determine the choice of three hospitals for the in-depth case studies. A review of the literature, regulatory framework and guidance documents relevant to waste disposal complimented discussion with waste management experts and hospital employees. The in-depth case studies were carried out during a two-week period of observation and interviews with employees. At each hospital the waste policy was reviewed to determine the content and the extent of implementation.

A pro-forma for each waste stream was developed to examine the level of compliance with the policy in practice. This was also analysed for compliance with current and pending waste disposal legislation. Arising from the studies the generic issues common to all three and the specific issues of each one, were identified, taking into account the health, safety and environment aspects. This allowed the development of a framework for the future sustainable management of hospital waste.

The results indicated a wide variance in knowledge level and expertise as demonstrated by the waste managers. Training in waste management and access to legislation and guidance document was limited. There was little evidence of risk assessment on the waste produced although there was awareness that this was a legal requirement.

The clinical waste disposal guidance notes informed the policy documents and were adapted in each hospital to include the other waste streams. The policies in general did not address local constraints, which could prevent implementation; however, in one hospital the existing practice of waste management exceeded the requirements of the policy.

Education and training was restricted to those handling waste and did not address the government's hierarchy for waste management. The sustainable management of health service waste was not and will not be attainable until the environmental protection and health and safety issues of waste management are addressed on an equitable basis. The management of waste framework would to a great extent require local flexibility to ensure compliance with both existing and pending legislation and to be in line with the government strategy of waste reduction. Education and training are required for all occupational groups, who are involved in the production and management of healthcare waste. This training should include the environment issues concerning waste disposal, placing emphasis on waste reduction. An integrated framework approach to the health, safety and environmental protection issues of waste management is needed to avoid duplication and to prevent compliance in health and safety issues being gained at the expense of environment protection.

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Chapter 1 Introduction and Objectives

1.1 Introduction

The United Nations Conference on Environment and Development; the 'Earth Summit' held in Rio de Janeiro in 1992, placed the concept of sustainable development as the key to environmental understanding into the international policy arena. The concept of sustainability was defined by the United Nations World Commission on Environment and Development (UNWCED) in the Brundtland Report as:

> 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (UNWCED, 1987, p8).

Significantly, the commitments achieved in Rio were for the first time, where national governments were concerned, representative of negotiated international agreement. The development of 'Agenda 21', an action plan for achieving sustainable development world- wide in the 21st century, emphasised the importance of this. In order to monitor progress in this programme the Commission on Sustainable Development was created to receive annual reports submitted by the members.

The United Kingdom, in response to their commitment, produced and published the Government's Sustainable Development Strategy (Department of Environment (DoE), 1994). This report outlined the environmental policies and gave guidance for waste management. It introduced the principle that the 'polluter pays' and is associated with the precautionary principle in 'This Common Inheritance' 1990 p9, that 'prevention is better than cure'. The Government viewed this as an important means of influencing potential polluters. As an adjunct to developing the ideas on waste management, a strategy was devised with three main objectives (DoE and Welsh Office, 1995a p7):

- to reduce the amount of waste that society produces;
- to make best use of the waste that is produced;
- to choose waste management practices which minimise the risks of immediate and thus future, environmental pollution and harm to human health.

The strategy also addressed a 'waste hierarchy' of reduction, re-use and recovery, which formed the government's policy for achieving sustainable waste management. Disposal was identified as a poor choice, due to the lack of any benefit or gain to the strategy, therefore the emphasis was placed on the reduction of waste as the best environmental option.

Also targets were set:

- to stabilise the production of household waste at the 1995 level;
- to reduce the proportion of controlled waste going to landfill by 10% over the next 10 years; and to make a further similar reduction in the 10 following years;
- to recycle 25% of household waste by the year 2000.

In order to achieve the aims of the strategy the government set out a five-point plan, with the following objectives:

- A regulatory strategy;
- A market based strategy;
- A planning strategy;
- A promotion strategy;
- An information strategy.

The waste strategy for England and Wales produced revised targets. However, with an actual 9% target recycling rate for municipal waste identified in the Waste Strategy 2000 (Department of the Environment, Transport and the Regions (DETR), 2000). The strategy retained a voluntary target of reducing the amount of industrial and commercial waste to landfill to 85% of 1998 levels by 2005. The remainder of waste in the UK was classed as agricultural waste and mine and quarry waste and both remain excempt from waste licensing as controlled waste. This contrasted sharply with the statutory recycling target imposed for domestic waste.

The general waste management policy the Government and the European Commission

were committed to, was the safe and sustainable management of health service waste. Healthcare contributes significantly to environmental pollution and as any increase in environmental pollution may result in health risks it could be argued that a commitment to the improvement and sustainability of the external environment is an intrinsic part of a healthcare strategy. The Government's strategy for 'Our Healthier Nation' (Department of Health (DoH), 1998) placed responsibility for the success of the health strategy with the National Health Service (NHS). The strategy included demonstrating a commitment to health and safety and addressing the potential environmental impact of NHS practice on the local communities and the environment (DoH, 1998).

1.2 National Health Service Trusts

The National Health Service (NHS) and Community Care Act 1990, introduced the conversion of directly managed units to NHS Trusts and this resulted in the formation of NHS contracts where one health service body arranged for provision to it, by another, of either goods or functions. The Trusts were responsible for their own budgets and competed for business within the NHS. The first Trusts were established in 1991 and were referred to as the 'first wave' of NHS hospital Trusts; thereafter each year was referred to as a 'wave'. The NHS was the largest group of employers in Europe with around one million staff in 1994 / 5 (National Audit Office, 1996). An average acute hospital of 500 beds produced more than 10 tonnes of waste a week. This was partly made up of household waste similar to the types of waste produced at home and cost between £20 and £70 per tonne to be disposed of to landfill. Other waste such as human tissue, infectious material and used syringes produced as a by-product of clinical processes was classified as clinical waste and cost £180 and £320 per tonne to dispose of because of its hazardous nature and special regulatory requirements (Audit Commission, 1997). The annual NHS bill for clinical waste was between £60 million and £150 million. The volume of waste produced and the associated costs were considered higher than in other European countries.

Since 1997 there has been a raft of policy documents, guidance documents and circulars which set out health care and to some extent the social agenda for NHS organisations, the public and the professions. The New NHS-Modern Dependable (DoH, 1999a) was the White Paper informed by the Modernising Government (DoH, 1998) which reiterated the

commitment of the government to modernise every area of public service including health care. A First Class Service–Quality in the NHS (DoH, 1999) reaffirmed the government's intention to place quality at the heart of NHS services. The modernisation impetus produced developments such as Clinical Governance, a concept that involved statutory bodies, local Trusts and individual professionals working together in order that quality standards were in place to underpin effective practice on a continual basis.

The NHS Executive has produced a series of Controls Assurance Standards for many aspects of healthcare. These addressed amongst others: waste management (NHS Executive, 2000a), environmental management, (NHS Executive, 2000b) and health and safety management (NHS Executive, 2000c). Each standard addressed an aspect of the waste management process in the traditional approach of separation, not integration, of the health safety and environment issues of the waste management process with the emphasis on the clinical waste stream.

1.3 Crown Immunity

All employers were required under the Health and Safety at Work etc. Act 1974 (HSWA) to ensure as far as is reasonably practicable the health, safety and welfare of their employees and the safety of others affected by activity in the work place. The Act placed a dual responsibility on both the employers and employees. However, the Health Service was regarded as the servant or agent of the Crown and as such Crown immunity ensured that the NHS and many other public sector organisations were protected until 1990 from prosecution in respect of non-compliance with health and safety legislation. Crown immunity was abolished under the NHS and Community Care Act 1990 Part v S60. This resulted in a review of Health and Safety within the NHS. Although the NHS was previously under the purview of the Health and Safety Executive (HSE), as enforcers of the HSWA the HSE role was no longer only advisory and the protection from prosecution for the NHS was removed.

The failure to manage health and safety effectively could result in injuries, sickness and deaths, leading to financial cost, for example sickness absence and judicial costs. Removal of Crown immunity introduced corporate liability which placed accountability

on the Chief Executive and the potential risk of punitive consequences (unlimited corporate fines or personal fines of up to £20,000 and/or a term of imprisonment) for non-compliance with legislation.

At the same time the Environmental Protection Act 1990 (EPA) introduced new standards for incineration. Many hospitals had on-site incinerators that were convenient and inexpensive for the hospitals to run. However, Crown immunity had resulted in a lack of maintenance and this was coupled with a lack of training for the operators. The feed-rate was often too fast and this resulted in plumes of black smoke which generated health concerns within the general public living in the surrounding communities (DoE and Welsh Office, 1995 b).

During the eighties there were a number of widely publicised instances of clinical waste substance emerging in public and recreational amenities, resulting in public outcry (London Waste Regulation Authority (LWRA), 1989).

In mid 1992 a survey conducted on 200 of 600 NHS incinerators predicted that 187 (93%) would fail to meet the standard required by the EPA. The anticipated costs to achieve the required standard by modification for the fitting of measuring and recording equipment averaged £55,000, with a further expenditure of £125,000-£200,000 for the air pollution control equipment (DoE and Welsh Office, 1995b).

A further survey of 71 Local Authorities in England by Environmental Resources Management (ERM) and Countrywide Communication suggested that a sizeable number of Trusts had not developed long term disposal routes despite the 5 year lead period granted (ENDS Report 248, 1995). Faced with the closure of their incinerators many Trusts had to rapidly make alternative arrangements, ranging from the upgrading of the existing incinerator, to the construction of a new one in partnership with the private sector.

Others looked to contractual arrangements involving the transportation of waste off-site. Contracting out the disposal of waste did not absolve Trusts of their responsibilities under the EPA and the 'proximity principle' was intended to prevent long distance transportation of waste. Some contracts had a requirement to supply a minimum tonnage

and this may have impeded the opportunity for waste minimisation to avoid financial penalty or a levy charge for not fulfilling a quota agreement to contractors. The management of health service waste that had not previously been viewed as a priority was suddenly realised to be a complex and multifaceted problem, with the potential substantial financial and criminal penalties directed at the accountable person.

The future of an efficient and effective health service may well depend on its ability to develop cleaner, more efficient and less wasteful operational methods of waste disposal which are compatible with regulatory legislation and public opinion (Jones, 1995).

The requirement and scope of the health and safety provision for the NHS was laid out in Health Service Guidelines for Occupational Health Services for NHS Staff (DoH, 1994).

The future sustainable management of health service waste had to be determined by including safety, health and environmental concerns into the process of managing the waste. The potential benefits of an integrated approach of environmental, health and safety (EHS) are being recognised by companies in an increasing number of business sectors, trade unions, charitable and enforcement agencies (Gillies, 1996). The processes of sustainable development and safety, health and environment are interdependent and interconnected. It is difficult to identify the specialist boundary beyond which health and safety objectives cease to operate and environmental issues begin, as the essential areas of each one support and complement the other.

1.4 Aims of this Research

1.4.1 Assess the management of healthcare waste within the United Kingdom (UK). Conduct reconnaissance visits to six hospitals to select hospitals for three in-depth case studies. These in-depth case studies will investigate current practice on waste disposal in three acute units in the public sector. The information gathered during the detailed examination of the three hospitals will be reviewed. Based on this review develop an integrated framework and strategy for the efficient, effective and sustainable management of hospital waste. This framework will address the health, safety and environmental issues of the waste management process.

Objectives:

1.4.2 Review of the published literature and statutory regulations pertinent to hospital waste disposal.

1.4.3 Conduct a reconnaissance visit to six hospitals in the London area covering a range of specialities in order to select three hospitals for the in-depth case studies into current practice.

1.4.4 Identify the hierarchy of responsibility for waste management within the acute units.

1.4.5 Conduct an in-depth case study on waste disposal in three acute units in the public sector.

1.4.6 Conduct a survey to identify the categories and sources of hospital waste.

1.4.7 Ascertain the disposal route and the frequency of collection.

1.4.8 Establish the total amount of healthcare waste and determine the proportion of clinical and household waste.

1.4.9 Review policy provisions and by observation and interview, determine compliance within actual waste management practice.

1.4.10 Review any existing training and education programmes; determine who is responsible for training and to which occupational groups.

1.4.11 Identify the legal issues involved, analyse their implications and make recommendations about actions that would be necessary to meet current and pending British and European legislative requirements.

1.5 On the basis of the information gathered under 1.4.1–1.4.11 above to develop a framework for the sustainable management of hospital wastes, including proposals for best practice in training, operation, implementation and inspection.

Chapter 2 Waste Definitions

2.1 Legal Definitions of Waste Arisings

The legal definition of clinical waste in the United Kingdom was formalised under two statutory instruments: the Environmental Protection Act (Duty of Care) Regulations 1991 and the Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1992.

2.2 Clinical Waste

Clinical waste is a mixture of wastes. Although defined and categorised by the Health and Safety Commission (1982), the first legal definition of clinical waste was given in the Collection and Disposal of Waste Regulations 1988 as:

(a) any waste which consists wholly or partly of human or animal tissue, blood or any other body fluids or pharmaceutical products, swabs or dressings, or syringes, needles or other sharp instruments, being waste, which unless rendered safe may prove hazardous to any person coming into contact with it; and transfusion, being waste which may cause infection to any person coming into contact with it and;

(b) any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion, being waste which may cause infection to any person coming into contact with it.

The Health and Safety Commission in 1982 (and revised in 1992) considered that there were five categories of clinical waste, as shown in Figure 2.1. They were classified according to the potential risk and this classification was adopted for general use in the UK. However, the categorisation included in Group D drugs or pharmaceutical products, which were subject to separate and more stringent controls under the Special Waste Regulations 1996.

Group A

- soiled surgical dressings, swabs and all other contaminated waste from treatment areas;
- material other than linen from cases of infectious disease; and
- all human tissue (whether infected or not), animal carcasses and tissues from laboratories and all related swabs and dressings.

Group B

- discarded syringes, needles, cartridges, broken glass and other sharp instruments.

Group C

- laboratory and post-mortem room waste other than waste included in Group A.

Group D

- certain pharmaceutical and chemical wastes (those falling within the definition of clinical waste).

Group E

- used disposable bed-pan liners, urine containers, incontinence pads and stoma bags.

Figure 2.1: Clinical Waste Categories defined by the Health and Safety Comission

The proposed definitions of healthcare waste, which may be used to inform a standardised European definition of healthcare waste to address the difficulty of comparison of healthcare waste produced within the EU are shown in Figure 2.2. Pharmaceuticals are defined as healthcare risk.

Healthcare: the medical activities such as diagnosis, monitoring, treatment, prevention of disease or alleviation of handicap in humans or animals, including related research, performed under the supervision of a medical practitioner or veterinary surgeon

Healthcare wastes: the solid or liquid waste arising from healthcare (the European Waste Catalogue was used as a basis).

Healthcare risk waste:

- biological (recognisable anatomical waste)
- infectious
- chemical, toxic or pharmaceutical including cytotoxins
- 'sharps' (, for example, needles, scalpels, sharp broken materials)
- radioactive

Figure 2.2: E U Priority waste streams project definitions of healthcare waste

2.3 Household Waste

Household waste is defined in Section 75 of EPA. Within the context of the healthcare environment, household waste is used to describe all non-clinical waste of the type usually to be found in households, for example domestic waste, paper, plastic etc. which is not contaminated with blood, body fluid, or other infectious material.

This includes:

- Cardboard waste: , for example, boxes, cartons, food packaging waste
- Food waste: from the wards or catering department
- Building services and furniture waste: mechanical equipment, furniture
- Glass and aerosol waste: uncontaminated glass and china ; empty aerosols and cans
- Confidential waste: all waste of confidential nature , for example, patient records

2.4 Special Waste

The Special Waste Regulations 1996 were made under Section 62 of the EPA 1990 and implemented the European Union's list of hazardous waste. They revoked and replaced the Control of Pollution (Special Waste) Regulations 1980 and the main purpose was to provide an effective system of control from production to final disposal or recovery. The regulation stipulated generic types of wastes and considered the constituents as well as the properties which render them hazardous. Because of this regulation the new definition required a change in the assessment of waste.

Special Waste is defined as:

a) waste on an EU list of hazardous waste, displaying a hazardous property

b) non-listed wastes displaying certain of those hazardous properties

c) waste prescription-only medicines

however,

d) several of the hazardous properties are subject to thresholds

e) most household waste is not special waste

f) save for the exceptions, waste that is not controlled waste cannot be special waste

g) radioactive waste (not a controlled waste) is a special waste if it comes within (a), (b) or (c).

(The definition of Special Waste - Technical Guidance 1996 p26)

The 'decision tree' approach, as described in the Special Waste Regulations 1996, is used to illustrate how to decide whether waste is special, by assessing the hazard and nature of the risk for example as toxic or flammable. Prescription-only medicines (PoM) are described as clinical waste in the UK. However, medicines that are available on prescription only, (PoM), are defined as Special Waste (Regulation 2 (2) (b)).

The one category of non-controlled waste which is subject to the Regulations is radioactive waste, which is not categorised as 'controlled' waste as it is already defined within the Radioactive Substances Act 1993. However, if the radioactive waste would

otherwise fall within the definition of special waste for other properties, for example low flashpoint, then the consignment note system, record keeping and any other controls would apply.

The regulatory framework applicable to health service waste and enforced by the Environment Agency is shown in Figure 2.3. Hospital waste is classified as Controlled Waste, unless Radioactive Waste in certain circumstances.

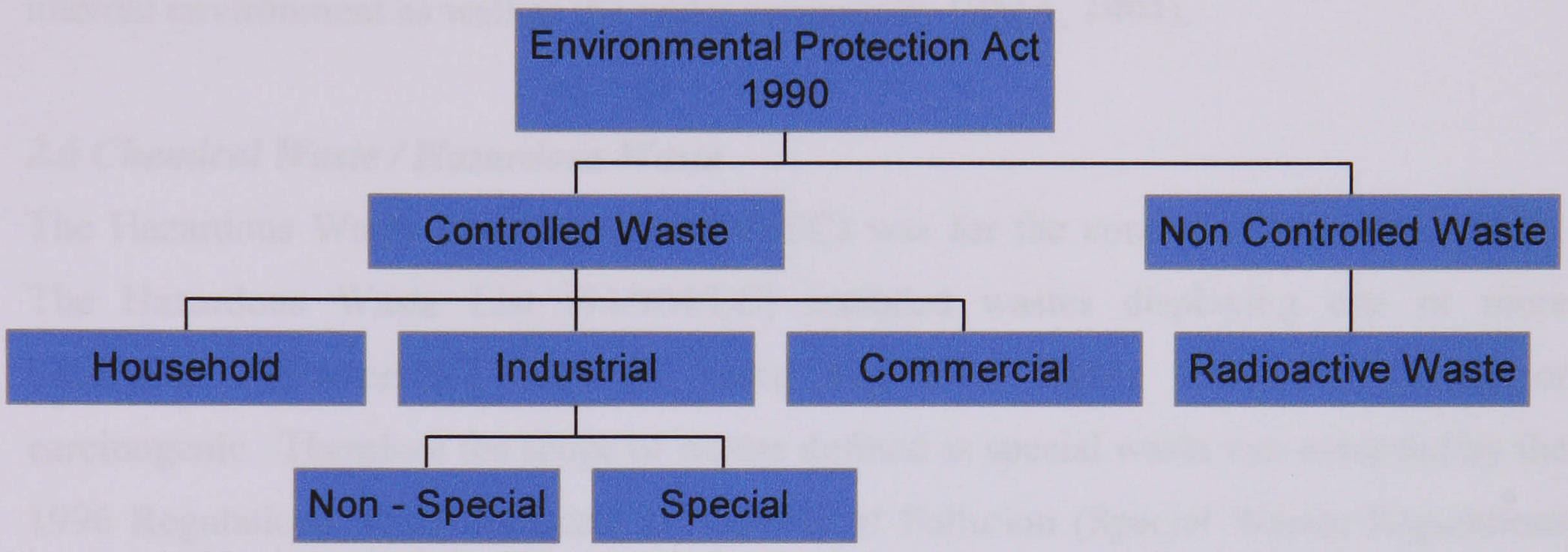


Figure 2.3: Healthcare waste EPA 1990 Controlled and Non controlled Waste

Hazardous properties and related thresholds are described in Schedule 2 Parts ii and iii. Regulation 2 (3). The Hazardous Waste Directive (91/689/EEC) provides the framework for the control of hazardous waste. The annexes to the Directive include descriptions of categories or generic types of hazardous waste according to:

- Their nature or the activity by which they were generated and;
- Properties of the wastes that render them hazardous.

Provided that properties H4 to H8 are displayed, the waste would be similarly classified to meet the requirements of the Chemicals (Hazardous Information and Packaging) Regulations 1994, known as CHIP 2. This replaced and revoked CHIP 1, removing the requirements covering the conveyance of chemicals by road now covered by the Carriage of Dangerous Goods by Road and Rail Regulations 1994.

2.5 Radioactive Waste

Radiation is energy that is transmitted, emitted or absorbed in the form of particles or waves. Radioactive wastes are those wastes which have a radioactive isotope attached to them. These may include not only the element itself but materials contaminated with this element, for example gloves or tissue. Ionising radiation can be divided into two main

groups; ionising and non-ionising radiation according to the effect it produces (Harrington *et al*, 1998).

The disposal of radioactive waste is regulated under the Radioactive Substances Act 1993. The enforcement of the Act is the responsibility of the Environment Agency. Natural background radiation is the primary source of radiation in England and Wales. However, the combination of physical and chemical properties of the radiation used within the health service has the potential to impact adversely on both the human and the internal environment as well as the wider community (BMA, 1994).

2.6 Chemical Waste / Hazardous Waste

The Hazardous Waste Directive (91/689/EEC) was for the control of hazardous waste. The Hazardous Waste List (94/904/EC) included wastes displaying one or more hazardous characteristics such as being explosive, highly flammable, toxic, or carcinogenic. Therefore the scope of wastes defined as special waste was extended by the 1996 Regulations which replaced the Control of Pollution (Special Waste) Regulations 1996 and came into force September 1996.

Mercury is an example of a hazardous waste with health risks. Symptoms of mercury poisoning range from loss of feeling in the limbs to tunnel vision, personality changes and coma. The condition was commonplace amongst hatters, who used mercuric nitrate to soften felt and gave rise to the expression 'Mad as a Hatter'. Despite its toxicity, mercury is an essential ingredient in a number of products, for example fluorescent and sodium lamps.

There are many chemicals in use in the NHS: for patient care; and as preservatives, fixatives, cleaning and disinfectant agents, for example: formaldehyde, glutaraldehyde as disinfectants and fixatives and ethylene oxide used for gas sterilisation. The 'hotel services' use cleaners, detergents and bleaches. Chemicals are classified under Chemicals (Hazardous Information and Packaging) Regulations 1994 revised CHIP 2 1999. The regulations are intended to protect people and the environment from the ill effects of chemicals by providing hazard information through the suppliers to the end user. It also requires the safe packaging of chemicals. There are similar requirements on the transport of chemicals by road or rail, Carriage of Dangerous Goods by Road and Rail (Classification, Packaging and Labelling) Regulations 1994 (CDGRR Regulations1994).

Chapter 3 Literature Review, Enforcement Agencies and Regulatory Framework

3.1 Literature Review

The literature was examined to identify key issues in waste management. This review was extended as necessary during the in-depth case studies in Chapter 5, 6 and 7.

There are many elements of a management system (Harvey-Jones, 1994). The disciplines of environmental protection, occupational health and safety may share many common elements, consequently smaller companies have resourced Environment Health and Safety (EHS) as an integrated role due to limited manpower. Larger organisations have tended to develop separate departments or fit the activities into existing departments, for example Occupational Health under Human Resources, Safety in Quality Assurance and Environment under Risk Control and Environment (Gillies, 1996).

The primary objective of waste management is to facilitate the collection and disposal of all waste streams arising from an organisation's processes. Guidelines for the management of waste from health care facilities are essential to maintain standards for occupational heath and safety and to prevent the process of waste disposal having an injurious health impact or adverse impact on the environment. The World Health Organisation (WHO) published the first report concerning waste management from hospitals, which defined infectious waste. Infectious waste was defined as waste that contained pathogens in sufficient concentration or quantity that exposure to it could result in disease (WHO 1985). The U.S. Environmental Protection Agency (EPA) defined any waste that was capable of producing an infectious disease as infectious (EPA 1986). However, if the primary goal of 'managing' waste from health care facilities is to prevent the accidental spread of disease, then the percentage of the waste stream which may be infectious must be established.

The majority of waste produced in hospitals is likely to be household waste (Environment Agency (EA), 1997). Only a small fraction, approximately 10-20 percent of healthcare waste is potentially hazardous for microbiological or chemical reasons (WHO, 1999). This figure has fluctuated due to the application of different criteria to determine the level of hazard.

The Waste Unit of the Commission of the Environment (DG XI) conducted an analysis in all member states from 1991-1993. The total amount of healthcare waste was

approximately two million tonnes per year. Two percent of this waste was classified as a higher risk than waste generated at home. However, there were wide variations in volume and categories of waste produced and the cost of disposal. This was due to the lack of standard definitions and differences in practice and segregation.

The danger of infection from hospital waste has been debated over the years. However the evidence was found to be primarily anecdotal and often inconclusive: Möse and Reinthaler (1985), Keene (1989) and Ayliffe (1994).

Pönkä *et al* (1996) revised guidelines in Finland to rationalise waste management based on verified risk by practical assessment, which resulted in a reduction in waste that required special treatment. Therefore disposal costs were reduced. However, Owen *et al* (1997) concluded that wastes from healthcare facilities were not a significant proportion of the pathogenic microbes in the total waste load produced by society. Rutala and Weber (1991) found no epidemiological evidence that hospital waste disposal had caused disease in the community and suggested that the presence of microbes did not make waste infectious. Salkin (2001) discussed the occupational and public health risks associated with the components of health care waste streams and concluded that they had not been determined. However, Canadian strategies which aimed to reduce the costs of biomedical disposal, conducted waste disposal reviews which found that the staff believed that all waste generated by healthcare was biomedical (Escaf and Sturtleff, 1996).

The probability of acquisition of infection and physical injuries from health care waste streams is relatively low, but if it does occur, there may be low hazard, high-risk consequences (Salkin, 1999). Some agents that persist in the blood are known to be endemic in the population and possibly unknown to the symptomatic carrier. These are principally the human immunodeficiency virus (HIV) and the hepatitis viruses: hepatitis B virus (HBV), hepatitis C (HCV) and hepatitis D (HDV) (Advisory Committee on Dangerous Pathogens (ACDP) 1996).

Throughout Europe a primary concern in the management of health service waste was to minimise potential damage to the environment and common legislation was informed by recognition of the importance of preventing further pollution: Waste Framework

Directive (75/442/EEC), amended by Directive (87/101/EEC) and Directive (90/656/EEC). Directive (91/156/EEC) and Directive (91/692/EEC).

The legislation was intended to address all aspects of health service waste management from production to disposal. Waste disposal plants have been targeted with strict controls being introduced for incineration.

The trend towards disposable items in the nineteen-eighties as a means of infection control greatly altered the nature of the clinical waste in terms of volume and weight. In addition this change in the nature of the load had implications for the environment. The potential risk was of increased levels of toxins in the gas released when certain plastics (such as PVC) and other substances were incinerated, for example dioxins, tetrachlorodibenzodioxins (TCDD) and furans, trachlorodibenzofurans (TCDF). This concern was first raised in Europe in the nineteen-eighties (Commission of the European Communities (CEC), 1982). Dioxins and furans can persist in the environment and accumulate in the food chain; the human population is exposed to them through food supply (Thornton *et al,* 1996). Both these chemicals, which have a variety of sources, are recognised by the public as 'hazardous' or 'toxic' (Comber *et al,* 1996). A study of incineration emissions indicated that the official design and operational guidelines intended to minimise dioxin formation might be inappropriate (ENDS Report: 237, 1994). However, high temperature incinerators work at temperatures of between 800-1000°C and have special emission-cleaning equipment to ensure that only insignificant amounts of dioxins and furans are produced (WHO, 2001).

The problems identified reflect those first identified in 1978, with reference to the seven member states of the European Union which found that the greatest producers of healthcare waste per occupied bed were hospitals with a capacity of up to 600 beds. The UK contribution of 3.25kg per occupied bed per day was higher than the mean of 2.33kg (CEC, 1982). By comparison, Freiburg University in Germany had been developing their waste management strategy due to the high costs of disposal and this had resulted in the reduction of the output to a total of 51 tonnes of clinical waste per annum (CEC, 1982). All waste was segregated at source allowing the recycling of glass and paper on site. However, a factor in this comparison is that not only is the definition of clinical waste

different between the countries, but there were also differences in clinical practice. In Germany the infectious status of patients was established on admission and only if infection was present was the waste categorised as clinical (British Medical Association (BMA), 1994)). In the UK most waste categories produced within a clinical area were treated as clinical waste. This notwithstanding, there were vast differences in the amounts produced, attributed to tougher regulations aimed at reducing end waste disposal, which were introduced earlier elsewhere in Europe than in the UK (Audit Commission, 1997).

The total European waste produced was initially forecast up to 1980, 1985 and 1990, with special reference to the use of disposables identified as the major contributor to the increased amount, on the basis of the estimated values for 1978, 13.3 million m^3, 135 kg per m^3 (CEC, 1992 p60).

a. 1980: 14.7 million m^3/1.84 m t/125 kg per m^3
b. 1985: 18.7 million m^3/2.15 m t/115 kg per m^3
c. 1990: 23.9 million m^3/2.39 m t/100 kg per m^3

Therefore, the predicted volume of waste in the European Community for 1990 was 1.8 times the 1978 value. This was rapidly exceeded. The Department of Environment (DoE) in 1983 estimated the amount of waste produced by the NHS and private hospitals in Great Britain to be 33,000 tonnes. This figure excluded clinical waste from home treatment within the community, which was estimated as 99,000 - 165,000 tonnes; three to five times that of the amount of hospital waste (Waste Management Paper No. 25, 1983).

The lack of segregation appears to be a major contributor to the overall cost and is the main concern pertaining to waste disposal. In 1993 the BMA concluded that by accepting that if the tonnage amount of clinical waste produced as reported by the National Society for the Protection of Clean Air (1992) was taken, then halved and multiplied by £200, (the 1993 average unit cost of incineration per tonne of clinical waste) this 50% of inappropriate incineration could cost the NHS £56 - £70 million a year. The 1996 average unit cost of incineration per tonne of clinical waste had increased to £250 per tonne. The predicted savings for a 500 bed hospital was £40,000 per annum if the clinical waste stream excluded household waste (Audit Commission, 1997).

Poor segregation of clinical and household waste resulting in mixed loads which

increased the risk of inappropriate disposal during collection was observed during a survey of Maidstone area (Smith, 1989).

Examination of the incineration loading data collected during the monitoring of gas release during incineration at a London hospital demonstrated the importance of segregation in the disposal costs (Sheperd, 1989). Although the weight division was not noted, the total weight for incineration as clinical waste was 4.3 tonnes (that is an assumed 70% of the total load). The Audit Commission (1997) predicted disposal costs for clinical waste were £180 - £320 per tonne and household waste costs at £20 - £70 per tonne. 4.3 tonnes at midpoint rate of £250 would be predicted at a cost of £1088 per 2 days or £544 per day. To this cost would be added the disposal of the household waste. The disposal of household waste via the clinical waste stream was now considered the major factor in the high costs of healthcare waste disposal (NAC, 1997). There was a lack of hard data and this was an ongoing problem, although the Audit Commission (1997) projected further savings. The information was derived from the tonnage of waste generated and separated into each category and not based on an actual content analysis. Observation of work practice by the audit team did support the view that lack of segregation of clinical waste was a contributing factor. An extensive examination of segregation practice that involved content analysis estimated that up to 75% might have been non-clinical. However, there was no comment on the clinical waste arising in the household stream (NHS Estates, 1997). The cost of the disposal of non-clinical waste as clinical was the primary focus of the research. Therefore, if the NHS were to reduce its contribution to environmental pollution and depletion of resources, then it would need to develop a more holistic approach to waste management without compromising hygiene standards. This balance and the essential support of the health care workers and hospital management were required to realise sustainable development within hospitals (Daschner *et al,* 1997).

3.2 Initiatives into waste reduction, recycling re-use.

Waste minimisation is an important aspect of waste prevention and emphasises the role of the purchasing policies of health-care providers. The NHS Supplies in England 1995 were involved in the arrangements for the purchase of £2 billion of goods bought annually by the United Kingdom NHS. Therefore they are key stakeholders in the issues

of reducing waste. If the waste can be reduced in the initial phase there will be less to dispose of. Producer responsibility regulations do not apply to hospitals, as they are end-users of the majority of products. However, any reduction in packaging results in a reduction of disposal cost. Waste minimisation has a number of potential benefits, for example there may be a reduction in insurance costs and increase in public support by demonstrating cleaner environmental practice.

A feasibility study of the mechanics of recycling unopened and undamaged single-use anaesthesia breathing systems conducted in the United States considered the system to be cost efficient and reduced the amount of waste. Eighty three per cent of the polled departments who used this system agreed to recycle voluntarily. However, others indicated that they would only participate if it were a mandatory requirement (Czajkowski-Beckwitch and Rosenblatt, 1996). Recycling was viewed as a very important component of Integrated Waste Management in Cape Town which aimed to minimise waste generation at both industrial production level and during consumer use (Campbell, 1994).

Lee *et al* (2002) evaluated the recycling potential of medical plastic waste and identified hospital cafeterias as producing the major sources of waste with the minimum risk of contamination. Therefore these would be the easiest recycling source. However, waste reduction at source is the best commercial and environmental option. The Government's strategy for achieving more sustainable waste management and the role of business in achieving national targets was set out in Waste Strategy (DETR, 2000).

The application of life-cycle assessment (LCA) analysed the impact of disposable products and durable products on the environment (Ison and Miller, 2000). However, risk assessment for transmission of variant Creutzfeldt Jakob Disease (vCJD) via surgical instruments has resulted in the (DoH) funding the introduction of single-use instruments for tonsil surgery (DoH, 2001) and this may reverse the trend towards re-useable equipment.

3.3 Adverse Effects to Health and the Environment

The disposal of health care waste is a sensitive issue and has ethical dimensions; the term 'ecotoxic' is used to describe waste that is a potential risk to the environment.

Environmental pollution arises from the improper handling and disposal of healthcare waste. The environmental impact may be classified as: infectious, mechanically injurious, chemically toxic or noxious, aesthetically objectionable, or any combination of the classifications (BMA, 1994).

3.3.1 'Sharps' Injury

Health care workers are at risk of infection in the health care setting (Hersey and Martin, 1994). Known routes of infection for blood bourne diseases are through parental exposure, mucous membrane exposure and exposure via cuts, abrasions or other open wounds (ACPD, 1996).

'Sharps' are defined as any sharp object in the health care setting that can cause laceration or puncture wounds. To date the only documented transmission of disease from health care waste has been from contaminated sharps. McCormick and Maki (1981) were first to identify the greatest risk of health care workers sustaining harm through parental exposure by a penetrating 'sharps' injury sustained from an infected person.

Before the advent of Human Immunodeficiency Virus (HIV), needlestick injuries received little attention although there was a significant risk, estimated to be 1 in 3 of contracting HBV and 1 in 37 of contracting HCV following needlestick injury (Caird *et al,* 1995).

Nurses were identified as the group most frequently reporting occupational injury and exposure (Ippolito, 1997). Approximately 100 health care workers in Europe have either definite or possible occupationally acquired HIV (Evans and Abieboul, 1999). However, HBV and HBC cases are more prevalent and pose a greater risk of infection. At least 5% of people do not respond to immunisation against HBV (Haslett, 1999). Therefore they are unprotected against the virus. Of those infected with HCV approximately 80% may become chronic carriers (Haslett, 1999) and of these 25% may require liver transplants.

The National Audit Office (NAO) found that of the 1,961 notified accidents in 30 Trusts in the UK over an eight week period, 317 (16%) were needlestick injuries (NAO, 1996) and concluded that the greatest risk to health was from a 'sharp' injury by accidental inoculation. A separate study conducted over one year found that those involved in the movement of waste, for example, porters, domestic and waste collection staff in one Trust

in one year accounted for 8% of the total needlestick injury per hundred staff (Audit Commission, 1997).

Extensive studies have been conducted which conclude that recapping or resheathing the needle is a contributing factor WHO (1985), Kopfer *et al.* (1993) and Moss *et al. (*1994). Recommendations not to recap used needles have been repeated for years (McCormick, 1981). Up to 40% of injuries may be attributed to this single procedure which is discouraged by the BMA, US Centre for Disease Control and Prevention and the WHO (Morgan 1999). A random sample found that 50% of GP's recapped needles (Caird *et al,* 1995). It is worth noting that the instruction to recap needles was issued during the late seventies in the UK accompanied by a publicity campaign to train health care workers in the procedure. The potentially devastating consequences of needlestick injuries have prompted many health care institutions to adopt education and training protocols to help reduce the occurrences of 'sharps' injuries, yet needlestick injuries continue to occur (Royal College of Nursing (RCN), 2001).

Given the serious and even fatal consequences of 'sharps' injuries and the limited effectiveness of post-exposure prophylaxis, this is an essential area to develop safe working practice (Hanrahan and Reutter, 1997). Health care workers in the USA account for 2% to 4% of acute cases of HCV and most cases are thought to be a result of accidental needle-stick injuries (1998 APIC Guidelines).

In the UK, there is a legal obligation under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995, for the employer to notify and report to the enforcing authority of any injury, dangerous occurrences and industrial disease. This includes any situation resulting in an inability to carry out normal work for three or more days. The accuracy of this system is dependent on a number of factors , for example, the employee informing the employer, the capability of the General Practitioner in linking the illness to work and communication to the employer. Under-reporting is a feature of this system. The Health and Safety Executive have concluded that NHS employers report only 37% percent of the accidents that they are legally required to report (Department of Employment (DoE), 1994). Nurses were more likely to report needlestick injuries (Rogers and Goodno 2000). Physicians may not report needlestick injuries if they have concerns that their medical practice would be jeopardised if they contracted an infectious disease (Hanrahan and Reutter, 1997).

