

**AN AUDIT OF VETERINARY WASTE MANAGEMENT IN**

**DURBAN**

**BY**

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Submitted in partial fulfilment of the academic requirements of the degree of  
Masters of Environmental Management in the School of Life & Environmental Sciences,  
University of Natal, Durban.

October 2003

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## ABSTRACT

Since 1994, there have been sweeping changes made to South African policy and legislation, including environmental rights for all people, environmental protection and the consideration of sustainability in all activities. A national policy for medical waste management is being developed and guidelines for the South African Veterinary Council are currently being revised. By auditing contemporary veterinary waste management in one of South Africa's largest cities, this study sought to provide appropriate input into these initiatives. As a study area, the Durban Unicity provided the opportunity to audit a large population of veterinary clinics within a relatively short distance of each other and also the opportunity to ascertain whether waste management practices were dependent on the socio-economic status of the clinics' catchment area.

A pilot study was used to inform the design of a questionnaire, which was then administered to thirty-two clinics sampled to represent a range in size of clinic, predominant type of patient treated and catchment socio-economic status. Another questionnaire was administered to four waste disposal companies and one veterinary diagnostics laboratory that removed waste for disposal from veterinary practices.

The main findings suggest that there is a health risk to staff and the public, due to the incorrect separation, storage, handling and disposal of sharps, anatomical, contaminated domestic and infectious material. Staff at 6.3% of clinics sampled are not provided with any safety equipment. Most veterinarians (63%) as well as two of the five waste disposal companies audited were not aware of their responsibilities in terms of waste management policy and legislation. Sixty nine percent of the practices sampled reported that employees have either never been trained or have not received training in waste management in the past five years. Domestic waste contaminated with other potentially hazardous waste forms 12% of the total waste stream reported by practices. Even though the results indicate that a few veterinary practices are mismanaging their waste, this has the potential for a negative impact on staff, the public and the environment. The findings of the study would suggest a need for well communicated,

enforceable guidelines outlining sustainable veterinary waste management for practices and waste disposal companies. The study highlights the similarities between veterinary and medical waste and the need to consider this in planning an effective waste management strategy. It also provides guidelines for a sustainable approach to veterinary waste management.

BRN 430258.



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## PREFACE

The experimental work described in this dissertation was carried out in the School of Life and Environmental Sciences, University of Natal, Durban, from February 2002 to August 2003, under the supervision of Dr. Helen Watson and Prof. McLean.

This study represents original work by the author and has not otherwise been submitted in any form for any degree or diploma to another tertiary institution. Where use has been made of the work of others, it is duly acknowledged in the text.

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## LIST OF ABBREVIATIONS

<b>ADA</b>	The Animal Diseases Act (Act No. 35 of 1984)
<b>APPA</b>	Atmospheric Pollution Prevention Act (Act No. 45 of 1993)
<b>DEAT</b>	Department of Environmental Affairs and Tourism
<b>DoH</b>	Department of Health
<b>DWAF</b>	Department of Water Affairs and Forestry
<b>ECA</b>	Environmental Conservation Act (Act No. 73 of 1989)
<b>EIA</b>	Environmental Impact Assessment
<b>HAZCHEM</b>	Hazardous Chemicals
<b>HBA</b>	Hazardous Biological Agent
<b>HPCSA</b>	Health Professions Council of South Africa
<b>NEMA</b>	National Environmental Management Act (Act No. 107 of 1998)
<b>OHS</b>	Occupational Health and Safety Act (Act No. 85 of 1993)
<b>RSA</b>	Republic of South Africa
<b>SABS</b>	South African Bureau of Standards
<b>SAVA</b>	The South African Veterinary Association
<b>SAVC</b>	The South African Veterinary Council
<b>SVO</b>	The State Veterinary Office
<b>TRPC</b>	Town and Regional Planning Commission

## ACKNOWLEDGEMENTS

This study was only possible with the help and support of many friends. My thanks and appreciation to the following:

My two supervisors, Dr. Helen Watson and Prof. Michelle McLean, who oversaw this study from the beginning, and whipped me into action when they needed to.

Staff and colleagues in the School of Life and Environmental Sciences, for their encouragement and support.

For a crash session in proofing Prof. Lenta and Tanya.

Respondents from veterinary practices (who were always keen to assist) and waste disposal companies, who all gave of me their time and attention (frustration), in particular Ms. E. Thomas (SAVA), Dr. S. Dhanilal (SVO), Dr. CM Cameron (SAVC) and Dr. J. Morton (SAVA). I hope this makes a positive difference in your work.

My sister for helping me out with the typing (*Manga nyumba bwino, ndipo ti za nkala bwino*).

Lastly but by no means the least, the Muswema's at no. 4 for their encouragement and support and constantly reminding me why. Park for being a great friend.

CHAPTER 1 - INTRODUCTION

1.1 BACKGROUND

Veterinary waste management is a cause of concern because there are both public health and environmental problems associated with improperly managed waste. Information about the types of wastes produced and how these are disposed of can be used as a tool to interrogate the management process. This can be done considering such aspects as prevention, minimising, segregation, identification, handling, treatment and disposal of veterinary medical waste (Town and Regional Planning Commission (TRPC), 2000).

Baldwin and Ball refer to data published by Hall (2000), which indicates that there were "almost 27000 potential sources of health care waste in South Africd" (Baldwin and Ball, 2000:429). The authors indicate that the composition and quantity of waste varies widely, but the sources of waste that they have quoted are mainly from human health care activities. Unfortunately, there is no indication of what veterinary sources contribute to these figures.

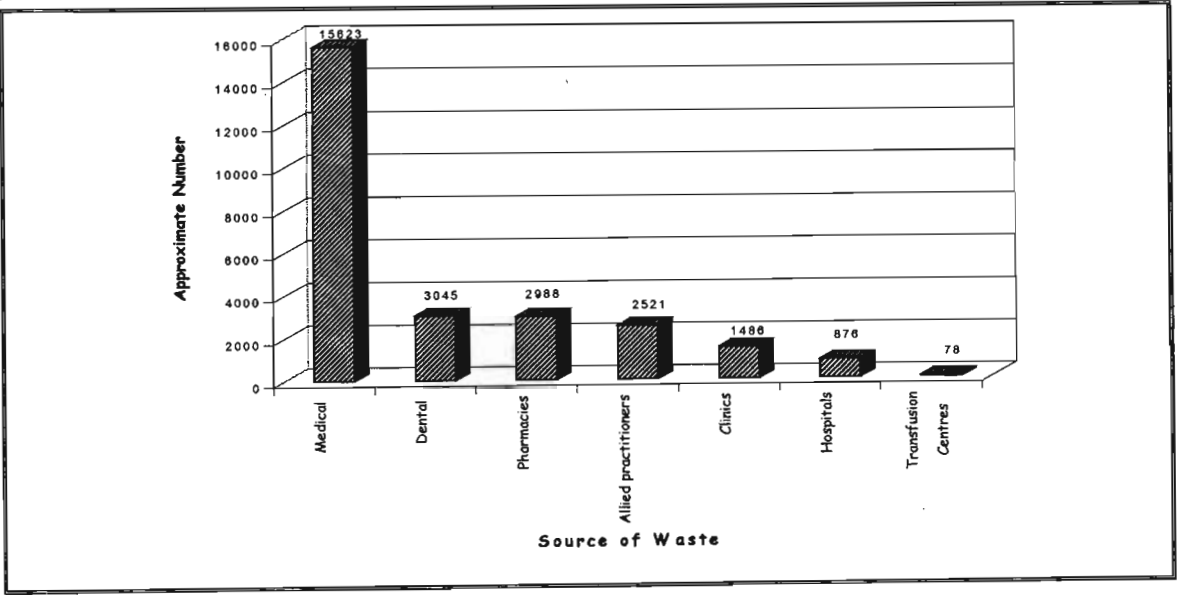


Figure 1. Sources of Health Care Waste in South African.<sup>1</sup>

<sup>1</sup> Modified from Baldwin and Ball, 2000. Allied practitioners include acupuncturists, paramedics and blood care services. Medical and dental practices include private and public facilities.

There were 871 South African veterinary practices (including those registered as close corporations) in 2001 (SAVC, 2001). These registered facilities provide veterinary services and produce veterinary waste. While the quantities of waste generated at veterinary practices may not be equivalent to those produced in human hospitals (Figure 1), this waste inevitably includes items such as sharps, anatomical waste and waste that may be contaminated with hazardous biological agents. Despite the low quantities of these wastes generated, if improperly managed they may pose a health and environmental risk.

## **1.2 MOTIVATION FOR THE STUDY**

This study was undertaken because of media reports highlighting the dangers associated with illegal dumping of medical waste. In most cases, these reports refer to concerns about the possibility of contracting Human Immuno-deficiency Virus (HIV) from mismanaged or dumped health care waste (HCW). Of particular concern therefore is the fact that veterinary waste has the potential to adversely affect the health of people and the environment, but this concern is not reflected in current waste management legislation. In light of the above, the South African Veterinary Association (SAVA) and the South African Veterinary Council (SAVC) have come under increasing pressure to revise policy and guidelines for waste disposal.

This pressure has also resulted in the Government revisiting its policy on medical waste management, in particular the identification of other sources of waste such as veterinary waste. Unfortunately, little is known about how veterinary waste is managed in South Africa today or about the types and quantities of waste generated. All of this provided motivation for the present study. Some of the benefits of this study include:

- The generation of baseline information on veterinary waste management.
- A better understanding of the relationship between veterinary and medical waste, including their potentially negative impact on the public and the environment.
- A review of contemporary veterinary waste management and identification of areas where improvement needs to be effected.

- Guidelines for sustainable veterinary waste management at the veterinary practice level.