3.3.2 Biological Risks

There is little known about the actual health risks from exposure to the potentially infectious clinical waste material. The concerns expressed about clinical healthcare waste were due to the high concentration of infected material, which was much more prevalent than in normal domestic waste (WHO, 1985). The USA Centre for Disease Control challenged this during 2000 and argued that there was no epidemiological or microbiological evidence to support the statement. Carson (1994) suggested that for waste to be infectious there must be three components involving a susceptible host, exposed via a port of entry to a dose of a sufficiently virulent pathogen.

Infectious waste also contains micro-organisms including viruses which may be present on dressings, body fluids and excreta, plus the containers and equipment (if disposable) used to collect them. More recently these viruses have caused concern: Hepatitis B (HBV) is present in the blood of infected patients and likewise, Hepatitis C (HCV) and Human Immunodeficiency Virus (HIV). Although there is a vaccine for HBV and Hepatitis A Virus (HAV), there is not a vaccine for HIV or HCV. There is a tendency for the focus to be on HBV and HIV despite the opportunity for successful intervention in treating HCV at an early stage (Hoepelman, 2000). Concern also centres on Prions, for example, Bovine Spongiform Encephalopathy (BSE) and other transmissible virus-like agents such as Creutzfelt-Jacob, or bacteria such as Tuberculosis, Serratia Marcescence, Staphylococci and Pseudomonas. This emphasises the importance of a safe system of waste management as a priority to protect individuals and the environment (BMA, 1994).

3.3.3 Chemical Waste

Contamination of both groundwater and surface water results from uncontrolled chemical discharge from the hospitals. Medical illustration departments, for example, are dependent on silver, which results in wastewater containing high concentrations of silver compounds (Jeyaseelan and Sathananthan, 1997). Silver in all forms is regarded as toxic and it is prohibited that it be discharged into public sewers. The Environment Agency has reaffirmed that photographic waste is special waste. However, legal responsibility for classification and handling waste lies solely with the producer (EA, 2000). Chemicals and pharmaceuticals amount to approximately 3% of waste from health-care (WHO, 2000).

The chemicals used as disinfectants and fixatives in laboratories and clinical areas, such as glutaraldehyde and formaldehyde, are recognised as potential sensitisors and have respiratory effects (Gannon *et al*, 1995). Glutaraldehyde, a liquid chemical used for the cold sterilisation of instruments and equipment is toxic, irritant and sensitising. Alternative disinfectants are available but the continued use of glutaraldehyde is primarily due to its efficacy, ease of use, cost effectiveness, lack of corrosiveness and speed of disinfection. Exposure to it can also act as a trigger to create sensitisation to other chemicals (Rastogi, S.K., Pantey, B.S., 1998). It was estimated that in 1996/97 about 20 workers suffered occupational asthma because of glutaraldehyde exposure (HSE, 1998). It is also implicated in causing allergic contact dermatitis (Fowler, 1989).

Following a review of research and literature, the HSC's Advisory Committee on Toxic Substances (ACTS) recommended replacing the current Occupational Exposure Standard of 0.2mg m^3 with a maximum exposure limit of 0.05mg.m^3. The HSC approved the removal of Maximum Exposure Level (MEL) in 1999. Recommendations made to reduce the exposure limit were questioned (Leinster *et al,* 1993, Gannon *et al,* 1995). The necessity to employ good work practice and education was recommended as essential (Andrion *et al,* 1994). In many cases, glutaraldehyde was viewed as the best available disinfectant (Babb *et al,* 1991). However, there was also an increase of mycobacterium chelonae contamination of the washer disinfectors, which were demonstrated as extremely resistant to 2% glutaraldehyde. The consequences of this have been identified as misdiagnosis and iatrogenic infection (Wang *et al,* 1995). Iatrogenic infections are infections that arise as an unwanted intervention in the context of healthcare, infection, or arise as a consequence of medical intervention.

Glutaraldehyde is acutely toxic to aquatic organisms and equally toxic to warm and cold-water fish (Hon-Wing Leung, 2000)

Formaldehyde is used mainly as a preservative and disinfectant in pathology and anatomy departments. Formaldehyde can cause both an irritant and hypersensitivity dermatitis when in direct contact with the skin in sufficient concentrations (Hathway *et al,* 1991). Formaldehyde has been identified as a cause of occupational asthma in health care workers. The first incidence occurred in a dialysis unit (Hendrick *et al*, 1975) where it was used to clean and disinfect the internal hoses of haemodialysis machines.

Ethylene oxide is most frequently used in sterile supplies units. Gas sterilizers have been

used for many years to sterilise surgical equipment that is heat sensitive or unable to tolerate moisture. However, several studies have shown ethylene oxide to have adverse health effects ranging from irritant contact dermatitis (Lerman *et al*, 1995) to peripheral neuropathy (LaMontagne *et al*, 1996). Studies have also demonstrated that pregnant laboratory animals exposed to ethylene oxide resulted in a higher incidence of malformations and abortion (Rowland *et al*, 1996).

The widespread use of cytotoxic drugs in the treatment of cancer has led to the production of large amounts of contaminated wastes (Castegnaro *et al,* 1997). The discharge, presence and potential adverse effects of pharmaceuticals in the environment are emerging research areas (Christensen, 1998). Hansel et al (1997) advised that genotoxic compounds used in cancer chemotherapy results in contaminated wastes that require decontamination before disposal. Therefore, there is a potential risk to health and the environment. Also pharmaceuticals waste generated during anaesthesia is considered to contribute significantly to the cost of anaesthesia care. Weinger (2001) concluded that intravenous drugs prepared but unused may be a significant cost. However, this study excluded the cost of disposal of part-used syringes or vials disposed via the waste stream which would increase the disposal cost.

3.3.4 Radioactive Waste

Ionising radiations from materials in radioactive wastes are controlled by the Radioactive Substances Act 1993. The spectrum of radioactive wastes produced in hospitals is diverse. It includes gaseous, liquid wastes and solid forms. Liquid radioactive waste may be authorised for disposal to the sewerage system. Radioactive excreta may enter the clinical waste stream resulting in inappropriate disposal (Evdokimoff *et al*, 1994); also small sources may be inadvertently placed into the clinical waste stream with the wound dressings.

The primary source of contamination with radioactive material was from nuclear medicine patients, for example, swabs, vials syringes, etc. (Ho-Sy and Shearer, 1992). When the amount of activity in a sealed source has diminished through natural decay it is described as 'spent' and becomes waste. However, sealed sources may leak radiation and contaminate waste streams (British Medical Association (BMA), 1994).

3.4 Education and Training

Workers who handle hospital wastes are at greatest risk from exposure to the potentially infectious wastes and chemical hazardous wastes. However, to minimise the risk to workers and the public the waste management process requires careful storage, transport, and final destruction. Education and training in the management of healthcare waste was identified as an essential requirement for all health care staff and this has been consistently restated by: the World Health Organisation (1984, 1999, 2000); the London Waste Regulations Authority (LWRA)(1984, 1989) and the Health Services Advisory Committee (HSAC) of the Health and Safety Commission (HSC), (1992, 1999). The EU project group report of the analysis of priority waste streams for health care waste in the Way Forward (CEC, 1995) recommended mandatory training on the risks involved in all the aspects of healthcare waste management together with a system of assessment of competence. The report also considered that 'existing Health and Safety Officers' responsibilities should be extended to include environmental matters'.

3.5 Health Service Enforcement Agencies

3.5.1 Environment Agency

The Environment Agency (EA) for England and Wales set up by the Environment Act 1995, became operational on 1 April 1996. It was one of the largest environmental regulators in the world and incorporated the functions and resources of: the National Rivers Authority (NRA); Her Majesty's Inspectorate of Pollution (HMIP); Waste Regulation Authorities (WRAs) and provided some Department of Trade and Industry (DTI) functions. It is now part of the Department of Environment, Food and Rural Affairs (DEFRA) and it's functions concern, for example toxic substances and contaminated land. The EA is also responsible for: regulating waste management; water pollution; the keeping and use of radioactive material and the disposal of radioactive waste. The EA is also responsible for regulating producer responsibility obligations, for example for packaging waste. Any discharge of trade effluent to sewers requires consent from the relevant water services company.

The London Waste Regulation Authority (LWRA) was created in 1986 to develop standards to improve the methods of segregation, handling and disposal of clinical waste. During the following three years, the LWRA continued to advise on improvements.

There were a series of incidences of inappropriate disposal which resulted in the formation of the Clinical Waste Enquiry in London (CWEL). LWRA (1989) published an Appraisal together with Guidelines for the Segregation, Handling and Transport of Clinical Waste. The 2nd edition was updated and published in 1994. The guidelines were comprehensive and included: clinical waste from hospitals and clinics; clinical waste from medical practitioners and dentists; clinical waste from research establishments; clinical waste from veterinary practices/animal hospitals and clinical wastes arising in the home. Although these guidelines have informed much of the guidance since, the Coastwatch UK project has been involved in annual surveys into the extent of littering around the coast and suggest that the ill-health-effects of discarded litter and medical waste are still not resolved (Philipp *et al,* 1997).

Before the (EPA 1990 Part 1), which aimed to improve control of pollution by extending the statutory provision in relation to waste, the control of waste was limited to waste disposal, under the Control of Pollution Act (COPA) 1974, which prohibited any disposal of waste unless the disposal was licensed. This had introduced a system of control for the disposal of waste to land. However, there were few controls imposed on the disposal facility that would have provided protection for the environment and health and safety. The approach was targeted at the point of waste disposal and did not consider risk to health, safety and the environment during the other key stages of the waste stream, from its production, transportation and then disposal.

The EPA 1990 Part ii extended the control of waste to include the three main stages of the waste stream: the production, transportation and final disposal. It also imposed a 'duty of care' on each individual involved during any of these three stages.

The efficiency of enforcement was questioned when 200 tonnes of high-risk clinical waste were discovered dumped on two warehouse sites, stored in lorry trailers in Hertfordshire in 1995, resulting in a £250,000 clean up bill for the local authority and causing concern about the effectiveness of the duty of care controls (ENDS Report, 251 1995).

The Waste Management Licensing Regulations 1997 states the level of training required for each type of waste facility. A joint report by the Department of Trade and Industry (DTI) and the Department of Environment (DoE) 1995, viewed training to National

Vocational Qualification (NVQ) level as a commercial opportunity and expected the Waste Management Industry Training and Advisory Board (WMITAB) to develop schemes leading to an NVQ for clinical waste. This request was developed and Regulation 4 of the Waste Management Licensing Regulations WMLR 1994 requires that there be a technically competent person (TCP) who holds either individually or collectively, a certificate issued by the (WMITAB). There are two levels of certificate either level 3 or level 4. The level of certificate is dependent on the site requirements.

3.5.2 Health and Safety Executive

There was a rapid escalation of Health and Safety legislation due to the Management of Health and Safety at Work Regulations 1992, which implemented the provisions of the Framework Directive (89/391/EEC) and came into force in 1993. There were a further five 'daughter directives' which were also adopted and transposed into UK law, four of which were applicable to waste management: the Manual Handling Operations Regulations 1992; Safety at Work Regulations 1992; Workplace (Health, Safety and Welfare) Regulations 1992 and the Personal Protective Equipment at Work Regulations 1992. In each the main impetus was on the risk assessment, which echoed the Control of Substances Hazardous to Health Regulations (COSHH) 1988 revised 1999.

The provision of the Health and Safety Commission and Executive evolved from the recommendations of the committee chaired by Lord Robins that informed the Health and Safety at Work etc. Act 1974. The Act was an attempt to set the objectives to be achieved and was intended to be a goal setting approach. This shift from the prescriptive approaches was informed by the extensive amount of legislation being generated in an attempt to meet the gaps in the existing legislation. The enforcing authority for the management of health and safety at work is the Health and Safety Executive. In practice this means that the advice and enforcement requirement that is, by necessity, inextricably linked, is to be provided by two separate agencies, Health and Safety Executive and the Environmental Agency. The NHS reforms under the National Health Service and Community Care Act 1990, which resulted in the creation of Trusts and the withdrawal of central funding and guidance, ensured that the economic issues of healthcare waste management were becoming increasingly important. The Audit Commission, which reviews the expenditure of public funds for propriety and regularity and for value for money, also conducts audits and provides recommendations on the economic aspects of

healthcare waste. A further source of advice is the NHS Estates, an Executive agency of the Department of Health (DoH) which produces guidance on the management of health service waste. However, to receive advice in this way is likely to result in confusion in the management of hospital waste as each advisory group will have a discrete perspective and a unique set of priorities which may ignore or be unaware of requirements in the other areas. The dissemination of the information had previously caused concern. The Welsh Affairs Committee (WAC 1990) was advised that the Waste Management paper on Clinical Waste first published 1983 had not been circulated to Health Authorities by the DoH in England or the Welsh Office in Wales. Therefore, when questioned, a number of Health Authorities were unaware of it.

The National Audit Commission (NAC, 1996) examined 30 NHS Acute Hospital Trusts to determine the extent of compliance with six areas of health and safety. Waste management, substances hazardous to health and manual handling were 3 of the 6 key areas. Eleven Trusts considered that they complied with more than 70% of the Health and Safety requirements. However, this was based on the perception of the staff. Ninety-two percent of staff stated that needles and other sharp instruments were always disposed of in accordance with the Trust's procedures. This was not reflected in the accident statistics which indicated that needlestick injuries were around one-sixth of the total injuries reported and placed top of the league at 16% of injuries. Although there were Occupational Health Departments, none of the 30 Trusts could provide information on trends in occupationally related ill health among their staff.

There were 34 successful prosecutions of the NHS by the HSE in the initial eight years. However, the average fine was £5,134 while the maximum fine limit is £20,000 (NAO, 1996). During the four months October 1995 to January 1996, the Health and Safety Executive issued 68 prosecutions against NHS employers (NAO, 1996). This figure is more likely to reflect the extent and severity of non-compliance and due to the infrequent inspection may be an underestimate. The Audit Commission, that advised that Trusts had to improve their arrangements to safeguard health, avoid prosecution and reduce costs, confirmed this.

The European Union's policy on waste outlined the hierarchy for waste management: prevention, recycling, re-use and safe disposal as a last resort (Commission of the European Communities (CEC, 1989).

The Council Directive 94/62 EC on packaging and packaging waste recognised the quantifiable economic benefits that are achieved from waste minimisation. In 1993, the ENDS Report 225 reported estimated potential savings of £1 billion, which supported the premise that waste minimisation should be a priority in any waste management strategy. Examination of the waste generated in preparation for surgery indicated that 18 kgs of 228 kgs was non-infectious, primarily paper and plastic (Francis *et al,* 1997). It was becoming evident that waste minimisation was the single most important strategy. This was reflected in the directive on Packaging and Packaging Waste (94/62/EC), which in the UK had resulted in the forming of a voluntary system within industry to recover value from 58% of packaging waste by the year 2000. VALPAC, an industry wide organisation was to administer the scheme funded by a levy on the subscribing industries. Any waste minimisation may have had a further impact for some Trusts, who, if they handled more than the tonnage/turnover thresholds (both of which were set to be reduced by the year 2000), would have fallen into the Obligated category which placed responsibility to carry out recovery and recycling either individually or collectively (Health and Safety Practitioner, 1997). The Trusts which had agreed to supply a minimum tonnage for incineration with external contractors, or pay a levy which served to increase the cost overall, may well have experienced a degree of dilemma in developing their waste management strategy.

3.5.3 The Control of Substances Hazardous to Health Regulations 1999 (COSHH)

The COSHH Regulations 1994 provided a framework of actions to control risk from a range of hazardous substances: chemicals, pharmaceuticals and biological agents. The COSHH Regulations 1999 replaced the 1994 regulations. COSHH 1999 removed the scheduled list of substances assigned Maximum Exposure Limits (MEL). The removal of MELs is one of the most important structural changes made since COSHH came into force more than ten yeas ago. In the past much of the impetus for amending COSHH had come from the need to make changes to the list of substances assigned MELs. The list doubled since 1989 from 30 to 66 and continues to increase. MELs remain legally binding but COSHH 1999 avoided the need to amend COSHH everytime a change needed to be made to the list of MELs. Statutory limits for occupational exposure to chemicals are published yearly in EH40 (HSE, 2000).

Blood-borne viruses are biological agents as defined in COSHH. There is a requirement

under the COSHH Regulations 1999 to make an assessment of all the risks to health from occupational exposure. When a risk has been established appropriate control measures must be selected to minimise the potential risk to health. Also employees must receive appropriate information, instruction and training on any identified risk. However, this is reliant upon sufficient knowledge to identify the risk and select the control measures.

3.5.4 *The Management of Health and Safety at Work Regulations 1999 (MHSW)*

The Management of Health and Safety at Work Regulations 1999 (MHSW) requires all employers to assess the risks to employees and others who may be affected by their work activity. The regulations are of a general nature and have a wide application to all areas of work activity. Because of this there may be an overlap with others, for example the assessment required under COSHH Regulations. Although the potential for duplication exists, it is not intended. If an assessment has been made for the purposes of the COSHH Regulations it will be sufficient unless the general duties in the MHSW go beyond those in the specific regulations and additional measures are required to meet the MHSW.

Since 1974, legislation to protect both the individual and the environment has grown apace. As is shown in Table 3.1 this rapid development of regulation to transpose into UK legislation the management of health and safety at work and accompanying directives led to ongoing demands for deregulation by industry.

Table 3.1: Regulatory Framework for Environment, Safety and Health

Environment Legislation	Health and Safety Legislation
Control of Pollution Act 1974	The Health and Safety at Work etc. Act 1974
Control of Pollution (Special Waste) 1980	The Reporting of Incidents, Diseases and Dangerous Occurrences Regulation 1985
Collection and Disposal of Waste Regulations 1988	The Misuse of Drugs Regulations 1985
Control of Pollution (Amendment) Act 1989	The NHS and Community Care Act 1990
Environmental Protection Act 1990	The Radioactive Substances Act 1993
Controlled waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991	The Manual Handling of Loads Regulations 1992
Environment Protection (Prescribed Process and Substances) Regulations 1991	The Management of Health and Safety at Work Regulations 1992
Controlled Waste Regulations 1992	The Personal Protective Equipment at Work Regulations 1992
Environmental Protection (Duty of Care) Regulations 1992	The Provision and Use of Equipment Regulations 1992
The Carriage of Dangerous Goods by Road (Drivers' Training) Regulations 1992	The Workplace (Health, Safety and Welfare) Regulations 1992
Environment Protection (Prescribed Process and Substances) Regulations 1993	Consultation with Employees Regulations 1996
Controlled Waste (Amendment) Regulations 1993	The Health and Safety (Dangerous Pathogens) Regulations 1996
Waste Management Licensing Regulations 1994	Chemicals (Hazardous Information and Packaging Regulations)1999
Waste Management Licensing (Amendment etc.) Regulations 1995	The Control of Substances Hazardous to Health Regulations 1999
Special Waste Regulations 1996	
The Carriage of Dangerous Goods by Road Regulations 1996	
The Carriage of Dangerous Goods (Classification, Purchasing and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996	
Special Waste (Amendment) Regulations 1996	
Packaging Producer Responsibility Regulations 1997	

Chapter 4 Reconnaissance Visits to Six London Hospitals

4.1 Introduction

The purpose of the preliminary visits to six London hospital sites was to identify the strengths and weaknesses in current waste management strategies. This would be a basis for the selection for three hospitals for in-depth case studies. These more detailed surveys would be used to develop a framework for the sustainable management of hospital wastes.

The initial selection was intended to be broadly representative of the NHS hospitals within the London area. Hospital types were: acute units, teaching hospitals and a community health unit. There are in total 260 acute units in England and Wales, of which London has 16 acute hospitals (Audit Commission, 1997). Acute hospitals produce the largest volume of waste per occupied bed. However, a community health hospital was included to examine the waste management practice for a wider geographic area outwith the acute units. The disposal, collection and storage of clinical waste produced within the community was considered relevant due to the increase in Day Surgery Units and the more rapid discharging home of patients from the acute units which was likely to increase the volume of clinical waste within the wider community.

4.2 Aims of the Reconnaissance Visits

4.2.1 Select six hospitals that were broadly representative of the NHS Hospitals within the London area and conduct a preliminary assessment of each hospital with results evaluated to inform the selection of three hospitals for the in-depth case studies.

Objectives

4.2.2 Develop selection criteria for preliminary visits.

4.2.3 Identify the hierarchy of responsibility for waste management within the hospital units.

4.2.4 Establish if there is a Waste Management Policy and identify key personnel.

4.2.5 Determine the categories and sources of hospital waste.

4.2.6 Identify any 'reduce, re-use, recovery' initiatives.

4.2.7 Establish the total amount of clinical waste.

4.2.8 Ascertain the disposal route and the frequency of collection.

4.3 Methodology for the Reconnaissance Visits

The regulatory framework was examined to provide a knowledge base of the legal requirements and options for waste disposal strategies. This identified the potential areas for discussion in order to achieve the objectives (see appendix 1). The author made six preliminary visits to the hospitals and meetings were held with personnel responsible for waste management. Contact was made with identified individuals to gain access to the hospitals and establish a protocol for the visits as follows:

Hospital 1

Contact route for the preliminary visit was by telephone to the Trust's Safety Consultant followed by informal discussion with the Logistics Manager for TarmacServisMaster. Permission for the preliminary visit was obtained from the Director of Facilities for TarmacServisMaster.

Hospital 2

Contact route was initiated via the Occupational Health Manager through a meeting with the Risk Manager; then by telephone to the General Manager of Facilities, with a follow up meeting.

Hospital 3

Contact Route: This was initially by telephone to the safety officer; with a follow up meeting and a further meeting with the Contracts Manager and the Facilities Manager.

Hospital 4

Contact Route: By telephone to Occupational Health Manager, meeting with Risk Manager.

Hospital 5

Contact Route: Safety Officer at Hospital 6; telephone call to Safety Officer at Hospital 5 redirected to Estates Manager.

Hospital 6

Contact route: This was by a telephone call to the Health Safety and Environment Manager.

4.4 Results and Analysis of the Reconnaissance Visits

Preliminary visits to six hospitals were made and meetings took place with personnel involved in waste management to determine current policies and practice. The hospitals' hierarchies of responsibility for waste management were identified and also whether waste policies were available. The categories of waste were identified and the total amount of waste disposed of via the clinical waste stream ascertained; also any 'reduce reuse recycling' initiatives were identified.

4.4.1 Description of Hospitals

Hospital 1

Hospital 1 was situated in central London and was a fourth wave National Health Service Trust that began in 1994. The Trust consisted of a 580-bed hospital, which opened in 1993. There was a separate building next to the hospital housing HIV/ GUM Services. The hospital was also the administrative centre for an outlying clinic for sexual health, which was based in Westminster. The Trust employed 2000 staff. Services were provided through five clinical directorates: Women's' and Children, Surgery; HIV/GUM; Medicine; Anaesthetics and Imaging. There were five corporate directorates: Human Resources; Finance; Nursing and Quality; Operations and Information Systems and Services. The Trust was also an undergraduate teaching hospital for medicine. The responsibility for waste was with the Operations Directorate. However the contract for waste management was subcontracted to Tarmac ServiceMaster. The contract was for seven years; this meant that any change in the waste management practice, which reduced the amount of waste, generated and therefore the associated costs of disposal would

increase the profit to the subcontractor. The hierarchy of responsibility for waste management within Hospital 1 is shown in Figure 4.1.

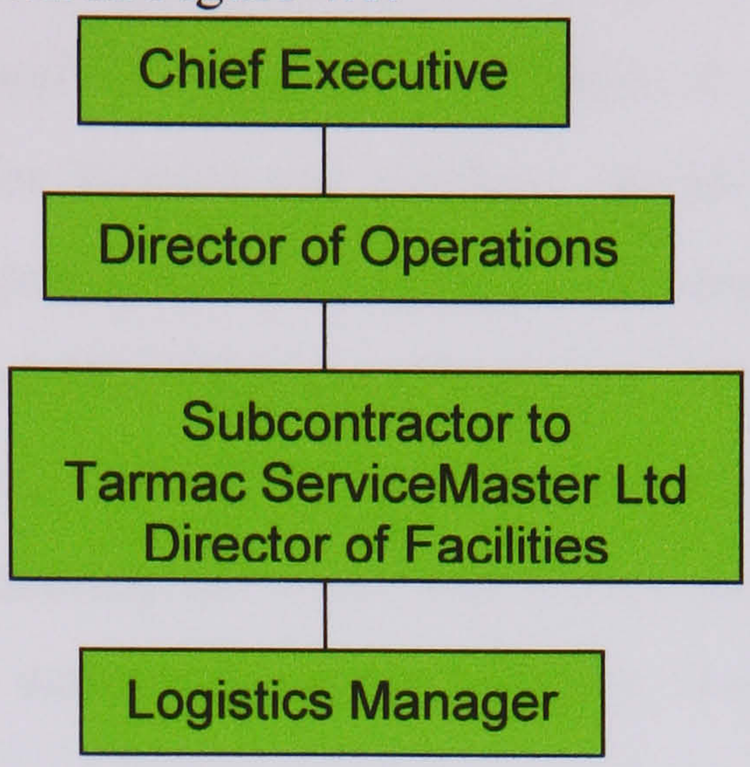


Figure 4.1: The hierarchy of responsibility for waste management within Hospital 1

4.4.2 Hospital 2

Hospital 2 Trust was 670 beds. The Trust provided a comprehensive range of acute and specialist services. There were 7 directorates: Medical; Finance; Corporate Management; Nursing; Marketing; Human Resource and Organisation and Clinical, which provided a full range of acute services. Two thousand five hundred staff were employed by the Trust.

The responsibility for waste was within the Directorate of Corporate Management and the waste management was subcontracted to Circo. Therefore any reduction in the amount of waste may again increase the profit to the subcontractor. The hierarchy of responsibility for waste management within Hospital 2 is shown in Figure 4.2.

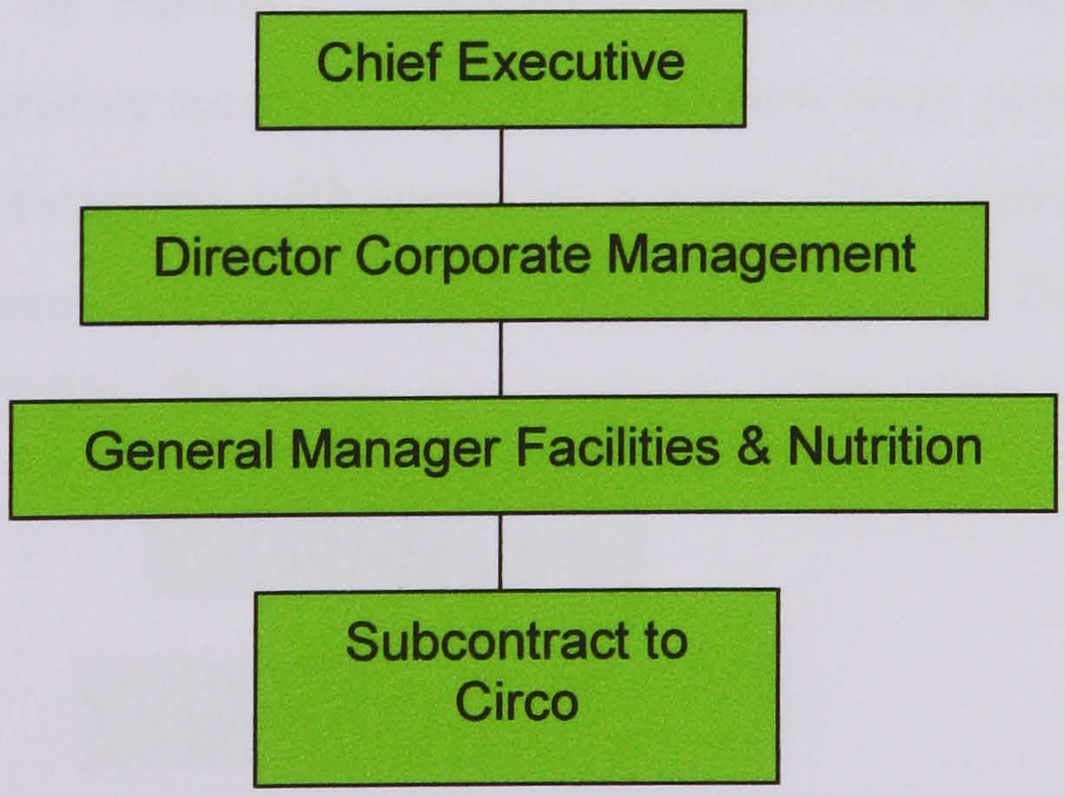


Figure 4.2: The hierarchy of responsibility for waste management within Hospital 2

4.4.3 Hospital 3

Hospital 3 was a major acute unit with 500 beds in West London serving the Boroughs of

Hounslow, Richmond and beyond. The management structure was based on the principle of managing three core processes: Elective Services managed all planned surgery, Emergency dealt with Accident and Emergency and Medical and Women's and Children's was a dedicated service for Women and children. In addition, there were the Clinical Support Services, which provided a comprehensive range of services e.g. Anaesthetics, Theatres, Nutrition and Dietetics and Pharmacy. The three non-clinical areas were Finance, Information and Technology and Human Resources. The Trust employed 1,200 staff and the responsibility for waste was within the Estates department. The hierarchy of responsibility for waste management within Hospital 3 is shown in Figure 4.3.



Figure 4.3: The hierarchy of responsibility for waste management within Hospital 3

4.4.4 Hospital 4

Hospital 4 an NHS Trust, c. 440 beds, was an acute district general hospital providing a comprehensive range of emergency, medical, surgical and obstetric services for residents of the London Borough of Hackney. Specialist Neuro-rehabilitation, fertility and neonatal intensive care services serving a wider population were provided on the site. There were four clinical directorates with specialist support. The equivalent of 1300 staff were employed. The responsibility for waste fell within the Estates Department's remit. The hierarchy of responsibility for waste management within Hospital 4 is shown in Figure 4.4.

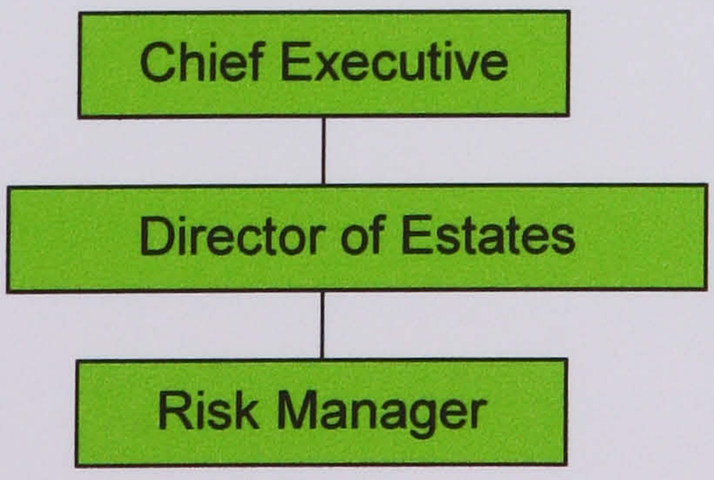


Figure 4.4: The hierarchy of responsibility for waste management within Hospital 4

4.4.5 Hospital 5

Hospital 5 was built in 1900. This 400-bed hospital was originally a workhouse. The Hospital applied for Trust status during the 1st Wave. It provided a comprehensive range of services. The number of employees was 2000. Hospital 5 held a waste station transfer licence. However, the necessity to have an NVQ Level 4 qualification was viewed as very expensive (£3,500) and there was reluctance to have the training, therefore the Trust intended to dispose of the licence. The Estates Department was responsible for waste management. The hierarchy of responsibility for waste management within Hospital 5 is shown in Figure 4.5.

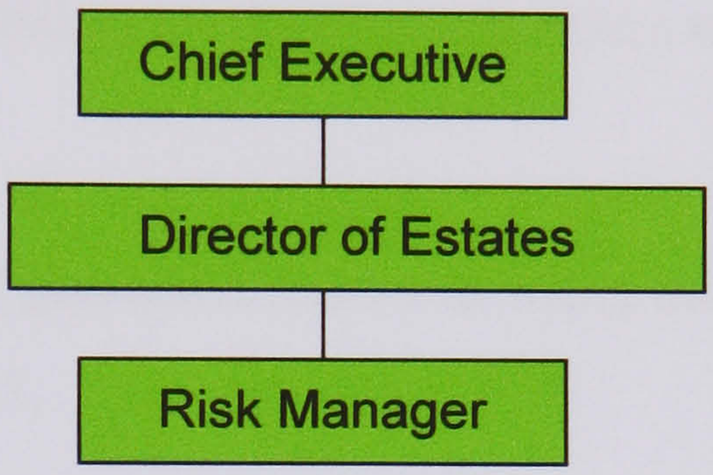


Figure 4.5: The hierarchy of responsibility for waste management within Hospital 5

4.4.6 Hospital 6

Hospital 6 was a Community Health Trust Hospital with 240 beds established in the 4th Wave. The hospital provided two in-patient services i.e. as a mental health unit and care of the elderly. There were also a variety of services for the community, e.g. day-care for the elderly and also a speech and language unit. The Trust had 1500 employees. The waste management responsibility fell within the Estates Department. However, Hospital 6 was the only hospital where there was a joint responsibility with the Health Safety and Environment Manager.

The hierarchy of responsibility for waste management within Hospital 6 is shown in Figure 4.6.

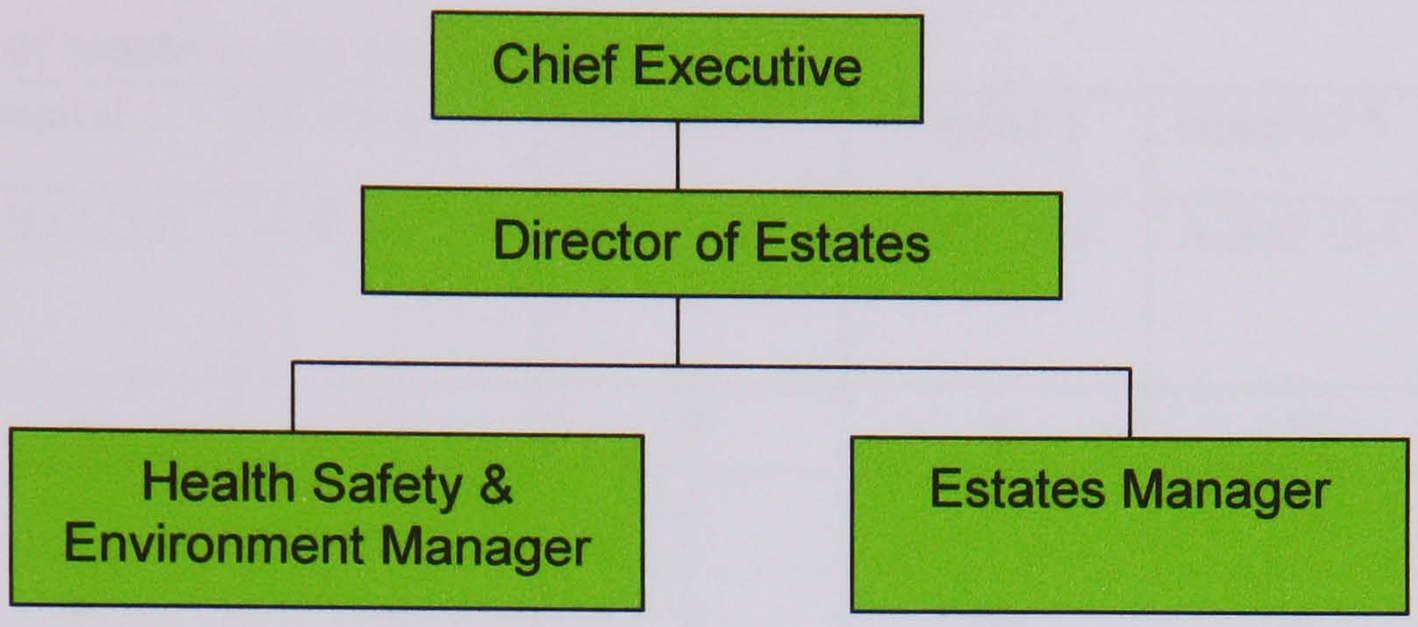


Figure 4.6:The hierarchy of responsibility for waste management within Hospital 6

The policy provision and associated personnel related to waste management practice was established and is shown in Table 4.1.

Table 4.1: Policy and personnel related to waste management in the six hospitals

	Hospital 1	Hospital 2	Hospital 3	Hospital 4	Hospital 5	Hospital 6
Environment policy	N	N	N	N	N	N
Waste policy	Y	Y	Y	N	N	Y
Health and safety Policy	Y	Y	Y	Y	Y	Y
COSHH assessments	Y	Y	Y	Y	Y	Y
Risk assessments	N	Y	N	N	N	N
Occupational Health Depart.	Y	Y	Y	Y	Y	Y
Infection control	Y	Y	Y	Y	Y	Y X
Environmental officer	N	N	N	N	N	Y
Safety officer	Y	Y	Y	N	Y	Y
Radiation protection advisor	Y X	Y	Y	Y X	Y X	N/A

Key: Y=Yes N=No X= off site

Table 4.1 shows that the policy and associated personnel primarily address health and safety requirements and exclude the environmental issues that relate to healthcare.

The categories of waste produced were established and are shown in Table 4.2.

Table 4.2: Types of waste in the six hospitals

	Hospital 1	**Hospital 2**	**Hospital 3**	**Hospital 4**	**Hospital 5**	**Hospital 6**
Clinical Waste Groups*	A,B,C,D,E	A,B,C,D,E	A,B,C,D,E	A,B,C,D,E	A,B,C,D,E	A,B,C,D,E
Household	Y	Y	Y	Y	Y	Y
Special	Y	Y	Y	Y	Y	Y
Hazardous	Y	Y	Y	Y	Y	Y
Radioactive	Y	Y	Y	Y	Y	N
Confidential	Y	Y	Y	Y	Y	Y

Key: Y=Yes , N=No

Table 4.2 indicates that the Hospitals produced similar waste arisings.

**Clinical Waste Groups as defined by the Health and Safety Commission see Figure 2.1*

Clinical Waste

Each hospital produced all categories of clinical waste. The clinical waste stream is detailed in Table 4.3.

Table 4.3: Clinical Waste Streams in the six hospitals

Hospital	**No of beds**	**Amounts Per Month**	**Frequency of Collection**	**Storage system**	**Collection Area**
Hospital 1	580	52 tonnes	Daily	Cart	Internal
Hospital 2	670	57 tonnes	Daily	Trolley Cart	External designated area
Hospital 3	500	21 tonnes	Daily	Cage	External non-designated
Hospital 4	440	31 tonnes	Daily	Cart	External designated area
Hospital 5	400	32 tonnes	Daily	Cart	External designated area
Hospital 6	240	2 tonnes	Daily	Cart	Separate secure building

Table 4.3 shows the volume of clinical waste and the route and frequency of collection in the six hospitals.

Household Waste

Hospitals 1, 2, 3, 4 and 6 had on-site compactors with a skip. Maintenance of the compactor could be problematic due to damage caused when the skip was being emptied.

This had resulted in one hospital changing system to contracted collection of non-compacted waste at a reduced cost, plus saving the cost for maintenance of the compactor and energy costs. Hospital 2 indicated a problem with fly-tipping by local residents.

Special waste

The disposal of prescription-only medicine (PoM) was deemed to be the responsibility of the pharmacy department. Only one of the key personnel involved with the disposal of clinical waste demonstrated knowledge of the legal requirements or the procedure for disposal of special waste. At Hospital 6 the pharmaceutical waste was segregated into 50 litre bins, sealed and stored in a secure holding store for collection every 3 months. Controlled drugs were destroyed in accordance with the Medicines Act 1981 and witnessed by either police or the Trust's Chief Executive.

Hazardous Waste

Each hospital had a separate storage area for chemical waste for storage before disposal. At Hospital 3 there were adjacent rows of tanks containing hydrochloric acid and caustic soda stored at the side of the hospital access road.

Radioactive Waste

The disposal of radioactive waste was deemed the responsibility of the Radiation Protection Officer. Only five of the hospitals visited had radioactive waste and of these only one had procedural knowledge of the procedural requirements for the disposal of radioactive waste at Hospital 3.

Confidential Waste

External contract arrangements were in place at Hospitals 1, 2, 4 and 5. Hospital 3 treated the confidential waste as clinical and it was incinerated. At Hospital 6 the managers were instructed to purchase a shredder, organise the shredding of the waste and dispose of confidential waste via the household waste stream. However, no extra money was available for the purchase and there had not been any check on the implementation of this instruction.

The amount of clinical waste was given as an overall tonnage for each hospital. There was no monitoring of waste produced by ward or area to allow comparison. Hospital 2 produced the most clinical waste but had the most beds. By comparison, Hospital 3 produced less than 50% of the waste produced at Hospital 1 with a bed capacity difference of 80 beds.

The waste was collected by a variety of methods.

Hospital 1 Hospital 1 (580 beds)*:* This was modern purpose built hospital with a waste policy and integrated waste disposal and storage system. It produced all categories of waste as defined; the amount of clinical waste produced was 52 tonnes per month. The bags on each ward were emptied into a cart contained in a lockable room near the entrance to the ward. Designated porters collected the carts twice daily; storing them for collection in a secure waste area beside the service lifts before transferring them to the disposal point in the basement.

Hospital 2 (670 beds): This had a non-integrated system with limited space for waste segregation. There was a waste policy. Previously there was an on-site incinerator, which was shut down and there remained a problem with access to the external waste bay that was situated on the opposite side of a main road. It produced all categories of waste as defined. The amount of clinical waste produced was 57 tonnes per month.

Porters collected the bags from the ward corridor areas. It was stated that there were problems due to the clinical waste bags bursting and the consequent dispersal of the contents. Once collected the bags were placed in a designated trolley and transferred to the disposal point across a busy road. The waste was then placed in lockable carts awaiting collection.

Hospital 3 (500 beds): This had a waste policy, a non-integrated waste disposal system and storage with the storage area outside in an unsecured area. It produced all categories of waste as defined. The amount of clinical waste produced was 21 tonnes per month. This figure was 50% less than Hospital 1, which was of a comparable bed number.

Hospital 3 was experiencing problems with the bags bursting open. The porters placed the bags in a cage twice daily and transported to either a sub-storage area or the end-disposal area. There were full clinical waste bags strewn around this area.

Hospital 4 (440 beds)*:* This did not have a waste policy and was therefore excluded, as it did not meet the criteria for selection. The waste bags were placed in a cart in a secure area near to the ward. Porters collected the carts and transferred them to the disposal point. Many of the carts were overfilled and not locked. The facility to clean the carts was in place but there was no evidence of it being in use or any record kept of use.

Hospital 5 (400 beds)*:* This did not have a waste policy and was therefore excluded, as it did not meet the criteria for selection. Designated porters collected the bags and placed them into a cart. This Hospital held a Special Waste Station Licence, which allowed it to act as a waste transfer station for smaller producers. The waste station was checked by the Environment Agency, which conducted a fortnight and a monthly check as a mandatory requirement of the licence.

Hospital 6 (240 beds community hospital): Had a waste policy, but due to the non-acute nature of the hospital did not produce all waste categories and did not generate a sufficient volume of waste to meet the criteria for selection.

The segregation of waste took place at source. The clinical waste was placed into a lockable bin and was towed manually to a secure area enclosed for subsequent collection. The waste produced was transferred to a waste transfer station. The amount of clinical waste generated was approximately one tonne per month within the community and was collected by a refrigerated van to be delivered to the waste transfer station.

4.5 Discussion of the Reconnaissance Visits

The policy and personnel related to waste management was a traditional approach to meet health and safety requirements. The areas pertinent to the Environment were not developed, none of the hospitals had an environment policy and there was only one Safety Officer with knowledge of environment aspects. All of the Trusts had a Health and Safety Policy although only four had a waste policy. All claimed to have completed in-house COSHH assessments except Hospital 3, which had subcontracted the responsibility. By comparison, the risk assessments had been carried out in one hospital only. Each hospital was well resourced with personnel in specialist fields, mainly on-site,

with the exception of Radiation Protection Advisors, three of whom were based at other hospitals and one Infection Control Nurse who was also based at another hospital.

The groups of clinical waste produced were not quantified by category and also the amount produced in each area of the hospital was not known. The overall amount ranged from 21 tonnes to 57 tonnes of clinical waste. However, the volume of the other waste streams was not determined, except that of radioactive waste, which has a legal requirement. The problem of the bags bursting was acknowledged at two hospitals but the specification of the bags was not known. The gauge of the bags was not stated in the policy of Hospitals 1 or 2. Moreover, in the policy of Hospital 3, 100 gauge was equal to 75 microns instead of 300 gauge and the minimum gauge was given as 225 (55 micron). The policy of Hospital 6 stated a minimum 100 gauge, 25 micron for high density and had reversed the specification requirements. Throughout the visits no one could establish the gauge, even when it was stated in the policy. However, 40 microns is the specification of the bags purchased via the supplies department. Having established the microns, no one could convert 40 microns to gauge. The management of the clinical waste stream did not inform the selection of the yellow bags. A relevant issue pertinent to the perceived strength of the bags would be whether a cart system was in use or whether the bags would have had to be multi-handled; also the nature of the storage prior to the collection. Hospital 3 used a cage system that required multi-handling to transport the waste to the main collection point, which was not secured and had a residential area in close proximity.

The Waste Streams

Household Waste

The household waste stream would have increased significantly in tonnes if appropriate segregation of the clinical waste stream were in place. The cost of disposal to landfill would have increased proportionally as the landfill tax increased and was likely to continue to do so. Therefore the initial saving by reducing the costly clinical waste stream was not a sustainable strategy. The best option would have been to reduce this stream by ensuring that everything in it could only by classified as household waste and not fit for any purpose other than end-disposal.

Fly-tipping of household waste was not acknowledged as a problem in the other hospitals and the accessibility of the skip at Hospital 2 may have been a contributing factor. There

also appeared an element of custom and practice in the acceptance of the fly-tipping. Fly-tipping of clinical waste was perceived as a problem for Hospital 3 and the proximity of the housing may have made it vulnerable to claims for needlestick injuries.

Special Waste

The definition of special waste in 5 of the 6 hospitals was limited primarily to pharmaceutical waste and highly infectious waste. Knowledge of the other classifications of hazardous properties, which would categorise the waste as special waste, was not evident. One of the key personnel demonstrated knowledge of the legal requirements and procedure for disposal of special waste. The pharmaceutical waste was segregated into 50 litre bins, sealed and stored in a secure holding store for collection every 3months. Controlled drugs were destroyed in accordance with the Medicines 1981 Act and witnessed by either police or the Trust's Chief Executive.

Radioactive waste

The responsibility for this was clearly the remit of the Radiation Protection Advisor (RPA). The RPA would have been traditionally the accountable person on behalf of the hospital. There is a mandatory requirement that the appointment has to be approved by the Health and Safety Executive following vetting of the individual's curriculum vitae. The RPA is the only key person who must demonstrate appropriate experience of waste categorisation.

Only 5 of the 6 hospitals visited had radioactive waste. In all but one of these, procedural knowledge involved in the disposal of radioactive waste was not evident. The exception was at Hospital 3, where the Health and Safety Officer was also the Radiation Protection Advisor.

Chemical / Hazardous Waste

Chemicals are required to be assessed under the COSHH Regulations to determine the potential effect if they become mixed. Although the Safety Officer at Hospital 3 was aware of the risk, the Estates Dept had refused to remove the 15-20 10 litre containers of hydrofluoric acid.

Although all the hospitals suggested that separate storage for chemicals was available,

Hospital 6 held the only inventory as to chemicals in store and the amount. Hospital 2 excluded chemical waste from the waste disposal policy completely.

Confidential Waste

Various approaches were applied to manage the confidential waste produced. Before the Environmental Protection Act 1990, confidential waste was incinerated on site. The closure of the incinerators had required alternative arrangements to be made. Hospitals 1, 2 and 4 had an external contract for the disposal of confidential waste. However, the quantity and source of the waste produced was not known. Hospital 3 opted for disposal in yellow bags via the clinical waste stream. Significantly the yellow bag specification is 40 microns; (25 microns=0 0 gauge), which means 40 microns equates to 160 gauge. The minimum gauge that is recommended for this purpose is 300 gauge or 75 microns. The lifting and handling of the bags containing confidential waste which are labelled as clinical waste then becomes a health and safety risk as there is nothing to alert the employee that the bag is likely to be much heavier than usual due to the high density of the material. The yellow bags may then burst during handling due to the weight of the confidential waste. This also pertained to the handling at the incineration plant. The unnecessary incineration was also contributing to air pollution and utilising excessive energy due to the high temperature required by legislation for the incineration of clinical waste. Hospital 6 had opted for the most cost effective option of shredding and disposal to land fills. However, although the staff had been instructed in the procedure, the level of compliance was unknown.

Clinical Waste Stream

The tonnage of waste produced was highest at Hospital 2 (670 beds), the least at Hospital 3 (500 beds) and a significant reduction per bed ratio with Hospital 1 (580 beds) (see Table 4.3 and Figure 8.1). The cart system was in use in all hospitals except Hospital 3. However, this was unlikely to explain the difference as to the volume of waste produced. The low volume of waste at Hospital 2 may have been due to segregation of clinical waste from the household waste.

The cart system was the most frequently recommended as it was perceived to reduce the handling of the bags. However, multiple handling took place at Hospital 2 as the waste was collected in trolleys and transferred to carts. There were a variety of cart sizes, from

20 litres, similar in size to a domestic wheely bin to the most common cart size of 820 litres. The latter were bulky; 1.8 metres length x 1.5metres high x 1metre breath and utilised considerable capacity of the collection lorries. This could have increased the number of journeys required to transport the clinical waste to the incinerator and result in greater air pollution. The life cycle of the carts was not known, nor was the end disposal. Three years was suggested as the life cycle but the locks appeared to be a weak point in the design. This created a serious problem with the external storage areas due to the risk of vermin and there was also a health and safety risk to children, vandals, or drug addicts looking for needles or drugs. At Hospital 3 the bags were strewn around the disposal point. Although there was a system of labelling and securing the contents before uplift and handling by portering staff, it was clear that the system was not fully implemented. The guidance, 'that waste would not be collected if the procedures were not carried out', was deemed to be impractical by the porter due to the rapid build-up within the ward areas. The Safety Officer stated that the fly-tipping was done by General Practitioners. However the porter associated the problem with hospital staff. As this hospital had sold off part of the site for housing development, the residential area was at risk from vermin.

The lack of storage facility at Hospital 3 prevented segregation at source and this increased the chance of mixing the streams.

The clinical waste generated through treatment in the home or other residential setting should be returned to the hospital or health centre for disposal under the Environmental Protection Act 1990 Statutory Duty of Care. However, it seems that there was reluctance on the part of staff to carry the waste in their cars to the hospital. Some health professionals were attempting to circumvent their responsibility and were disposing of clinical waste from home visits via the domestic waste stream, stretching the legal definition by choosing to call it 'household' waste if the patient removed their own dressing in their own home. However, Local Councils collect clinical waste from households where renal dialysis takes place, for long term treatment or certain medical conditions e.g. HIV.

Recycling options were examined in all six hospitals and shown in Table 4.4.

Table 4.4: Recycling initiatives in the six hospitals

Material	Hospital 1	Hospital 2	Hospital 3	Hospital 4	Hospital 5	Hospital 6
Cardboard	N	Y	N	N	N	N
Office Paper	N	N	N	N	N	Y
Glass	N	N	N	N	N	N
Plastic	N	N	N	N	N	N
Polythene	N	N	N	N	N	N
Newspaper	N	N	N	N	N	N
Aluminium	N	N	N	N	N	N
Furniture	N	N	N	N	N	N
Toners	N	N	N	N	N	N
Silver	Y	Y	Y	Y	Y	Y
Mercury	N	N	Y	N	N	N

Key: Y=Yes, N=No

Table 4.4 shows the limited take up of recycling options; silver recovery from x-ray films was the most frequent option for recycling, with office paper recycling schemes at two hospitals and cardboard recycling at one.

Recycling initiatives for all six hospitals

There was little evidence of recycling in practice, with a few exceptions such as, for example, silver recovery from x-ray films and office paper. The most frequent reason given was lack of space. However, the benefit of recycling remains two-fold; it reduces the cost by reducing the volume of waste, thereby reducing the containers required, which reduces the environmental impact and the cost of the landfill tax. The amount of cardboard and packaging for disposal was not measured. However, it appeared that the NHS was in a position to reduce this via the NHS supplies Department, directly with their suppliers.

Education and Training

The policies reflected the guidance of the NHS Estates. However, training was aimed at the domestic and portering staff. There was no guidance given on training for those involved in the management of controlled waste and concern regarding the lack of training of the personnel responsible for the waste was expressed at Hospital 1. A difficulty in awareness of publications and guidance notes was stated at Hospitals 1 and 3

although there were a number available pertaining to the disposal of clinical waste. The most recent publication to be distributed by the NHS Estates on healthcare waste management provided free to each Trust was available to the waste management team at Hospital 2 only.

4.6 Conclusion of the Reconnaissance Visits

The focus of policy and personnel in the six hospitals was primarily health and safety in orientation and with the exception of one hospital, environmental impact beyond legislative requirement was not considered.

Clinical waste was not segregated by group or volume produced, although 'sharps' were identified. The emphasis on segregation was biased towards the use of yellow bags for clinical waste and in many areas there was no option available for household waste segregation other than to dispose of it through the clinical waste stream.

The key personnel for waste management in, e.g. pharmaceutical and radioactive waste were responsible for its disposal, but often the waste manager was unaware of the disposal protocol.

Confidential waste was most likely to be disposed of via the clinical waste stream and much of the traditional NHS custom and practice of incineration continued.

Multiple handling, in direct breach of policy occurred frequently. In part this was due to lack of storage to segregate at source; also the collection schemes prompted porters to transfer the bags from one cart to another to cut down on the number of return journeys from the dirty utility area to the waste disposal bay.

4.7 Selection of Hospitals for the In-depth Studies

Based on information obtained from the preliminary visits, hospitals 1, 2 and 3 were selected as sites for the in-depth case studies. This was based on the need for the three in-depth case study sites to fulfil the following criteria:

That they would have:

1 A waste policy in order to compare policy and practice regarding waste management;

2 Sufficient volume and variety of all waste streams to allow comparison;

3 A diversity of purpose-built areas intended to be more efficient and non-purpose-built waste areas for comparison.

Hospital 1 was a purpose-built hospital with an integrated waste disposal area. However, the percentage of waste disposed of as clinical was significantly higher than the waste disposed of as clinical waste at Hospital 3. Hospital 1, had in 1997, subcontracted the waste disposal arrangements for seven years. The contractors arranged the end disposal, although the duty of care remained with the Trust. However, this meant that any waste minimisation and recycling would increase the profit to the sub-contractors.

Hospital 2 was built in the early 1900's. This hospital was selected because it was an old, outdated establishment and had commenced a re-development programme in 1986 due to the deterioration of many of the buildings. The Trust had applied to the Private Finance Initiative Scheme (PFI), created by the Conservative Government for funding of NHS development. The scheme was created to generate funding from the private sector instead of from central funds, as the hospitals had to develop subject to private funding. The new Government decided to simplify the scheme and this resulted in a delay in the re-development of the hospital. The Trust had already invested one million pounds in the scheme and had commenced clearing the central area of the site to allow the re-development to take place. In order to assist the bid for PFI the Trust sold part of the hospital site off for residential housing. The central area of the hospital site had become derelict and vulnerable to vandalism and the difficulties in the management of the waste was evidenced by the presence of a number of full clinical waste bags strewn around the site. The waste collection sites were not secure and were therefore vulnerable to vandalism and the encroachment of vermin.

Hospital 3 was built circa 1850. It was selected because it had the largest bed number capacity and produced the greatest volume of clinical waste of the 6 original hospitals visited. The hospital had it's own on-site incinerator plant until 1995, when it was closed

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down as it did not meet the Environmental Protection Act 1990 aimed at reducing the environmental pollution created by the incineration of health service waste. This was about to be enforced after a five-year lead-in period. Due to the age of the hospital, the lack of storage area availability created an acute problem and consequently the waste collection areas contained a mixture of clinical waste, household waste and dirty linen. This had resulted in no segregation at source of the waste stream and necessitated multi-handling of the waste at each stage from production to end-disposal. The collection point for the waste disposal involved crossing a busy main road.

The three in-depth case studies were carried out to:

- further develop the issues identified by the reconnaissance visits;
- to allow a more detailed examination of the actual waste management practices;
- to determine and quantify the sources, types and end-disposal of waste produced, from a health, safety and environment perspective;
- to consider compliance with the existing waste disposal policy and current and pending health legislation;
- to identify where compliance with legislation had not been met.

The aims and objectives were developed to achieve the above in each of the hospitals.

To address the areas of commonality and avoid repetition, a generic framework of methodology was designed. However, in the subsequent case studies additional objectives were developed to explore further any unresolved or new issues identified; also to re examine, where required, a particular area of waste management practice.

In all cases the interview structure was consistent with due consideration of potential bias and the same observation, checklist and pro-forma were used for all three in-depth case studies. Notes were taken of each interview under confidential cover.

4.8 Aims of the In-depth Case Studies

4.8.1 Conduct an in-depth case study on waste disposal at Hospital 1, Hospital 2 and Hospital 3.

4.8.2 ***Objectives***

4.8.3 Conduct a survey to identify the categories, sources and disposal of hospital waste.

4.8.4 Determine by observation the extent of compliance with waste management requirements.

4.8.5 Review any existing training and educational programs; determine who is responsible for training and to which occupational groups.

4.8.6 Analyse the implications of the legal issues involved and consider the implications of actions that would be necessary to meet current and pending British and European legislative requirements.

4.9 Methodology for the In-depth Case Studies

At each hospital, the waste policy was summarised. A review of the waste disposal policy was carried out to establish the actual level of implementation and compliance with the waste policy instruction. The review also allowed a correlation of the policy with existing and pending legal requirements and guidance. This was complemented by a two-week period of observation and interviews with employees, conducted to develop an understanding of the process involved in the existing waste management practice. This also determined actual practice at all stages from production to end-disposal in order to analyse the management of the waste streams from a health, safety and environment perspective.

Selection of Subjects for Interview

The Waste Disposal Policy was used to identify those responsible for handling of waste. A Specialist Team responsible for the review and monitoring of the Waste Disposal Policy was also identified within each policy. This included Occupational Health, Infection Control and The Safety Unit.

Contacting the Specialist Team

To facilitate the program arrangements it was essential to negotiate a base and telephone. A program of meetings was arranged with key personnel identified through the Waste Policy. Initial contact was by telephone and included a brief explanation of the research and request for an interview. The number of alterations to the dates and times required during the reconnaissance visits informed the decision to provide space for alterations to

the program at short notice without causing cancellation to the next arranged appointment. In order to accommodate busy schedules and prior commitments a flexible approach to time keeping was essential to agree dates and times. The early morning, 7.30 - 8am, was the most convenient for theatre areas and clinics prior to the patient list commencing. The interval between appointments was utilised for observation of waste management practice and documentation of the preceding interview. This allowed for reflection on the notes of the interview and to identify any issues that required cross-referencing at a later interview to increase validity.

Interview Structure

The reconnaissance visits at the six hospitals had identified the wide variance in knowledge levels and expertise held by the waste managers. This informed the decision to conduct in-depth one-to-one interviews with the purpose of exploring defined topics from the literature and guidance on waste management process and in addition to incorporate the issues raised by individuals during the reconnaissance visits. Therefore the interviews followed the same basic structure (see appendix 2). The interview responses were regarded as confidential cover and the responses from each individual are summarised in the results and analysis section of each in-depth case study; see section results and analysis chapter 5, 6 and 7.

The subjects were encouraged to contribute to the content their ideas and concerns on waste management to increase the validity of the research (Mays and Pope, 1996). This had a potential to increase the time anticipated beyond 20 minutes for each interview and was therefore built into the programme planning.

Any other issues raised by subjects were subsequently followed up at either Hospital 1 or if appropriate noted as a priority for the next case study.

Bias

Bias from different methods of interview was minimised by personal interview by the one interviewer and effort was made to maintain uniformity throughout.

Selection of Areas for Observation

The literature and the waste disposal policy, which indicated the wards as high producers

of clinical waste and domestic waste, informed the selection of areas for observation. Specialist areas produced hazardous waste. This included: the departments of Nuclear Physics and the radioactive store for radioactive waste; Pharmacy for special waste; theatres; outpatients and x-ray for chemical waste e.g. glutaraldehyde and formaldehyde and the chemical waste store. Other areas identified as producers of waste were informed by the reconnaissance visits. This included the Estates Department as a producer of special waste, for example batteries, oil and kitchens for food waste.

Visit Protocol

The specific protocol for hospitals was developed. Permission was obtained by telephoning the areas to identify the appropriate person to ask and if they were available a brief explanation of the research was given and a request for a visit to the area. If the individual was not available, a follow up telephone call was made having established whom to contact. A program of visits was then arranged with either the Head of Department or substitute.

Observation Check List

An observation checklist (see Appendix 3) was used for the tracking of the clinical waste stream. The checklist was informed by observations of situations made during reconnaissance visits to facilitate comparative analysis with the other case studies. The rating used was: (none) no evidence of the situation observed; (limited) evidence observed occasionally; (frequent) evidence observed on many occasions; (extensive) evidence observed on all occasions.

Policy Review

A review of the existing waste disposal policy was carried out to determine accuracy and compliance with health safety and environmental legislation and existing guidance documents on waste disposal. Procedures were identified which did facilitate waste minimisation, re-use and recycling initiatives. Consent was not given for the actual policies to be included. One hospital required the signing of a confidentiality clause and verbal agreement was required for permission to conduct the research from the other two, to exclude named material.

Compliance with Waste Disposal Policy

A pro-forma for each waste stream was developed to allow for a comparative numerical analysis of the level of compliance with the other two case studies at Hospital 2 and Hospital 3 and to allow the data to be tabulated.

The rating scale for compliance with the waste disposal policy was structured on a Likert Scale of one to five:

Rating 'very poor' (1), 'poor' (2), 'acceptable' (3), 'satisfactory' (4) and 'good' (5).

Compliance with Health, Safety and Environmental Legislation

The relevant health safety and environmental legislation was identified and the level of compliance examined. The rating scale for compliance with health, safety and environment was the same as above. The health, safety and environment legislative pro-formas are shown in Appendices 3a-3e.

Chapter 5 In-depth Case Study Hospital 1

5.1 Introduction

A detailed in-depth case study was conducted to examine the personnel and organisational structure pertaining to waste management. The waste policy was examined and a comparison made with the policy requirements and actual practice. Hospital 1 was one of the twelve hospitals of The Imperial School of Medicine following the mergers with the Medical Schools in 1996, formerly known as the North West Thames School of Medicine. The hospital was purpose built on an innovative open plan design on six levels and was the most recent in the group to open with the advantage of an integrated waste disposal system. The storage area for waste was in the basement area of the hospital with good access for delivery of containers and collection of waste.

Human Resources

The Trust employed 2,000 staff. The percentage breakdown by occupational group is shown in Figure5.1.

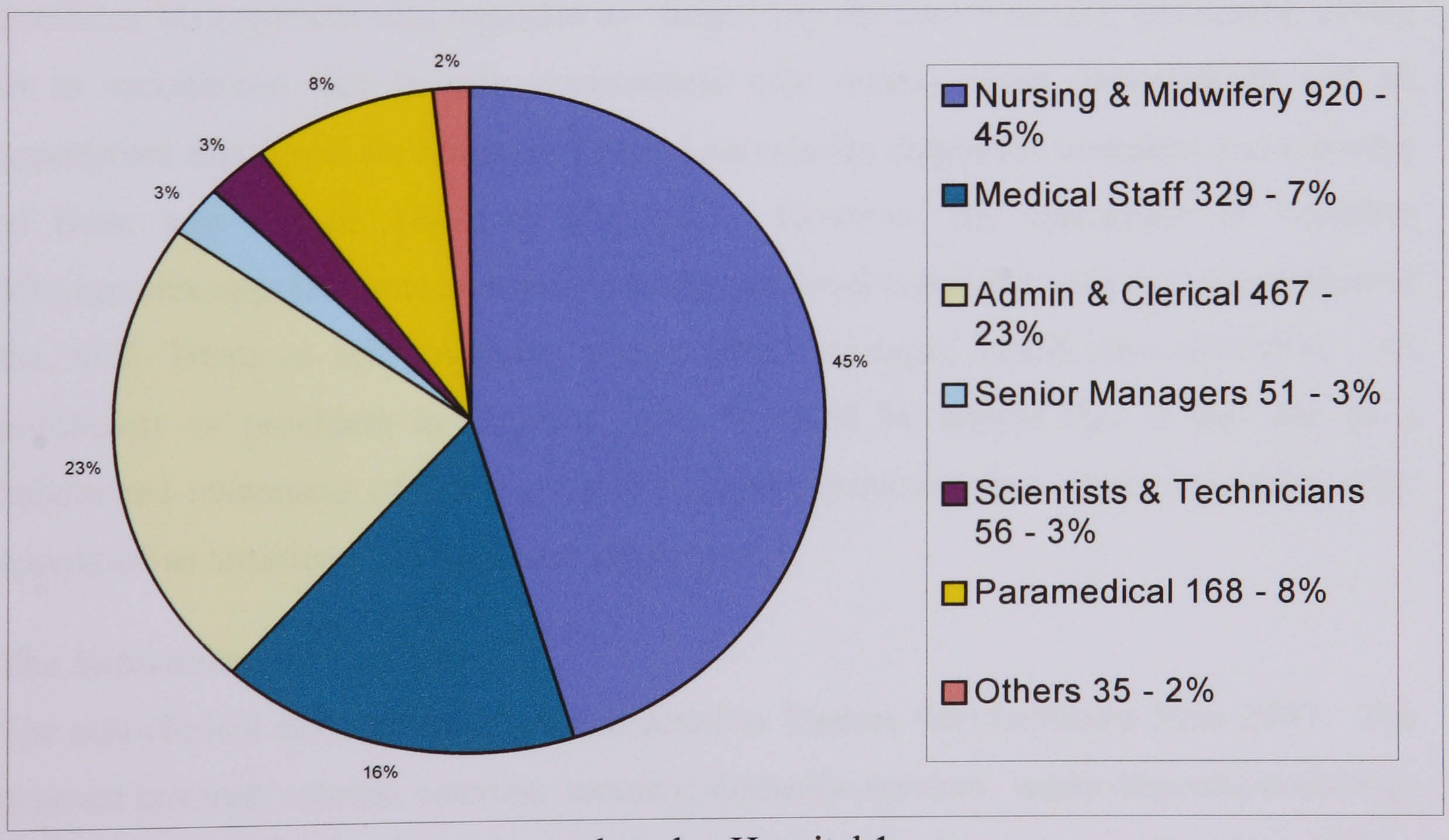


Figure 5.1: Occupational groups employed at Hospital 1
Source Third Annual Report

Organisational Structure for Waste Management

The hierarchy of responsibility for waste management is detailed in Chapter 4. The Director of Operations, the responsible person for waste disposal for the Trust, reported to the Chief Executive and was responsible to the Trust for: Nutrition; Facilities (which included waste disposal); Operational Service Delivery; Paramedical Services and Private Patients. This extensive brief also included the role of Responsible Person for Waste. However, under the duty of care imposed by the Environmental Protection Act 1990 the Chief Executive as the Company Secretary remained accountable for each stage of the waste management process.

The removal of Crown immunity resulted in the introduction of corporate liability for breaches of legislation. The predecessor to the Trust was taken to court following a serious 'sharps' incident at a hospital in 1990. As a result of this the Trust had adopted a prudent approach to waste management which was evident in the extensive use of yellow waste bags for household waste. This appointment of a senior manager with responsibilities for a wide range of non-core services reflected the development of facilities management within the NHS.

Facilities Management was regarded as 'supporting the core business' (Akhlaghi, 1996), or as recognition that 'a safe environment (the estate), clean surroundings and an appropriate diet (hotel services) are integral parts in the diagnosis, treatment and recovery of those who are ill' (Rees *et al,* 1998). However, the emergence of Facilities Management appointments at senior management level coincided with the introduction of the NHS Trusts as self-governing bodies which managed health care provision. As purchasers or providers in financial terms it could be argued that it was due to a heightened awareness of the cost of the service provision that senior managers were appointed to improve efficiency and reduce cost.

The Sub-contracted Services

The non-clinical services were subcontracted to Tarmac ServiceMaster from 1997. The contract covered: estates; catering; security; domestic services; waste disposal; portering; linen and laundry; pest control; accommodation and car parking. The £50 million contract was for seven years; this meant that any change in the waste management practice, which reduced the amount of waste generated and therefore the associated costs of disposal, would increase the profit to the subcontractor. The Director of Facilities was

employed by Tarmac Services, reported to the Trust and was accountable to the Director of Operations.

The Logistics Manager was also employed by Tarmac Services and was responsible for the day to day running of the services provided. Prior to Tarmac Services contract, the clinical and household wastes were the responsibility of the Estates Department, which had now been subsumed by Tarmac ServiceMaster. Tarmac ServiceMaster employed approximately 158 employees as shown in Table 5.1.

Table 5.1: The Total Number of Tarmac ServiceMaster Employees in Hospital 1

Occupational Group	**Number of Employees**
Director of Facilities	1
Logistics manager	1
Administrative	5
Human Resources	1
Portering Staff	48
Estates Staff	22
Security Personnel	17
Catering	63
Total	158

Source: Human Resources Tarmac ServiceMaster

Portering staff were the second largest group of employees and approximately 25 percent were designated 'Heavy Gang', who were directly involved with waste disposal and were responsible to the Logistics Manager.

5.2 Results and Analysis

This results section presents the findings of the in-depth case study. It represents information obtained from: observation; interview and the tracking of the waste stream i.e. segregation; training; specification of containers; labels; storage; transport; handling before disposal; personal protective equipment (PPE); manual handling and final disposal in Hospital 1; also examination of the waste disposal policy

Waste Disposal Policy:

The Trust in Hospital 1 had a comprehensive waste disposal policy that documented the waste streams. The policy fell into 10 sections and is summarised in Table 5.2.

Table 5.2: Summary of Waste Disposal Policy at Hospital 1

1 Responsibilities	**Outlines management responsibilities.**
2 Definitions	Clinical waste was classed into five groups A-E Radioactive Waste was categorised as Clinical waste group A Special Waste was categorised as Clinical waste group D
3 Segregation Colour Coding and Labelling	Provided details of all waste streams to be segregated using colour coded waste containers; excluded labelling
4 General Principles	Detailed handling, labelling and storage requirements; also staff training requirements
5 Disposal, transportation and waste bay	Stated the responsibilities of Porters and Domestic staff for cleaning waste bays handling waste and segregation of waste
6 Clinical waste	All waste from laboratory dept. was classified as Clinical waste without exception. Designated Yellow bag area
7 Non Clinical waste Domestic	Detailed the arrangements required for household waste stream, included batteries which are Special Waste
8 Radioactive waste	Identified dept. of Radiation Physics at another hospital as Radiological Protection Advisor to the Trust
9 Special waste	Was correctly defined and arrangements for disposal are clear. Excluded batteries which were special waste
10 Policy Review	Stated the policy was to have an Annual review by estates dept. and general services

The policy stated that it should be reviewed annually and it was last amended in February 1997. The Logistics Manager for Tarmac ServiceMaster was responsible for updating the waste policy annually.

The policy indicated that it was based on HSC publication 'Safe Disposal of Clinical Waste' revised 1992 and the London Waste Regulation Authority Guidelines revised 1994. However, the Logistics Manager for Tarmac ServiceMaster responsible for updating the policy did not have access to either document. He had previously been employed as Head Porter and had not received any formal training in waste management; consequently he was unaware of the more recent guidelines and reports relevant to waste disposal.

Review of the Waste Disposal Policy at Hospital 1

The waste disposal policy fell into 10 Sections and is summarised in Table 5.2.

Section 1 Details Responsibilities for Waste Disposal

The waste disposal policy was informed by the health and safety requirements within the framework of the 1995 guidance. There was no consideration of the impact waste disposal may have had on the wider community and the environment.

The policy also outlined the responsibilities of managers, all staff and the role of the Specialist Team to monitor and review the policy. The Chief Executive was correctly identified as the accountable person with overall responsibility.

Section 2 Definitions of Waste Streams

Clinical waste was described as potentially hazardous. The Health and Safety Commission categories were intended to inform the Departmental/COSHH Risk assessments. There were two inaccurate classifications of clinical waste. Group A is the addition of radioactive waste which is not controlled waste as it is subject to the Radioactive Waste Regulations 1993 and excluded from the legal definition of clinical waste under the EPA 1990 and Controlled Waste Regulations 1992. Group D refers to flammable chemical and cytotoxic wastes, which are legally defined within the Special Waste Regulations 1996.

Section 3 Colour Coding of Containers

The details for the colour coding of containers provided accurately reflected the HSE Guidance Document recommendation for colour coding for waste containers, although it did not state the requirement for UN approval.

Section 4 Training for Employees

Staff training was restricted to those who may be required to move waste, with emphasis placed on portering and domestic staff. Although the policy contained an appendix, which was much more extensive regarding staff training and reflected the HSC guidance document, the training in practice was very limited.

Section 5 Cleaning and Segregation of Waste in Designated Areas

This provided procedural guidance on the frequency of cleaning by the domestic staff and segregation of the waste streams by porters.

Section 6 Laboratory Waste

The Laboratory areas were designated yellow-bag-areas; this included office and toilet areas.

Section 7 Non Clinical Waste

Included in the definition of non-clinical waste were batteries, although it was accurately stated in the special waste section that large batteries were special waste and should be dealt with accordingly.

Section 8 Radioactive Waste

Radioactive waste disposal was identified as the responsibility of another hospital. Special waste disposal reflected legislative requirements.

Section 9 Pertains to the Estates Department and General Services Responsibilities

The Estates Department and General Services no longer existed which indicated that the policy did not reflect the current contractual arrangement with Tarmac ServiceMaster.

Section 10 Stated the frequency of policy review (see table 5.2)

Classification of Clinical Waste within the Policy at Hospital 1

The classification of clinical waste with the exception of the addition of radioactive and special waste was as provided by HSC1982 revised 1992. This classification has been widely adopted and is utilised in all clinical waste guidance documents in the UK.

It had been anticipated that these classifications would be revised and extended to address the potential environmental impact of inappropriate clinical waste disposal (BMA, 1994) risk. However, they did not reflect the requirements of the Special Waste Regulations 1996. Special waste is classified as such due to its hazardous nature and requires a consignment note to facilitate its handling and disposal in accordance with the Special Waste Regulations 1996.

To include phrases such as 'certain pharmaceutical products' in the clinical waste classification increased the risk of wastes, which are special wastes, entering the clinical waste stream. 'Certain pharmaceutical products' was interpreted by the NHS Estates 1995 guidelines and was taken to mean (p14):

> a. 'any medicinal product as defined by section 130 Medicines Act 1968 (or a component used in the manufacture of such a product), which becomes unsuitable for use on the grounds of safety, quality or efficacy'; or

b. 'residues from healthcare treatment', for example out of date medicines.

As all prescription-only medicines are now classified as special waste, the policy was reliant on prior knowledge. However, if non-prescription medicines were classified as clinical waste the debate would then have to focus on the legal definition to determine whether non-prescription medical components may prove hazardous to any person coming into contact with it. The policy special waste, was described as and called controlled waste, but all health care waste other than radioactive waste, which is subject to the Radioactive Substances Act 1993, is classified as controlled waste. However, radioactive waste that is low flashpoint organic material previously classed as hazardous waste, would be classed as special waste.

The waste policy allowed recycling initiatives at departmental level, for example cardboard could be re-cycled.