### **1.3 MOTIVATION FOR THE STUDY AREA**

The Durban Unicity<sup>2</sup> was chosen as the focus for this study. Durban provided the opportunity to study different types of veterinary practices. These included the different patients seen (including practices that treated small or large animals); practices described as clinics or hospitals and the opportunity to study these variations in different socio-economic areas of the Unicity (also section 3.2). In addition, Durban provided these different types of practices within a relatively short distance of each other.

### **1.4 AIMS AND OBJECTIVES OF THE STUDY**

The main aim of this study is to describe the current management of veterinary waste in the Durban Unicity. Specific objectives include:

- Identifying the types of veterinary waste generated at practices.
- Determining the quantities of veterinary waste being generated in these categories.
- Identifying areas of weaknesses in the current waste management processes (specifically veterinary practices and companies disposing of veterinary waste).
- Making recommendations regarding a more sustainable waste management process. This will include improvements to the entire process, to make it more environmentally and socially acceptable, while keeping in mind the economic implications of such suggestions.
- Developing guidelines for veterinary waste management, similar to those available to human medical practitioners.

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<sup>2</sup> What is described as the "*Unicity Durban Metropolitan Boundary*" in the eThekweni Municipality IDP document (eThekweni Municipality, 2002:1)

## 1.5 STRUCTURE OF THE DISSERTATION

This dissertation consists of seven chapters. The first introduces the study, provides background and describes the aims and objectives of the study. The second reviews South African legislation and available literature on veterinary waste management. This also sets the context for veterinary and human medical waste in South Africa (section 2.2 for a definition), and reviews principles for veterinary waste management, describing an ideal model for waste management. Chapter 3 presents the methodology for the study. This includes a description of the study area, the sample frame, questionnaires administered and a summary of the data analysis. Chapter 4 presents the findings of this study. This is presented in two parts. The first is a summary of the responses from veterinary practices. The second provides responses from companies that remove waste from veterinary practices (waste disposal companies and a veterinary diagnostics laboratory). Chapter 5 discusses these results in the light of the literature presented in Chapter 2 (based on general waste management principles and the ideal model presented). From these discussions and the results presented, it becomes apparent that there are certain 'areas of need'. These relate to the veterinary waste management process, where the guidelines available are insufficient or inadequate, identified in Chapter 4 and Chapter 5. A set of guidelines and recommendations is provided for the 'needs' identified in Chapter 4 and Chapter 5. This is done through the guidelines proposed for veterinary waste management in Chapter 6.



## CHAPTER 2 - LITERATURE REVIEW

### 2.1 INTRODUCTION

Little published information is currently available on the management of waste from veterinary practices in South Africa. More specifically, there is a lack of information on the management processes, public health issues and guidelines for handling wastes. Where this information does exist, it may not be readily available. While various laws and draft policies regulating waste exist, regulations specifically applicable to veterinary practices are at the White Paper stage i.e. DEAT (2000).

The work done overseas has focussed mainly on the waste management process (British Veterinary Association, 1993a; Nowlan, 1997). This includes the shift away from incinerator technology as a form of treatment, due to public health concerns. Aspects of responsibility for waste generated at veterinary practice level and reviews of legislation governing waste management are dealt with. There appears to be considerably more information available on the management of human medical waste. Indeed, certain principles or aspects of waste management applicable to medical practices may also be applied to veterinarians. There are, however, differences that must be kept in mind. For instance, the activities that generate waste and where these are generated (on the farm or at the practice), (Brody, 1993; Hannah, 1995).

This chapter begins by defining veterinary waste and considers its relationship to and similarities with medical waste. Legislation applicable to veterinary waste management, consisting of South African laws, policy documents and guidelines for management is then reviewed. A set of principles for the management of veterinary waste, bearing in mind the activities that generate this waste follows. These are derived either from existing or proposed legislation or from waste management theory.

An overview of the dangers associated with veterinary waste is also provided. This is followed by a consideration of the risks associated with poor waste management and

how they can be mitigated. Finally, an ideal model for veterinary waste management is presented, against which the results from this study will be compared.

2.2    DEFINING VETERINARY WASTE

For the purpose of this study, veterinary waste includes all wastes originating from veterinary practices. There are many similarities between veterinary and human medical waste, these include the similar categories into which both can be subdivided (Table 1). Nowlan (1997) describes five categories of veterinary waste. These include biological (also known as anatomical), infectious, chemical, sharps and radioactive waste (Table 1). These are similar to human medical waste categories described by others (i.e. Pruss *et al.*, 1999; Health Professions Council of South Africa (HPCSA), 2002) (Appendix 1). Based on the data collected in this survey, domestic waste should be defined as an additional category. It includes plastic, paper, cardboard or other wrapping material. This is because of the poor separation of waste that sometimes occurs at source, rendering what should be harmless, potentially harmful. In relation to medical waste, this is sometimes referred to as health care risk waste (HCRW) or health care general waste (HCGW), (Yawitch *et al.*, 2002).

Table 1.   Categories of Waste Produced by Veterinary Practices<sup>3</sup>.

VETERINARY WASTE CATEGORY	CONTENTS
Domestic	Office refuse, in particular paper or plastic wrapping, cardboard boxes (also known as general waste).
Anatomical	Recognisable tissue, animal carcasses, swabs and dressings (soaked with blood).
Infectious	Any health care waste likely to be hazardous to human health, including microbiological cultures and potentially infective waste from different activities.
Chemical	Toxic substances including pharmaceuticals, sterilising agents and used drugs (including X-ray film).
Sharps	Hypodermic and suture needles, including broken glassware, blades and lancets.
Radioactive	This includes wastes that emit alpha, beta or gamma radiation.

Health Care Waste describes wastes that are produced by human health care institutions. Other terms encountered in the literature are clinical waste. The Veterinary Record (British Veterinary Association, 1991; British Veterinary Association, 1993a) describes clinical waste as all waste from veterinary practices except domestic

<sup>3</sup> Modified from Nowlan, 1997.

waste. This includes any anatomical waste, bodily fluids including blood, sharps and infectious waste (British Veterinary Association, 1993a; Giles, 2001). The SAVC is currently revising its code of conduct for veterinarians concerning waste disposal. The Council defines clinical waste as animal tissue, blood and bodily fluids, pharmaceuticals, chemicals, swabs or dressings and sharps. Domestic waste is not considered clinical waste by the Council. The Department of Health (DoH) Proposed Regulations for the Control of Environmental Conditions Constituting a Danger to Health or a Nuisance (hereafter referred to as the 'Proposed DoH Regulations'), lists veterinary practices, treatment stations and kennels as sources of medical waste (DoH, 2000). This dissertation focuses on private veterinary practices, and companies disposing of this waste (Chapter 3).

There is at present no statutory definition of medical or veterinary waste in South Africa (Rigby, 2002). The 'Proposed DoH Regulations' (DoH, 2000) describe five classes of medical waste (similar to the categories presented in Table 1). These regulations still need to be promulgated. The Department of Water Affairs and Forestry's (DWAF) Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (DWAF, 1998) uses a source-based system to define medical wastes. This includes all wastes generated by hospitals, clinics, doctors' rooms and research facilities. Unfortunately, veterinary practices are not mentioned. In the same document, however, infectious waste is defined as waste generated when humans or animals are treated, diagnosed or immunised. It also includes those wastes (e.g. pathological waste, sharps, human and animal anatomical wastes) that may contain infectious substances (DWAF, 1998). The drafters of that document were perhaps unaware of or possibly neglected to consider veterinary practices in this definition. Potentially infectious wastes from veterinary practices would fall under this definition of infectious wastes. This is a problem, which Brody (1993) describes in defining a regulated environment and the disadvantage of adopting a checklist approach to listing the different types of waste generators in the definition. It would be better to base the definition of medical waste on certain characteristics of the waste, e.g. its potential to infect people, animals

or environmental dangers. For the purposes of this dissertation, veterinary wastes will be defined as all wastes from veterinary practices, as depicted in Table 1. Unless otherwise stated, the terms 'medical waste' and 'HCW' will be used interchangeably and represent the 'umbrella' term for wastes generated through health care activities (relating to both animals and humans). It logically follows that wastes from either human medical or veterinary practices, will be known as human medical waste or veterinary waste for the purpose of this dissertation.

Having presented a definition of veterinary waste, it is important to describe a legislative framework within which veterinary waste management falls. It is important to understand this because the mismanagement of waste in general is an offence punishable by law. Also contained in the legislation are principles for waste management applicable to veterinarians.

## **2.3 LEGISLATIVE FRAMEWORK FOR VETERINARY WASTE**

A legal framework is presented for veterinary waste management, although there are certain aspects of human medical waste management that are also applicable. This is most apparent where disposal options, management principles and guidelines for veterinary waste are considered. Following is a review of the legislation, policy and guidelines applicable to veterinary waste management (Table 2).

### **2.3.1 Waste Management Legislation**

Our Constitution (Republic of South Africa (RSA), 1996) provides people with the right to a safe and healthy environment. In addition, citizens have the right to have the environment protected from pollution and degradation (section 24 of the Bill of Rights). Improperly disposed of veterinary waste could eventually end up as litter, pollution or as an occupational health and safety risk for people handling waste. The Environmental Conservation Act (ECA) (RSA, 1989b) provides for the controlled utilisation of the environment and protection from pollution. Under the ECA, it is an offence to litter or dump veterinary waste. The ECA also recognises certain activities that might have a

deleterious affect on the environment. This includes the siting of landfill sites covered under section 21, 22 and 26 of the ECA.