Organisational Structure for Waste Management

The variety of Directorates that the specialist teams fell within is shown in Table 5.3. The specialist teams reported to a variety of directorates who independently reported to the Chief Executive. The Specialist Teams reflected the guidelines on Occupational Health Services for NHS staff. However, involvement in the management of waste process was limited due to the contract situation. The Safety Advisor was employed by a safety consultancy which sub contracted the service to the Trust.

Table 5.3: Specialists who report to the Chief Executive via their Directorate in Hospital 1

Specialist Team	**Directorate**
Occupational Health	Nursing and Quality
Safety Advisor	Directorate of Operations and USC
Infection Control Nurse	Nursing and Quality
Infection Control Advisor	Medicine
Radiation Advisor	Anaesthetics and Imaging

The Occupational Health Department (OHD) was the largest department and was supported by a receptionist and a full time administrator. The Consultant Occupational Physician was a Member of the Faculty of Occupational Health (MFOH). The nursing staff held appropriate qualifications, with two of the four nurses holding specialist qualifications in Occupational Health Nursing, Certificate (OHNC) Diploma (OHND) and another with a Diploma in Health Promotion (Dip.HP).

The Safety Officer was employed by external contract and worked outwith the OHD. He had a Diploma in Health Safety and Hygiene (Dip.H S H). The signed advisor for Infection Control was a Consultant Microbiologist employed at Hospital 1. There were two infection control nursing posts, one of which was currently vacant; the nurse in post held a specialist qualification in infection control. The Radiation Protection Advisor was employed by another hospital, but acted as advisor to Hospital 1.as shown in Table 5.4.

Table 5.4: Staffing Levels of the Specialist Teams in Hospital 1

Specialist Team	**Title**	**Qualification**	**Sessions/wk**
Occ. Health (OHD)	Consultant	MFOM	6
	Manager	ONND	8
	OHN	OHNC	10
	RN	Dip.HP	10
	Agency Nurse	RN	10
Safety	Safety Advisor	Dip.HS.and H	10
Infection Control (IC)	Consultant	Microbiologist	Advisory
	ICN	Dip.IC	10
	ICN	Vacancy	10
Radiation Protection	RP Advisor (RPA)	Physicist	Advisory

Qualifications: Member of the Faculty of Occupational Health (MFOH), Occupational Health Nursing, Diploma (OHND), Occupational Health Nursing, Certificate (OHNC), Diploma in Health Promotion (Dip.HP) and Diploma in Health Safety and Hygiene (Dip.HS. and H).

The Occupational Health Department was fully staffed and those employees were suitably qualified as were the others identified as members of the specialist team. However, Table 5.5 indicates that the specialist input was limited to policy development.

Table 5.5: Role and input into the waste management process of the Specialist team in Hospital 1

Specialist	**Title**	**Input**
Occ. Health	Consultant	Policy IC. and RM
	OHN	Health Screening 'sharps' injury monitoring and Training
Safety	Safety Advisor	Training
Infection Control	Consultant	Advisory Policy and M
	ICN	'sharps' Awareness Days
Radiation Protection Advisor	Radiation Protection Advisor	Radio active waste disposal

The Occupational Health Department

The OH Consultant had input into the Infection Control and Risk Management Policy but demonstrated limited knowledge of the Waste Disposal Policy. The OHN estimated the needlestick injury rata to be one per/week and the most likely cause to be discarded needles left on bedside lockers. The exact figure was not available and in order to find out, the OHN was going to review the accident forms. The Occupational Health Department provided a limited service for those involved in waste disposal subject to the contractual arrangement. This involved Pre-employment Health Screening, which was carried out by the OHN by vetting the contractor's health declaration form. The Tarmac ServiceMaster employees were given immunisation against Hepatitis B, Tetanus and Polio. The cost of the service provision had resulted in the exclusion of the contract employees from the Trust's full range of occupational health service.

The Safety Advisor

The Safety Officer acted as advisor to the Trust in the role of 'competent person' on safety. This was interpreted as discrete from what were perceived as clinical matters. The advisory role was limited to the negotiated terms of the contract. The Safety Officer, therefore, would generally advise the Trust on areas of non-compliance with waste disposal, for example risk assessments had not been carried out, but he would not advise the contractors on remedial measures. There was clearly a willingness to re-negotiate the safety contract to include the provision of Occupational Health and Safety to both the Trust and Tarmac and this had resulted in a fragmented service provision in terms of health and safety generally. More specifically the lack of application to the management of the waste had lead to the exclusion of the contract employees from the Trust's health and safety provision and the contract managers from input on relevant issues, for example risk assessment and manual handling. The Safety Advisor had informed the Logistics Manager that there was a legal requirement to conduct risk assessments but the manager concerned had received no formal training in either area. The Safety Advisor had responsibility for monitoring and investigating accidents within the Trust but excluded the subcontracted employees. His expressed view was that Tarmac ServiceMaster did not monitor accidents. Therefore, there was no facility to identify causes and monitor trends. The operational manager for Tarmac ServiceMaster claimed that there had been one needlestick injury in three years.

Infection Control (IC)

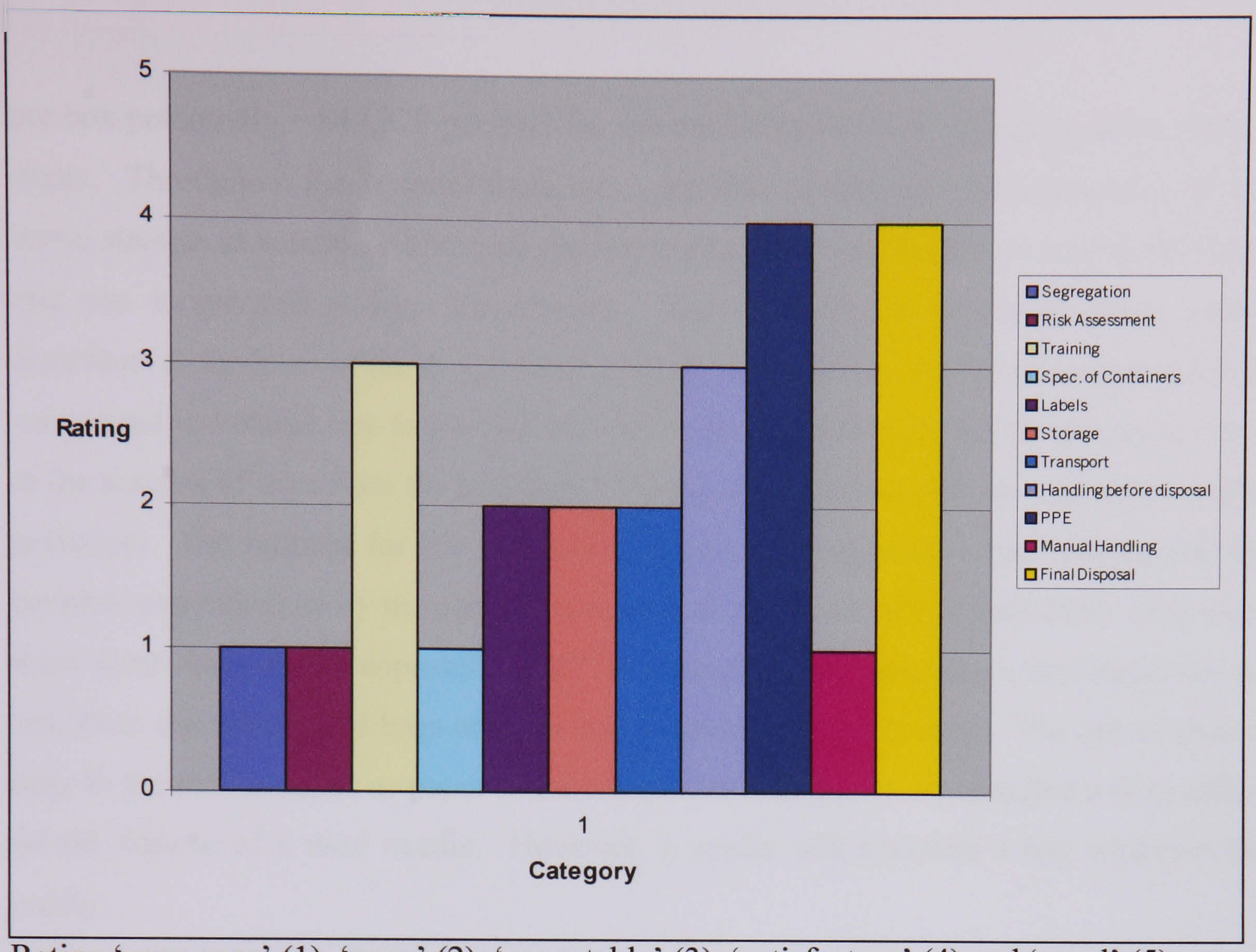
The primary activity concerning waste disposal of the ICN was organising 'sharps' awareness days intended to reduce the number of needlestick injuries. The ICN had agreed with the suggestion from OHN that the number of needlestick injuries was 1 per week, but there was no active monitoring of the incidence and the Safety Officer had stated that he was unaware of any needlestick injuries. The Consultant Microbiologist's role was to advise the Trust on infection control issues.

Clinical Waste

Hospital 1 had 580 beds and produced approximately 52 tonnes of clinical waste per month or 624 tonnes per year. Clinical waste Groups: A, B, C, D and E were all produced and. there was no differentiation of treatment between the categories A-D. The amount of clinical waste was given as an overall tonnage for the hospital. There was no monitoring of waste produced by ward or area to identify which areas produced the greatest volume or type of waste. The volume of each group as a percentage of composition of the waste total was not known.

Segregation of Clinical Waste

The segregation of clinical waste was rated as 'very poor' (1), although acceptable in terms of compliance with current legal requirement. However, it did not address the potential environmental impact. Contemporary European and International legislation views the integration of environmental issues as essential in the context of sustainability. The predominant waste stream was the clinical waste stream. This was evident by the extensive provision of clinical waste bags throughout the hospital in clinical and non-clinical areas, which included areas of staff facilities without public access, in the basement. The availability of household waste bags by comparison was very limited and indicated a restricted opportunity for segregation of the waste streams to any other than the clinical waste stream. Therefore, this strategy to ensure compliance was not only the most expensive; it was very poor in terms of best available environmental option (BAEO) as shown in Figure 5.2.



Rating 'very poor' (1), 'poor' (2), 'acceptable' (3), 'satisfactory' (4) and 'good' (5).

Figure 5.2: Clinical Waste Stream: The level of compliance with Health, Safety and Environmental Legislation at Hospital 1.

Designated Clinical Waste Areas

The laboratory areas were identified as designated clinical waste areas only in the waste disposal policy. All laboratory waste was disposed of as clinical waste. 'Risk microbiological hazard waste' was placed into clear bags with blue writing and autoclaved before being placed into yellow bags for disposal as clinical waste; there was evident segregation of confidential waste. There were other areas described as designated clinical waste areas, mainly theatres where all waste generated was handled as clinical. This included food waste from the staff eating areas and all unused surpluses from sterile packs, for example swabs, galley pots and kidney dishes. A high percentage of the waste was unused and uncontaminated plastic waste. Another source of waste generation was that of layers of external packaging paper used on the outside of theatre sets; usually a minimum of 3 layers per set. There were two sizes; the large size was 130 x 150cm, supplied in 100-sheet boxes. The Theatre Sterile Supplies Unit (TSSU) used 14 boxes per week, an annual amount of approximately 728 boxes. Also, there were 5-6 boxes of smaller wrap per week; an annual amount of approximately 286 boxes. The paper used was of an exceptionally high quality British Standard virgin pulp and expensive at £65

per box potentially = £47,320 per year for use excluding the high cost disposal as clinical waste. Throughout the hospital there was very little opportunity for segregation of the waste streams at source. Almost all the waste generated was treated as household waste and was incinerated at high temperature. The high volume of plastic waste would contribute to the level of dioxins produced during incineration. As the waste could not be compacted in volume due to the risk of aerosol contamination the result was an increase in the number of trips from the hospital to the site and contributed to an increase in traffic pollution. The rational for the 'fail safe' system of using yellow bags throughout the hospital was informed by the concern that clinical waste would be compacted. However, there were flaws in this approach. Staff handling the bags were aware that there was no risk from the majority of bags and this had resulted in complacency. The use of yellow bags in the public toilets as paper towel receptacles was due to concern that a drug addict would dispose of a used needle. However, a needle will puncture a bag whatever the colour.

Comments by some staff suggested that all waste should be treated as clinical waste and that incineration was the most appropriate method. Another expressed view was that disposal outcome was the same for all waste and so was the cost. Figure 5.3 demonstrates the poor segregation of clinical waste and the limited opportunity for segregation of household waste.



Figure 5.3: Segregation of the Clinical Waste Stream at Hospital 1

Laboratory Waste

Laboratory waste, which contained risk microbiological hazards, was autoclaved and all waste from the pathology department autoclaved at a standard destruction cycle 135. Procedures from TB class 1 Pathogens were loaded into the autoclave by a member of the laboratory staff. This was then treated as clinical waste. The Consultant expressed the view that the situation was more difficult to monitor at local level due to privatisation, resulting in the loss of a regular team of cleaners.

Risk Assessment

The risk assessment rating of 'very poor' (1) was due to the lack of risk assessment on clinical waste. The assessment of risk is an essential component of the management of health service waste for compliance with the COSHH Regulations. Because of the risk of contamination of clinical waste with micro-organisms all clinical waste should have been assessed. There had been no risk assessment carried out on the handling of clinical waste. This breach of compliance was due to the Waste Manager's lack of training in risk assessment; he did not know how to conduct a risk assessment. The Safety Officer was prepared to provide advice on risk assessment if he was paid by Tarmac ServiceMaster. However, the Chief Executive remained accountable under the Duty of Care Regulation irrespective of the contracted arrangements and it was questionable if he was aware of this situation.

Training

The rating of 'acceptable' (3) for training was due to the limitation in the training opportunities. The range of training topics and appropriate occupational groups is seen in appendix 3. However, there were some good examples of training, which included:

a. All 'Heavy Gang' members and all agency staff porters were given training in the waste disposal process but this was limited to segregation. Instruction was given on the colour coding of waste bags and the staff had to complete a 'Declaration of Understanding of the Waste Bay Disposal Process' before they began work. The Logistics Manager provided the training, which included segregation, tying and handling of bags and training on the use of PPE, for Tarmac ServiceMaster.

b. The Domestic staff received two days general induction, which included waste disposal, lifting the waste bags and infection risks, conducted by their manager.

c. Senior staff and Consultants' secretaries were given a Corporate Induction Training that included waste management. Nursing staff had a mandatory annual update. Five minutes of the one-hour session was on waste management and was provided by the Safety Officer.

d. There were 'Sharps' Awareness Days organised by the Infection Control Nurse. However, evaluation of the effectiveness was difficult to determine due to a lack of data on the incidence of 'sharps' injury. Nor was there any evaluation or feedback from staff.

The appropriate teams ran the training programs. However, there was not a system in place to educate, train, update and disseminate information on the waste management process for the trainers or support for the key personnel involved in the policy monitoring, for example the Logistics Manager responsible for waste disposal had had no training in waste management.

Specification of Containers

The specification of containers was rated as 'very poor' (1). The requirements for compliance are detailed in Carriage of Dangerous Goods (Classification and Labelling) and Use of Transport Pressure Receptacles Regulations 1996.

Clinical waste was placed in yellow sacks provided by NHS Supplies approved for transport of UN3291 clinical waste. The bags were placed in purpose-made polyurethane carts, which were 820 litre bins of an appropriate specification. However, the council directive on the approximation of laws of Member States with regard to the Transport of Dangerous Goods by Road 1994, (commonly known as the ADR framework directive) requires the use of rigid disposable containers. This means that the current system will be unacceptable and the use of all plastic bags for the transport of clinical waste will be illegal.

The UK had negotiated derogation from this requirement to allow the continued use of plastic bags and carts, which had a time limit of five years from January 1997 until 2002.

The carts were lockable, but on inspection, approximately 50% were not locked due to either overfilling or the lock being broken, which indicated that the current system was not effective. There was a maintenance system in place or a programme of replacement if the locks were broken. The yellow carts have a limited life cycle of approximately three years and the method of disposal of the carts is not known. The pending legislation indicates that the use of the carts may not satisfy European Standards. However, the use of the carts continues to be recommended by the Audit Commission and was intended to reduce manual handling. This reinforces the necessity for dissemination of information and training for those involved in the waste management process. Limbs and body parts were placed in rigid containers, which were lightweight bins resistant to penetration and chemicals, designed for one-trip use. The containers were marked 'Human Waste'.

Handling Prior to Disposal

The handling prior to disposal was 'acceptable' (3) as it complied with health, safety and environmental legislation. The Trust's waste management policy clearly documented the waste stream. Clinical waste bags on each ward were emptied into a cart, contained in a lockable room (dirty utility room) near the entrance to the ward. Porters collected the bins twice daily, temporarily storing them in a lockable waste area near the service lift before transferring them to the disposal point in the basement. The waste areas were rarely locked. A subcontractor was further subcontracted by the main contractor responsible for the end disposal of the waste and transported clinical waste off the site to the incineration plant. This system of storage and collection required a risk assessment under the Management of Health and Safety at Work Regulations 1992 and this had not been done. The porters had received no training in manual handling of waste which is required under the Manual Handling Operations Regulations 1992 and in practice they pushed and pulled two carts simultaneously. The Logistics Manager was aware of this but would not instruct the porters not to do it. The porters claimed that they would require additional time to make the repeated journeys but there was no monitoring of their work practice and between collection rounds they watched a television, which they had placed in the waste disposal area. Waste was collected twice a day irrespective of the volume that had accumulated and the ward managers did not initiate action to resolve the waste situation as it accumulated.

Waste Monitoring

The clinical waste stream was subject to a Waste Disposal Audit Checklist that was designed to audit compliance with the Trust's monitoring requirements to enable measurement of service elements for performance point system. The sub contractor monitored this by using a checklist of the waste disposal process and the waste disposal policy on a monthly basis. This involved a visit to the waste bay area, the lifts and lobbies and a random check of six wards. The rating was 'acceptable' (3). The Audit had a Rating Scale and was a measure of the performance. However, the time of the previous waste collection was an important factor to note and compare with the time of waste monitoring. The results of the waste monitoring altered significantly dependent on the time duration between collection of waste and monitoring. The initial monitoring was conducted immediately following the morning waste collection and was therefore indicative overall of a very satisfactory standard. However, a further two repeat visits to the same areas at 8a.m. and mid afternoon the following day illustrated the importance of the timing of waste collection and waste audit. Observation was made of the clinical bags strewn about the dirty utility room, often being piled up. The contractors had requested additional yellow carts. However, there was very little evidence of household waste black bags due to the Trust's policy of non-segregation and this increased the need for the carts.Figure 5.4 demonstrates the potential for waste bags to accrue between collection times.



Figure 5.4: Designated Waste Storage Area in Hospital 1

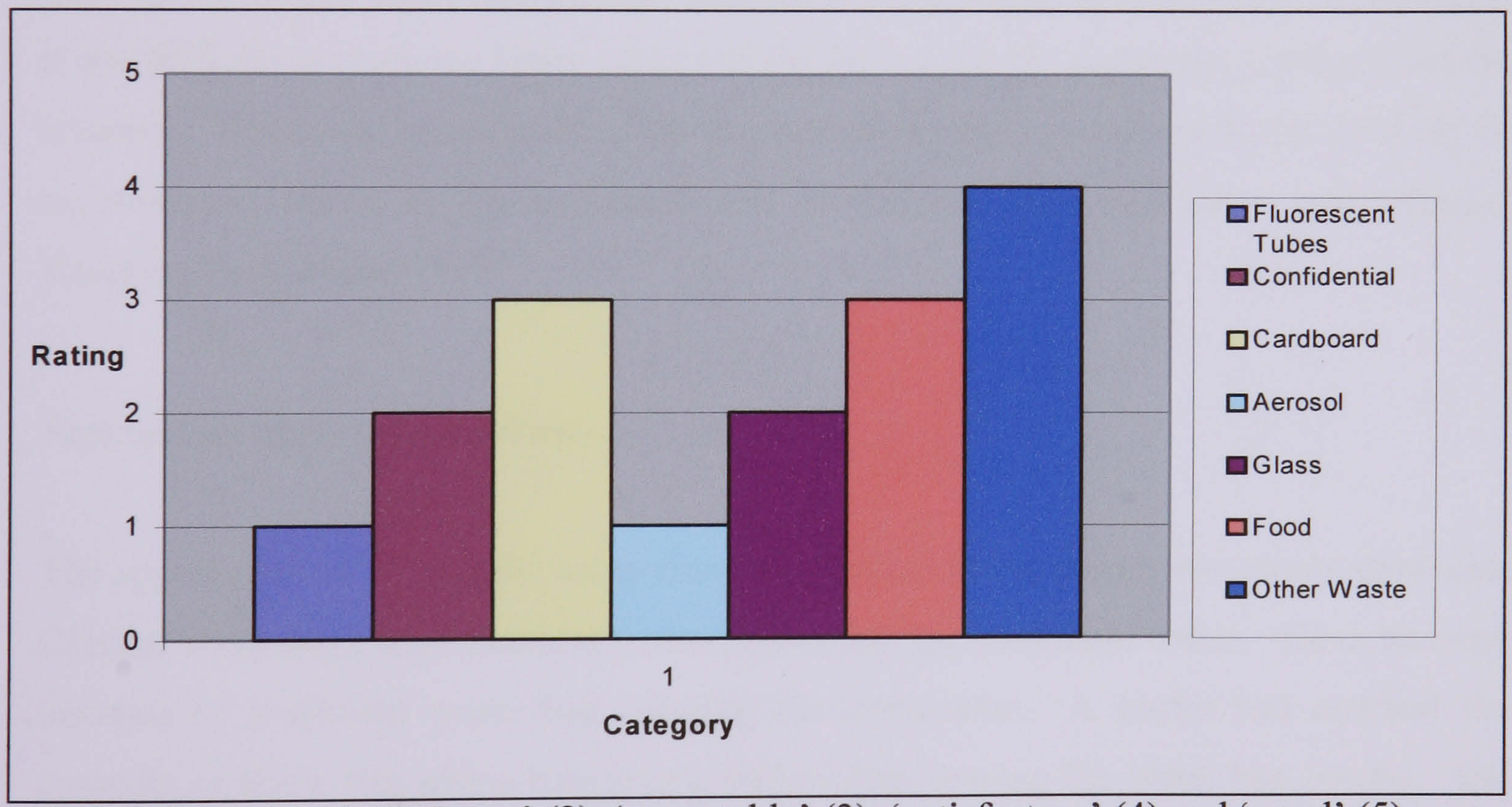
Personal Protective Equipment (PPE)

The COSHH requirement that employees are suitably protected was 'satisfactory' (4). The porters were provided with British Standard (BS) safety shoes and three pairs of chainmail gloves each, with the exception of one porter who found the shoes uncomfortable. The gloves and shoes were observed to be worn.

Household Waste

The Trust produced approximately 33 tonnes of household waste per month;396 tonnes per annum.

The waste disposal policy provided procedural detail for the disposal of household waste. The areas of non-compliance identified were the disposal of fluorescent tubes, confidential waste and aerosols. Figure 5.5 illustrates the level of compliance for each category of household waste with the Waste Disposal Policy.



Rating: 'very poor' (1), 'poor' (2), 'acceptable' (3), 'satisfactory' (4) and 'good' (5).
Figure 5.5: Household waste stream: Compliance with waste policy at Hospital 1

Sources of Household Waste

There were two sources of household waste; staff residencies and the hospital. The primary source of waste that was treated as household waste was the staff residences. However, there was little evidence of the use of black bags for household waste throughout the hospital. This indicated that the majority of household waste produced in the hospital was treated as clinical waste. The combined total volume of household waste

was quantified as approximately 19 tonnes less than the clinical waste produced by the hospital (see Table 4.3). The volume of household waste that was inappropriately disposed of as clinical waste was unknown. However, if the waste from the residences were excluded it would have allowed the percentage of the household waste generated in the hospital itself to be calculated more accurately..

Household Waste

The household waste was placed into black bags collected from the staff residences in blue carts sized 820 litre, which were similar to the yellow carts. The carts were taken to the disposal bay for compacting of the contents, which reduced the volume in the skip, to be uplifted when full. There were six carts in daily use, which were unloaded manually at the waste bay into the compactor by one of the porters. This involved him in leaning over and into the bin, grasping a bag and throwing it over his shoulder into the compactor. There had been no training in manual handling, nor had there been a risk assessment. It is unlikely that it was ever intended that these carts should have been manually unloaded, as it was difficult to reach the lower sacks and the loading of the compactor compounded the situation. Due to the ergonomics of the practice there was a considerable risk of injury or accumulative injury to the employee and represented non-compliance with Manual Handling Regulations 1992.

Segregation of Household Waste

The segregation of household waste from the clinical waste stream was rarely observed. Clinical waste bags were frequently observed in use for household waste. There was one instance of a clinical waste bag entering the compactor. A porter had emptied the contents of black bag office bins into a yellow bag, leaving the black bag in-situ. The porter then placed the yellow bag inside a black bag because he knew it contained household waste only. The situation was retrieved because it was established that the contents were not clinical waste. However the implications were that the porters were aware of the correct procedures but did not always adhere to them. If a compacted yellow bag had been found in the skip at the waste disposal operator it may have resulted in the entire skipload being reclassified as clinical waste.

Fluorescent Tubes

The policy stated that: 'a system was in place to store the residue (of lighting tubes and lamps) and disposed of by a contractor in consignments'. The disposal of fluorescent tube was rated as 'very poor' (1) due to the discrepancy between policy and practice. The system as described in the policy was appropriate but not implemented. It was proposed to meet the requirements of the Special Waste Regulations 1996 where the fluorescent tubes were initially designated as special waste due to the mercury and sodium content. The system refers to a designed system to extract the mercury into a filter and dispose of it as special waste. However, the Environment Agency declared it acceptable to feed the tubes out in small quantities into the domestic waste stream. The number of fluorescent tubes in total for this hospital was between four and five hundred per year making it difficult to feed out the tubes in small quantities. If the total were approximately 450 per annum this would have indicated a rate of approximately 38 per month. However, as all the lights might be changed in some areas of the hospital at the same time and there was no storage facility, it was unlikely that the fluorescent tubes were being fed out in small numbers.

Confidential Waste

Confidential waste was rated as 'poor' (2). The Policy stated that 'confidential waste was the responsibility of each ward and departments. A shredding service was available on request by writing to the Facilities Department. This service was provided by a contractor who would provide a bin or sacks for this purpose and would collect the waste generated and replace with an empty bin or provide further bags; they would also issue a 'Guarantee of Destruction Certificate.' There were two options in place as described in the policy. The first provided a collection for shredding and end disposal by incineration of confidential waste. The second was for non-confidential waste. The first amounted to approximately 20 bins per month, which cost £240. This figure remained consistent, which indicated that the bins were exchanged without monitoring the extent of use of this provision. The most frequent response to the issue of the disposal of confidential waste was that it was torn up and disposed of as clinical waste for incineration. In six of the areas visited there was no awareness of the shredding facility although there was concern expressed at the volume of confidential waste generated. The exception to this was the Laboratory area which had 3 sealed entry-only bins, which were exchanged once weekly.

In total per annum this would be 156 bin exchanges = approximately 13 per month. This indicated that the Laboratory area was utilising an average of 65% of the entire hospital confidential waste disposal facility. The likely explanation is that confidential waste entered the clinical waste stream for disposal. The volume of confidential waste produced by the laboratory indicated that the provision for the disposal of confidential waste would not match the requirement of the volume of confidential waste being generated or the laboratory was disposing of non-confidential waste by this route. The use of the green bins that were ' sealed entry-only' for non-confidential waste was confusing and the difference for use was not apparent. It is most likely that this provision was not fully utilised due to lack of awareness. In the Occupational Health Dept. there was a non-confidential bin available, but the contents had to be viewed to establish what was in it.

Cardboard

Cardboard waste was rated 'acceptable' (3). The policy indicated that cardboard may be recycled and that the boxes were to be flattened at source. The cardboard waste was not recycled; it was compacted only. There was rarely any evidence of the boxes being flattened at source for transportation. Frequently the intact boxes were visible on the wire trolleys used to transport it and taking up considerable volume of the space. The total amount of cardboard waste that was produced was not known. The main sources of the waste were identified as Supplies Department and Catering Department.

Glass / Aerosols

Glass waste disposal was rated as 'poor' (2) due to the poor segregation of the glass waste. Aerosol waste disposal was rated as (1) 'very poor', as there had been inappropriate disposal of the aerosols as clinical waste. There were 'glass' boxes available for the disposal of glass but they were not distributed to all areas and were observed to frequently contain other materials. They were not available in the X-Ray department and the staff were unaware of the provision. Used glass bottles were observed placed in a variety of containers, for example, wastepaper bins with a black plastic bag as a liner. There was a considerable stockpile of full containers throughout the department. The 'glass' boxes were also used for aerosols. The Theatre staff had been instructed by a Safety Advisor that empty aerosol containers should be placed in the

'glass' box and once full should be placed in a yellow bag to be incinerated. This dangerous practice had been ongoing for a number of years although the clinical manager had questioned the practice.

Special Waste

The special waste was rated as 'acceptable' (3). Stream sources identified were pharmacy department and wards for pharmaceuticals, also oil from the boiler house and chemicals that were described as originating from the medical school. The pharmaceutical waste disposal from the pharmacy department was in compliance with the Special Waste Regulations and a Consignment Note system was in place. Two members of staff dealt with the waste disposal system. However, the new Head of Department although aware that there had been legislative change, had no knowledge of the actual requirements of the Special Waste Regulation. The procedures reflected the policy requirements and were of an acceptable standard rating (3). The pharmaceutical waste in the form of part-used drugs from the ward areas should have been returned to pharmacy for disposal as special waste and this was stated in the policy. However, the pharmacy staff had refused to accept them, advising clinical staff that they had to organise and pay for their own disposal. This may have been in part due to the contractual situation. It appeared that the pharmaceutical waste had continued to be paid for separately by the Trust. Regarding the disposal from the clinical areas, a committee had been set up to address the problem. Neither the Occupational Health nor Infection Control Nurse appeared aware of the policy statement. The most frequent response to the disposal of part-used drugs from the staff was that they should be put in the 'sharps' bin.

Oil as Special Waste

The arrangements for disposal of oil were not detailed in the waste disposal policy. There was used lubricating oil stored beside the boiler. The oil was residual due to a change in procedure following a fly-tipping of the oil by a sub-contractor. The boiler had subsequently been adapted to burn the waste oil. The storage arrangement for the oil was in breach of legislation as the containers were unsuitable and unlabelled. The oil was apparently suitable for recycling but as the hospital still had to pay a consignment note, this was deemed too expensive.

Flammables and Chemicals as Special Waste

Flammables and Chemicals as special waste were rated as 'poor' (2). The policy included Medical School pharmaceutical waste, with flammables and chemical waste for storage in the external store, prior to removal arranged by the Safety Advisor using the consignment note system. There was limited access to the store, which was locked, but no inventory or storage system was maintained. The chemicals were not logged in or monitored by an identifiable individual who was responsible for storage and disposal. The Safety Officer's company had arranged the disposal of the chemicals in the store the previous year at a separate charge. However, it appeared that no action had been taken since.

Radioactive Waste

Radioactive waste was rated as 'acceptable' (3). The radioactive waste was not quantified, as it was one of the most difficult to quantify due to the lack of reliable information. The radioactive waste store was situated in the basement. There were three categories A, B and C. The main category was A Tritium and Carbon 14 which was used in tests in microbiology. It was supplied in bottles for use in testing bacteria. The store contained hundreds of accumulated bottles over a period of a year. These bottles were previously destroyed in a bottle crusher and it was expected that there would be a non-radioactive system installed. However, the new equipment was not purchased and no provision was made to dispose of the bottles, of which there were hundreds every month. Previously there had been a special contract negotiated with a sub-contractor to dispose of the bottles via the clinical waste stream without charge. The sub-contractor gave one-week's notice of the intention to charge commercial rates and there was no resolution for a year. The problem of the actual removal and disposal was primarily due to the difficulty in apportioning the cost of the radioactive waste generated prior to 1997. It was resolved when the Radiation Advisor calculated the waste as 71% pre 1997 and 29% post 1997. The total activity was 575.797 MBq. The policy stated that the Radiation Advisor was to be notified if the total was in excess of 4MBq, which indicated that the level due to accumulation was excessive. The Consultant Microbiologist stated that a specialist contractor disposed of the waste Carbon 14, indicating that he was unaware of the level of accumulation in the radioactive store.

Discharge to Sewers

Radioactive Aqueous Waste

There was a table of limits agreed and set by the Water Authority to reflect the potential use and disposal of radioactive substances. The authorisation certificate stated the actual permissible limit. However, potential excess was built in by the Trust to avoid the Trust exceeding the agreed limit. There was a hazard assessment to minimise risk to the public. Liquid waste could be disposed of via designated sinks depending on the level and was recorded. A copy of the issue went to local authorities, Public Register and Water Authority. The radioactive waste produced in the laboratory was not disposed of via the designated sink, but the excreta of patients receiving chemotherapy and diagnostic tests, for example, bonescans would be radioactive and were disposed of into the sewage stream.

Cytotoxic drugs

The disposal of urine from patients receiving cytotoxic drugs was via the toilet and sewer system, for example, patients who receive 40mg mytomyacin. This was injected into the patient's bladder and was then excreted in the first void of urine, which may have contained 40 mg of the unchanged cytotoxic drug or active metabolites.

Iodinated X-Ray Contrast Agent

Iodinated x-ray contrast media were applied in doses up to 200 mg per person and were rapidly excreted into the sewage system.

Glutaraldehyde

Glutaraldehyde was used in Endoscopy Theatres as a disinfectant in the washing machine system. Five and a half gallons of used solution were disposed of via the drains weekly. Glutaraldehyde was also used in theatre, where there was a trough which contained 2 litres and was changed once every two weeks. The disposal route was via the sluice and the staff had been advised to flush through the glutaraldehyde with 200 litres of water or the equivalent of 200 hundred times the volume. In practice, the estimated volume of water used was described as approximately ten times the volume of the chemical. The Safety Officer stated that the Trust did not use any glutaraldehyde on site. This indicated

limited awareness of practice as detailed above and as shown in Table 5.6.

Table 5.6: Sources and volume of glutaraldehyde at Hospital 1

Source	**Volume**	**Rate of Change**	**Flush/Water**
Endoscopy	25.08	1 x 1 week	
Theatre	2 litres	1 x 1-2 weeks	100*volume
Day Surgery	10 litres	1 x week	Not done
Total Weekly	37.08		
Total Annual	1861.6+52litres =1913.6		

Recycling Initiatives

X-ray film, which had gone out of date, was collected and treated to recover silver. There were little other observed recycling initiatives. One department had set up collection points for drink cans and paper but inconsistency in the collection of the items resulted in the decision to stop the scheme.

5.3 Discussion

The results of this in-depth case study demonstrate the complexity of waste management within the healthcare setting. Even as a relatively new hospital with a purpose built area for waste disposal, many of the traditional problems pertaining to waste disposal remained.

Primarily the limited segregation of the waste streams was identified as the most significant factor in reducing the efficiency and the effectiveness of the waste disposal at the Trust. The practice of treating almost all waste generated within the hospital as clinical waste impacted on each stage of the waste disposal process in the hospital.

The existing waste disposal policy was limited to health and safety aspects and concentrated on end-disposal, not the management of waste. The waste disposal policy did not include any environmental issues. Therefore it did not reflect the government's commitment to sustainability. There were no targets or goals set within the policy framework which limited any evaluation of the extent of policy implementation. Although there was a system of monitoring the waste disposal process, it was limited by a lack of data to determine which areas produced most waste and what was included in the clinical waste stream. There was limited awareness of the policy demonstrated at all levels, including those within the specialist teams. The policy had been developed prior

to the contracting out of facilities and safety service and this had changed the ethos of the traditional team approach by introducing the concept of cross-charging for some services. The Logistics Manager had received no training in waste management, risk assessment or manual handling. There was no dissemination of information and no access to relevant publications.

Training was limited, aimed at the portering and domestic employees and education for other staff was provided at 'Sharps' Awareness Days. Data was not available for the incidence of needlestick injuries and there was disparity in the number of estimated needlestick injuries. Nor was there any monitoring of accidents to the subcontractors.

Policy Development

Health and safety issues, had, due to legislative requirements under the HSWA, received priority within the waste disposal procedures in the Trust. However, the aim should be to minimise waste produced, which is the most effective waste option and there was no evidence found at the Trust that waste minimisation was a priority.

Education and Training

The agreement by the Trust and contractor may have acted as a constraint for education and training. A reduction in the amount of waste incinerated would have increased the profit to Tarmac ServiceMaster by the reduced cost of disposal and conversely would have increased cost to the Trust, as there would be financial implications for training in terms of time and cost of materials for the Trust.

Discharge to Sewers

The amount of chemical discharge to domestic drainage was not known, nor was there any appreciation of the mixes of chemicals. The established practice of pouring chemical waste such as glutaraldehyde, flushed through with a large volume of water creates a two-fold problem as it a source of chemical contamination and a waste of the water. Water is an environmental resource and its waste and cost should be included as a factor for sustainability.

5.4 Conclusion

The Case Study indicated that despite the many published reports the reports did not necessarily inform guidance on waste management, or the actual practice. The Case Study has demonstrated that the environmental issues pertaining to waste management were not being addressed by the Trust. The waste disposal policy placed the emphasis on health and safety issues of waste disposal and did not consider the wider issues of waste management. The present system of waste management was not sustainable; poor segregation of wastes of domestic and clinical waste resulted in unnecessary incineration of non-clinical wastes. There was insufficient recycling and minimisation of wastes

This in-depth case study has highlighted the need for the segregation at source of waste; also further exploration of volume and types of chemicals in the health service which are discharged to sewers. The practice of disposing of part-used drugs, the amount of plastic waste generated by the catering department and the monitoring of accident and injuries during the waste management process, in particular needlestick injuries, was poor.

Chapter 6 In-depth Case Study Hospital 2

6.1 Introduction

This in-depth case study was carried out: to develop and analyse the issues identified by the initial case study; also to conduct a detailed examination of the actual waste management practices at Hospital 2 and to identify properties and behavior which may have impacted on the sustainable management of health service waste.

Hospital 2

The waste management facilities were in sharp contrast to the facilities at Hospital 1. The current state of many of the buildings and roads was evidence of the need for redevelopment. The waste collection bay was an open-air, penned-off area in the hospital grounds and was situated at the back of the site. There were clinical waste carts positioned at the entrances to the main corridors and collection points at the site. Access to the waste bay was via the main hospital entrance. The Facilities Department held the responsibility for waste management. The contract for the end-disposal of the waste at the time of the case study had recently changed from high temperature incineration to microwave technology. The microwave treatment system shreds and sanitises waste by a series of microwave processors and the granulated residue was disposed of in landfill sites.

The aims and objectives were the same generic aims and objectives as Hospital 1 detailed in Chapter 4 (4.10), with two additional objectives developed on the basis of the work completed at Hospital 1.

The main areas to consider in addition to the generic aims and objectives were to identify factors that would explain the difference in the ratio of clinical to household waste at Hospital 2 by comparison with Hospital 1. It was also necessary to explore further the chemical discharge to sewers.

6.2 Aims

6.2.1 Evaluate the advantages and disadvantages of reducing, re-using and recycling waste strategies within the hospital similar to those at Hospital 1 and compare these with the results from Hospital 1.

6.2.2 Ascertain the impact on the waste management practice of the change of end-disposal from incineration to microwave technology.

6.3 Objectives

6.3.1 Determine the amount of plastic waste generated by the catering department.

6.3.2 Establish the method of disposal of pharmaceutical drugs from wards and theatres.

6.4 Methods

The generic framework was applied as detailed in Chapter 4 Section 4.10.

Selection of Subjects for Interview

The Facilities Manager requested prior notification of personnel to be interviewed. The areas of interest were advised and given to the Contracts Manager.

Contact Route

The Contracts Manager made the initial contact, explaining the value of the study to the Trust. This was followed up by a telephone call to explain briefly the objectives of the study and a request for a visit to the area. The subject area was an important factor in gaining support for the study as it was perceived to be of relevance to the NHS.

The programme of meetings was arranged as for Hospital 1.

Interview Structure

The interview structure was the same as for Hospital 1, incorporating any issues to be further developed.

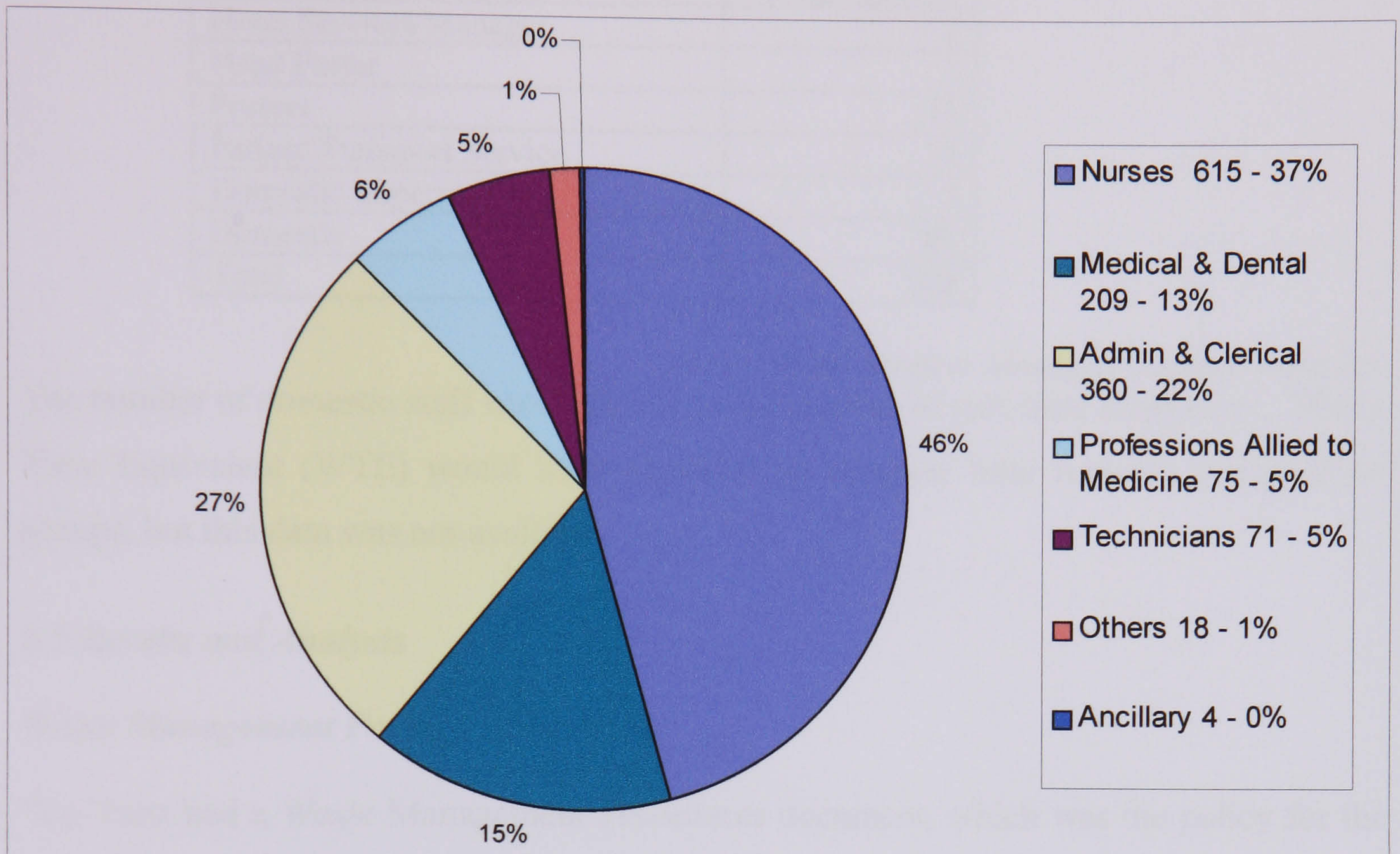
Bias

Although it was convenient to be provided with a list of pre-notified contacts, cognisance was taken that this introduced a potential selection bias.

Selection of areas for observation

The selection of areas for observation built on the experience of the Hospital 1 case study and was informed by this first case study.

The trust employed 1,200 staff. The percentage breakdown by occupational group is shown in Figure 6.1.



Source: Human Resources, Hospital 2

Figure 6.1: Occupational Groups Employed at Hospital 2

Organisational Structure for Waste Management

The hierarchy of managerial responsibility is detailed in Chapter 4. Figure 4.3. The Facilities Manager was responsible within the management structure for all waste management. All services that were classed as hotel services were subcontracted. The portering and domestic service was subcontracted to Gardner Merchant as shown in Table 6.1, the estates department was subcontracted to Taylor Woodrow and the catering was subcontracted to Granada Catering Services. The Contract Manager acted as liaison between the contractors and the Trust's Facilities Manager responsible for waste disposal reported to the Director of Finance and Information.

The arrangements differed from Hospital 1 where all the services were subcontracted to Tarmac ServiceMaster. Another significant difference was that at Hospital 2 the Facilities Department had retained control of the waste management contract and negotiated this independently. By contrast, Tarmac negotiated the waste disposal contract as part of their contractual agreement with Hospital 1.

Table 6.1: Total number of Gardner Merchant employees

Occupational Group	Number of Employees
Hotel Services Manager	1
Head Porter	1
Porters	15
Patient Transport Service	18
Domestic Supervisors	3
Domestic	88
Total	126

Source: Hotel Services Manager, Gardner Merchant

The number of domestic staff was high due to the number of part-time employees. Whole Time Equivalent (WTE) would have provided an accurate ratio between occupational groups, but this data was not available.

6.5 Results and Analysis

Waste Management Policy

The Trust had a Waste Management Procedures document, which was the policy for the disposal of clinical and domestic waste. The Policy fell into 14 sections (see Table 6.2) following.

Table 6.2: Summary of the Policy for the Disposal of Clinical and Household Waste at Hospital 2.

Section	
1. Policy Objectives	Stated legislative requirements, Department Head responsibilities and identified the Health and Safety Advisor, Infection Control Nurse Radiation Advisor and Chief Pharmacist as advisors
2. Management Responsibilities	For Dept. Head, Hotel Services Contractor, Infection Control Officer, Radiation Protection and Chief Pharmacist
3. Procedures	Definitions of waste stream and disposal. Cytotoxic waste was inaccurately classified as clinical waste
4. Non Compliance	Actions to be taken for non-compliance
5. Special Medical Waste	Definitions included Radioactive waste described as 'not normally a controlled waste'. Includes amputated limbs, aborted foetuses and placentas
6. Other wastes	Glass, aerosols, batteries, fluorescent lights and mercury
7. Specification for Yellow bags	Stated gauge of bags relating to waste density
8. General Procedures	Identified labelling, segregation, storage and transportation of waste
9. Training	Required a register be kept for all training of service supplier staff
10. Monitoring	Quality control programme
11. Containers	Listed type of waste and the container type, yellow bags are to be used for confidential waste
12. Instruction Sheet	For Service Staff Handling Waste.
13. Instruction Sheet	Sealing of clinical bag.
14. Instruction Sheet	Disposal of waste.

The policy was developed in 1997 but it was established that it was not ratified in July 1998 and there was no review date. The policy had been written by the Facilities Department and incorporated the comments made by Health and Safety and Pharmacy. There was no indication of what sources of information informed the policy other than the Health and Safety at Work etc. Act 1974 and the Environmental Protection Act 1991. The Health and Safety Advisor's only reference material relevant to waste disposal was a copy of the Special Waste Regulations. The Facilities Manager had a copy of the Audit Commission Getting Sorted Document (1997).

Review of the Waste Disposal Policy at Hospital 2

Section 1 Policy Objectives

The legal requirements in this section are restricted to HASWA 1974 and EPA 1990 and exclude relevant legislation pertaining to waste management i.e. the Duty of Care Order for the management of waste (Section 34) made under the EPA 1990. This set a legal and personal liability on senior members of management for non-compliance with the relevant legislation. These included: the Controlled Waste Regulations 1992, the Management of Health and Safety at Work Regulations 1992, the Manual Handling Operations Regulations 1992 and the Personal Protective Equipment Regulations 1992, COSHH 1999, the Special Waste Regulations 1996 and the Carriage of Dangerous Goods by road and rail (Classification and Packaging and Labelling) Regulations 1996.

Section 2 Management Responsibilities

Management responsibilities were identified for: Departmental Heads, the Hotel Services Contractor, the Trust Infection Control office, the Trust Radiation Protection Advisor and the Trust Chief Pharmacist. There was no Specialist Team identified within the policy and the Safety Advisor had no management responsibilities for waste within the policy, although the Safety Advisor was identified in the monitoring section. There was no reference made to the Occupational Heath Department throughout the policy.

Section 3 Procedures

The clinical waste classification for Group D referred to 'Certain Pharmaceutical and Chemical Wastes, including Cytotoxic Wastes'. Cytotoxic wastes are particularly hazardous and are classified within the Special Waste Regulations 1996.

Section 4 Non-Compliance

The addition of non-compliance action is unusual in any policy. However, this could have served as a goal target if it were implemented and recorded.

Section 5 Special Medical Waste

The classification of Special Medical Waste in the policy was an interpretation of the Special Waste Regulation 1996 and the inclusion of radioactive waste, which was

described as 'not normally a controlled waste', is inaccurate. Radioactive waste is not 'controlled waste' as it is subject to the Radioactive Waste Regulations 1993. The exception is when the radioactive waste has a low flash point and then the Special Waste Regulations apply.

Also included in this section were limbs, aborted foetuses and placentas, which fall within legal definition of clinical waste under the EPA 1990 and Controlled Waste Regulations 1992. The procedural guidance states that the items should be double bagged. It is not recommended that this type of clinical waste is 'double bagged'. The NHS Estates (1995) strongly advocates the use of rigid, one-trip use, containers. This is advocated because there is less risk of puncture and contamination during handling, storage and transportation.

Section 6 Other Wastes

Batteries, which are described as toxic waste in the policy, are within the legal definition of Special Waste Regulation 1996 and are subject to the regulations for disposal.

Section 7 Specification for Yellow bags

The specification for yellow bags at Hospital 2 stated the gauge of bags to be used according to the density. Regulation 6 of CDGCPL 2 prohibits the use of packages that do not conform to a design type which has been approved and has been assigned to UN 3291. The policy indicated a choice of gauge that was not available.

Section 8 General Procedures

Section 8 stated that waste that was not labelled would not be removed from the designated collection point and that this would be treated as a serious incident.

Section 9 Training

The training was limited to service supplier staff and did not reflect the guidelines for training by the NHS Estates (1995) or NHS Estates (1997).

Section 10 Monitoring

The quality control involved ensuring that bags were sealed at source. Notification of any

failures of segregation and all accidents/incidents to be reviewed by Facilities Manager, Health and Safety Advisor and the Hotel Services Contractor.

Section 11 Containers

Section 11 provided a list of the common categories of waste and specified the bag/container in which the waste should be stored and transported. The use of yellow bags for confidential use implied that confidential waste was being disposed of and treated as clinical waste.

Sections 12, 13, 14 and 15: Instruction Sheets

The training was restricted to service staff and was limited to the provision of instruction sheets. Section 12 had an instruction not to overfill clinical waste bags with confidential papers for incineration. For ease of lifting and carrying, bags should not exceed 5 kgs in weight.

Classification of the Waste Streams within the Waste Policy at Hospital 2

The most notable misinterpretation identified related to the definition section on special waste. The policy indicated that there was evident confusion in the classification of special waste, which included human tissue. A possible explanation was that any waste perceived as not falling into an otherwise identifiable category was categorised as special waste. However, categories of special waste, for example batteries, were not described as special waste and fluorescent lights were to be stored for special disposal.

Radioactive waste was described as 'Special (Medical) Waste', not normally a controlled waste. The Special Waste Regulations 1996 state that 'waste that is not 'controlled', is unlikely to be Special Waste'. Radioactive waste that was low flash point organic material previously classed as hazardous waste would be classed as special waste. It was not controlled waste as it is subject to the Radioactive Substance Act 1993. Special waste is defined in the Special Waste Regulations 1996.

Organisational Structure for Waste Management

The organisational structure for waste management is shown in Table 6.3, which

identifies the individuals with management responsibility and the service/directorate.

Table.6.3: Specialists who report to the Chief Executive via their Services/Directorates at Hospital 2.

Management Responsibility	**Services/Directorate**
Safety Advisor	Human Resources
Infection Control Nurse	Directorate of Nursing
Radiation Protection Advisor	Chief Executive
Chief Pharmacist	Clinical Support Services

Table 6.3 shows that the Radiation Protection Advisor was the only specialist who reported directly to the Chief Executive. The Safety Advisor, who also acted as Radiological Advisor, had resigned. The Director of Human Resources was reviewing the role of Safety Advisor and was considering sub-contracting the service. It is interesting to note that the only reference to Occupational Health in the policy was the necessity to report needlestick injury. The Occupational Health Department provided pre-employment screening for all staff and immunisations as appropriate.

The specific role and responsibilities for waste management procedures is shown in Table 6.4. There was no Specialist Team for waste disposal. The policy was a statement of actions and responsibilities. This type of policy development focuses on individual contribution and is limited to each individuals area of expertise. There was no evidence of further opportunity for discussion on the policy development, implementation, or monitoring of the policy.

Table 6.4: The role and responsibilities for waste management procedures at Hospital 2

Title	**Responsibilities**
Department Head	Segregation and labelling of waste within dept.
Hotel Services Contractor	Collection, segregation, transportation and storage of waste
Control of Infection Officer	Advice and guidance to service suppliers, staff practices and procedures for handling clinical waste
Radiation Protection Advisor	Instruction on handling and disposal procedures for radioactive waste
Chief Pharmacist	Advice for the handling of pharmaceutical materials

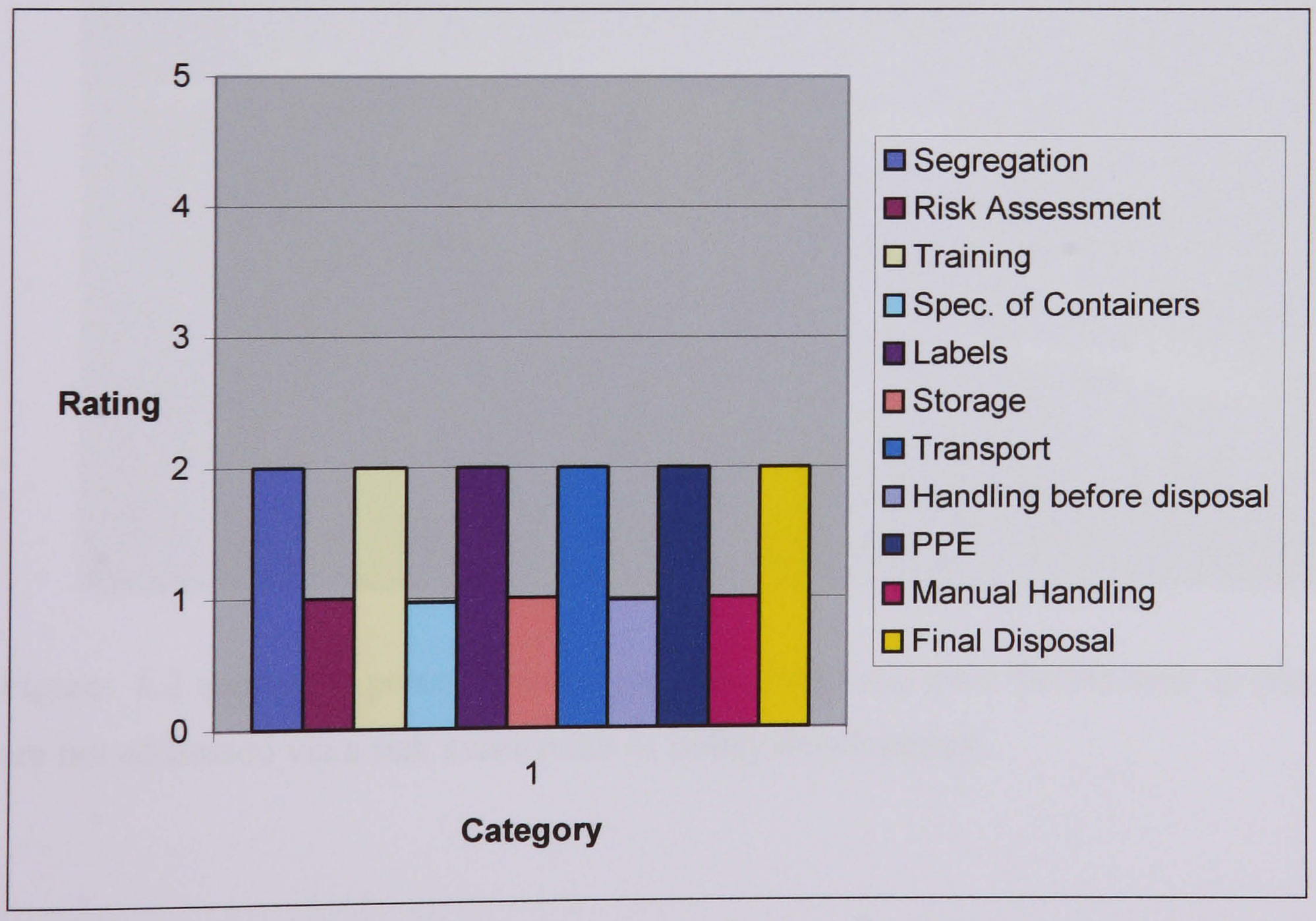
Infection Control (IC)

The Control of Infection Officer was an Infection Control Nurse, who was supported by a Consultant Microbiologist.

Clinical Waste

Hospital 2 had approximately 500 beds. Twenty-one tonnes of waste were disposed of as clinical waste per month, which was equal to 252 tonnes per year; approximately 39% of the 648 tonnes of the total clinical and household waste streams. At Hospital 1, 61% of the 1,020 tonnes of total clinical and household waste was disposed of as clinical waste. The Clinical Waste Groups A, B, C, D and E were all produced. There was no differentiation of treatment between the categories A-D.

Group E wastes, for example the contents of disposable items, were macerated and discharged to the sewer via waste disposal units. In the event of breakdown of the unit these wastes were disposed of as clinical waste. The amount of clinical waste was given as an overall tonnage for the hospital. There was no monitoring of waste produced by ward, or area, to identify which areas produced the greatest volume or type of waste. The volume, therefore, of each group as a percentage of composition of the waste total was not known. Figure 6.2 shows that good compliance with the clinical waste stream addressing health and safety legislation excluded segregation based on a fail safe approach to treat the majority of waste as clinical.



Rating: 'very poor' (1), 'poor' (2), 'acceptable' (3), 'satisfactory' (4) and 'good' (5)

Figure 6.2: Clinical Waste Stream: Compliance with Health, Safety and Environmental Legislation at Hospital 2

Segregation of Clinical Waste

Segregation of clinical waste was rated 'poor' (2). There was more opportunity for segregation provided by the evident availability of both black household waste bags and yellow clinical waste bags. This gained compliance with current legal requirement and reduced the volume of waste treated as clinical waste thereby reducing the cost of disposal.

There was limited evidence of black bags to allow segregation of waste at source in some areas, for example, theatres. However, there was more evident availability of black bags in the ward areas. In the laboratory areas there was evident and appropriate use of both household waste and clinical waste bags.

Transport of the waste carts in the hospital grounds was difficult due to the poor state of the roads as shown in Figure 6.3.



Figure: 6.3 shows the potential consequences when local level factors such as poor roads are not addressed via a risk assessment or policy development.

Risk Assessment

The risk assessment rating of 'very poor' (1) was due to the lack of risk assessment on clinical waste. The assessment of risk is an essential component of the management of health service waste for compliance with the COSHH Regulations 1999. Because of the risk of contamination of clinical waste with micro-organisms, all clinical waste should have been assessed. There had been no risk assessment carried out on the handling of clinical waste. An environmental management consultancy group, SYPOL Environmental Management Ltd., had carried out the initial COSHH assessments. There was a consistent response that the assessments had been carried out, but knowledge of what was involved was not demonstrated. This had implications for compliance with the COSHH Regulations 1999, as the assessments appear to have been limited to information gathering exercises. There was no evidence of training or information provided, which is a requirement of the COSHH Regulations 1999 following the COSHH assessments.

Department Heads and Clinical Managers were advised that they were responsible for all other risk assessments, but had not received training in risk assessment and had not carried this instruction out, which indicated non compliance with the Management of Health and Safety at Work Regulations (MHSAW), 1992).

Training

The rating of 'poor' (2) for training was due to the limitation in the policy for training opportunities. The Guidance on Waste Disposal recommends training for all employees on clinical waste disposal (NHS Estates, 1995).

Specification of Containers

The specification of containers was rated as 'very poor' (1). The requirements for compliance are detailed in Carriage of Dangerous Goods (Classification and Labelling) and Use of Transport Pressure Receptacles Regulations 1996. Clinical Waste was placed in yellow sacks provided by NHS Supplies, approved for transport of UN3291 Clinical waste. The policy indicated that the gauge of the bag reflected the density of the load, but there was only one gauge available. The bags were placed in purpose-made polyurethane carts, which were 820 litre bins. The carts were lockable, but on inspection, there was extensive evidence that the carts were left open as shown in Figure 6.4. This indicated that the storage system awaiting collection created potential risks to health and the

environment in respect of obstructing a walkway and being accessible to public and/or vermin. It was also likely that contaminated linen in the red bags and linen in the white bags would be added to the load.



Figure 6.4: The storage system for waste at Hospital 2.

There was evidence of use of 'one-way' 60 litres rigid containers for amputated limbs, placentas and foetuses. However, there was also a suggestion that double bagging of these types of waste was also taking place. Foetuses aborted less than 24 weeks were retained in the mortuary for 6 months, then double bagged and disposed of as clinical waste.

Labelling

Labelling rated 'poor' (2), as the labels when in place were rarely completed. The system of quality assurance in respect of not uplifting the waste if inadequately labelled was not implemented, as the problem was deemed by the porters to be so frequent that designated storage areas would quickly overflow.

Transport

Transport rated 'very poor' (1) as the yellow clinical waste carts were placed outside the main entrance. The carts, which had a working lock, were usually left with the lid open as the lock mechanism engaged when the lid shut. If the cart was locked, the waste bags were piled beside it to await collection.

The carts were collected by the porters, linked up to a wire cage trolley and were then towed to the waste bay by a tractor unit. They were linked together by a lock that was designed to remain engaged unless manually depressed. However, the roads were in poor condition and the movement was sufficient to disengage the lock. There was evidence that this had happened on a number of occasions cumulating in considerable damage to a parked car. The risks involved with this were increased as the cage restricted the driver's visibility and unhitched carts only become visible when viewed in the wing mirror.

The driver who had reported the situation had identified the problem as the cart-securing mechanism. The previous cart system in use was fitted with a pin system, which had to be removed manually. The carts were filled up by transferring the contents from one cart to the next to ensure that all carts were at capacity during the collection round. This resulted in some carts remaining static and thus excluded from the exchange system of replacing the dirty cart with a clean one. The wire cage was used to collect cardboard boxes and additional mixed waste bags, for example linen and household waste bags en route to the collection points.

Handling Prior to Disposal

The handling before disposal rating, was 'very poor' (1). The waste bags generated by the clinical areas were transferred to a waste cupboard situated in the main corridor near the exit. The waste cupboards were not locked and were in constant use. They contained both clinical and household waste bags and 'sharps' boxes and if the cupboards were full the waste bags were left in the corridor.

There was also evidence of clinical waste bags in corridors that were not adjacent to the waste cupboards. Porters used a cage to collect the bags; the bags were then segregated and transferred as clinical or household waste. This resulted in multiple handling at each stage. The use of carts was frequently quoted as a method of minimising manual handling of the clinical waste bags. However, at each stage in practice, there was multiple handling. The transferring of bags from cart to cart was to minimise the number of trips required. It was frequently observed that the porters and waste contractors compressed the bags with their hands to fill the carts.

Personal Protective Equipment (PPE)

PPE was rated 'poor' (2), as COSHH Regulations 1999 requires that employees are suitably protected and provided with appropriate PPE. The only area of agreement between the porters and the head porter was that safety shoes were not provided and the Hotel Services Manager confirmed this. It is recommended that protective shoes be issued in the guidance document (HSAC1992); whilst it has no legal force, it's standing as agreed practical guidance demonstrates the standards that need to be met under the law.

The porters were employed by the Trust. The contractor, Gardner Merchant, advised that as they had been issued with four pairs of gloves two years previously, no more gloves would be issued by the contractor. There was no suggestion of raincoats as a requirement for the two porters who loaded the waste in the waste bay, but it was suggested that the porters be provided with three pairs of trousers. There was no record of issue or replacement exchange system for PPE in place. The benefit of retaining a record of issue and replacement scheme is that it avoids this type of debate that is reliant on memory. This indicated non-compliance with COSHH Regulations 1999 and did not meet the guidance on the provision of Personal Protective Equipment (PPE) at Work (HMSO, 1992).

Final Disposal

Final disposal was rated as 'poor' (2). The end-disposal route had changed from high temperature incineration to microwave technology but the staff were unaware of the change and the implications for the waste disposal practice. There was evidence that the most usual method of disposal of prescription-only medicines and cytotoxic drugs was in 'sharps' boxes via the clinical waste streams. It was recommended that cytotoxic drugs should be incinerated at high temperature to ensure destruction (HSAC, 1992). The current practice could result in cytotoxic drugs reaching landfill sites. The mixing of the special waste and clinical waste resulted in reclassification of waste and the Special Waste Regulations 1996 applied. This was a breach of compliance as the microwave plant did not have a Special Waste Disposal license. The importance of removing metal waste from the clinical waste stream had not been communicated to the theatre staff and a

hammer placed in a clinical waste bag from the orthopedic theatre had resulted in arcing and damage to the microwave. The Theatre Manager estimated that a percentage of the clinical waste each day included metal. The cinbins for 'sharps' were the disposal route for metal replacement joints.

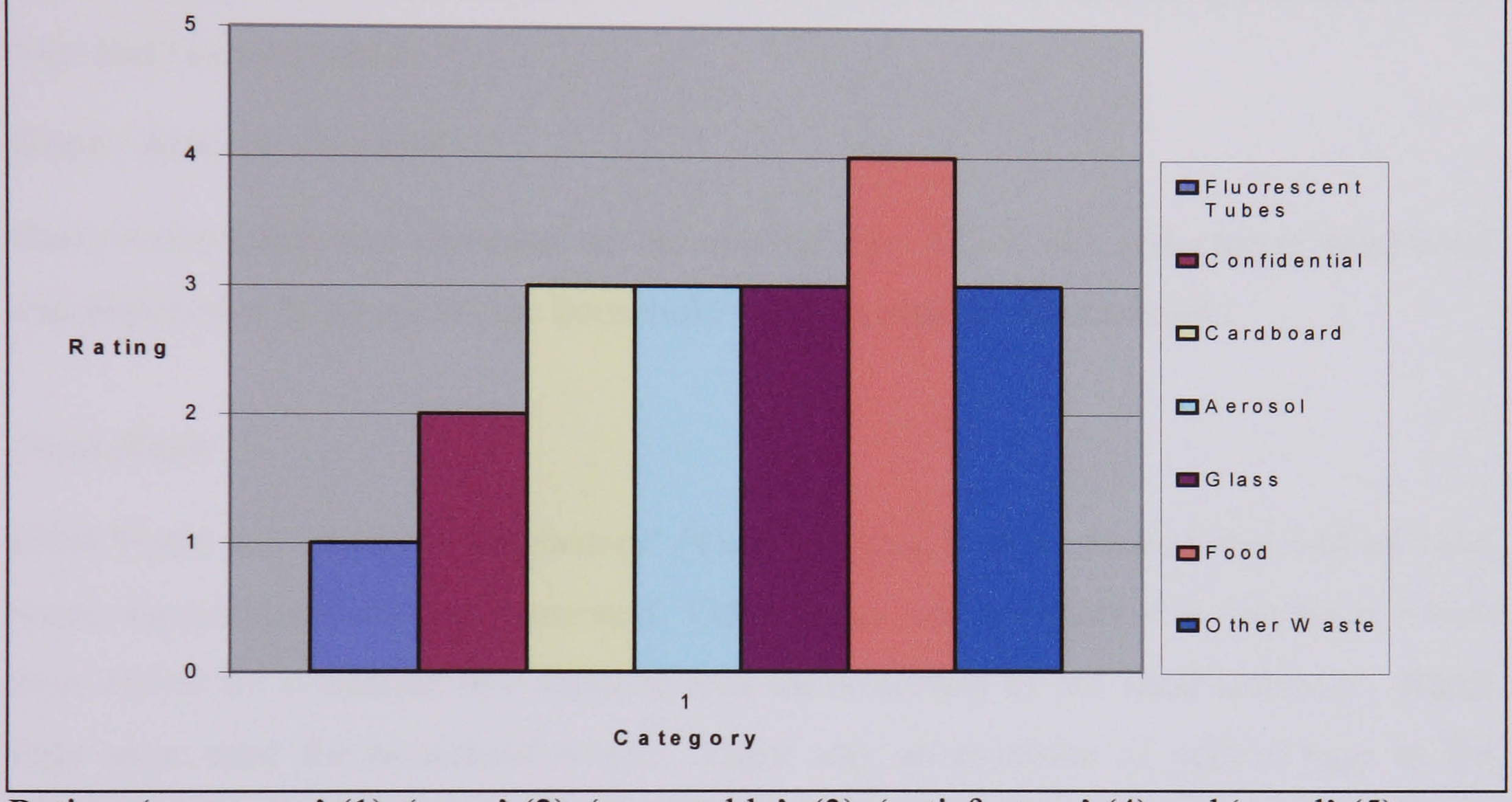
Another problem identified was the disposal of contaminated linen via the clinical waste stream, which resulted in the shredders becoming blocked and the microwave being shut down until the blanket was freed. This also raised the question of what happened to these types of wastes on removal, as clearly if waste was not clinical waste before being placed in the microwave, it became so, once it was in the process.

Waste Monitoring

Waste monitoring was rated as 'very poor' (1), as there was no evidence of waste monitoring or action taken for non-compliance with the waste disposal policy. Suitable monitoring and audit procedures have been recommended in practical guidance documents for waste management since 1983, by a variety of sources (HMSO, 1983), (LWRA, 1989), (HSE, 1992), (NHS Estates, 1995), (Audit Commission, 1997), (NHS, Estates, 1997).

Household waste

Hospital 2 produced approximately 33 tonnes of household waste per month, which was equal to 396 tonnes per annum. This compared with an equal 396 tonnes of household waste at Hospital 1, which indicated that a greater volume of the total waste produced was treated as household waste at Hospital 2. Figure 6.5 shows the poor level of compliance with the policy for household waste.



Rating: 'very poor' (1), 'poor' (2), 'acceptable', (3), 'satisfactory' (4) and 'good' (5)

Figure 6.5 demonstrates the level of compliance with household waste policy procedures at Hospital 2.

Fluorescent Lights

Fluorescent light disposal was rated as 'very poor' (1) due to the discord between policy and practice. The policy stated that fluorescent lights should be stored for special disposal but it is likely that this was written before the Environment Agency indicated that it was acceptable to treat the fluorescent tubes as household waste in small quantities. The fluorescent lights were changed during the theatre suite shutdown for routine maintenance. There were three suites which rotated the shutdown, generating 500–800 fluorescent lights for disposal each year, resulting in an accumulation of three full skip loads, which were removed for disposal as household waste. Clearly this concentration changed the classification to special waste and required a consignment note procedure to meet the requirements of the Special Waste Regulation 1996.

Confidential Waste

Confidential waste was rated as 'poor' (2); and there was evidence of inconsistency in the disposal of confidential waste. The policy suggested that confidential waste had to be treated as clinical waste. The pharmacy department had its own waste policy that had been updated and confidential waste was placed in a black household waste bag with an A4 sized label stating 'Confidential Waste'. The Facilities Department, who had not noticed the apparent contradiction, had vetted the policy. As the bags were not stored in a secure storage area and the large label was conspicuous, it was surprising that none of the bags had been removed.

Glass / Aerosols Disposal

Glass/Aerosol disposal was rated as 'acceptable' (3). Glass was collected at ward level and disposed of in boxes via the household waste stream, as were aerosols.

Food Waste

Food Waste was rated as 'satisfactory' (4), as catering food waste was disposed of via a waste disposal unit and was macerated. Other waste was disposed of in blue bags, which were stored for collection in a separate area for collection by the local authority. Black bags were used for household waste. There was no evidence of yellow bags in the catering areas. The storage areas were clean and secure. The Catering contractor was Granada Catering, which supplied four restaurants on site and provided the meals for 450-500 patients. The use of plastic disposable items was extensive and included plates, cutlery, cups and napkins. The purchase cost of the disposable items was approximately £1,000 per week. However, this cost was preferable to the replacement costs of the high level of pilfering of non-disposable items. Foil-containers, which held 8 portions of food, were to be replaced with reusable metal trays to minimise the foil waste.

Other waste

The rating for the disposal of large items of waste was 'acceptable' (3). The procedure for dealing with waste, for example condemned equipment, refrigerators, fixtures and fittings, was via the Estates department and was held in a separate storage area until there was sufficient to organise a collection.

Special waste

Special waste was rated as 'poor' (2). The pharmaceutical waste disposal from the pharmacy department was in compliance with the Special Waste Regulations 1996. A consignment note system was in place, but there was evident accumulation of waste; in this case, 40-50 'sharps' containers.

The wards had disposed of pharmaceutical drugs via the cinbins on the assumption that the cinbins would be incinerated. In some areas the ward staff were now returning the cinbins to the pharmacy for disposal as special waste, unaware that the system of disposal had changed. Although the microwave plant was licensed for clinical waste, it was not licensed for special waste and the pharmaceuticals, including cytotoxic drugs, changed the category of what had been 'sharps' and syringes from clinical waste to special waste.

The Estates Department was responsible for the disposal of batteries as special waste. The batteries were stored with the furniture, condemned equipment and large items of other waste awaiting collection. Following the removal of the waste items it was discovered that 30 large nickel cadmium batteries were missing, presumably cleared with the rubbish. There was no consignment note completed and the destination of the load was unknown, in breach of the Special Waste Regulations 1996.

Radioactive Waste

Hospital 2 no longer produced or stored radioactive waste. The Laboratory used an infra-red system and did not produce any radioactive waste.

Discharge to Sewers

Discharge to sewers was also difficult to quantify due to the lack of reliable information. The main sources of chemical waste discharged via the sewers were identified as the Endoscopy Unit and Laboratories. Table 6.5 estimates the volume of chemical waste discharged to sewers from the laboratories.

Endoscopy Unit

Hospital 2 had a purpose built endoscopy unit which opened in 1993 and the disinfectant

in use was glutaraldehyde. Although on the contact list, the manager had not been contacted and access was not gained. The endoscopy unit at Hospital 1 produced 25 litres glutaraldehyde weekly and produced an estimated 1300 litres of glutaraldehyde per annum.

Chemical Waste from the Laboratories

Table 6.5: Type and volume of chemical waste discharged to sewers from the Laboratories

Chemical Source	**Volume**	**Rate of Change**	**Annual Volume total**
Formaldehyde tank	20 litres	Monthly	240 litres
Specimen Pots	3 litres	750	2250
Specimen Pots	100mls.	500	50
Specimen Pots	25mls.	3750	3.75
Specimen Pots Total			2543.75

Table 6.5 demonstrates the estimated volume of formaldehyde. The specimen pots totalled 5000: approximately 15% 3 litre pots; 10% 100 mls pots and 75% 25 mls pots.