**Table 2. Legislation Policy and Guidelines Applicable to Veterinary Waste.**

<b>LEGISLATION</b>	The Health Act (Act No. 63 of 1977).
	The Animal Diseases Act (Act No. 35 of 1984).
	Atmospheric Pollution Prevention Act (Act No. 45 of 1993).
	Occupational Health and Safety Act (Act No. 85 of 1993).
	Constitution of the Republic of South Africa (Act No. 108 of 1996).
	Environmental Conservation Act (Act No. 73 of 1989).
	National Environmental Management Act (Act No. 107 of 1998).
<b>POLICY</b>	Minimum Requirements for the Handling and Disposal of Hazardous Waste (DWAF, 1998).
	A Draft Policy of the DWAF concerning the Issuing of Permits for Waste Management Facilities and other Alternative Waste Disposal Technologies (DWAF, 2000).
	White Paper on Integrated Pollution and Waste Management for South Africa (DEAT 2000).
	Proposed Regulations for the Control of Environmental Conditions Constituting a Danger to Health or a Nuisance (DoH, 2001).
	KwaZulu-Natal Draft Medical Waste Management Policy (KwaZulu-Natal DoH, Undated).
<b>GUIDELINES</b>	SABS 0248: Code of Practice for the Handling and Disposal of Waste Materials within Health Care Facilities (South African Bureau of Standards, 1993).
	Guidelines for the Management of Health Care Waste by Medical Practitioners, Dentists and Medical Scientists (HPCSA, 2002).
	Code of Conduct and Practice: Veterinarians (SAVC, 1998) <sup>3</sup> .

The Occupational Health and Safety Act (OHSA) (RSA, 1993a) provides protection to staff at places of work. It also extends this protection to the general public (section 9). Under section 7 of the Act, employers may be directed to describe arrangements made to protect the health and safety of employees. It is the employer's responsibility to provide a safe environment (as far as this is practicably possible) for workers (section 8). Reducing the hazards, e.g. physically separating the patient treatment area from other high traffic areas in the work place, before using any protective equipment, may achieve this. As an employer, a veterinarian has a duty to minimise hazards in the workplace. This would include hazards associated with any wastes produced in the practice.

Hazardous Biological Agents (HBA) Regulations contained in the OHSA are relevant to veterinary waste management. Under these regulations, it is the employer's responsibility to ensure that workers are adequately informed and trained before they are exposed to HBA (section 4). This training includes theoretical and practical aspects of protective equipment and the general management of HBA. Employers must also develop and implement a procedure, which they display on their premises, that enables infectious wastes to be disposed of safely. All reusable waste containers must be disinfected and employees involved in the waste management process must be provided with appropriate safety equipment. Annexure B of the HBA Regulations provides a list of zoonoses<sup>4</sup>, for some of which vaccines are available. There are approximately 235 HBA listed. These consist of bacterial, parasitic and viral agents. Many of the HBA listed are encountered in practice as zoonotic conditions (Appendix 10). It is for this reason that the veterinarian should have a system in place to manage the wastes produced. This needs to be guided by principles provided by the National Environmental Management Act (NEMA) (RSA, 1998). Briefly, some of these include sustainability and a responsibility for wastes, including a 'duty of care'<sup>5</sup> and the 'polluter pays'<sup>6</sup> principle (NEMA, section 2.4).

The control of infectious substances similar to that in the HBA Regulations can be found in the Animal Disease Act (ADA) (RSA, 1984). Under this legislation, items contaminated with a controlled disease must be disposed of through either burning or burial. Burial should be to a depth of 1.8 m or burial with quicklime to a depth of 1.3 m. Although veterinary waste is not explicitly mentioned, specific categories of waste that might be infectious include anatomical, pharmaceutical, domestic and infectious waste. Sharps and chemicals are not discussed in this Act.

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<sup>3</sup> Reviewed the section in the code of conduct dealing with veterinary waste.

<sup>4</sup> The group of diseases that is transmissible between humans and animals is termed zoonoses

<sup>5</sup> An obligation to ensure that in carrying out one's service or profession, the waste produced is managed in a safe and responsible manner.

<sup>6</sup> Those producing waste are responsible for its safe disposal, and in the event that the waste causes any adverse effects, the producers are responsible for the costs associated with remedying this.



The Atmospheric Pollution Prevention Act (APPA) (RSA, 1993b) lists processes that require an Environmental Impact Assessment (EIA) in terms of the ECA. These scheduled processes include the incineration of waste materials that may give rise to noxious or offensive fumes.

### **2.3.2 A Review of Waste Management Policy**

The White Paper on Integrated Pollution and Waste Management for South Africa (DEAT, 2000) lays the foundation for an integrated approach to waste management. There is an emphasis on prevention, minimisation, cross media integration, government department integration, and affected party involvement in decision-making. The drive is for holistic management by looking at waste management from the 'cradle to grave'<sup>7</sup>. For example, this includes generation, storage, collection, transportation, treatment and final disposal of waste. The White Paper also recognises hazardous medical and veterinary waste as being possible sources of land pollution. In attaining the overarching goal of managing waste and pollution in an integrated way, the DEAT has identified seven strategic goals (DEAT, 2000). These include an effective institutional framework and legislation, pollution prevention, waste minimisation, impact management and the remediation of transgressions, holistic integrated planning, participation and partnerships, empowerment and education, information management and international co-operation. Some deliverables include a register of waste treatment facilities (including those for medical and veterinary waste), public awareness about the hazardous nature of medical waste and the legal responsibilities of medical waste generators. This should be extended to veterinary waste generators. In addition, a register of waste handlers and pollution indicators will be developed. The White Paper also contains a number of principles for an integrated waste management system (section 2.4).

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<sup>7</sup> Waste management from its point of creation, until it is finally disposed of.



In the spirit of the White Paper, the DoH has proposed regulations which need to be implemented (DoH, 2000). Chapter 6 of the 'Proposed DoH Regulations' deals with the management of veterinary waste. Under these proposed regulations, veterinary practices are recognised as a source of medical waste. This means veterinarians are required to carry out their waste management activities in such a way that they do not become a nuisance or hazard. Cytotoxic and genotoxic wastes must be labelled. Also, all perishable waste should be frozen or stored at 4 °C. Vehicles moving medical waste must be thermally insulated, equipped with spill kits and all exposed surfaces need to be disinfected on a daily basis. Both vehicles and storage areas must be inaccessible to vermin and unauthorised persons must be denied access. These guidelines are not yet legally binding (DoH, 2000)

In addition to the 'Proposed DoH Regulations' above, the DWAF has a Draft Policy for the Management and Disposal of Medical Waste (DWAF, Undated) and a Medical Waste Management Strategy (DoH, Undated). The management strategy outlines principles for medical waste management. These are presented in section 2.4 of this dissertation. These include prevention, segregation, identification, handling, treatment and disposal. The draft policy recognises that alternative technology (to incineration) exists for the disposal of medical waste. In order to licence alternative technology, the DWAF requires a general technical evaluation be undertaken. This includes a description of the process or technology to be used, the disposal details for the final product and evidence that the results are similar to or better than incineration.

### 2.3.3 Guidelines for Waste Management

The South African Bureau of Standards (SABS, 1993) and the HPCSA have available guidelines for the management of medical waste. National medical waste management guidelines are in the process of being developed (WD Khanyile, 2003, *pers. comm.*<sup>8</sup>). In addition to these, guidelines for veterinary waste management which are also in the process of being revised are available (CM Cameron, 2002, *pers. comm.*<sup>9</sup>). The HPCSA guidelines recognise nine separate categories of medical waste. These include infectious, pathological, sharps, pharmaceuticals, chemicals, heavy metals, radioactive, genotoxic wastes and pressurised containers (HPCSA, 2002). These guidelines provide a comprehensive treatment of various aspects of human medical waste management, from separation at source to final disposal of wastes. The HPCSA waste disposal guidelines recognise the need to manage sharps in a safe and responsible manner (Sharps must be disposed of into a puncture-proof, lockable, durable container; Seibert, 1995; HPCSA, 2002). A summary of these guidelines is provided in Appendix 1. These guidelines were not intended to address the management and disposal of wastes from veterinary facilities or animal care centres (HPCSA, 2002). Most of the principles described can, however, be applied to veterinary waste management. They are discussed in the following section and again in Chapter 5 of this dissertation.

Veterinary waste management guidelines are currently being revised by the SAVC (CM Cameron, 2003, *pers. comm.*<sup>10</sup>). Clinical waste is defined as including anatomical, pharmaceutical, chemicals, sharps and infectious waste. Domestic waste, which would include all of the wrapping (paper or plastic for example) is not discussed. Anatomical waste should also be frozen or refrigerated. The duty of care principle is recognised, in that the guidelines acknowledge the fact that veterinary waste could be the cause of ill health for both humans and animals. The guidelines do not, however, provide for other waste management principles, such as waste prevention and minimisation, separation at source, appropriate waste identification and responsibility for waste. It is also part of

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<sup>8</sup> Mr WD Khanyile, Director-Environmental Health, Department of Health, Pietermaritzburg.

<sup>9</sup> Dr CM Cameron, CEO-South African Veterinary Association, Monument Park, Pretoria.

the waste generator's responsibility to ensure that others disposing of waste do so in a responsible manner (British Veterinary Association, 1992; British Veterinary Association, 1993a).

These draft policies, guidelines and legislation are important because disposal options for veterinary waste are similar to those that are currently in place for medical waste. They include the use of incineration technology. Recently, an alternative to incineration using autoclave<sup>11</sup> technology was introduced into KwaZulu-Natal. This process uses steam to sterilise waste, which is then shredded to render it unrecognisable. Human anatomical waste must still be incinerated according to the Human Tissues Act (Act No. 65 of 1983). The OHSA recommends that incineration be the method of treatment for animal carcasses infected with HBA (Annexure E of Hazardous Biological Agents Regulations of the OHSA).

## 2.4 PRINCIPLES FOR SUSTAINABLE WASTE MANAGEMENT

Having discussed a legislative framework, it is important to identify what principles need to be applied for a safe waste management system. The most important principles governing environmental management are to be found in the Constitution of South Africa, NEMA and the White Paper on Integrated Waste Management (DEAT, 2000). These introduce two important themes: people's right to a healthy environment and the concept of intergenerational equity (the protection of the environment for present and future generations).