Other chemicals in use were: xylene, cyanide and biological waste and chemical discharge to drain via the sink from the Chemical analyser. The volume of chemical was not known. However, there were approximately 100 different chemicals in use.

Chemical Waste from the Mortuary and Post-mortem Room

Each day there were 6 buckets of diluted sodium hypochlorite used as a disinfectant in the Mortuary and this was discharged to drains.

Reduce Re-use Recycling Initiatives

The catering department was reducing the amount of tinfoil waste by substituting re-useable metal trays for food portions.

It was the policy of Central Sterilize Support Unit (CSSU) to contact the suppliers of instruments and the contents of surgical packs to determine the re-usability of some instruments, for example half-moons used for impacting cement into bone were described as disposable. It was established from the supplier that they were re-useable up to 5 times. Plastic items, for example gallipots and bowls, were washed and returned for sterilization. The use of sterile cloths instead of paper reduced the volume of waste when used to protect the Theatre sets. There was a replacement program to increase the number of metal re-usable instruments in place. There was no evidence of recycling other than the silver recovery from the x-ray film.

6.6 Discussion

The results of the second in-depth case study demonstrated the problems in applying a generic framework, as suggested by the Audit Commission (1996), without considering any specific problems or constraints that might influence the waste management practice. The logistical difficulties of waste management within Hospital 2 were numerous. The site was divided into blocks that were connected by large corridors. Originally designed as a workhouse, there were inherent problems created due to the limited storage space for waste. The placing of the 180 litre carts outside the corridor exit/entrance to collect the clinical waste and 'sharps' boxes filled with needles and syringes presented a hazard to employees, patients, visitors and the wider community. The proximity of the social housing, resulting from the selling of part of the site to raise money for the Private Finance Scheme, increased the risk of accidents, injury and environmental contamination relating to waste disposal.

Private Finance Initiative (PFI)

The Trust's strategy to raise the finance to secure the bid for the Private Finance Initiative (PFI) resulted in scrutiny of all expenditure, including waste disposal and resulted in increased opportunity for segregation of the waste streams at source. The PFI was created under the Conservative government and was reviewed under the incoming Labour government. PFI was not without its critics; it was argued that the assumption that savings resulting from the involvement with the private sector would offset higher capital costs was wrong. NHS Trusts would have to make savings on other budgets to meet the high costs of the investment (Gaffney and Pollock, 1999). Paradoxically it was predicted that shareholders in the schemes could expect returns of 15-25% a year (Gaffney *et al,* 1999). If areas of hospital sites were to be disposed of for financial gain the consequences of development of these sites would have to be carefully considered. The increased risk of vandalism and theft created by the proximity of the development of social housing on the hospital site had not been considered and this was particularly relevant to waste disposal.

The Waste Disposal Policy

The waste disposal policy, which was restricted to health and safety requirements, was similar in format to Hospital 1 waste disposal policy and staff demonstrated similar lack of awareness of the policy. Significantly, debate on whether the policy was ratified by the Trust, was not resolved at the end of the case study. The Facilities Manager who produced the policy had received no training in waste management, although he did have a copy of Getting Sorted (NAO, 1996).

The main impetus for improving the waste management was to reduce the cost of disposal. Hospital 2 had increased the use of household waste bags to allow segregation at source and reduce the amount of waste treated as clinical waste. The percentage of the combined clinical and household waste streams disposed of as clinical waste was 39%, by comparison with 61% of the combined clinical and household waste streams at Hospital 1.

Environmental issues

Environmental issues arising from waste disposal were not addressed. However, there was a recently formed environmental policy group considering a draft environmental policy statement that was a step towards the Government's commitment to sustainability.

Training

Training in the policy was limited to the subcontracted staff and was deemed the contractor's responsibility. This responsibility extended to the monitoring of accidents and injury, for example needlestick injuries was not included in the Trust's statistics. In practice the training was extended to nursing staff and induction talks to new employees.

Policy Development

The policy development was a reactive strategy to legislative requirements and dealt with procedures related to health and safety issues of the waste disposal. The environmental policy and strategy were developing discretely and were not available. However, it seemed likely that there would be many areas of overlap as they developed. The study

demonstrated the need to integrate the health, safety and environment issues to promote a sustainable approach

Waste Reduction

The study indicated that the ratio of waste treated as clinical as opposed to household was reversed at Hospital 2 by comparison with Hospital 1. Hospital 2 with approximately 500 beds had 21 tonnes of waste disposed of as clinical waste per month, which equalled 252 tonnes per year. This represented approximately 39% of the 648 tonnes of the total clinical and household waste streams produced per annum by the Hospital. By comparison at Hospital 1 with (580 beds), 61% of the 1020 tonnes of total clinical and household waste was disposed of as clinical waste. The total waste produced at Hospital 2 was 372 tonnes less than that produced at Hospital 1.

A factor that may have contributed to this was the inclusion of a large mental health unit that would predictably produce less waste. Another factor was that 60% of patients for elective surgery were day patients. Although all these other factors may have had an influence the Trust was also increasing the use of re-useable products and the 'reduce and re-use' strategies had contributed positively to the reduction of waste produced by the Trust. Re-use and waste reduction strategies are deemed increasingly important to meet the changing needs of hospital waste management. The Medical Devices Agency (MDA), has provided information on the re-use of medical devices supplied for single use only (MDA, 1995). The environmental designs for medical products are being developed which also considers multi-use as a specified number of uses before disposal to reduce waste (Royal Society of Arts, 1996). The results demonstrate the importance of reducing the overall amount of waste produced as well as the importance of segregation.

Training programs

The training programs for waste disposal were in place for the subcontractor employees, nursing staff and new employees. The importance of training and education of all employees to meet changes in the waste disposal process had been reinforced by the shutdowns at the microwave plant and highlighted the importance of communication and management of change in the waste disposal practice. Concurrently the Trust was considering the inclusion of environmental issues in the training program.

COSHH Assessments

The staff who were responsible for risk assessments required specific training. The COSHH Regulations 1999 detail the level of training required and the current system the Trust had adopted was not demonstrating compliance with the legislative requirements (HSE, 1993). The Facilities Manager had no training in waste management, nor had the Contract Manager who was involved in the change from incineration to microwave. Waste disposal was traditionally the remit of the Estates Department. However, the rapid development of Facilities Management as a core service (Rees, 1998) had marked the decline in status of the Estates Department, which had been reclassified as a non-core service. Tarmac ServiceMaster had subsumed the Estates Department at Hospital 1 and the responsibility for waste disposal was devolved to the Logistics Manager. At Hospital 2 the Facilities Manager responsible for waste disposal had no previous experience in waste management and the Estates Department had been subcontracted to Taylor Woodrow. Concern has been expressed that the level of expertise requiring knowledge and understanding in an area such as waste disposal has been declining (BMA, 1994). The shift to microwave technology was informed by a reduction in cost of the end-disposal of clinical waste and the information presented by the Directors of the Microwave Company during the bid. There was no contact with other users of the system in the consideration of tender.

Needlestick Injuries

As stated in the policy, the Occupational Health Department was required to follow up needlestick injuries but there was no data available on the incidence. A copy of the accident form was given to a designated individual to record accidents. One accident form had been received in the preceding 6 months and this was a needlestick injury not connected to waste disposal. The needlestick injuries were collated as a category and excluded any injury to the subcontractor's employees. However, it is a legal requirement for every employer to record needlestick injuries so that those trends in the procedures and practice that result in needlestick injuries can be identified and preventive action taken. There are many studies that identify inappropriate needle recapping as the causal factors of needlestick injuries. However, there is less information available on non-reporting of needlestick injury. Unison, the largest Public Services union in the UK

conducted two surveys on the level of occupational health related costs to Acute Trusts and found that (p2):

> 'Many Health Service staff have a fatalistic acceptance that the appalling working conditions and high levels of violence are "part of the job", viewed as a hangover from the days of Crown immunity which meant that at most workplaces health and safety issues were not seriously addressed. The union considers this fatalism leads to extremely low reporting levels as staff feels that little will be done. This in turn feeds into employer complacency.'
>
> (HMSO, 1997)

6.7 Conclusion

The Case study demonstrated that although Hospital 2 had begun to consider the environmental issues of healthcare, much more progress was required to create environmentally sound policies which would integrate the health and safety issues of waste disposal. A significant reduction in the clinical waste stream had been achieved by increasing segregation opportunities. There was evidence of a shift in waste management from disposal towards waste reduction, by re-use of equipment where appropriate and replacing disposable equipment by multi-use items.

Since the removal of Crown immunity, non-compliance with legislative requirements had potentially exposed the Trust to the threat of prosecution and financial penalty due to the inappropriate disposal of special waste as clinical waste. Risk assessment of the waste disposal process would have identified the control measures required. A prerequisite to a successful transition would have been a campaign to inform, educate and persuade the employees of the value of the strategy.

Chapter 7 In-depth Case Study Hospital 3

7.1 Introduction

This in-depth case study was carried out in order to complete the examination of the actual waste management practices within the three hospitals. It was also to identify any further specific issues of the process of waste management which would inform the development of the integrated framework of health, safety and environment used to address the sustainable management of health service waste.

Hospital 3

In 1997 the development of Hospital 3 site was completed to concentrate the acute services on the main site. Hospital 3 provided a comprehensive range of acute and specialist care, ranging from Accident and Emergency to Palliative Care. There were areas of speciality that are unique in Britain, for example, the Interventional Magnetic Resonance (IMR) which is capable of viewing any part of the anatomy from any angle in any plane without x-ray exposure. Other projects included work on the transmissible spongiform encephalopathies and a research programme into viral hepatitis. This had resulted in increased bed capacity and as acute services, an increase in the volume and types of waste produced.

The hospital opened in 1846 and had it's own on-site incinerator for waste disposal until closure in 1995. The development of the site had utilised all space available and there was limited storage area for waste. The waste collection point was an external bay and access to the area involved transportation across a main road. The Trust had altered the end disposal from high temperature incineration to microwave technology and the treated waste was destined for landfill.

The main areas to consider in addition to the generic aims and objectives as detailed in Chapter 4 (4.10) were to identify any special considerations required for the complex waste streams at Hospital 3.

7.2 Aims

7.2.1 Analyse the health, safety and environmental impact of the waste streams.

7.3 Objectives

7.3.1 Evaluate the advantages and disadvantages of high temperature and microwave technology as the end-disposal option for the waste streams.

7.4 Methods

The generic framework was applied as Chapter 4 (4.10)

Selection of Subjects for Interview

This was as informed by the other two case studies and discussion with the Dietetic and Facilities Manager.

Contact Route

Further to discussion, the Dietetic and Facilities Manager communicated a memorandum to identified employees, to advise them that an interview and visit to the areas would be requested. This was followed by a telephone call to discuss the study and arrange the visits.

Interview Structure

The interview structure was the same as for Hospital 1 and Hospital 2, incorporating any issues to be further developed.

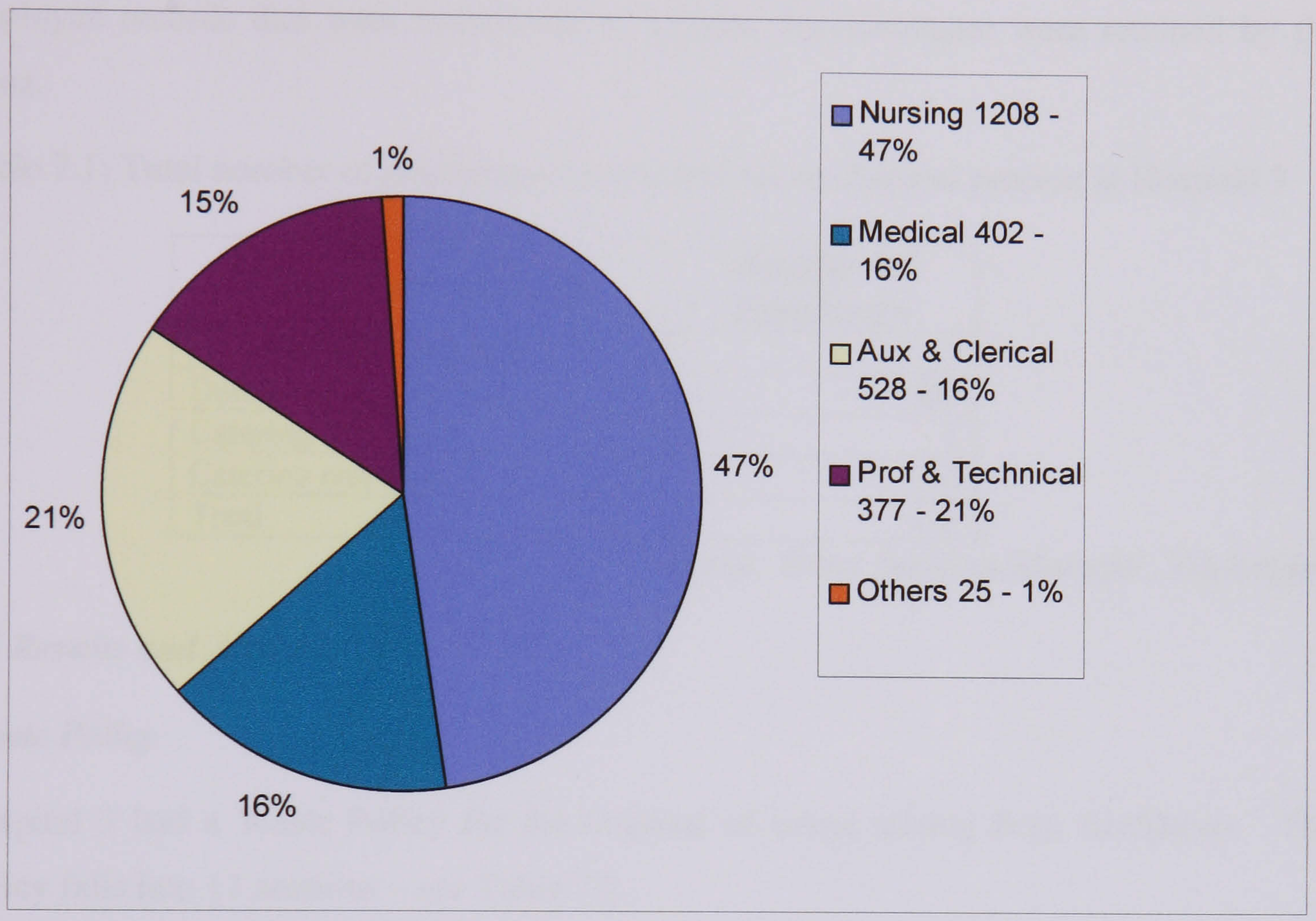
Bias

Bias was limited in the selection of subjects as a considerable number of those pre-notified were unaware of or had no recollection of receiving the communication from the Dietetics and Facilities Manager.

Selection of areas for observation

The selection of areas for observation built on the experience gained at Hospital 1 and Hospital 2 and included the specialist areas.

Figure 7.1 shows that the Trust employed 2,517 staff, whole time equivalent (WTE), of whom approximately 1,208 (47%) were nursing staff and 402 (16%) were medical staff, which was a similar ratio to Hospital 1 and Hospital 2 as shown in Figures 5.1 and 6.1. The occupational group categories were not standardised within the Trusts, which limited the comparison with the other occupations.



Source: Human Resources, Hospital 3

Figure 7.1: Occupational groups employed at Hospital 3

Organisational Structure for Waste Management at Hospital 3

The hierarchy of managerial responsibility is detailed in Chapter 4. There was an external contract for waste disposal held by Serco Health Service Ltd., a part of an international company that provided a wide range of facilities and management services. The company took over the Hotel Services contract and retained the employees.

The General Manager of Serco Health Services reported on waste to the Manager of Dietetics and Facilities for the Trust. Taylorplan held the domestic and portering contract. The arrangements were similar in structure to Hospital 1, where all the services were subcontracted to Tarmac ServiceMaster. However, Serco negotiated the waste

contract on behalf of the Trust, which was effectively the same as at Hospital 2. However, any reduction in the waste disposal costs would benefit the Trust. By contrast, Tarmac negotiated the waste disposal contract as part of their contractual agreement with Hospital 1 and would increase the company profit if waste disposal costs were reduced. The number of domestics and porters is a combined total in Table 7.1 as the actual number in each group was not available. This was similar to Hospital 1, where the employee records that were transferred to Tarmac ServiceMaster were retained by the Trust.

Table 7.1: Total number of employees involved in waste disposal process at Hospital 3

Occupational Group	Number of Employees
Hotel Services Manager	1
Domestics and Porters	300
Catering manager	1
Catering employees	116
Total	418

Source: Hotel Services Manager, Taylorplan

7.5 Results and Analysis

Waste Policy

Hospital 3 had a Waste Policy for the disposal of waste arising from healthcare. The Policy falls into 11 sections – see Table 7.2.

The policy was developed in 1996 and ratified in 1998. There was no review date. The Risk Manager for the Trust had written the policy following an initial meeting with the Pharmacist, Radiological Protection Advisors and Laboratory Representatives. The policy was then distributed for comment before finalisation. The Health and Safety Executive Code of Practice informed the policy for clinical waste. There was no indication as to what sources of information informed the policy other than the EPA 1990, the HSAWA 1974 and COSHH 1994. The Risk Manager had access to the available reference material and guidance documents.

Table 7.2: Summary of waste policy at Hospital 3

Section	
1. Introduction	Identified the Departmental heads as having overall responsibility for implementation of the policy
2. Legislation	EPA 1990, HASAW 1974.COSHH 1994
3. Definitions	Included the Special Waste Regulations 1996. Definitions of clinical, domestic, food, radioactive waste and cytotoxic waste. Included confidential waste ,for example, patients records must be shredded
4. General	Stated procedures for handling and container specification
5. Storage	• Waste must be held in secure places of storage waiting disposal • Unattended waste must not be stored or left in basements, stairways or corridors • Escape routes must be kept clear at all times • Black and yellow bags must be stored separately • All waste bins must be lidded, foot operated and fireproof
6. Training	Details content, excludes segregation and pertains only to clinical waste
7. Transportation	Specified the designated trolleys. States the cleaning procedure and that waste bags should not be mixed.
8. Final Disposal	Collection area requirements, identified labelling, segregation, storage and transportation of waste
9. Radioactive waste	The Trust and Medical school has each appointed a RPA. The policy detailed the present limits for discharges down the drain for the Trust and Medical school.
10. Pharmaceutical	Detailed procedures and containers for pharmaceuticals. All waste contaminated with cytotoxic drugs is to be treated as cytotoxic hazardous waste. A distinction is made between the disposal of prescription only medicines and cytotoxic waste
11. Pathological Waste	Indicated that all infected clinical waste should be autoclaved

Review of the Waste Policy at Hospital 3

Section 1 Introduction

The introduction did not place the responsibility for policy implementation within the context of the legislative framework pertaining to waste management under the Duty of Care Order for the management of waste (Section 34). This was made under the EPA 1990, which sets a legal and personal liability on senior members of management. There was no specialist team identified within the policy nor was there any reference to safety, infection control, or occupational health throughout the policy.

Section 2 Legislation

Demonstration of the relevant legislation was limited as in the previous two policies of Hospital 1 and Hospital 2.

Section 3 Definition

The definition of special waste was restricted to prescription-only medicines and 'biological agents that cause severe human disease likely to spread into the community and for which there is no effective prophylaxis or treatment available'.

Waste prescription-only medicines are special waste and the biological agent was included as it is on the EU list of hazardous wastes. However, the Special Waste Regulations 1996 not only stipulates generic types of waste, but considers the constituents as well as the properties which may render them hazardous. Therefore, the definition of special waste would apply to non-listed wastes displaying hazardous properties, for example flammable or explosive properties may result in the waste classification changing to special waste and must be considered in the assessment to determine if waste is special. Several of the hazardous properties are subject to thresholds and this is relevant, for example fluorescent tubes and batteries, in determining the final disposal procedure.

Section 4 General

Section 4 indicated that there was a separate confidential waste procedure, but this was not available. The container for aerosols was described as standard plastic, which may have resulted in disposal as clinical waste as the only standard plastic containers available are those used for 'sharps'. There were 3 categories of clinical/infected wastes described: yellow bags were used for 'infected clinical waste'; 'sharps' were disposed of in 'sharp's' bins and light blue (or transparent with light blue lettering) plastic bags were used for waste material for autoclaving. However, in practice all clinical wastes except 'sharps' were disposed of in yellow bags and known infectious clinical waste was autoclaved and placed in clinical waste bags before disposal.

Section 5 Storage

The storage requirements reflected the guidance (HSE, 1992) and not the local application.

Section 6 Training

Training was restricted to porters, domestic staff and Trust staff who handled waste. The departmental head was responsible for ensuring that the training was given and to keep a record of this. There was no information on needlestick injury or reporting procedure.

Section 7 Transportation

This section indicated that the policy had not been updated as the procedure detailed was not the current system of carts.

Section 8 Final Disposal

Section 8 detailed the Trust's responsibility for records of end-disposal and the 'responsibility to trace the waste from its creation to its disposal'. However, the person responsible for this was not identified.

Section 9 Radioactive Waste

The actual limits were detailed as a monthly maximum for aqueous waste and annual for solid waste and organic liquid waste.

Section 10 Pharmaceutical Waste

The earlier definition of special waste in the policy included prescription-only medicines. However, this section suggested that only cytotoxic drugs required a consignment note.

Section 11 Pathological Waste

There was a specific statement that all infected clinical waste arising from work in the laboratories and post-mortem room must be made safe by autoclaving. This contradicted the earlier procedure for clinical waste which stated that 'Group E waste presents a low level of risk. However, as all patients are considered potentially infectious, all clinical waste therefore carries the same potential risk of infection'.

Classification of the Waste Streams within the Hospital 3 Policy

The classifications of waste streams that were identified were more limited than comprehensive. The policy did not refer to components of the special waste, for example waste batteries and oil. Another hazardous waste not included in the policy was the disposal of fluorescent tubes.

7.6 Organisational Structure for Waste Management

The variety of Services/Directorates that had management responsibility for waste disposal is shown in Table 7.3. The Radiation Protection Advisor reported directly to the Chief Executive. The Risk Manager's responsibility for waste disposal appears to have been limited to producing the policy. There was no reference to occupational health, safety, or infection control within the policy.

Table 7.3: Specialists who report on waste disposal to the Chief Executive via their services/directorate at Hospital 3

Title	Services/Directorate
Radiation Protection Advisor Trust and Medical School	Chief Executive
Chief Pharmacist	Chief Executive
Consultant Microbiologist	Pathology Directorate
Risk Manager	Dietetics and nutrition

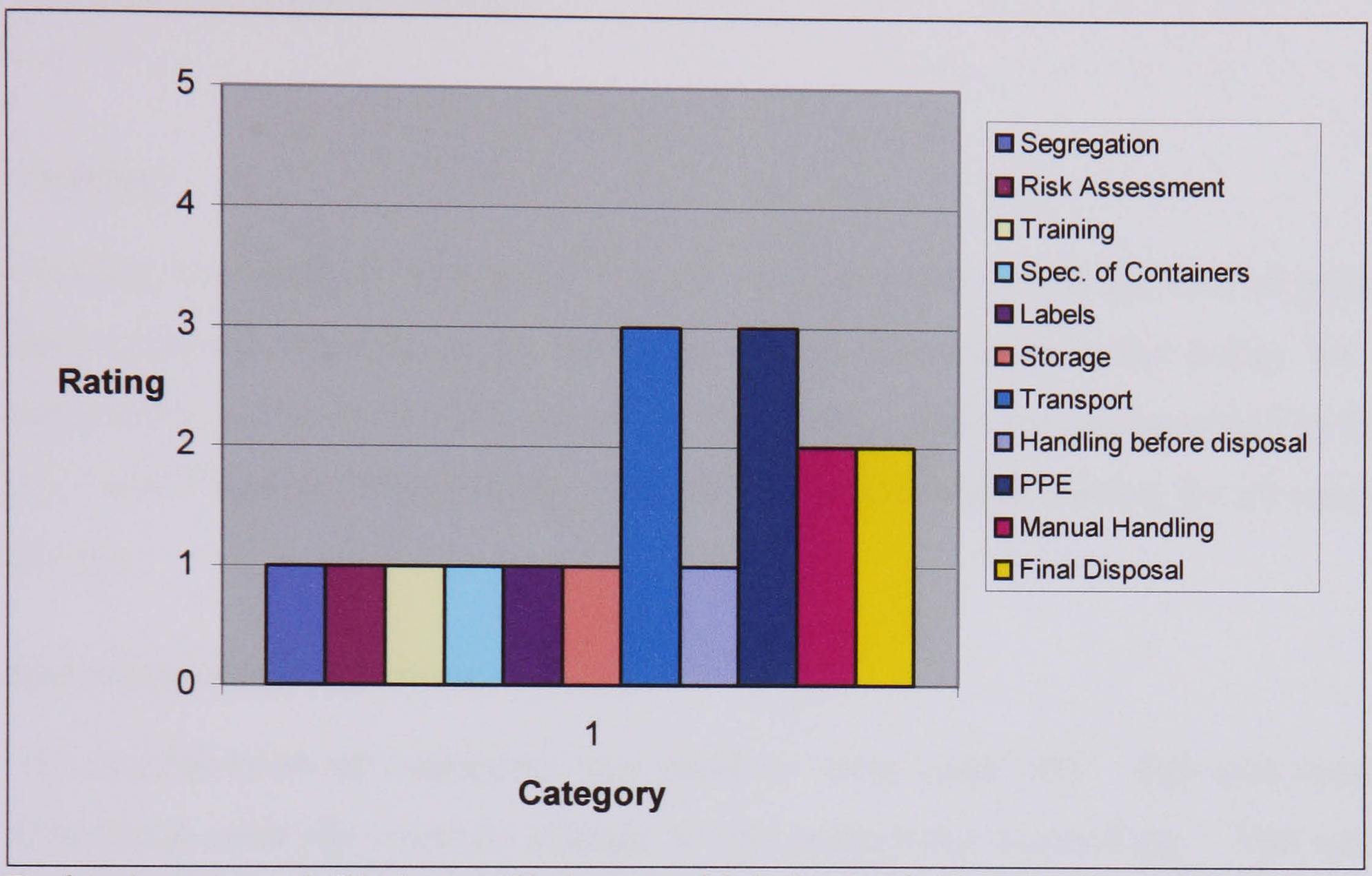
There was limited evidence of a specialist team or contact numbers for advice. There was emphasis placed on training and recording of the training in the policy. However, the content was a brief list of outcomes with no information, for example 'know the procedure in case of injury'. There was no indication of where the information was available as shown in Table 7.4.

Table 7.4: The role and responsibility for the waste management process at Hospital 3

Title	Responsibilities
Department Head	Ensure proper implementation of policy. Training and record of training
Hotel Services Contractor	Training and record of training
Serco	Training and record of training
Radiation Protection Advisor	Detailed limits and procedures on handling and disposal of radioactive waste
Chief Pharmacist	Detailed procedures on handling and procedures for disposal of pharmaceutical materials

Clinical Waste

Hospital 3 had approximately 670 beds and 57 tonnes of waste was disposed of as clinical waste per month, which equalled 684 tonnes per year. Figure 7.2 illustrates the level of compliance with health, safety and environmental legislation.



Rating 'very poor' (1), 'poor (2), 'acceptable' (3), 'satisfactory' (4) and 'good' (5).

Figure 7.2: Clinical Waste Stream: Compliance with Health, Safety and Environmental Legislation at Hospital 3

Segregation of Clinical Waste

Segregation of clinical waste was rated as 'very poor' (1). There was some opportunity for segregation at source provided by the evident availability of both black household waste bags and yellow clinical waste bags. Packaging produced in Theatre Sterile Supplies Unit (TSSU) was disposed of via the household waste stream, but clean paper tray wraps for the theatre instruments, weighing approximately 654kg per month were disposed of as clinical waste.

Risk Assessment

Risk assessment was rated as 'very poor' (1) due to the lack of risk assessment on clinical waste. Because of the risk of contamination of clinical waste with micro-organisms, all clinical waste should have been assessed. This was particularly significant due to the

high concentration of potentially infectious material in the clinical waste stream produced within the specialist areas at Hospital 3. The assessment of risk is an essential component of the management of health service waste for compliance with the COSHH Regulations. The clinical waste stream as in Hospital 1 and Hospital 2 was excluded from the risk assessment procedures in place.

Training

Training was rated as 'very poor' (1); this was primarily due to the lack of guidance on the procedures required in the policy as well as a limitation in the policy for training opportunities. The policy did not reflect the training requirements provided in Guidance on Waste Disposal (NHS Estates, 1995) which recommended training for all occupational groups.

Specification of Containers

The specification of containers was rated as 'very poor' (1). The cart system was introduced with the contract change to the microwave technology. The carts were lockable, but on inspection the locks on many carts were found to be jammed with card to prevent the lock engaging.

Labelling

Labelling was rated as 'very poor' (1). There was little evidence of use to ensure that the source of waste could be identified.

Storage

Storage was rated as 'very poor' (1), as areas allocated were not of adequate size related to the volume of waste produced and the areas were often unsecured.

Transport

Transport was rated as 'acceptable' (3). The yellow clinical waste carts and blue household waste carts were placed throughout the hospitals and collected for transfer to

the waste bay.

Handling Prior to Disposal

The handling before disposal was rated as 'very poor' (1). The waste bags generated from the clinical areas were frequently observed piled up in the sluice areas. The introduction of the yellow carts was expected to reduce the handling of the waste bags. However, it was observed that the rationale for use of the carts was not explained to staff and frequently when there was no available cart in an area it was discovered that the staff had refused to have one in place due to lack of space. In some areas the carts were placed in corridors and observed to be blocking fire exits.

Personal Protective Equipment (PPE)

PPE was rated as 'acceptable' (3). Porters involved in lifting and handling specimens and waste were issued safety shoes. All porters were provided with three sets of uniforms: trousers, shirts and jackets. Porters directly involved with waste disposal were issued overalls and gloves.

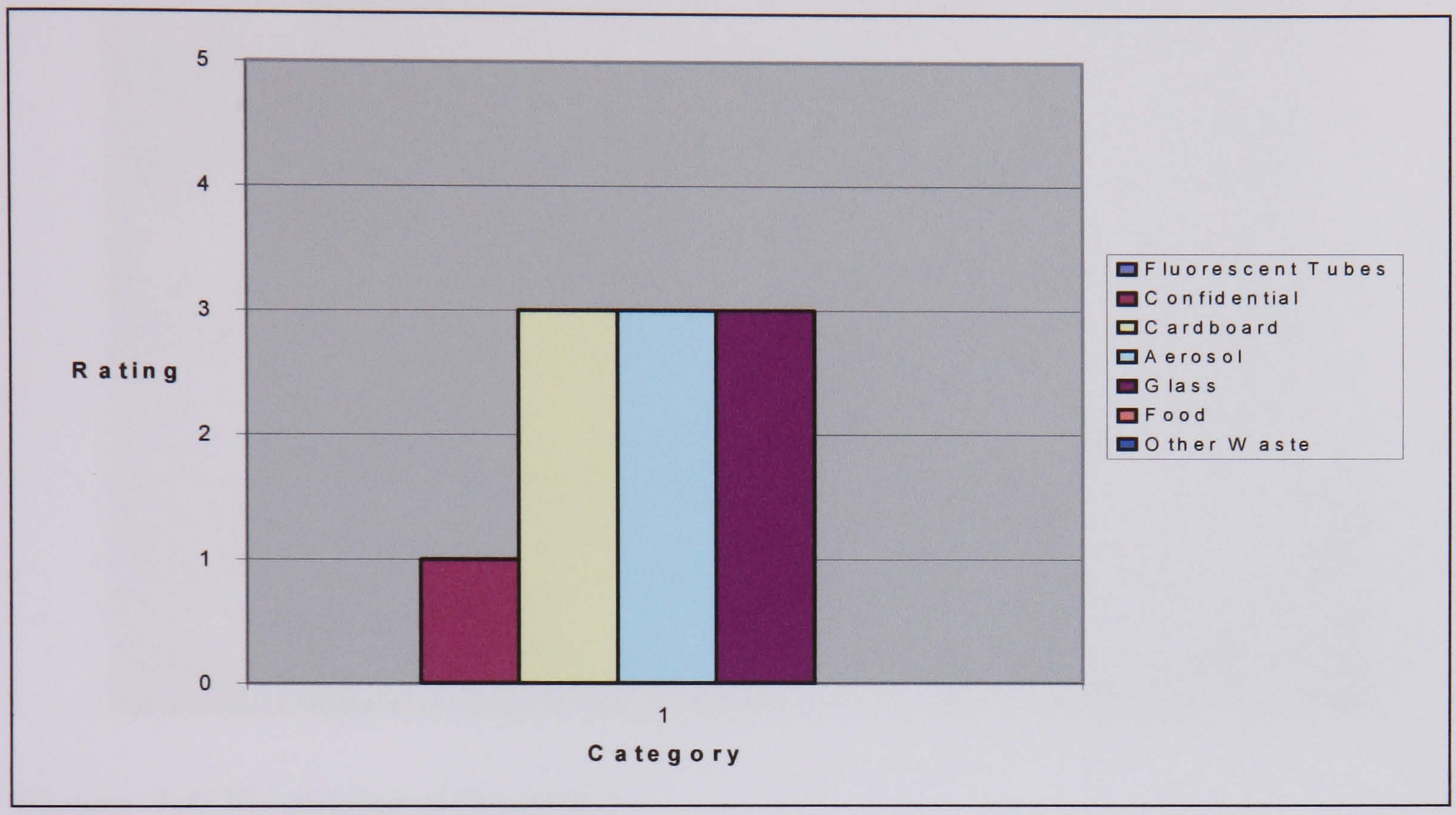
Final Disposal

Final disposal was rated as 'poor' (2). The disposal route for each category of waste was not clearly identified within the waste policy. There was no evidence of systems in place to ensure compliance. As with the change of final disposal at Hospital 2, the staff were unaware of the change. This was particularly relevant to the laboratory staff, who were only alerted to the change during the case study. The primary concern was the disposal of specimens, which may contain prions. There were a number of assumptions made, for example that all waste generated by the lab would be autoclaved, which was not the case and that autoclaving would destroy the prions. The Microbiology Department autoclaved specimens, but Biochemistry and Virology departments did not autoclave specimens.

Household Waste

There was an on-site compactor for household waste situated in the waste collection bay.

The system was the same as Hospital 1 and Hospital 2. Figure 7.3 illustrates the level of compliance for each category of household waste identified within the waste policy. There were some notable exclusions in the policy i.e. fluorescent tubes, general items of other waste and food from the catering department.



Rating: 'very poor' (1), 'poor' (2), 'acceptable' (3), 'satisfactory' (4) and 'good' (5)

Figure 7.3: Household waste stream: Compliance with waste policy at Hospital 3

Fly-tipping to avoid removal charges was perceived to be a problem at Hospital 3 as shown in Figure 7.4.



Figure: 7.4: Fly-tipping at Hospital 3

Confidential Waste

Confidential waste was rated as 'very poor' (1), with particular reference to medical records. The only confidential waste produced in the Medical Records Department were old result forms, which had been duplicated, in the medical record. The Medical Record Department was situated in the basement due to the weight of the records and was accessed by steep stairs. There was originally a 'dumb waiter' lift to the first floor, but this had been removed. The collection system to remove the forms was erratic. A blue wheely bin was delivered and removed when full. Three weeks had lapsed since the recent exchange and it had latterly required four men to lift the bin up the stairs. To avoid this happening, again black bags were observed to be in use to store the confidential waste and hidden to avoid uplift by domestic staff and consequently entering the household stream. The old medical records were stored externally in a specialist storage unit off-site and it was estimated that there were 15,000 boxes, which held 20 sets of case notes per box. There was evidence that confidential waste produced in other areas was

disposed of via the clinical waste stream, or ripped up and disposed of in black bags.

Glass / Aerosols Disposal

Glass/Aerosols disposal was rated as 'acceptable' 3. The domestic staff collected the glass and aerosols from the ward entrance and this was observed happening. However, no one could state what happened to the waste, following collection.

Special Waste

Special waste was rated as 'poor' (2). The policy requirement of internal consignment notes was not in place and this had resulted in an accumulation of waste in the pharmacy department. The level of stacking was observed as being so high as to present a safety hazard. The disposal of cytotoxic and pharmaceutical waste generated in the wards was frequently in 'sharps' containers, as clinical waste. The pharmaceutical waste generating from the Pharmacy Department complied with the Special Waste Regulations and a Consignment Note system was in place. Approximately 50 patients per week received chemotherapy. Therapeutic drugs in use were: bleomycin, carboplatin, cisplatin, cyclophosphamide doxorubicin, epiruicin, methotrexate and vinocristine. The drugs were excreted without change directly into the sewage system.

Radioactive Waste

Radioactive waste was rated as 'good' (4). The practice of disposal reflected the policy section written by both the Medical School and Trust RPAs. Solid waste was retained in the radioactive store until non-radioactive and disposed of via the clinical waste stream. The solid waste C-14 and Tritium limit was 1GBq per year. All other isotopes were 750 MBq per year. The Aqueous Waste was discharged via the drains. Limits were set in 1988 and reviewed 1997 due to a change of incineration operator. Each radioactive area had one sink for the disposal of radioactive material and this was identified with a radioactive waste label.

The discharge limit for ^{131} Iodine is not greater than 17 GBq/month. ^{131} Iodine is primarily used for thyroid ablation following thyroidectomy to remove all tissue residues. Approximately the entire limit was used and went down the drain at a rate of one treatment per month. 17 GBq was the permissible monthly limit and may be excreted via faeces and urine to sewers over a two-day period. If two treatments were carried out in a month the set limit would have been exceeded by 100%. However, the annual average was the base line. This excluded all peaks and did not address the possibility of other hospitals carrying out the same procedures within the area.