Section 2 of NEMA outlines principles of environmental management. In relation to veterinary waste, these include advancing the needs of people at the forefront of concern in environmental management. In relation to veterinary waste, this can be interpreted as providing a safe and risk free environment for people (general workers<sup>12</sup>

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<sup>10</sup> *Op. cit.*

<sup>11</sup> The use of high water vapour at high temperatures and pressure to sterilise waste.

<sup>12</sup> For this dissertation general workers are taken to be all workers without a formal medical background. This includes personal assistants, assistants and cleaners in the practice.

in a veterinary practice or other individuals involved in the waste management process) through careful management of veterinary waste. This principle establishes a homocentric approach to environmental management (NEMA).

For sustainability three important elements in decision-making are needed, that is a process or activity must be environmentally, socially and economically viable. In relation to this, pollution and waste is to be avoided and where this is not possible, minimised or remedied. The precautionary principle must be applied to decisions or actions relating to the environment. Environmental management must be integrated, taking cognisance of the linked and interrelated nature of most activities with the environment. This in turn leads to the choice of the best practicable environmental option when making decisions about waste management and the environment. Environmental justice must also be applied and individuals must be made aware of their rights to an unpolluted environment. Environmental justice would apply to people involved at all levels of the waste management process (veterinarians or general workers delegated responsibility for waste management in the practices) including those involved in the handling, transportation and final disposal of veterinary waste. General workers should not be discriminated against because of their lack of knowledge, poor education or ignorance, they have the right to be informed of the dangers related to the work they perform (NEMA; Anonymous, 2000).

Responsibility ('related to a 'duty of care' and 'polluter pays') is another important principle. Responsibility for waste disposal rests with the generator of wastes. It follows that veterinarians are responsible for the waste they generate in delivering their services. This is for the entire lifetime of the waste. Even after it has been handed over to a waste disposal company for disposal, the veterinarian is still responsible for the waste that s/he has generated. If this is not disposed of correctly, the original generator of veterinary waste is liable for any clean-up costs or for any adverse health effects that may have resulted. Brody (1993:1076) recommends the appointment in every practice of a veterinary "*waste co-ordinator*" who would be

responsible for allocation of responsibilities like record-keeping, co-ordinated waste management training or refresher courses for staff. The appointed individual will also have responsibility for implementing the practice's waste management programme. This responsibility could be delegated to one of the staff instead of appointing a new individual.

The White Paper (DEAT, 2000) represents a paradigm shift away from end pipe solutions to a more sustainable approach to waste management, which includes preventing waste. If prevention is not possible, then minimisation should be considered. The Medical Waste Management Strategy for KZN (DoH, Undated) describes three ways to achieve this: careful stores management, use of items designed to be easily sterilised or re-used and the recycling of pressurised gas cylinders. In addition to this, following a policy of 'first in first out' would help to reduce pharmaceuticals or chemicals that expire in stores (Kaiser *et al.*, 2001).

Another method of minimising waste is referred to as "*green purchasing*" (Kaiser *et al.*, 2001:206). This is in reference to the bioaccumulation of mercury and dioxins. Kaiser and co-workers (2001) describe how the purchasing mechanism is used to promote environmentally preferred products (e.g. substituting mercury thermometers with digital ones to reduce the amount of mercury waste the practice produces). These authors state that cost, efficacy, availability and quality currently carry more weight in the decision to purchase, whereas environmental criteria are usually not considered. For those individuals making the purchases, an environmental background, training or even awareness of environmental issues would help. The goal is to use 'green purchasing' to reduce the waste produced and then to manage the waste that cannot be avoided. To facilitate the disposal of those unavoidable wastes, separation at source should be encouraged.

Source separation is the process of removing from a particular waste stream those (usually small) wastes with an objectionable characteristic (e.g. separating hazardous from non-hazardous waste or separating wastes contaminated with infectious material

from uncontaminated waste). In doing this, one can reduce the amount of waste requiring special treatment, storage, transport and disposal. This invariably leads to savings on the part of the practice (Quayle, 1998; J Parkin, 2003, *pers. comm.*<sup>13</sup>). Segregation of waste is one of the problems highlighted by Baldwin and Ball (2000) for South African incinerators. Other authors (Reinhardt and Gordon, 1991; British Veterinary Association, 1993a) also indicate that due to the different kinds of medical waste, it is important to separate waste. This is because depending on the process used to dispose of it; the presence of some substances may cause expensive mechanical or process failure for waste disposal equipment.

Separation must be carried out with knowledge of what process constitutes the final treatment of the waste and what statutory requirements exist. Waste must be separated at source. Sorting through medical waste to separate it is unacceptable. The Medical Waste Management Strategy for KwaZulu-Natal (DoH, Undated) indicates that there is currently very little 'at source' separation of medical waste. In addition, general domestic wastes are at present being mixed with medical waste. This ultimately could lead to higher disposal costs for practice, especially when disposal becomes more strictly controlled, or it could lead to exposure of the public to infectious diseases (Cook, 1995). In order to assist the separation process and ensure proper management, some form of coding system should be introduced to identify waste. Colour coding must be applied to medical waste containers. The recommended colour coding system by the HPCSA's Guideline document (HPCSA, 2002) is summarised in Appendix 1.

## **2.5 DANGERS ASSOCIATED WITH VETERINARY AND MEDICAL WASTE**

One of the greatest dangers associated with the improper disposal of HCW (medical and veterinary waste) is undoubtedly that of infection. It is often claimed that around 50% of the bio-hazardous waste stream (Anonymous, 1993) in South Africa is unaccounted for. The Town and Regional Planning Commission (TRPC, 2000) indicates

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<sup>13</sup> Mr J Parkin, Plant and Disposal Manager, Durban Solid Waste, Durban.

that in addition to infection, there is also a concern for pollution and public health and safety from poorly functioning incinerators and bad waste management practices.

#### **2.5.1 Risk of Infection from Poorly Managed Wastes**

Some of the risks associated with infectious HCW are the contraction of AIDS and Hepatitis B or C (Franz, 1999). Most veterinary waste is not infectious to humans (Brody, 1993). The control of zoonoses is covered under the Animal Disease Act and the OHSA. The OHSA provides a list of HBA, most of which are zoonotic conditions routinely encountered in practice.

#### **2.5.2 Pollution**

Due to the similarities between the human medical and veterinary professions, it is not surprising that the types of waste produced are similar. This means it is difficult to distinguish between medical and veterinary HCW. With estimates that 50% of the medical waste stream is unaccounted for (Anonymous, 1993; TRPC, 2002). Rigby (2002) has provided a possible explanation. First, this waste is probably being miss-classified resulting in HCW's being deposited in the domestic or general waste stream, due to negligence or ignorance. Secondly, HCW may be being dumped illegally. Either way, this hazardous waste is probably being disposed of with no control measures in place, resulting in pollution. This has the potential to affect occupational and public health, not to mention the risks posed to people scavenging on landfills (pickers) or the risks to environment (British Veterinary Association, 1993b). A problem in some areas of South Africa is the development of informal settlements on the periphery of landfill sites. These communities use the landfill site as a source of livelihood. Improper disposal of HCW, especially sharps and infectious waste, can result in their exposure to these potential dangers (Anonymous, 1993a; Baldwin and Ball, 2000; Rigby, 2002; Rossouw G, 2002).



### 2.5.3 Incineration

Incinerators have been cited as sources of dioxins and furans<sup>14</sup> (Quayle, 1998; Poggiolini, 2000). If they are incinerated at sub-optimal temperatures, polyvinyl chloride (PVC) containing products oxidise and form these pollutants. Poor construction or operating process within the incinerator lead to the possibility of incomplete combustion of wastes (see associated problems in section 2.8.4.1 of this dissertation), especially in the presence of chlorine based plastics (Tickel and Watson, 1992).

Tickel and Watson further describe a study to compare the products of destruction, between hospital and general or domestic waste. The investigation found that medical waste produced 30% of the dioxins and furans, whereas domestic waste produced only 1% of dioxins and furans generated. The presence of furans and mercury (Kaiser *et al.*, 2001) in the exhaust gases from incinerators, is also recognised as being carcinogenic. Other harmful substances from incinerators include nitrous oxides, sulphurous oxides, hydrogen halides and carbon monoxide, in addition to the heavy metals left in the ash residue at the bottom of furnaces (Rigby, 2002).

### 2.5.4 Sewage

There is very little information on the composition of effluent from hospital sewage (Tolosana, 1996). Although this dissertation will not consider sewage disposal in detail, it is important to mention it here. Tolosana (1996) has indicated that phenolic compounds, used for the disinfection of surfaces, can reach 1000 times normal permitted levels stipulated by some local authorities. He also refers to a study that compares Chemical Oxygen Demand (COD) between hospital and domestic effluent. There was virtually no difference in the COD levels but an analysis of the composition revealed that the effluent contained more toxic substances, such as mercury, antibiotics, disinfectants and other chemicals. These chemicals may interfere with the microbes that are involved in the breakdown of wastewater and thus disrupt these

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<sup>14</sup> These have been identified as carcinogenic products of incomplete combustion, derived from poorly functioning incinerators.

processes (American Veterinary Medical Association, 1994). Another concern is the bioaccumulation of these toxins in the food chain and eventually in human tissues, especially where sewage sludge is used to fertilise agricultural land.

## **2.6 INDIVIDUALS AT RISK FROM POORLY MANAGED WASTE**

Poor waste management poses serious risks to both people and the environment. People at risk include all those involved in handling veterinary waste, including the public when these wastes are disposed of in areas where the public has access (Baldwin and Ball, 2000; Kaiser *et al.*, 2001).

### **2.6.1 Patients and Workers at the Veterinary Practice**

Animal patients and personnel are at the interface of the generation of medical waste. It is here that the risks posed by human medical or veterinary waste might first make an impact through improper disposal methods. Wastes should be disposed of into the right container or receptacles as soon as they are generated. Appropriate containers should be provided for the disposal of waste, within easy reach of the veterinarian. Sharps containers and different bins for infectious and non-infectious waste must be easily accessible (DoH, Undated).