Chemical Waste from Endoscopy Unit

The Endoscopy Unit had three tanks of glutaraldehyde in use and each tank held 22.5 litres. The tanks were discharged to drains every fourteen days maximum. This was approximately 1,755 litres per year. At Hospital 1 Endoscopy Unit the glutaraldehyde was changed weekly using 25.8 litres/week, or approximately 13,416 litres per year. Formaldehyde was used to immerse specimens in their containers. Hycolin 2% is a phenol based concentration of 20 mls per litre of water mixed up to wash floor and surfaces following contamination with multiple-resistant staphylococcus aureus (MRSA) contamination. This required 3-4 litres of solution; also 50mls of methylated spirit 50% was sucked through the bronchoscope to reduce bacteria. Methylated spirit was also used to fix cytology specimens. Isopropyl Alcohol 10% was used to wash instruments before autoclaving as shown in Table 7.5.

Table: 7.5: Type and volume of chemical waste discharged to sewers from the endoscopy unit

Chemical	Volume	Rate of Change	Per annum
Glutaraldehyde	67.5	10-14 days	1755 litres
Formaldehyde	60ml.x 100-200	2-3 weeks	16-20litres
Hycolin 2%	80 ml	Single use	Not known
Isopropyl Alcohol	Not known	Single use	Not known
Meths 70%	50mls	Single use	Not Known

Chemical waste from the Laboratories

There was a mixture of chemicals discharged to sewers; no information was available on the concentrations or potential synergistic effect of the chemicals as shown in Table 7.6. The exception was xylene, which was recycled by a specialist contractor.

Table 7.6: Type and volume of chemical waste discharged to sewers at Hospital 3

Chemical	**Volume**	**Rate of Change**	**Per annum**
Formaldehyde	Not known		
Xylene	100 litres	Month	1200 litres
Acetone	Small volume		
Sodium hypochlorite	Not known		
Alcohol	15-20litres	Month	130-240 litres

Reduce Re-use Recycling Initiatives

The recycling of xylene and silver recovery from the x-ray film was the only identified recycling initiative.

7.6 Discussion

The results of the third in-depth case study demonstrated the complexity of the risk factors involved in the process of waste management.

Hospital 3 shared the same problem of lack of storage space to hold the waste as Hospital 2. The carts were viewed as a solution and placed throughout the hospital but many carts were placed in corridors with public access and a number of areas had decided against the use of the carts due to their size.

The Waste Policy

The waste policy did not reflect the local circumstances. The storage requirements as stated in the policy would be impossible to achieve. The policy was not comprehensive for each waste stream and was therefore limited as a procedure manual. There was limited awareness of the policy. However, the actual waste management process was not in itself informed by the policy, for example, in the change of end-disposal from high temperature incineration to microwave technology. Environmental issues arising from

waste disposal were not considered within the policy.

Final Disposal

The move away from landfill disposal of clinical waste and the further development of high temperature incinerators to meet increasingly stringent environmental legislation had increased the cost of disposal by incineration (Blenkharn, 1995). Microwave exposure of macerated wastes is one of the newer waste treatments to be developed and is less expensive to operate. Two of the hospitals had changed to microwave technology as a method of end disposal.

The system in use was the first UK installation of a 'microwave' processing system for medical waste treatment. The waste was fed through a shredder and conveyed to a steam injection point where it was moistened with steam, then heated to temperature of 95°C and passed by a series of six microwaves. The waste then emerged as a 'confetti-like' substance that was disposed of to landfill; there was a volume reduction of 80% of the initial waste load. No liquid effluent was produced and a High Efficiency Particulate Air (Hepa) filter captured pathogens that may have been present when the waste entered the system. There was a carbon filter to control odors that were generated in the process. The system was initially developed in Germany and manufactured in the United States where there were 47 units in use.

The UK Microwave Unit had a total capacity of 1,800 tonnes per annum which exceeded the clinical waste requirements of the hospital, with which it had formed a partnership, by 1,400 tonnes. Hospital 3 had created an incineration facility in 1992, which closed in 1994, resulting in the clinical waste being transferred to another incineration unit. The system of waste being treated on site was stated as preferable as it minimized transport (press release June 1998). However, as approximately 684 tonnes were from Hospital 3 and 252 tonnes were from Hospital 2 there was at least 52% of the total capacity currently being transported on to the other hospital's site and 20% of the total treated waste subsequently transferred off-site for landfill disposal.

High temperature incineration of clinical waste had traditionally been the recommended final disposal treatment (Advisory Committee on Dangerous Pathogens, 1996) (NHS Estates, 1992). It was viewed as the most effective overall method for destroying

infectious and toxic material (Medical Waste Committee, 1994). However, the increasing cost had been influential in transferring the waste contract to microwave treatment.

There was little research into decontamination efficacy; the waste contractors had only one research article which concluded that microwave treatment could be used to render safe the bulk of ward-generated waste (Hoffman and Hanley, 1994). There was no available research on the efficiency of the microwave treatment for specific waste such as Group 3 pathogens, for example blood borne hepatitis viruses or prion tissue. Both were significantly increased in the waste streams at Hospital 3 due to Specialist Hepatitis Unit and the Specialist Prion Disease Clinic. The prion protein research applied a test for diagnosing new variant Creutzfeldt-Jakob disease (nwCJD). This involved testing around 2,000 tonsils from a sample of 80,000 in the UK each year for the infective protein to determine the prevalence in the general population (Kmietowicz, 1999).

The main consideration for waste management is whether the temperature of the microwave unit is sufficient to render this type of waste safe for landfill. By comparison high temperature incineration commences at 1,000°C. Other factors to consider are: the capacity of the unit, contingency for breakdown and maintenance and storage.

The shredding mechanism was described as a weak link in all treatment systems (NHS Estates, 1998) and as the shredding occurs before the treatment the mechanism is in contact with pathogens, which means that the system is reliant on the effective disinfection of all pathogens at 95°C.

Training Programs

Training was limited to statements of outcomes deemed the contractor's responsibility. It had not addressed training regarding the final disposal. Waste disposal was traditionally the remit of the Estates Department and much of the process of waste management disposal process was determined before the waste policy development. However, the 'custom and practice' approach had resulted in a mismatch between those who manage the waste disposal and those with responsibility for producing the waste policy. Aspects of waste management not addressed in the policy were carried out in practice in compliance with legislation and good practice.

7.7 Conclusion

The Case study indicates that there were limitations in the waste policy and the actual practice itself was not necessarily informed by the policy as it stood.

The issues for consideration before a change of final disposal have demonstrated that a waste audit to determine actual practice was essential to identify risk. Only when all the risk factors have been identified can a risk management system be developed and implemented and consideration of all the issues must inform the decision of the final disposal option. The success of waste management is then determined by a system of audit and review and is dependent on communication, commitment and training.

Chapter 8 Discussion of the In-depth Case Studies

8.1 Introduction

The in-depth case studies reported in Chapters 5, 6 and 7 have examined the actual process of waste management within each of the three London teaching hospitals referred to as Hospitals 1, 2 and 3. Analysis of the studies identified generic issues pertaining to the three hospitals and specific issues that would have to be considered to allow the development of a framework for the sustainable management of health service wastes, taking into account the health, safety and environment issues.

The case studies demonstrated common problems, for example limited segregation of the clinical waste stream and restricted opportunity for this by only placing clinical waste bags for use in non-risk areas or designating clinical areas as 'yellow bag only'. This had resulted in low risk household waste being inappropriately and expensively disposed of as clinical waste. It was also demonstrated that the risk factors of waste management increased proportionally to the specialist areas, for example areas producing cytotoxic and radioactive waste, yet the focus remained on clinical and household waste disposal.

Emphasise was on the disposal of the yellow clinical waste bags and 'sharps' bins. Little attention was paid to the content of the clinical waste bags, or the area of origin.

The practice of disposing of prescription-only medicines via 'sharps' bins was noted; these wastes are special waste and require separate disposal.

The switch from incineration to microwave in Hospitals 2 and 3 compounded this problem. The temperature of the microwave treatment is not high enough to destroy the drugs and cytotoxic drugs are a particularly high risk to the environment and health if they are disposed of to landfill.

This emphasised the need to shift from 'end-of-pipe' disposal of household and clinical waste stream responsibilities of the waste manager to incorporate waste minimisation as an essential preliminary to disposal and to consider the management of all waste streams from production to disposal (NHS Estates, 1998).

8.2 Evaluation of the Current Waste Management System

Evaluation of the current waste management strategies confirms that the risks relating the health, safety and environment aspects of waste management have historically been addressed separately, influenced by the initial development of health and safety legislation and then latterly the development of the environmental legislation. In the context of the NHS protection from prosecution under Crown immunity this resulted in little investment in health and safety in general and waste management was no exception.

Three important factors inform much of the current philosophy of waste management. Firstly, before the EPA 1990, many hospitals had on-site incineration. There was therefore no requirement for segregation. Secondly, the removal of Crown immunity resulted in managers promoting a 'fail-safe' strategy that all waste generated within clinical areas should be disposed of as clinical waste to avoid prosecution in case of inappropriate disposal of clinical waste as household waste. Thirdly, the creation of the NHS Trusts with a business ethos reduced communication and dissemination of practice was restricted due to the contractual status.

Significantly, the escalating cost of waste disposal within the current system was recognised and yet the most obvious steps to reduce the expenditure by ensuring efficient segregation and end-disposal of the waste streams were not afforded priority. There was also limited evidence of waste minimisation as detailed in Chapter 5 and this was an important issue regarding the household waste stream. Much of the waste could be recycled instead of being treated as clinical waste. Waste minimisation would create a threefold benefit: by reducing expensive incineration costs, reducing the tonnage charge to landfill and as household waste can be compacted, decreasing the volume and the transportation costs of the waste. Within the ongoing constraints, hospitals were obliged to agree separate disposal contracts and this could demand an agreed minimum tonnage, which did not encourage waste minimisation as it may have resulted in a financial penalty being imposed. The knowledge and beliefs of employees was an important facet in the success of sustainable waste management. The commonly expressed view, that all waste was treated the same and that all waste should be treated as 'clinical waste', will require to be addressed within a persuasive training and educational program. Escaf and Shurtleff (1996) found that during a review of biomedical waste disposal the staff believed that all waste generated by healthcare was biomedical.

8.3 The Main Risks to Health, Safety and Environment within the NHS Trusts

The main risks to health, safety and environment within the NHS Trusts were identified as contaminated 'sharps' waste. These resulted in a dual risk of injury by cuts, punctures and infection transmitted via the injury sites if the 'sharps' were contaminated with pathogens (McCormick and Maki (1981), Caird *et al* (1995), Ippolito (1997), Evans and Abieboul (1999)).

The primary concerns relate to blood borne viruses such as human immunodeficiency virus (HIV) and hepatitis viruses B and C that may be transmitted by subcutaneous introduction of the causative agent. Non-reporting of the injury due to the poor monitoring systems in place was the main risk to safety. However, a further risk to the environment was created by the disposal of 'sharps' bins being treated by microwave technology prior to end-disposal at landfill sites (Westlake 1997). These systems are dependant on appropriate segregation (Blenkharn, 1995).

The primary risks to the environment were the amount of biological and chemical agents present in the hospital environment (Fishbein, 1998); also the chemical residues discharged into the sewers with adverse effects on biological sewage treatment plants. There may also be toxic effects on the ecosystems of receiving waters which may indicate a negligible human risk (Steger-Hartmann *et al,* 1997). A similar risk to ecosystems was the discharge of pharmaceutical residues such as antibiotics (Christensen, 1998) and heavy metals such as mercury; also disinfectants used in large quantities such as glutaraldehyde (Wang *et al*, 1995, Hon-Wing Leugh, 2000). Radioactive waste material in the excreta of patients discharged to the sewers (Evdokimoff *et al* 1994) may have created peaks in the permitted level, which exceeded the limit set for each hospital due to the accumulative effect because of the geographic proximity of other hospitals.

elicise Bacteria such as the antibiotic-resistant Esherichia coli (E. coli) may have been be present in the hospital sewage sludge and used on agricultural land. This may have resulted in uptake to the food crops.

Environmental pollution was also caused by the release of waste anaesthetic gases, which were captured via scavenging to lower the exposure level to employees and exhausted to the external atmosphere, contributing to ozone depletion.

8.4 Waste Disposal Policy Specific to each Hospital

Issues to be addressed within the framework were exemplified by the limited awareness of the waste policy and procedures within each hospital. The policy document in each case was adapted from the 'Safe Disposal of Clinical Waste' Guidance document (HSC, 1995) and extended to include the other waste streams. All the policies focused on the end-disposal of the waste streams and emphasised compliance with legislation relating to health, safety and the environment. The definitions of waste streams in Hospital 2 and Hospital 3, of the three waste policies examined, were interpretations of the legal definition rather than the strictly accurate application. Table 8.1 provides a summary of issues common to all 3 Hospitals.

Table 8.1: Summary of the issues common to all three Hospitals

Issue	
Dissemination of waste disposal policy/ procedures to employees.	Limited awareness of policy and procedures demonstrated.
Risk assessment procedures.	No evidence of risk assessment for waste disposal for health or environment risk.
Waste minimisation initiatives.	Not considered as a priority, no corporate response to waste minimisation.
Recycling opportunities.	Limited initiatives at departmental level only.
Segregation of waste streams at source.	Restricted opportunity available for segregation of the waste streams.
Multi-handling of waste.	The cart system did not prevent multi-handling waste bags transferred and multi handing evident.
Appropriate labelling of waste.	Limited evidence that bags are labelled with source and date.
Compliance with guidance on training for employees.	Does not meet current guidance on training for occupational groups.
Compliance with disposal of special waste.	Non compliance of PoM. Disposed of in sharp bins via the clinical waste stream.
Confidential waste disposal.	Disposed of as clinical waste.

Hospital 1 evidenced limited awareness of the appropriate guidance notes and waste regulations. There was also no specialist training in waste management for the lead

person in the waste policy development process and this resulted in the policy being informed by an existing policy that did not reflect the contractual changes in the waste management process at Hospital 1. A similar situation presented at Hospital 2. However, whilst there was greater awareness of the waste disposal documentation, there was a more limited access to the appropriate guidance and regulation at Hospital 2, due to financial constraints. At Hospital 3, the established practice of waste management actually exceeded the policy expectations and procedural guidance. The waste management practice as established previously by the Estates Department had been effectively overwritten by the Risk Manager employed by the Trust and reflected his relative inexperience in waste management.

Where the policy did not address local constraints as indicated in Chapter 7, referring to Hospital 1 and Hospital 3, for example poor access and exit routes and limited storage space, compliance with the policy was not in practice possible. The policies did not indicate any quality assurance standards to ensure that the policy was achievable, implemented and measurable. The importance of monitoring the policy and the essential support from senior management was identified in Chapter 6 (Hospital 1), where a purpose built waste storage area had been designated a storage area for medical records. Consequently, the clinical waste and household waste bags were stored for collection in the corridor, rather than the designated area. There was no contingency plan for non-collection of waste and due to limited storage this should have been considered and written into the policy. The emphasis on legal compliance excluded any consideration of the wider environmental issues pertaining to waste in any of the policies as detailed in Chapter 5, 6 and 7. The policies did not address the waste hierarchy of 'reduce, re-use, recycle', although the increasing cost of waste disposal was deemed an important issue in each hospital. An annual review of the waste policy was suggested as annual at Hospital 1 but was not carried out. Hospital 2 and Hospital 3 policies did not indicate any review date for the waste policy.

Risk Assessment

The systematised approach to health and safety is formally expressed within the UK legislative requirements for waste management as indicated in chapter 3. There is a

general requirement in the Management of Health and Safety at Work Regulations 1999 to carry out risk assessments and there are more specific requirements in the Control of Substances Hazardous to Health Regulation 1999, the Manual Handling Operations 1992 and similar legislation.

The requirement in the management regulations is:

> Part 3 Risk assessment
>
> (1) Every employer shall make a suitable and sufficient assessment of:
>
> (a) the risks to the health and safety of his employees to which they are exposed whilst they are at work; and
>
> (b) the risks to the health and safety of persons not in his employment arising out of, or in connection with, the conduct by him of his undertaking;
>
> for the purpose of identifying the measures he needs to take, to comply with the requirements and prohibitions imposed upon him by or under the relevant statutory provisions for waste management.

The law does not specify how risk assessments are to be carried out and it is therefore not prescriptive in application. The approach is goal orientated and the law lays down some basic requirements. However, there was no evidence of formal risk assessment procedures for the management of waste as demonstrated, although Hospital 3 did employ a Risk Assessment Manager. The issues identified by examination of the risk assessment process emphasised the requirement for training in basic risk assessment. Clear outlines of responsibilities, accountability, communication channels and policy development implementation and review would have to be addressed within the framework. For example, in Hospital 1 the Logistics Manager responsible for waste disposal was advised of the requirement by the Safety Officer but did not know how to conduct a risk assessment. The Safety Officer was subcontracted to the Trust and viewed his responsibility as limited to the terms of contract. In Hospital 2 and 3, the change of 'end-disposal' from incineration was not addressed as part of the risk assessment process. This had resulted in potentially serious breaches in legislation relating to special waste disposal.

Awareness of the change from incineration to microwave and landfill was restricted to those immediately involved in the waste disposal process and employees had not been consulted or informed. This resulted in a series of meetings at Hospital 3 between Directors of the waste-disposal company and representatives of the Trust to determine responsibility.

Particular concern was expressed regarding the disposal of prion tissue waste by the laboratory staff, as the Trust was a specialist centre for prion research. Incineration was proposed as the best disposal option for prion waste as the high temperatures would reduce the activity of the prion and the concern was expressed that microwave process operates at a much lower temperature. Prion waste is not classified as special waste by legal definition. However, it was apparent that consideration of the health, safety and environment issues of waste management would have ensured that the evaluation of risk was addressed at each stage of the disposal process prior to the change implementation.

Waste Minimisation

Waste minimisation was not addressed within a corporate strategy at any of the three hospitals despite the importance of the financial cost of waste disposal expressed at each hospital and the evident expensive, inappropriate disposal of non-clinical waste in the clinical waste stream.

Recycling Initiatives

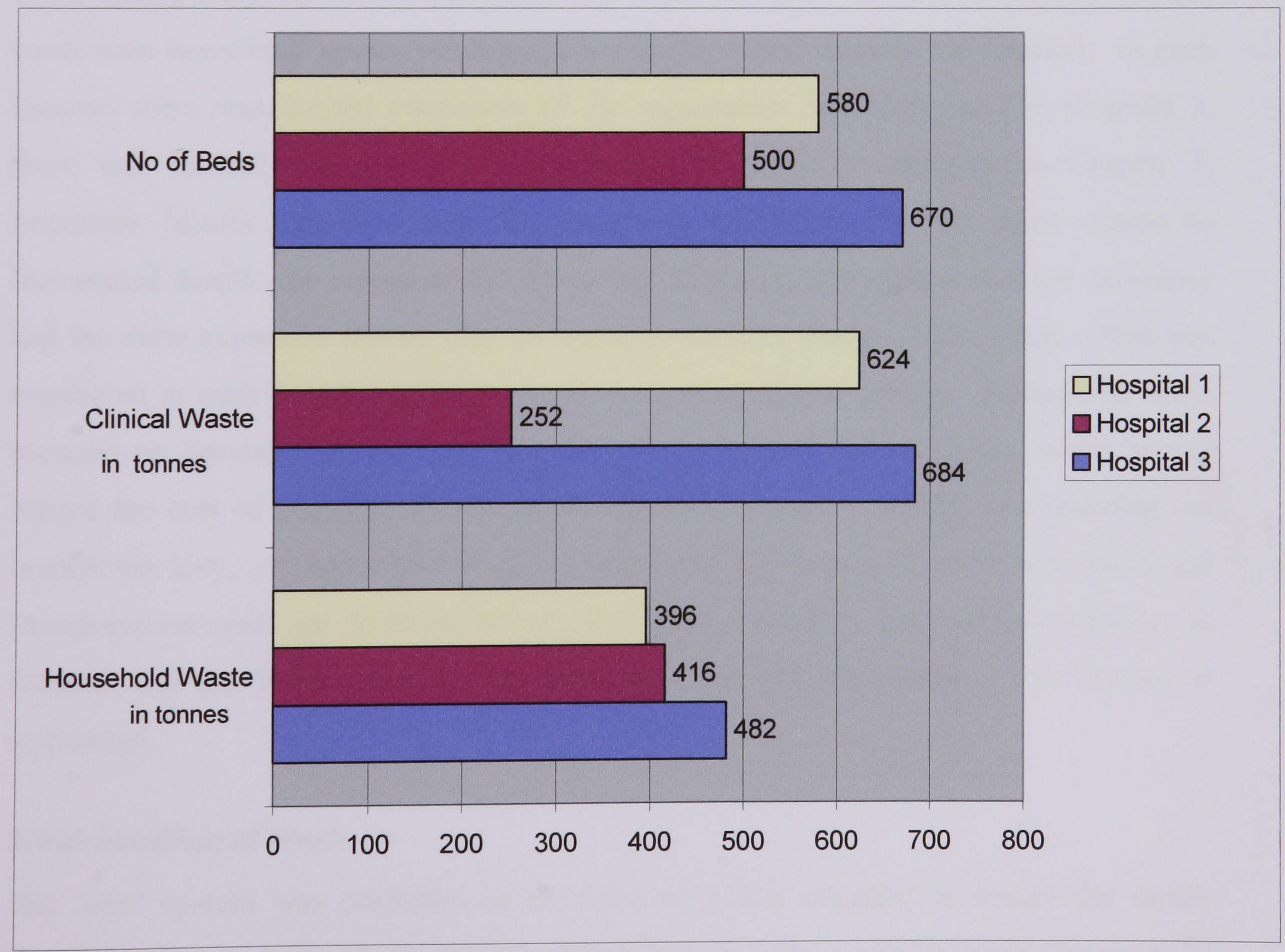
Recycling initiatives as reported in Chapter 5 were poorly developed; limited to silver recovery from x-ray films in all three hospitals and office paper recycling schemes operating at local level in each hospital. There was no corporate commitment and recycling was viewed as low priority. There was little information, guidance, or co-ordination on possible recycling options. This had resulted in the abandonment of initiatives when the material collected was not removed for recycling and had caused storage problems, for example Hospital 3 had abandoned the aluminium can collection when flies were attracted to drink cans awaiting collection, creating an infection risk.

Most waste within the Trusts was treated as clinical waste, which was the most expensive disposal option; appropriate segregation reduces the amount of waste treated as clinical waste.

Correspondingly this increases the amount of household waste, potentially reducing the cost by nine tenths. Recycling of the household waste would reduce the volume and thus the use of land for waste disposal. There are 320 NHS acute hospitals in England and Wales. The waste disposal costs in acute hospitals amounts to more than £30 million a year (Audit Commission, 1997).

Figure 8.1 demonstrates the segregation of the waste streams at the three hospitals. The greatest volume of waste produced within hospitals falls within the definition of household waste. However, in Hospital 3 and Hospital 1 it was demonstrated that a greater volume of all waste produced was disposed of as clinical waste. This indicated that the potential reduction in the cost of waste disposal was greatest in Hospital 1. It was treating 624 tonnes of waste as clinical waste from 580 beds and by reducing the tonnage per bed to the average of 6 tonnes per bed, it could have reduced the cost by 50% each year.

Figure 8.1: The volume of waste treated as clinical and household waste per annum



It is essential that any waste produced within hospitals which is hazardous or infectious is disposed of appropriately, minimising the health, safety and environmental risk. The common assumption made was that to dispose of non-clinical waste as clinical waste was a safer option than risking the inappropriate disposal of clinical waste as household waste. However, this was before the Special Waste Regulations 1996 and the assumption was dependent on high temperature incineration as end-disposal. The cost of high temperature incineration informed the decision to change to microwave disposal as a less expensive option at Hospital 2 and 3. The risk of non-compliance with legislation then increased, primarily due to the omission of a risk assessment of special waste for the microwave disposal option. This excluded all waste defined as special waste, from the clinical waste, as required to meet the Special Waste Regulations 1996 and precluded consultation with employees to advise them of the changes in the process. Responses from the employees should inform the strategies regarding the change of practice in waste management.

The increasing cost of waste disposal was considered an important factor in hospital waste management and it was estimated that it cost ten times more to dispose of clinical waste than household waste, yet segregation of the waste streams was limited. In each hospital there was limited awareness of the segregation procedures and in Hospital 3, there was limited opportunity for segregation at source as detailed in Chapter 7. Important factors identified were the expressed perception that all waste would be incinerated despite the colour of the waste bag, therefore segregation was not necessary and the view expressed that to treat all waste as clinical, was the best option. This was reinforced at each hospital and by a variety of occupational groups. Household waste requires no special treatment and has the most potential for recycling, which would reduce the cost of end-disposal by decreasing the tonnage to landfill and reducing the landfill tax levy. As household waste is compacted the volume of waste is reduced and transportation costs are therefore lower. Pollution created by the exhaust emissions is reduced and the health risks from manual handling are minimised as the process is automated.

Multi-handling of Waste

The 'cart' system was promoted in all cases as it was intended to reduce the multi-handling of waste bags. In theory this means that once the waste bags are placed in the

cart they will be transported without further manual handling. However, this was dependent on the porters removing each cart to the waste collection point regardless of the volume of waste in the cart. In practice this afforded an opportunity to transfer the waste bags to the carts that were not at capacity, thereby limiting the number of trips to the waste station. Before removal of the carts the waste disposal contractors checked that each cart was completely filled and transferred waste bags to the maximum capacity, which reinforced this practice.

At Hospital 2 there were carts that remained static suggesting that the cleaning of the carts was not taking place on a regular basis. In Hospital 3 the ward staff had not been informed about the introduction of the cart system and consequently refused to have the carts placed in the dirty utility areas, continuing to store the clinical and household waste bags in the dirty utility areas or in the hospital corridors. The carts were introduced universally as a solution to the lack of internal storage space for waste. However, in Hospital 3 the Fire Officer expressed concern that the carts placed in the corridors would impede emergency evacuation procedures.

Labelling

In each hospital this system of identification of the waste produced, together with source and date, had been introduced. Labelling was inconsistently applied. In Hospital 1 the wrong labels were in use more frequently than in Hospital 2 and Hospital 3, although in the latter two there were frequently no labels in place at all.

Special Waste

The Special Waste Regulations and the definition of special waste presented the greatest challenge of all to the procedural guidance. The definition was accurate in the Hospital 3 policy but not supported by procedural guidance. At Hospital 2 the definition was interpreted as meaning all waste that required special treatments. At Hospital 1 special waste was also deemed controlled waste. In fact all waste produced by hospitals is designated as controlled waste but is subsequently categorised. It was established practice to dispose of prescription only drugs, including cytotoxic drugs via the 'sharps' container in all three hospitals. This has the effect of changing the classification of the 'sharps' containers from clinical waste to special waste requiring a consignment note and disposal by high temperature incineration. This is important to ensure the destruction of

the drugs and emphasised the need for training for those producing the waste as well as those responsible for the disposal. In the case of cytotoxic drugs, which are potentially carcinogenic or mutagenic, microwave disposal is not acceptable and will result in environmental contamination.

Confidential Waste

The amount of confidential waste was not quantified at each hospital. The most common disposal was via the clinical waste stream. This resulted in expensive incineration or microwave end-disposal and transportation costs as the wastes had to be taken to the point of incineration. There was also the added risk of the weight in manual handling resulting in a risk of injury. In each hospital where alternatives to the disposal were available, the actual requirement to address the volume of confidential waste produced was not known. It was anticipated in each case study that the provision was underestimated and this was confirmed by observation of the confidential waste disposal practice. At Hospital 3 the closure of the dumb waiter in the medical record storage area had resulted in high risk, manual handling of extremely heavy loads of bins filled with records, up a narrow staircase. This required three or four employees each time to negotiate the stairs whilst carrying the bins. There was also evidence of build up of records awaiting removal which was addressed by staff concealing bags of records until the empty bin arrived, to avoid inappropriate disposal and this created a fire risk.

Training

The training on waste handling was limited to those directly involved with the handling of the waste such as the porters and domestic staff and was the responsibility of their line managers. Infection Control Officers were responsible for training on 'sharps' disposal. However, the national guidelines for training on waste disposal as detailed in Chapter 5, had not been implemented. The current national guidelines do not address the environmental issues as proposed in Chapter 6. None of the employees directly responsible for the waste disposal had received any training in waste management, nor was there any evidence of dissemination of information to those responsible. In Hospital 1 and Hospital 2 there was no awareness of the publication on Healthcare Waste Management issued to each Trust without charge (NHS Estates, 1997).

8.6 Progress from the Present System of Waste Disposal

The system of waste management was hospital specific within each of the NHS hospitals and was not sustainable at national level. A major constraint was the limited communication about contract costs and current waste management practices. The lack of base line data of the volume and nature of the hospitals' waste streams and end-disposal options utilised, prevented the dissemination of good practice which could have contributed to a national strategy on hospital waste management. The lack of epidemiological studies to identify health risk was a further limitation; also the dependency on hazard identification to inform risk assessment. As the largest employer in the United Kingdom the NHS is in a powerful position to negotiate financially beneficial contracts to the Health Service. By developing a homogenised national strategy, each hospital could contribute collectively to the Government's commitment to sustainability.

Chapter 9 A Framework for the Sustainable Management of Health Service Waste

9.1 Introduction

A critical evaluation of the information from the three case studies reported in chapters 5,6 and 7 has provided the basis for the development of the Framework for the Sustainable Management of Hospital waste. The framework effectively involves two tiers: firstly, the initial review of the waste management practices and secondly, a review of the management processes relating to waste management. Table 9.1 shows the initial steps to provide a baseline for sustainable waste management.

Table 9.1: Initial review of the waste management practice

◆ Inventory of wastes generated to establish baseline information
◆ Sources, quantities, types, physical and chemical characteristics of wastes identified (duty of care arrangements)
◆ Track the waste streams from production to disposal
◆ Assess the risk to people and to the environment
◆ Training to learn about how to deal with and reduce or improve risk factors identified

Waste management requirements are multi-faceted and require a holistic approach to address the management issues as shown in Figure 9.1.

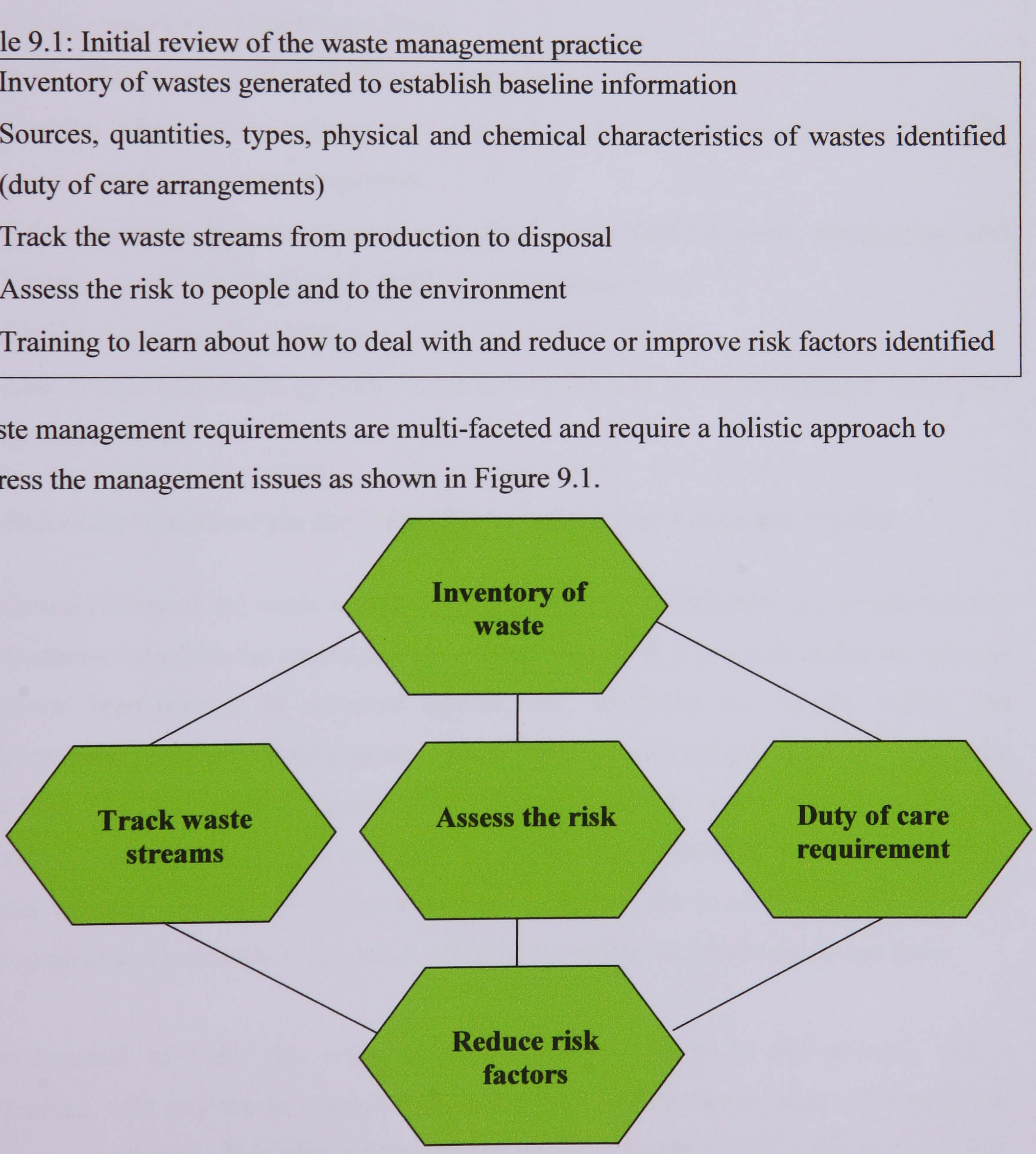


Figure 9.1: Multi-faceted issues of waste management

The management process involved in waste management is shown in Table 9.2.

Table 9.2: The management process relating to waste management

- Appoint a senior manager to lead initiative
- Inform staff of the reason for the changes
- Consult employees and their representatives
- Set Trust Objectives and Targets for waste management
- Identify a priority list of actions to be dealt with (this will develop, in part, from the initial review and in part in response to actual and pending changes in law).
- Identify Responsibilities and Departmental Objectives / Targets
- Change practice and implement policy
- Waste Minimisation, Reduce, Re-use, Recycle
- Training needs, review training provision and conduct a needs assessment for training requirements on waste management.
- Communication Systems to receive feedback from staff on waste management and Systems to provide feedback to staff on waste management
- Quality Assurance by systematic review of all of the above
- Annual report produced by policy team to be presented by senior manager to hospital executive board

9.2 Procedural Guidance for the Initial Review of the Waste Disposal Practice

The initial review of the waste management process was to determine actual practice and allow comparison with the procedural document. However, it is essential that the process of waste management is assessed against and informed by, health, safety and environmental legislative requirements and the existing national guidance documents for accuracy. The Environment Agency and Health and Safety Executive provide advice and guidance on waste management and there are many useful web sites. It would have been helpful to make contact with other hospitals to discuss the practical aspects of waste management and to compare standards, which may initiate the basis of external audit.

It is essential to track the waste streams from production to end-disposal and a comparison with any waste management policy will identify those areas of compliance and non-compliance. It is also worthwhile to consider whether each stage in the policy

statements is achievable and to identify any constraints.

The inventory of wastes generated is required to establish base information, to determine both the volume of waste produced and the disposal route. It is important to identify any areas in which waste is being stored, but not disposed of because employees are unaware of the appropriate disposal route. Confidential waste that is not disposed of and stored inappropriately is a potential fire hazard. The sources, quantities, types, physical and chemical characteristics of each waste identified are important in order to identify the relevant legislative requirements and determine where the duty of care arrangements apply.

Risk assessment as noted in Chapter 3 is required to evaluate and manage the potential danger of unwanted circumstances. It involves hazard identification, risk assessment, evaluation of risk and the level of acceptability of risk to inform risk management process. The aims of risk assessment are the protection of individual health and protection of the environment during the waste management process. Risk assessment allows prioritisation of resources to meet informed targets over a given period. There are many sources of information on risk assessment from 'Five Basic Steps to Risk Assessment', published as a free leaflet by the Health and Safety Executive, to complex quantitative methods which identify a risk rating by multiplying a probable frequency rating by a severity rating.

The framework details the process for conducting basic risk assessments. The four basic steps are:

1) The classification of work activities;
2) The identification of hazards;
3) The determination of risk; decision if risk is tolerable; preparation for risk control action plan; and
4) A review of the adequacy of action plan.

It will not include the more advanced techniques or quantified risk assessments. Training is necessary to learn to deal with and reduce or improve risk factors in the waste management process and training for the Waste Management Officer is required. The

essential components are hazard identification and a focus on risks that are liable to arise because of the waste management process. It is important to prioritise any improvement required to tackle high risks. In the first instance trivial risks can usually be recorded and a decision taken as to whether to proceed further. The level of detail recorded should be broadly proportionate to the risk.

In the definition of clinical waste as within the EPA 1990 and the Controlled Waste Regulation, the emphasis at this stage is on the health risk assessment. The health hazards not covered by specific assessment legislation should be assessed under the Management of Health and Safety at Work Regulations 1992. However, the environment risk increases with progression through the waste management process. There is also an obligation to include aesthetically objectionable or offensive waste.

Table 9.3: The legislation defining risk assessment for the environment regarding hospital waste disposal

Regulation	***Risk***
Environment Protection Act1990	Environmental Pollution, air, water or land
Environment Protection (Duty of Care) Regulations 1991	Improper handling and disposal of waste resulting in environmental pollution
Waste Management Licensing Regulations 1994	Environmental contamination and pollution during the waste management process
Carriage of Dangerous Goods (Classification and Labelling) 1996	Risk of contamination during collection and transport of waste
Special Waste Regulations 1996	Risk to the environment due to inappropriate disposal
Misuse of Drugs Regulations 1973	Risk to the environment due to inappropriate disposal

9.3 Action Required for Monitoring the Sustainable Management of each Waste Stream

The action required for monitoring the sustainable management of each waste stream is shown in Figure 9.2. The waste streams are detailed below and each stream is presented as a table, which relates to the waste stream identified. This provides reference for the

legal definition examples of the actual waste within the definition; the primary sources of the waste and legislation and implications. The action tables inform a relevant checklist for use with each waste stream. The tables provide the framework to be addressed for the waste streams and the checklist is to be completed in conjunction with the table to address the issues identified for sustainable management of health service waste. The tables show an integrated strategy to meet the health, safety and environment issues of the management of health service waste.