### **2.6.2 Workers at the Veterinary Practice and the Public**

Staff charged with handling HCW within practices are also at risk. Improperly segregated waste including over-filled sharps containers pose a risk to people who handle HCW (risk of cuts and needle sticks or risk of infection from waste in domestic waste containers). This also includes the people who move HCW, the waste transporters, people at the treatment plants, the final disposal sites and the public (Constable and Harrington, 1982; Australian Veterinary Journal, 2000).

In moving HCW within the practice, improper storage or excessive handling runs the risk of rupturing the containers or receptacles. 'Clean' areas in the practice become contaminated with HCW. This is why it is necessary to use the most direct route possible within the practice to the storage areas (HPCSA, 2002). Generally, proper

packaging, labelling and handling of waste which starts at practice level is the first step in ensuring the protection of people and the environment in the waste management process. A good waste management plan includes a preventative attitude, including inoculation against zoonoses in the practice. This includes the inoculation of workers against rabies or tetanus and regular health checks of veterinary staff, especially those involved in handling waste (Seibert, 1995).

## **2.7 WHAT CAN BE DONE TO PROTECT PEOPLE AT RISK?**

### **2.7.1 A Plan for Waste Management at Practice Level**

An effective waste management process is one of the keys to protecting people and the environment. At the practice level, Brody proposes three ways in which to ensure effective medical waste management (Brody, 1993). These include:

A statement of policy for the practice: the policy should outline goals and objectives as far as veterinary waste management is concerned. These might include maintaining the good health of employees, patients and the public who might be affected by the activities in the practice and a commitment to staff training.

Procedures and the processes to be followed: the procedures will highlight exactly how the policy will be accomplished. These need to be formalised in writing, describing how each of the objectives in the policy statement will be met. Included with the procedures is a policy specifically for training in line with the goals and objectives above. This might occur during job orientation, with regular updates.

Assignment of responsibility: this includes assigning responsibility for specific tasks (e.g. how frequently bins or bags are to be collected by staff), to the overall responsibility for waste management in the practice.

In addition to the above, there needs to be continual review of the process. This must be done in anticipation of changing legislation and the development of improved process technology.

### **2.7.2 Continuing Education**

Human error is a serious danger in the waste management process. There is a need to educate workers about best practice, safe handling procedures and disposal methods. This would include an initial definition of the role and responsibilities of the individual concerning waste management in the practice. This must be updated as regularly as possible (e.g. during the introduction to the job or after completion of a certain number of man-hours). The link between veterinary waste, the environmental and occupational health impacts needs to be made clear to veterinary practitioners, general workers, practice managers, waste transporters and disposal companies (Cys, 1999; TRPC, 2000; Kaiser *et al.*, 2001).

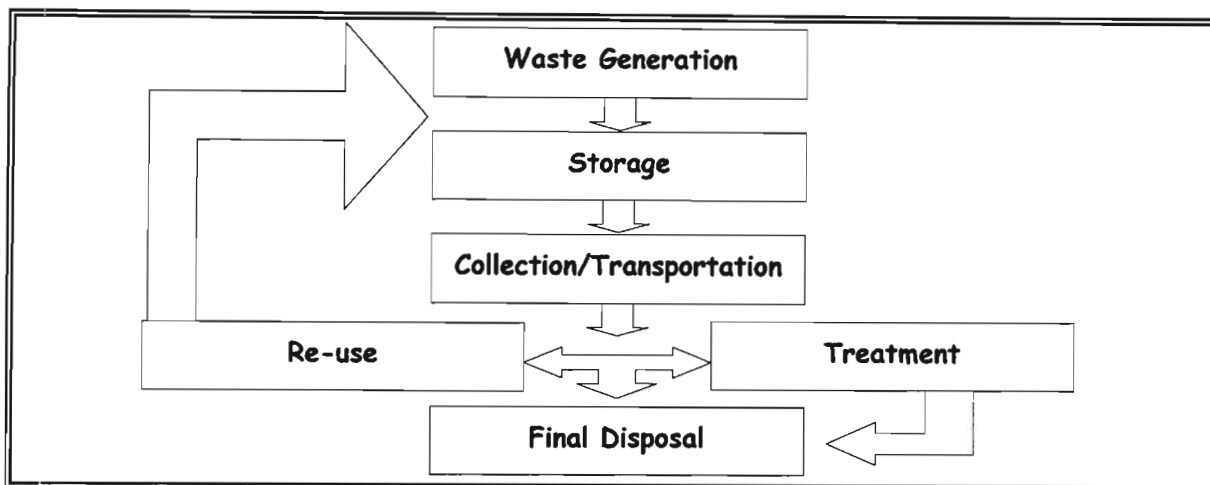
### **2.7.3 Legislation and Enforcement Capacity**

There already exists good waste management legislation, which includes NEMA, ECA and the Constitution (as described in section 2.3). The trouble is that legislation is not always enforced, (especially NEMA, which offers a broad framework within which the context is set regarding principles, institutions and procedures for environmental decision-making). The White Paper on Integrated Waste Management for South Africa is potentially an effective piece of legislation that needs to be implemented. There is also a need for enforcement of the regulations that are already in place. There is currently little capacity to monitor infringements. This area needs to be addressed by regulating authorities.

## **2.8 THE WASTE MANAGEMENT PROCESS**

At a national level, the White Paper on Integrated Pollution and Waste Management provides a framework around which veterinary waste management could be considered. The White Paper, which represents a "*paradigm shift*" from end pipe solutions to

pollution prevention, waste minimisation, horizontal and vertical institutional integration of departments and spheres of government (DEAT, 2000:9). The process or life cycle of waste management can be divided into six interconnected stages. These are outlined in Figure 2, and are further described below



**Figure 2. The Waste Management Process.**

### **2.8.1 Generation of Veterinary Waste**

Considering waste generation, there are three types of practices. These are described as small, large and mixed veterinary practices (J Morton, 2002, *pers. comm.*<sup>15</sup>). The following is a description of these three practice scenarios, which will suggest the different settings in which wastes are generated.

#### **2.8.1.1 Small Animal Practices**

These practices tend to be located in urban areas (Plate 1). Patients could include dogs, cats, birds, small reptiles, rodents and fish. Normally, the practice is situated in a high-density area. The veterinarian would probably spend a lot of time seeing individual

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<sup>15</sup> Dr J Morton, Rinaldo Veterinary Clinic, Durban North.

patients as opposed to populations of animals. This would affect the location of the waste generated, which is likely to be at the practice.



**Plate 1. Small Animal Practice Located in a Low Poverty Area.**

**2.8.1.2 Large Animal Practices**

These include food animal practices. These practices would normally be located in farming areas (Plate 2). The dominant agricultural activity around Durban is sugar cane farming. There is, however, some intensive animal production systems along the N2 to Pietermaritzburg. This includes poultry, with some beef or dairy feedlots<sup>16</sup>. This scenario dictates that there are large distances between farmers and the veterinarian. Veterinarians might be required at a dip tank where cattle are being treated. In some cases, the veterinarian would be treating large populations of animals (including poultry and dairy farms). In this situation, the veterinarian would more than likely travel to most of his clients. This is where s/he would produce waste (Meerdink, 2000).



**Plate 2. Patients in a Large Animal Practice.**

<sup>16</sup> An intensive animal production system.

### **2.8.1.3 Waste Identification**

According to Pratt (1994), one of the first steps in managing medical waste is the identification and quantification of wastes produced by the practice. Nowlan (1997) also advocates the identification of various waste categories (Table 1) produced in a practice setting. This is the start to managing wastes produced in the veterinary practice.

Knowing exactly what is being produced in the practice is crucial for the successful management of waste from veterinary and human medical practices. There is currently inadequate information on what wastes are being produced by veterinarians in Durban. A report by the TRPC (TRPC, 2000) on the need for and location of high hazardous waste sites for KZN, mentions veterinary waste but provides no data on the amounts of waste produced.

A positive move is the Waste Information System (WIS) being developed by Department of Environment Affairs and Tourism (Goal 6, in the White Paper on Integrated Pollution and Waste Management). The intention is to create a database to provide readily accessible information to any interested or affected parties, to help towards integrated pollution and waste management (DEAT, 2000).

### **2.8.2 Intermediate and Final Storage of Waste**

Wastes should be stored in containers with appropriate labelling and at recommended temperatures where appropriate. Currently, there are no statutory instruments dealing with storage requirements. There are guidelines prepared by the Medical and Dental Professions Board, of the HPCSA. The HPCSA (2002) guideline document is based on the South African Bureau of Standards (SABS) code 0248 guideline document (SABS, 1993). It is clearly stated, however, in section 1.4, of the guidelines, that these guidelines are not meant to address the management of wastes from veterinary facilities. A possible reason for this not being applicable might be the extremely



facilities. A possible reason for this not being applicable might be the extremely variable nature of veterinary practice. Practices vary from the small animal practitioner with a consulting room in an urban area to large animal practitioners who generate their waste on farms. Some of the basic principals in the above guidelines may be applicable to all kinds of practice. There will be a need to develop a set of guidelines for dealing with medical waste at the veterinary practice, especially wastes from large animal practices. Concerning the storage of waste the DWAF, Waste Management Series, otherwise known as the minimum requirements series (DWAF, 1998) stipulates that wastes may be stored on site at a generator for no more than ninety days before disposal. If stored for longer, they will require a permit in terms of the ECA. In addition, any small additions of hazardous, toxic or infectious waste mixed into a domestic waste class will render the total waste mixture hazardous. If domestic waste is mixed in with small quantities of infectious waste, this will increase the financial burden for disposal on the practice. Access to storage areas should be restricted and must be separated from food preparation areas or supply rooms. Any anatomical waste must be refrigerated at a minimum of 4 °C for a maximum of one week or if frozen, indefinitely. These must be lockable to ensure access is restricted (Gilles, 2001; HPCSA, 2002).

There also needs to be some form of contingency made for situations where excess waste is beyond the capacity of the fridge or storage facilities. For example, where there is a disruption of the services by waste disposal companies or a failure in the refrigeration system. A possible contingency measure could be to engage the services of an alternative waste disposal company. The next stage in the waste management process is the collection handling and transfer of waste.

### **2.8.3 Collection, Handling and Transfer of Waste**

The HPCSA guideline document provides some principals, applicable to veterinary practices (HPCSA, 2002). Wastes should be handled as little as possible and should be disposed of directly into the appropriate container. This removes the need to sort

through waste for separation later. Separation should take place at the point of waste generation (section 2.4 of this dissertation).

Waste should be transported by the most direct route possible, bypassing 'clean' areas in the practice. If this is done, then clean areas are automatically protected from contamination because infectious or other hazardous waste is not allowed to pass through them. Staff handling veterinary wastes should also be provided with protective equipment including gloves, overalls, aprons and or boots. The final disposal of wastes involves transportation from the practice. The manner in which waste is transported should be suitable to the particular waste stream, e.g. domestic waste does not need many special precautions. Infectious waste might need to be thermally insulated if it is not going to be processed immediately and vehicles might need to be equipped with spill kits in case of an accident. After wastes have been collected they will need to be treated and finally disposed (Reinhardt and Gordon, 1991; Brody, 1993; HPCSA, 2002).

#### **2.8.4 Medical Waste Treatment Technology**

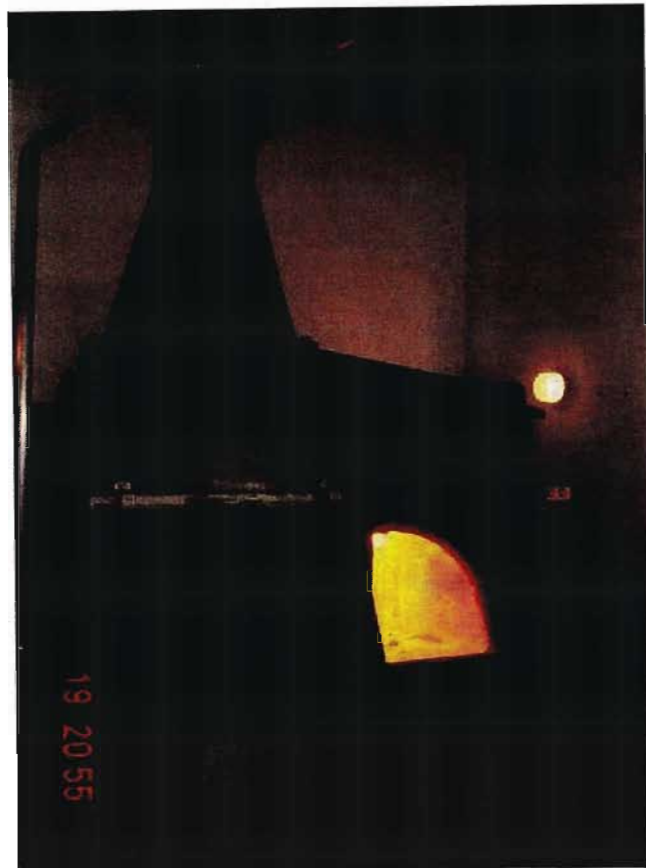
There are different methods for treating medical and veterinary wastes. A major goal of treatment technologies is to reduce the hazard level of the wastes. The following is a description of treatment technologies that are also suitable for veterinary waste.

##### **2.8.4.1 Incineration Technology**

Incineration is the DoH and HPCSA preferred method of treatment for sharps, anatomical and infectious waste (DoH, Undated; HPCSA, 2002; Rigby, 2002). There is provision for the registration and use of other treatment technologies with the DoH, but as a condition these proposed treatment alternatives must have similar or better results regards impacts on the environment or human health (DWAF, Undated).

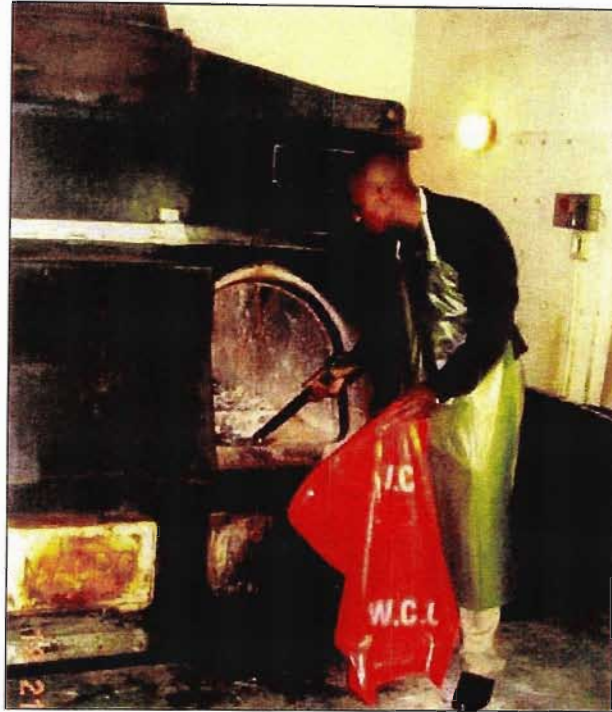
The establishment or operation of a waste disposal site is regulated in terms of the ECA (RSA, 1989b) and requires the application of an Environmental Impact Assessment. Rigby (2002) reports that there are approximately 180 registered medical waste

incinerators in South Africa. Most of the unregistered incinerators belong to public hospitals (Plate 3).



**Plate 3. Marcoburn Incinerator for disposal of Cadavers.**

The basic principle operating is the oxidation of carbon-based substances (Plate 3 and Plate 4). Five principal factors determine the efficiency of incinerators. These are sufficient oxygen; turbulence and mixing in the incinerator; a suitable temperature (to ensure that the waste is volatilised); atomisation into small particles or gases and sufficient time to allow the reactions to take place. Dioxins and furans may be formed if any of the above conditions are not met (Eales and Wood, 1999; Pruss *et al.*, 1999; Martin Creamer's Engineering News, 2000). See section 2.5.3 for some of the hazards associated with incineration. Efficient incinerator technology must ensure that combustible material is kept for at least two seconds at over one thousand degrees centigrade. Alkaline wet scrubbers should be fitted to remove acidic gaseous compounds or particles.



**Plate 4. Removal of Ash from an Incinerator.**

#### **2.8.4.2 Steam Sterilisation of Waste**

This form of sterilisation relies on the fact that most waste contains water. The water is heated by steam moving through the waste load, which aids the sterilisation process. It is important that there be direct contact of waste with the steam. Steam sterilisation has been used at a recently commissioned medical waste disposal plant in the Durban area. The plant can handle about 1000 tonnes of medical waste per month (Armstrong, 2002).

Other technology exists for the treatment of medical waste, some of which are described in the DWAF Waste Management Series (DWAF, 1998). They include pre-treatment by sterilisation through direct irradiation or microwaving or disposal through encapsulation in concrete (Poggiolini, 2000).

#### **2.8.5 Final Disposal of Veterinary Waste**

The waste management series (DWAF, 1998) outlines the minimum requirements that have to be met before final disposal of HCW. Veterinary waste falls under the definition of infectious and hazardous waste in the waste management series. It is

inadequately covered in the definition of medical waste. A more suitable definition would have been that of medical waste in the 'Proposed DoH Regulations' or alternatively Health Care Waste, which are both inclusive of veterinary waste.

The minimum requirements outline disposal of infectious or medical waste. Under section 9.4.1, infectious waste has a hazard classification of one (extreme hazard). Prior to disposal this waste must be incinerated, where this is not possible pre-treatment by sterilisation, direct irradiation or micro-waving prior to disposal to a (H:H or H:h) landfill site (DWAF, 1998). Radioactive wastes are not generally a feature of veterinary practice in the Durban area (J Morton, 2002, *pers. comm.*<sup>17</sup>). There is still only one authorised medical waste incinerator in KZN (Armstrong, 2002). Unfortunately ash from the incinerator is being disposed of on site, in a trench and not at a hazardous (H:H or H:h) landfill site (W Dlamini, 2003, *pers. comm.*<sup>18</sup>).

## 2.9 CONCLUSION

Veterinary waste was defined in section 2.2 as consisting of all waste produced by veterinary practices. These include anatomical, infectious, sharps, chemicals (including pharmaceuticals) and domestic waste. These are similar to the classification of medical waste. Because of these similarities, it is important that these wastes are disposed of in a similar and appropriate manner. The OHSA list over two hundred HBA. Most of these are encountered in veterinary practices as zoonotic conditions that have the potential to adversely affect the public's health. Also, there is no reason for veterinary waste to be excluded from the definition of medical waste in the Minimum Requirements Series. This appears to be an oversight, although technically, infectious veterinary waste is covered in the same document, in the definition of infectious waste.

Also presented in this chapter are principles for waste management. Some of these are general principles developed for waste management, but they have been used for

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<sup>17</sup> *Op. cit.*

<sup>18</sup> Mr W Dlamini, Environmental Health Officer, Ixopo.

medical waste management and can be applied to veterinary waste. The SAVC guidelines are currently being revised. The present guidelines do not reflect the principles for sustainable veterinary waste management presented in waste management legislation (e.g. NEMA and ECA). These include waste prevention, minimisation, separation at source, a 'duty of care' and responsibility for waste generated. An idealised waste management process is presented. This includes aspects of waste generation, intermediate and final storage, collection handling and transfer, treatment and final disposal. It is against this model that veterinary waste management in Durban will be interrogated in Chapters 4 and 5. The next chapter discusses the study's theoretical foundation, describes the study area and rationale of the questionnaire design, data collection and analysis.