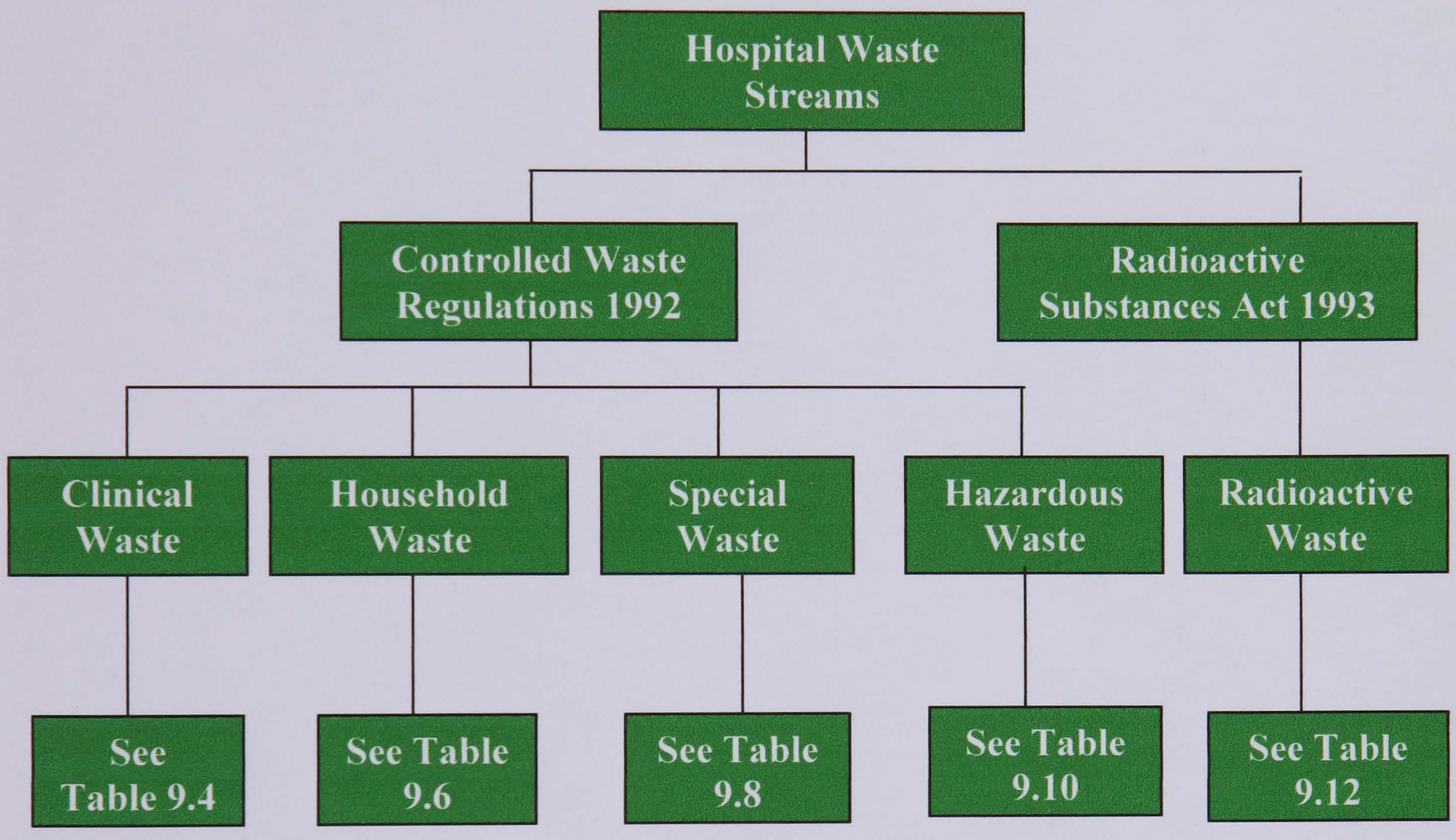


Figure 9.2: Action table required for the monitoring of the waste stream

Table 9.4 provides information on legal definitions of clinical waste streams. Examples of each type of waste and the potential sources of waste are given. The legal requirements are given and the implication considered. Actions required are identified to providing an integrated approach to health, safety and environment requirements.

Table 9.4: Clinical waste as defined in the Controlled Waste Regulations 1992

Legal Definition	*Examples*	*Primary Sources*	*Legislation*	*Implications*
EPA1990, CWR 19992	Group A: Human tissue, blood or bodily fluids; used swabs or dressings.	• Wards • Theatres • Specialist Depart. • Outpatient clinics	Health and Safety at Work etc. Act 1974	Waste Management Policy required as part of general health and safety policy
	Group B: Syringes/ needles or any other contaminated disposable sharp instruments	• Wards • Theatres • Specialist Depart. • Outpatient clinics	COSHH 1999 Manual Handling Operations Regulation 1992	Risk Assessment Record required
	Group C: microbiological cultures. infected waste	• Pathology Dept. laboratories	PPEAW 1992 CDGCPL2 1996 And CDGR 1996r	Risk Assessment Record required Classified, marked packed and carried to meet requirements
	Group D: Drugs or pharmaceutical products. All Prescription only Medicines (PoM)are classified SPECIAL WASTE and require compliance with the Special Waste Regulations 1996	• Wards • Theatres • Specialist Depart. • Outpatient clinics	Special Waste Regulation 1996 Training Consultation with Employees Regulations 1996	Clinical waste containers are not suitable. Must be appropriate to the classification of the waste Needs Assessment Record required. Communication

Clinical Waste Checklist

The observation checklist for clinical waste should be used to indicate the priority required in the action plan. Any observation in the extensive evidence of the contravention should be rated as a high priority, with the action level at each stage reflecting the frequency of the observation as shown in Table 9.5.

Table 9.5: Checklist for clinical waste

Dept.	Observation	None	Limited	Frequent	Extensive	Priority
	Storage areas for waste collection. Secure limited access					
	Segregation opportunity available at source					
	Piles of yellow or black bags in public areas or corridors					
	Bags too full (>3/4). Bursting					
	Yellow bags not labelled with point of origin					
	Mixed clinical and household waste in waste bags					
	Waste carts left with lid up. Lock not in use or broken					
	Carts static, dirt build up due to no cleaning					
	Single handling during transport					
	Transport carrying mixed waste bags					

The rating: (None) no evidence of the situation observed), (Limited) evidence observed occasionally, (Frequent) evidence observed on many occasions, (Extensive) evidence observed.

The priority: (High), immediate action required, (Medium), action required within 2 months, (Low), action required within 6 months.

The requirement for waste minimisation and risk assessment for all work activities is indicated in Table 9.6.

Table 9.6: Household waste as defined in EPA 1990

Legal Definition	Examples	Primary Sources	Legislation	Implications
Section 75 EPA	All types of waste normally found in households	• All Areas	Landfill Tax Regulations 1996 MHSAW 1999	Escalating costs Risk Assessment for all activities not covered by COSHH
	Newspapers waste paper	• Wards • Out patients	EPA 1996	Waste minimisation /recycling strategy required
	Packaging	• CSSD	Packaging Regulations?	Reduction required recycling. NHS Supplies review contracts
	Food Waste	• Catering Dept • Wards	EPA 1996	Waste minimisation Nutritional review to determine cause
	Plastic	• Catering Dept • Wards	EPA 1996	Waste minimisation recycling opportunity
	Aluminium Cans	• Catering Dept • Wards	EPA 1996	Waste minimisation recycling opportunity
	Redundant Equipment	• Building Services • Estates Dept	Electrical and Electronic Equipment Directive?	Separate collection for recycling
	Glass	• All areas	EPA 1996	Waste minimisation recycling

The checklist for household waste, which will identify potential areas of waste minimisation or existing good practice to be incorporated into the process of waste management, is shown in Table 9.7.

Table 9.7: Checklist for household waste

Area	**Waste Minimisation Yes/no?**	**Reduction Yes/no?**	**Re-use Yes/no?**	**Recycle Yes/no?**	**Action Required**
for example, wards					

Special waste is the most hazardous waste. Table 9.8 indicates that any observation of contravention should be rated as a high priority.

Table 9.8: Special waste as defined in SWR 1996

Legal Definition	*Examples*	*Primary Sources*	*Legislation*	*Implications*
SWR 1996	Oil	Estates Dept.		• Consignment Note system
	PoM Cytotoxic drugs	• Pharmacy • Wards • Theatres • OPD	SWR 1996 EPA 1990	• Destroyed only by high temperature Incineration. • Must not go to landfill sites
	Any highly infectious waste resulting from treatment of a disease of which there is no curefor example, viral haemorrhagic fever patient	• Wards	CDGCPL2	• Consignment note required. • Fee is payable to the Agencies each time the waste is moved. • Records must be held for 3years • Approved packaging required
	Group 4 biological agents	Laboratories		

The special waste checklist action plan must prioritise immediate action to rectify any contravention of the Special Waste Regulations 1996 to avoid prosecution under EPA 1990 as shown in Table 9.9.

Table 9.9: Checklist for special waste

Source	**Consignment Note Yes/no?**	**Records for 3 yr. Yes/no?**	**Approved Container Yes/no?**	**Incineration/ Approved contractor Yes/no?**	**Action required?**
,for example, Pharmacy					

Table 9.10 provides: the legal definition, examples of the primary sources, legal requirements and implications of the hazardous waste stream

Table 9.10: Hazardous waste defined in CHIP 2 1999

Legal Definition	*Examples*	*Primary Sources*	*Legislation*	*Implications*
CHIP2 1999			EPA 1990	Duty of Care
Chemical waste which is: • ***Toxic,*** • ***Corrosive,*** • ***Flammable*** • ***Reactive*** • ***Genotoxic***	Glutaraldehyde	Endoscopy Units Theatres Laboratories	COSHH 1999	Specific Risk Assessment
	Formaldehyde	Mortuary	CHIP2 199	Statutory requirements to be met
	Photographic chemicals	X-Ray Dept. Medical Illustration.	MHSAW 1999	
		Laboratories		General Risk Assessment
	Solvents	Housekeeping		Procedure to deal with Spillage
	Organic chemicals	Estates Dept.		Discharge to sewers review
	Inorganic chemicals			
Pressurised containers • ***Cylinders*** • ***.aerosol cans*** • ***cartridges***	Anaesthetic gases	Theatres Midwifery	All Above Plus CDGCPL2 1996 CDG 1996	As Above Discharge to atmosphere review
	Ethylene oxide Oxygen	C SSU		
	Compressed air	All patient care areas Laboratories Environmental control systems		

Any omission in the disposal of hazardous waste is rated high priority and requires immediate action to avoid possible prosecution. Discharge to sewers to dispose of

chemicals and discharge to atmosphere, for example anaesthetic gases, requires annual review as indicated in Table 9.11. Future restrictions are also likely.

Table 9.11: Checklist for hazardous waste

Waste	**Risk Assessment Yes/no?**	**Secure Storage Yes/no?**	**Limited Access Yes/no?**	**Custodian Name Yes/no?**	**Record Yes/no**	**Procedure for Spillage Yes/no?**	**P***
,for example, Chemical							
Pressurised Containers							
Heavy Metals							

Checklist for hazardous waste - P* = Priority - H (high), M (medium), L (low).

The legal definition, examples of the primary sources, legal requirements and implications of the radioactive waste stream are indicated in Table 9.12.

Table 9.12: Radioactive waste defined in Radioactive Waste Regulation 1999

Legal Definition	*Examples*	*Primary Sources*	*Legislation*	*Implications*
Ionising Radiations Regulations (IR)1999	Unsealed sources Diagnostic procedures for example, imaging procedures	Nuclear Medicine	I R 1999	• Records, required for at least 2years from the date of disposal • Suitable store receptacle and label • Discharge to sewers requires review
	Therapeutic applications Radioactive Iodine	Wards Research Laboratories		
	Low level contaminated wastefor example, swabs, syringes	Clinical Laboratories Operating Theatres		
	Sealed Sources Therapeutic applicationsfor example, teletherapy apparatus, brachytherapy sources	Radiotherapy Medical Wards		

Table 9.13 indicates the priority ranking for radioactive waste. P*= Priority: H (high), M (medium), L (low). Any omission in this area is rated high priority and requires immediate action to avoid possible prosecution. Discharge to sewers requires review. The present limits are set for individual hospitals and do not address or reflect the potential peak level discharge of the hospitals in the area as an accumulative limit.

Table 9.13: Checklist for Radioactive waste

Source	**Area**	**Storage Yes/No?**	**Labels Yes/No?**	**Containers Yes/No?**	**Record Yes/No?**	**Priority*/Action?**

9.4 Recommendations for a Local Strategy for NHS Hospital Waste

A Waste Minimisation Officer post appointment should be created, with training provided that is specific to the complexities of the culture and diversities of waste management within the NHS hospitals. The Waste Minimisation Officer's responsibilities should include training in waste management issues for all occupational groups and the promotion and facilitation of reduction and recycling initiatives. The Waste Minimisation Officer responsible for co-ordinating the waste minimisation strategy will liaise with the Waste Manager to develop best practice. The Waste Manager, whether a Trust employee or contractor, reports to a senior member such as the Director of Facilities or equivalent who is responsible to the Trust Board. At ward level a Local Co-ordinator of Initiatives to reflect the priorities of staff, will facilitate implementation and monitoring of the strategy.

Initially the aim to develop a sustainable waste management strategy is achievable by reducing the volume of waste treated as clinical by excluding all uncontaminated household waste from the clinical waste stream. The use of all disposable equipment and the possible re-use without risk requires audit. Also, the disposal of non-contaminated items during operations as household waste, not clinical waste, reduces the volume. Increased opportunity for segregation encourages appropriate segregation at source and results in an increase in the household waste stream. The household waste stream can then be reduced in volume by increasing recycling initiatives and reducing the amount of packaging.

9.5 Recommendations for a National Strategy for NHS Hospital Waste

The strategy should outline the rationale for sustainable waste management within NHS hospitals. It should detail:

- national requirements;
- management responsibilities for waste within and outwith the hospital;
- legal definition of hospital wastes and regulations for each waste stream;
- consultation process with employees;
- dissemination of a framework;
- audit programmes for waste management;
- training requirements;

- pending European directives.

In order to achieve successful implementation of this national strategy, two essential requirements to be addressed are: communication and training and education. The NHS Estates Department is pivotal in the process of co-ordinating and monitoring a national waste management strategy. The training and education should be tailored to each occupational group and be mandatory for all staff responsible for the generation of hospital waste. Training on waste management is recommended at induction, at the commencement of employment and periodic updates during the period of employment.

The importance of waste management has to be acknowledged at Board level. This may be in the first instance by regional seminars where each Trust representative provides an overview of current waste management practice. A working group for policy development and implementation on a national level should be convened in parallel with local groups to prioritise and address any issues of non-compliance with regulatory requirements.

A cascade approach is recommended as an efficient way to disseminate information to a large number of employees by 'training-on', trainers.

9.6 The Benefits of a National Strategy for the Sustainable Management of Hospital Waste

The integrated approach to health, safety and environmental issues of waste management is a holistic approach addressing the issues pertaining to waste management in each aspect area separately, but not to the detriment of the others. This approach addresses the recommendation of 'Integrating the environment and development in decision making', as detailed in United Nations Sustainable Development Agenda 21 Chapter 8(1994).

The benefits can be considered as multifaceted; waste minimisation reduces the pollution impact of waste disposal and saves land by requiring less use of landfill sites. Less energy is required for transportation and disposal to incinerators or microwave disposal. Reduced cost of end disposal by appropriate segregation and waste minimisation is achieved by developing 'reducing, re-using, recycling' initiatives. This would result in safer disposal of hospital waste and a reduction of the health and environmental risk to the local and wider communities. It would also encourage sustainability at each stage of

the process of waste management.

The dissemination of information will enhance compliance with existing United Kingdom legislation and also future European Directives designed to meet environmental requirements within a waste management strategy which will: minimise harm to health or the environment; minimise the costs and release funding for patient care.

9.7 Conclusion

The reconnaissance visits to six hospitals provided an overview of waste management practice and identified the key personnel involved in the waste management process. The three in-depth case studies were conducted to observe the actual waste management practice and to follow the waste streams from production to disposal.

On the basis of discussion and observation pertaining to the practice of waste management, the perceived hierarchy of waste management responsibility by the waste managers, as restricted to clinical waste disposal and household waste disposal, was identified. This was with regard to waste streams such as pharmaceutical and radioactive waste, where separate disposal arrangements were in place, but not monitored by the Waste Manager and where there was limited knowledge demonstrated of the process in practice, or legal requirements.

An examination of the policies relating to Waste Management identified inaccuracies in the policy definition of the waste streams. Where local constraints on policy implementation had not been considered, non-compliance with the policy was inevitable, but was also not addressed due to the omission of audit of the waste management process.

Limited opportunity for segregation of the waste stream at source existed, resulting in the unnecessary disposal of household waste as clinical waste that increased the cost of waste disposal. The intention to avoid prosecution by disposing of the majority of waste as clinical waste regardless of the limited risk or cost, as a fail-safe approach, is contradictory in application.

The commitment to waste minimisation was not supported as a strategy or considered as

potential cost saving. The total volume of waste treated as clinical waste was known but there was no monitoring of the waste produced by area to allow comparison. The lack of reliable base line statistical data to determine the volume and weight of each waste stream was a key deficiency in the process within the hospitals.

Risk assessment on the waste streams was not carried out, yet it is a legal requirement at each stage of the process. The risk assessment procedure requires training to ensure hazards are identified and actions taken to minimise the risks. The actual practice of monitoring the incidence and follow up of needlestick injuries was poorly developed and under-reporting is likely, as the subcontracted groups were excluded from statistics.

Education and training in waste disposal was aimed at domestics and porters, but this training excluded the environmental issues. Lack of training was a major issue during the transfer from waste disposal by high temperature incineration, to waste disposal using microwave technology. This was further compounded by limited communication to staff at all levels.

Contingency plans for non-collection of waste by contractors were not in place. Waste carts awaiting collection congested corridors and when placed at collection points in corridors created a fire hazard. The intention of introducing the cart system was to reduce manual handling of the waste. However, the practice was to fill each cart by transferring bags on the collection round to minimise the number of journeys between the waste station and disposal collection route. The European Union supports the use of rigid one-way containers for clinical waste and there was no consideration of the future implications of this.

Chapter 10 Conclusions and Recommendations for Further Research

10.1 Conclusions

This thesis presents the first comprehensive evaluation and examination of the waste management policy and waste management practice in selected NHS hospitals.

In relation to earlier work, the aim of the framework is to facilitate and guide the implementation of sustainable waste management, through the process of identifying and addressing the issues related to the health, safety and environmental aspects of waste management within NHS hospitals. The framework is addressing health, safety and environment aspects of the waste management issues in a tripartite way and is the first attempt to combine the management of all the waste streams, widening the approach from clinical waste stream only. This will also assist in the development of a management strategy with respect to those issues, which is efficient, effective and sustainable.

The framework aims to identify both the high-risk aspects of waste management, which require immediate attention to meet legislative requirements and existing good waste management practice, which can be incorporated into the waste management policy. The emphasis of the framework is on the minimisation of waste, appropriate segregation of waste streams at source and continuous monitoring through to final disposal. The framework also alerts the non-specialist to waste management issues and addresses the requirements of the waste streams separately, within a holistic waste management strategy.

The application of the framework addresses the objectives of reducing the amount of waste produced, by effective waste minimisation, re-use and recycling. It reduces the environmental impact in respect of the consequent reduction of the volume of waste disposal via incineration or landfill sites. This also reduces exhaust emissions during transportation of healthcare risk waste and reduces the amount of healthcare waste requiring special treatment by appropriate segregation and thereby lowering the cost. By ensuring that the tonnage of waste treated as clinical waste is only clinical waste, then the economic advantages are substantial savings in the cost of waste disposal

The framework promotes safe handling of the waste streams at each stage during the

process of waste management from production to end-disposal and protects patients, employees and visitors within the hospital from waste-related injury and infection. It also protects the local residents of neighbouring communities and those involved in the transportation and end-disposal of the waste streams. The sustainability of a well-run service will further enhance the perception of the importance of waste management and increase support for sustainable policies from all the stakeholders within the hospital and local community.

10.2 Waste Segregation

The developed framework for the sustainable management of hospital waste is a holistic approach to address the issues of Health, Safety and Environment pertaining to all hospital waste streams at each stage of the waste management process, as identified during the reconnaissance visits and in-depth case studies.

The future sustainable management of health service waste must address health, safety and environmental concerns in the process of managing the waste streams from the point of production to end-disposal. The current and traditional practice of reactive response to health and safety issues to ensure compliance with legislative requirements, which primarily relate to the clinical waste stream, is restrictive. It results in non-clinical waste being disposed of as clinical waste, placing an unnecessary and costly burden on the Trusts and the environment, by expensive end-disposal due to poor segregation and excludes the many other waste streams generated during health care.

10.3 Waste Categorisation

There is not a standard waste definition or classification of healthcare waste within the European Union. This makes comparison of types of waste and overall volume difficult

The waste disposal regulatory framework see Chapter 3 Table 3.1 indicated that health safety and environment issues were distinct, with different agencies for health and safety and the environment. However, it is difficult to identify the specialist boundary beyond which health and safety objectives cease to operate and environmental issues begin.

The Environment Agency estimates that special waste arisings in England and Wales have increased from 1.5 million tonnes in 1986/87 to a provisional estimate 5.5 million tonnes in 1998. This indicates an increase of 3.5 million tonnes in ten years, excluding the special waste disposed of as clinical waste. There was no research available on the actual practice of waste management within hospitals in the UK and there was limited baseline data available on the volume and types of waste streams.

Preliminary Visits to Six Hospitals

The reconnaissance visits to six hospitals were exploratory and provided an overview of waste management practice, identified the key personnel involved in the waste management process and informed the criteria for the choice of the in-depth case studies. On the basis of discussion pertaining to the practice of waste management, the perceived hierarchy of waste management was identified. The hierarchy for waste management was different within each unit and the responsibility was restricted to clinical and household waste streams only.

With regard to waste streams such as pharmaceutical and radioactive waste, where separate disposal arrangements were in place but not monitored by the waste manager, there was limited knowledge demonstrated of the process in practice or legal requirements. There was little evidence of any strategies to reduce, re-use, or recycle materials, apart from silver recovery from x-ray departments.

10.4 Waste Minimisation

The Government's commitment to waste minimisation at all the hospitals visited was not supported as a strategy, or considered as potential cost saving. This was surprising, as the emphasis was on the financial cost of waste disposal. Many areas were designated as 'yellow bags only'; these included office areas where there was no clinical waste produced. There was limited opportunity, if any, for segregation of the waste stream at source in clinical areas and no training for staff, resulting in the unnecessary disposal of household waste as clinical waste, which increased the cost of waste disposal. The intention to avoid prosecution by disposing of the majority of waste as clinical waste,

regardless of the limited risk or cost, as a fail-safe approach, was contradictory in application.

The total volume of waste treated as clinical waste in each hospital was known, but there was no monitoring of the waste produced by area to allow comparison. The lack of reliable base line statistical data to determine the volume and weight of each waste stream was a key deficiency in the present process within the hospitals.

Fly-tipping

Not only was the problem of waste minimisation to be addressed, there was evidence of fly-tipping of clinical waste at one of the hospitals and despite the increased risk to health as bags were left outside, no effort was made to determine source. It was suggested that the local GP's left the waste bags at the hospital to avoid disposal costs. Fly-tipping of household waste equipment was also accepted as historic practice and was a common occurrence at another hospital, for example a pile of six soiled mattresses had been brought on site, unloaded and left beside the waste skip. This practice is likely to increase due to the charges levied for disposal of waste to landfill sites following the introduction of the Landfill Tax.

10.5 Risk Assessment

The health risks of uncollected waste were most severe for those living near the hospital site. Children were at risk of injury or infection. Wastes also provide feeding stock for insects, rodents and other vermin that are potential carriers of enteric pathogens. The requirement to conduct risk assessment on the waste streams was not carried out although it was a legal requirement at each stage of the process. It was apparent that without training to ensure hazards are identified and actions taken to minimise the risks, non-compliance with legislation would continue.

10.6 Health and Safety

It became apparent in the course of this research that the actual practice of monitoring the incidence and follow up of needlestick injuries was poorly developed and under-reporting was likely. It was suggested by the sub-contractor in each hospital that there were no needlestick injuries, nor had there been, in anyones' recollection. The incidence of

needlestick injury was not readily available and estimates were contradictory. That there were no such injuries was unlikely, as during the collection of the waste carts it was observed that there was a practice of compacting the bags in the carts with bare hands to increase the number of bags in each cart. An associated problem with the statistics was that the subcontracted groups of porters and domestic staff were excluded from the figures. The contractors were not directly responsible to the hospitals and had their own hierarchical structure. This did not remove the responsibility for health and safety from the hospital and a detailed assessment was required for contracting-out that included training, accident monitoring and investigation and provision of protective clothing with a record of issue and an 'old for new' exchange system.

Waste Disposal

Contingency plans for non-collection of waste by contractors were not in place. Waste carts awaiting collection congested corridors and when placed at collection points in corridors, created a fire hazard. The intention of introducing the cart system was to reduce manual handling of the waste. However, the practice was to fill each cart by transferring bags on the collection round to minimise the number of journeys between the waste station and disposal collection route. The European Union supports the use of rigid one-way containers for clinical waste within the ADR framework. The UK has been granted derogation from compliance for a five-year period as of Jan 1997; this would make the use of plastic sacks illegal following this period. Derogation appears to be interpreted in the UK as a period in which to carry on with existing practices and as the time runs out, argue to retain these practices. The stance was similar to the incineration standards, which ultimately were imposed and incinerators were shut down due to non-compliance, without an alternative strategy for waste disposal. This resulted in a reactive response within a short time-frame instead of using the derogation period to consider and develop the best management strategies for compliance with legal requirements.

Waste Management Policies

The waste management policies were examined to determine accuracy of the policy, feasibility of implementation and compliance. Inaccuracies were evident in the policy definition of the waste streams. Where local constraints on policy implementation had not been considered, non-compliance with the policy was inevitable but was also not

addressed due to the omission of audit of the waste management process.

Education and Training

Education and training in waste disposal was limited to domestics and porters and this training excluded the environmental issues. The lack of training was a major issue during the transfer from waste disposal by high temperature incineration, to waste disposal using microwave technology. Staff continued to dispose of PoM via the clinical waste stream and it was noted that poor communication was causing problems with the operation of the microwave due to inappropriate disposal. For example, an artificial hip joint placed in the 'sharps' bin for disposal, had arced the microwave and caused a break down. Hospital staff were unaware until the hospital was informed of the incident and it was clear that this was the normal route of disposal. It was also apparent that there was no consideration of an alternative disposal route. Another example was a soiled blanket, which was placed for disposal in a yellow bag and was trapped in the shredders. The risk factors to health, safety and the environment were of particular concern when it was established that prion clinical waste was assumed to be safely disposed of by high temperature incineration and the laboratory staff were unaware until advised of the problem during the case study.

Selection of Hospitals for In-depth Case Studies

Three hospitals were selected which met the criteria of having a waste policy, a variety of waste streams and geographic proximity. The volume of waste generated in each case was sufficient for comparison of the waste management processes and the identification of the health, safety and environment issues, which informed the development of an integrated framework for the sustainable management of hospital waste. A generic methodology detailed in Chapter 4 (section 4.10) was applied to each case study to allow comparison within the hospitals. Due to the evolving nature of the in-depth case studies, additional objectives to analyse further issues identified during the previous case study, were developed.

In- depth Case Study: Hospital 1

The in-depth case study undertaken at Hospital 1, a purpose-built modern hospital, highlighted the importance of senior personnel commitment to the waste management process. A designated waste storage area had been changed to a record storage area resulting in the bags of waste accruing, without prior consultation, in the public corridor.

The complexities of contracting-out waste disposal services revealed a lack of training or availability of guidance documents to inform practice. Contractual financial agreement and not a common goal of addressing the pertinent issues of health, safety and environment, determined responsibilities. Where the cart system was used to collect the clinical waste bags, the practice was to push one cart and pull another simultaneously, to minimise the number of trips. Observation of this indicated non-compliance with the Management Regulations1999 and the associated Approved Code of Practice.

In- depth Case Study: Hospital 2

The constraints due to the restricted finance were evident at Hospital 2. The failed bid for Private Finance Initiative (PFI) resulted in a postponement of the upgrading of the hospital site and some areas were derelict. The risks to health and safety were increased as a substantial part of the hospital site was sold for development and the lockable carts used to transport waste were placed outside in areas of public access. On inspection, there was extensive evidence that the carts were left open and frequently bags were transferred from one of the carts to fill another, resulting in repeated handling; a known risk factor. If the carts were locked the waste bags were piled up alongside, awaiting collection.

The financial restraints for end disposal had informed a change from high temperature incineration to microwave technology. Lack of communication regarding the change and no risk assessment resulted in an increase in environmental risk, as traditionally many PoMs were disposed of via the cinbins and this practice was continued, in breach of the waste disposal contract and legislative requirements.

In- depth Case Study: Hospital 3

The development of concentrated acute services at Hospital 3 increased the bed capacity and acute services represented an increase in the volume and types of waste produced. Health risks, identified by research on transmissible spongiform encephalopathies and viral hepatitis, were increased as a result of the change to microwave technology. The change was not communicated to the Laboratory staff and they were still using precautions based on risk factors for waste disposed of by high-temperature incineration.

The cart system for waste collection was in place, although in some areas the staff refused to have the carts, as they overloaded available space in the utility areas and created a fire hazard.

10.7 The Development of a Framework for the Sustainable Management of Hospital Waste

The in-depth case studies reported in Chapters 5, 6 and 7 examined the actual process of waste management within each of the three hospitals referred to as Hospitals 1, 2 and 3. Analysis of the studies identified generic and specific issues pertaining to the three hospitals. The application of the framework discussed in Chapter 9 addresses the objectives of reducing the amount of waste produced by effective waste minimisation, i.e. 're-use, reduce, recycle' strategies. By so doing it reduces the environmental impact in respect of the consequent reduction of the volume of waste disposal via incineration or landfill sites and the exhaust emissions during transportation. The economic advantages are a substantial saving in the cost of waste disposal.

10.8 Recommendations for Further Research

This research was primarily to determine waste policy and actual waste management practice and to inform the development of the framework for the sustainable management of hospital waste.

10.10.1 Waste minimisation and recycling

Waste minimisation is a prerequisite of successful waste management strategy and requires further research to determine the cost benefits to the NHS through planned segregation of waste and an investigation of the potential concurrent viability of recycling within the culture of the hospitals.

Further research into what informs the employees' risk perception will also be necessary to address the underlying concerns within the training and education programmes.

There was no waste minimisation strategy primarily due to the concerns of non-compliance resulting in the disposing of clinical waste as non-clinical. This fail-safe approach was an expensive option. However, the fear of the consequences in terms of financial penalty and bad publicity informed the decision. Other reasons included the

expressed view that this was the best option and that segregation was an inappropriate cost cutting exercise. It was also suggested that all waste be incinerated. Therefore it was not necessary to segregate the waste. This implied that if there was an understanding of risk at all, the perceived risk of non-compliance with clinical waste disposal legislative requirements was much higher in actual cost than the actual health, safety and environment issues.

10.10.2 End-Disposal

End-disposal has significance far beyond its immediate practicalities. Environmental impact in both the short and more particularly the long term, will need significant research investigation into all aspects of disposal, be it landfill, incineration, recycling or other future innovations. The health and environmental impacts of hazardous waste, such as fluorescent tubes, requires investigation to determine actual disposal practice and relative risk.

10.10.3 Microwave Technology

Microwave technology will need further research in respect of its suitability for a true cross section of NHS waste. Despite its alleged cost-benefit attraction, it has exposed in practice a number of problems relating both to the plant operation and some real doubt as to the subsequent product's application to landfill end disposal.

10.10.4 The Use of Carts

The use of carts requires further investigation to reduce the risk of accumulative back injury as a health risk to employees. Ergonomic risk assessment research is required to establish whether the current practice of pushing one cart and pulling another simultaneously, is a causal factor for accumulative back pain. The assumption that multi-handling of the bags is decreased by the use of carts was challenged by observations of practice. There were a number of other significant factors in respect of the security of the waste stored in unsecured areas; the actual hygiene of the cart system itself and fire hazard implications due to the positioning of the carts in corridors, were matters requiring further investigation.

10.10.5 Contracting Out

In the course of this research, it became apparent that the sub-contracted groups were responsible for the waste disposal process. At ward level, if the waste areas became congested with bags, they remained so until collected. This resulted in piles of bags strewn around the collection points. It became apparent that once the bags left the immediate clinical areas the staff ignored any overload. They did not request an additional pick-up to resolve the build-up and ignored it. Waste management has to include a shared responsibility for end-disposal. Future research is required to determine the number of appropriate disposal containers needed and the frequency of collection.

Associated problems

The porters did not have any authority to request any change in practice and it did appear that there was little communication between the groups. When a designated waste area was changed to store medical records the logistics manager was not informed, although this resulted in waste bags being left for collection in the corridor. Contracting-out requires close scrutiny as it significantly impacts on the hierarchy of responsibility i.e. contractors were not directly responsible, which further impacts on training and education and the provision of protective clothing. Insurers may ultimately provide the impetus for change in this practice. However, further research is required to determine where waste management falls within the hierarchy or priorities in the NHS. The impact of contracting-out to assess the advantages and disadvantages of the options should be evaluated and the findings disseminated to inform choice.

10.10.6 Discharge to Sewers

Chemotherapy and cytotoxic drugs are a particular concern regarding the current methods of disposal and their potential in respect of their discharge in urine into the public sewage system. Treatments for thyroid cancer generate a significant amount of radioactive waste. Each hospital has its own maximum limit, but there was no appreciation of peak levels due to simultaneous treatment within the hospitals served by the same plant. It is recommended that a multiple holding tank system be developed to hold the toilet discharge for physical decay before it is released. This would prevent the creation of peak levels exceeding the permissible concentration. It is important that further research

is conducted to establish what the peak levels during the discharge to the sewage system are; also to develop a risk analysis tool to determine the risk to health and the environment.

This research has demonstrated the complexity of issues pertaining to sustainable waste management within the NHS and confirms the employment of a multi-faceted approach to address the health, safety and environment issues of hospital waste management.
The guidance on the implementation of the waste management strategy is in accord with the principles of Agenda 21's global action plan for achieving sustainable development and the Government's strategy for waste minimisation of 'reduce, re-use, recycle'.

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Appendix: 1 Reconnaissance Visits

Hospital
Contact Name
Position
Telephone Number

Areas for discussion

- General information on the hospitals, No of beds

- Hierarchy of responsibility for waste management

- Waste Policy, Key Personnel related to waste management practice

- Categories and sources of hospital waste

- Initiatives to recycle, reduce, re-use, or recovery of waste

- The amount of clinical waste produced

- Disposal route, storage system and frequency of collection of clinical waste

Consent for follow up In-depth case study
Name
Contact No
Position

Appendix 2: In-dept Case Studies Pro-forma

- Base Tel no
- Areas for observation

Contact Names and Tel No
Position

Time of Observation

- Interviews

Contact Names and Tel No

- Types and Volume of Waste
- Times of Waste Collection
- End Disposal
- Documentation

Special Waste

Constraints /Restraints Policy Implementation

- Comments
- Follow up

APPENDIX 3: OBSERVATION PRO-FORMA

Observation	None	Limited	Frequent	Extensive
Piles of yellow or black bags in public areas				
Bags too full (>3/4).				
Yellow bags not labelled with point of origin				
Yellow carts not locked				
Single handling during transport				
Transport Mixed waste bags				
Storage areas with public access				
Porters not wearing PPE				

The rating used was: **None** - no evidence of the situation observed;

Limited - evidence observed occasionally;

Frequent - evidence observed on many occasions;

Extensive - evidence observed extensively.

APPENDIX 3A: CLINICAL WASTE: COMPLIANCE WITH HEALTH, SAFETY, AND ENVIRONMENT LEGISLATION

Category	Type A	Type B	Type C	Type D	Type E
1 Risk Assessment					
2 Specification of containers					
3 Labels					
4 Storage					
5 Transport					
6 Handling, before disposal					
7 PPE					
8 Manual Handling					
9 Final Disposal					

APPENDIX 3B: HOUSEHOLD WASTE: -COMPLIANCE WITH HEALTH, SAFETY AND ENVIRONMENT LEGISLATION

Category	Rubbish	Cardboard	Glass/Aerosol	Confidential	Fluorescent Tubes
1. Risk Assessment					
2. Specification of containers					
3. Labels					
4. Storage					
5. Transport					
6. Handling, before disposal					
7. PPE					
8. Manual Handling					
9. Final Disposal					

APPENDIX 3C : SPECIAL WASTE: COMPLIANCE WITH HEALTH, SAFETY AND ENVIRONMENT LEGISLATION

Classification	Pharmaceutical	Oil	Chemical		
1. Risk Assessment					
2. Specification of containers					
3. Labels					
4. Storage					
5. Transport					
6. Handling, before disposal					
7. PPE					
8. Manual Handling					
9. Final Disposal					

APPENDIX 3D: RADIOACTIVE WASTE: COMPLIANCE WITH HEALTH, SAFETY AND ENVIRONMENT LEGISLATION

Classification	Category A	Category B	Category C	Other	
1. Risk Assessment					
2. Specification of containers					
3. Labels					
4. Storage					
5. Transport					
6. Handling, before disposal					
7. PPE					
8. Manual Handling					
9. Final Disposal					

APPENDIX 3E: CHEMICAL WASTE: COMPLIANCE WITH HEALTH, SAFETY AND ENVIRONMENT LEGISLATION

Classification					
1 Risk Assessment					
2 Specification of containers					
3 Labels					
4 Storage					
5 Transport					
6 Handling, before disposal					
7 PPE					
8. Manual Handling					
9. Final Disposal					