## CHAPTER 3 - METHODOLOGY

### 3.1 INTRODUCTION

The study is based on veterinary practices in the Durban Unicity (Figure 3). Private veterinary practices were chosen (as opposed to state veterinarians) as the basis of this study (section 3.2). An explanation of how the total population of veterinary practices was determined and how practices were sampled is provided in sections 3.2 and 3.4 of this dissertation.

Data for this study were obtained using questionnaires and interviews. In order to analyse the waste management process, it was necessary to identify what happened to waste produced and disposed of in veterinary practices. A population of private veterinary practices operating in the Durban Unicity was drawn up and formed the source from which the sample was drawn. The study area was then characterised, based on three particular practice characteristics. These include the size of the practice, the patients treated, and the socio-economic status of the area in which the practice was located. A sample was drawn from the total population and these practices were invited to participate in the survey. Questionnaires were drafted and tested in a pilot survey. The final revised questionnaire was administered and responses were analysed using SPSS (Statistical Package for Social Sciences). A separate questionnaire was prepared for the veterinary practices (refer to Appendix 4) and companies removing waste from practices (refer to Appendix 5).

### 3.2 DETERMINING THE TOTAL POPULATION

The majority of private veterinarians (roughly 70%) are registered with the SAVA (J Morton, 2002, *pers. comm.*<sup>19</sup>), for which a provincial listing of registered members was obtained (E Thomas, 2002, *pers. comm.*<sup>20</sup>). In addition, a SAVC listing of 'Registered Facilities' was obtained from the State Veterinary Office (SVO) in Durban. The SAVC is the legal body under which all practising veterinarians are registered. Unfortunately,

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<sup>19</sup> *Op. cit.*

<sup>20</sup> Ms E Thomas, South African Veterinary Association, KwaZulu-Natal Chapter, Durban.

the list only provided details of the names of the veterinary practices and the registration number at a national level. The contact details, the name of the attending veterinarians and addresses were not provided. From this national list, it was difficult to determine which practices were Durban-based. An alternative to determining the total veterinary practices in the Durban area was needed. Fortunately, a list of private veterinarians practising in the Durban area was provided by the SVO in Durban (Dr. S. Dhanilal, 2002, *pers. comm.*<sup>21</sup>). The list includes the name of the attending veterinarian, practice name, address, telephone, fax number and consulting hours. From the above resources, a provisional listing of Durban-based veterinarians was drawn up. This list was further refined by removing duplications or practices that were no longer operating. The sample for the study was drawn from this provisional listing of veterinary practices. Practices were chosen based on three characteristics (section 3.3 below and Appendix 2).

### 3.3 CHOOSING THE SAMPLE

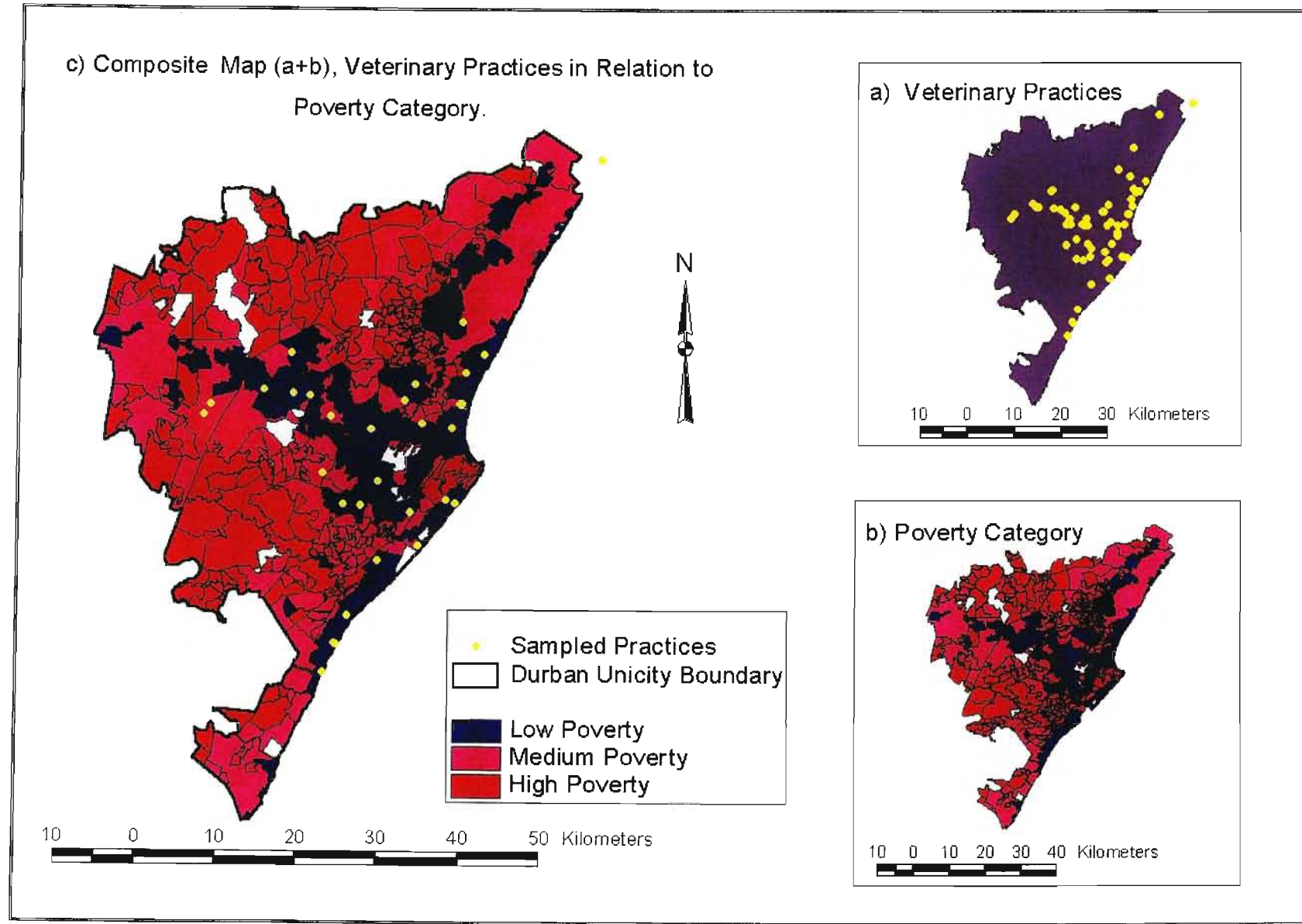
Thirty-two of the 61 practices identified were sampled. Of 42 questionnaires distributed, 32 were returned and used for the data analysis. This makes up a response of 52.5% of the total population. Two factors determined how practices were to be sampled. First, a purposive sample of rare elements (Smith, 1975) was used. Veterinary practices were sampled for a particular characteristic (section 3.4). Secondly, practices were selected to maximise the spatial spread within the Durban Unicity. After determining some characteristics of private veterinary practices, it was decided that practices with particular attribute be included in the survey. Thus, all practices described as hospitals and other (section 3.4.1 of this dissertation), all mixed and large animal practices (section 3.4.2 of this dissertation) and finally all practices located in areas classified as medium and high poverty (section 3.4.3 of this dissertation) were approached to participate in the study.

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<sup>21</sup> Dr S Dhanilal, State Veterinarian, State Veterinary Office, Durban.



Figure 3. The Distribution of Veterinary Practices in the Durban Unicity.



Based on whether the above practices agreed to participate or not, a list of practices were scrutinised and a selection made to bring the sample to around 50% of the total population of veterinary practices. These remaining practices were selected to achieve as much of a spatial spread as possible. This 'good spatial spread' was determined visually using the mapped practices (Figure 3).

Waste disposal companies were chosen based on responses to questions 62.0 of the veterinary practice questionnaires (Appendix 4). Veterinarians were asked to indicate who removed waste from their premises. In addition to various waste disposal companies, some practices indicated that a veterinary diagnostic laboratory was removing sharps from practices. The case study presented in section 4.3.1 is based on these data. A final listing of companies that removed waste from veterinary practices was drawn up (section 4.3.2 of this dissertation). These were then invited to participate in the study.

### **3.4 CHARACTERISTICS OF THE STUDY AREA**

Sixty-one veterinary practices were identified in the Durban area. These were described using three criteria. These criteria were deemed to have an influence on various aspects of veterinary waste management in each practice. It was decided to include as representative a sample as possible, based on each of the criteria set out above, which are further described below.

#### **3.4.1 Size of Practice (Clinic or Hospital)**

Based on lists provided by the SVO, the SAVC and the SAVA, practices are listed as either clinics or hospitals. There was no motivation for this difference in classification and practices listed as hospitals were assumed larger than clinics. It was also assumed that the size of the practice would influence the amount of waste produced and how waste was managed in each practice.

Based on size, the practices surveyed were classified as follows. Nine (14.8%) of the practices were classified as hospitals and fifty-one (83.6%) as clinics. An additional group (4.9%), termed 'Other' consisted of one practice that was not described as either a clinic or a hospital. This practice is named after the owner of the practice and no indication was provided as to whether this was a clinic or hospital (Table 3).

**Table 3. The Clinics and Hospitals Participating in the Study.**

	% PRACTICES IN TOTAL POPULATION (n = 61)	% PRACTICES IN SAMPLE POPULATION (n = 32)
<b>Size of Practice</b>		
Hospital	14.8	15.6
Clinic	83.6	81.3
Other	1.6	3.1
<b>Total</b>	100.0	100.0

**3.4.2 Patients Treated at Veterinary Practices**

The types of patients visiting veterinary practices may vary from small to large animals. A practice may specialise in treating either category of patient or any combination of the two. Practices could therefore be classified as a small, large or mixed animal practices. The term 'companion animals' is used more in place of small animals. These patients include but are not limited to dogs, cats, birds, rodents, fish and other pets. The term 'large animal' is normally applied to cattle, horse, sheep and goats. It seems inappropriate to include poultry in the above definition and yet some veterinarians who work in agriculture may specialise in this type of patient. An alternative term used is 'food animals'. This would include poultry and other production animals (Meerdink, 2000).

There was no indication (on any of the practice lists) as to what types of patients were treated at each practice. In order to determine this, veterinarians were consulted during the 'pilot study' (section 3.6 of this dissertation) to determine which practices were considered small, large or mixed animal practices. It became apparent that there were very few large and mixed animal practices in the Durban area. This was not

surprising considering that the area is highly urbanised. The majority of practices were thus classified as small animal practices.

Each of the 61 veterinary practices was thus categorised as large, mixed or small animal practice. Most are classified as small animal practices (91.8% of all the veterinary practices in the study area). Three practices (4.9%) were classified as mixed animal practices and two (3.3%) as large animal practices (Table 4).

**Table 4. Classification of Veterinary Practices Based on Patients Treated.**

	% PRACTICES IN TOTAL POPULATION ( <i>n</i> = 61)	% PRACTICES IN SAMPLE POPULATION ( <i>n</i> = 32)
<b>Patients Seen</b>		
Large Animals	3.3	6.3
Mixed Animals	4.9	3.1
Small Animals	91.8	90.6
<b>Total</b>	100.0	100.0

### 3.4.3 Level of Poverty

Another factor that was thought to influence waste production and management was the level of poverty and practice location. The assumption made was that practices located in high affluence areas would manage their waste better. In order to determine the level of affluence of a particular veterinary practice, a poverty index system (0-1 Standardisation) developed by Singh (V Singh, 2002, *pers. comm.*<sup>22</sup>) was used. The system is based on a poverty index developed for use with a Geographic Information System (GIS). Using this system, various areas in Durban that could be classified as either low, medium or high poverty areas were identified and mapped using ArcView GIS, (Appendix 3, Figure 3).

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<sup>22</sup> Mr Vishanth Singh, School of Life and Environmental Sciences, University of Natal, Durban.

There was then a need to determine which practices were located in each of the area classifications. Initially, this was done by first determining, by means of a 1:20 000 street map, the approximate location of each practice. The location was approximated by determining the distance to the nearest 'named intersection' or a 'landmark' feature (e.g. a post office, hospital or school). Where necessary, practices were contacted telephonically to establish their location in relation to the landmark. It was then a simple task to determine the approximate co-ordinates (latitude and longitude) for each of the practices. Later, when practices were confirmed as participating in the survey, a more accurate measure of practice location (latitude and longitude) was made using a GPS unit. The latitude and longitude values were converted to decimal degrees and re-projected for input into ArcView GIS (Wilson, 2003).

A table was created in Microsoft Excel including the name of the practice with latitude and longitude values in degrees, minutes and seconds. This was converted to decimal degrees and then exported to ArcView GIS as a tab delineated table. It was then possible to overlay each practice on to the thematic map created using Singh's (V Singh, 2002, *pers. comm.*<sup>23</sup>) 0-1 Standardisation Index and thereby determine where a practice was located. This was done using the 'select by theme' function of ArcView GIS.

The majority of practices, (86.9%), were located in low poverty areas. There were no veterinary practices located in high poverty areas. Eight practices (13.1%) were located in medium poverty areas (Table 5).

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<sup>23</sup> *Op. cit.*

Table 5. Location of Practices in Relation to Poverty.

	% PRACTICES IN TOTAL POPULATION ( <i>n</i> = 61)	% PRACTICES IN SAMPLE POPULATION ( <i>n</i> = 32)
Level of Affluence		
High Poverty Area	0.0	0.0
Medium Poverty Area	13.1	21.9
Low Poverty Area	86.9	78.1
Total	100.0	100.0

### 3.5 WASTE MANAGEMENT QUESTIONNAIRES

Two questionnaires were prepared, one for veterinary practices and the other for companies removing waste from practices. A summary of the veterinary and waste disposal questionnaires is provided in Table 6 and Table 7. The waste disposal questionnaire was also administered to the veterinary diagnostics laboratory. Ideas about the structure and phrasing of the questionnaires were drawn from a United Nations rapid assessment tool<sup>24</sup> (WHO, 2003). 'Open' and 'closed' questions are used in the questionnaires. 'Open' questions were used where the respondent was required to provide information freely about a certain aspect of his activities; questions 0-4 and 1-7 (in Appendix 4 and Appendix 5, respectively) request biographical information, as well as information about current practices. Other examples of 'open' questions include the last sections dealing with policy and regulations in both questionnaires (Smith, 1975; Shaw and Wheeler, 1994).

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[http://www.who.int/docstore/water\\_sanitation\\_health/Documents/Healthcare\\_waste/HCWMTol\(3r\).xls](http://www.who.int/docstore/water_sanitation_health/Documents/Healthcare_waste/HCWMTol(3r).xls) -last accessed 1<sup>st</sup> August 2003.

**Table 6. Summary of Questionnaire Administered to Veterinary Practices.**

QUESTIONS	ISSUES INVESTIGATED
0-4	<b>Biographical data:</b> name of respondent and contact details.
10-13	<b>Practice information:</b> type of practice and patients seen.
20-22.1	<b>Size of the practice:</b> time spent treating different patients and number of different cases seen.
30-34.4	<b>Staff levels:</b> staff categories, occupational health considerations, waste management training.
40-48	<b>Types and segregation of waste:</b> types and amounts of waste generated including other services that generate waste and protective equipment for staff.
50-52.1	<b>Waste storage:</b> storage areas, conditions and containers used for waste.
60-64.1	<b>Health care waste disposal:</b> who treats the waste (what process), any recycling in the practice, who removes waste from the practice, and are there any controls before waste is removed?
70-74.1	<b>Policy and regulations:</b> tested knowledge about waste management regulations and records kept by practices.
80-84.1	<b>Budgeting and finance:</b> charges for services offered and money spent on disposal.
90-91	<b>General comments:</b> on veterinary waste and the questionnaire.

**Table 7. Summary of Questionnaire Administered to Waste Disposal Companies.**

QUESTIONS	ISSUES INVESTIGATED
1-7	<b>Biographical information:</b> company details e.g. the name and contact details.
10-16	<b>HCW disposal facility:</b> how long the company has been operating and waste collection from the client.
20-24.1	<b>Staff:</b> number of staff at a practice, vaccination and training provided for them.
30-37	<b>Types of HCW disposed:</b> categories of HCW accepted by the waste disposal company, treatment and disposal methods used. Also investigates seasonal variation to waste disposal, containers provided to clients and protective equipment for staff.
40-43	<b>HCW transportation:</b> records kept and the type of vehicles used for transportation.
50-55	<b>HCW treatment and storage:</b> this section investigates the segregation and sorting of waste at veterinary practices. It also looks at the security and storage conditions at waste disposal companies.
60-65	<b>Policy and regulations:</b> this section investigates records kept by waste disposal companies and charges associated with disposal companies. Awareness of waste disposal legislation is also tested.

The majority of the questions were closed. Closed questions were used where either a yes/no response was required (e.g. Robinson's "*single answer*"), or respondents were to



choose between options provided (Robinson, 1998:386). This was usually followed by an open-ended question that allowed the respondent to 'justify' his response (Question 33 in Appendix 4). Other examples of closed questions include variations on Robinson's "*multiple answer*" and "*numeric*" closed questions (Robinson, 1998:387). An example of multiple answer questions can be found in question 46 of Appendix 4. The respondent selects from the list provided various safety equipment that staff handling waste have. These questions provide the option of selecting the most appropriate responses from a list provided. In some cases, a combination of a closed and open structured format was used. This was especially true where it was felt that the list of options provided for the respondent was not exhaustive enough. The respondent was given the opportunity to add another category (described as 'other', e.g. questions 13, 30, 35, 37 in Appendix 5), to the list.

### 3.6 PILOT STUDY CONDUCTED

The purpose of the pilot study was to remove any ambiguity and ensure that questionnaires could be completed independently by the respondents. It was intended that the investigator be present while the respondents completed the questionnaires. This was to ensure a good return rate for the questionnaires and for the investigator to be on hand in case there was any explanation necessary concerning any of the questions. Where the questionnaires were to be left with the respondents to be completed later, the investigator 'walked through' the questionnaire with the respondents to ensure that any difficult or complicated sections were understood. Contact details were also made available on the questionnaire.

The pilot study also intended to test whether the questions were relevant or applicable to both veterinary practitioners and waste disposal companies and to see how long it would take to complete the questionnaire. Three practices were chosen for this task, as this was considered a small enough size to test the questionnaire. In addition, the practices chosen would be able to comment on the relevance of the questions. The



responses from these practices later formed a part of the veterinary practices sampled.

It was estimated that the questionnaire should take  $\pm 30$ -40 minutes to complete. Appropriate revisions were made to the pilot questionnaire to make it easier for the respondent to interpret what data were being requested and to remove any inconsistencies.

### **3.7 DATA COLLECTION AND ANALYSIS**

#### **3.7.1 Waste Streams Produced by Veterinary Practices**

Respondents were required to estimate how much (kg) waste they had produced in the previous week. It was important for them to indicate which wastes left the practice in the same container or as a single batch, i.e. under category A the respondent might have indicated that cadavers and anatomical waste was removed. He then estimated a mass for this waste (Appendix 5 questions 40 to 41). The result was a list of waste that left each veterinary practice (Appendix 6). This list was further refined by combining similar 'waste streams'<sup>25</sup> and their estimated masses. It was not possible to categorise some waste streams and these were included under a separate heading as 'Other Waste Not Easily Classified' (section 4.2.1). Respondents were also asked to indicate what other waste was produced at their practices (e.g. from radiological procedures, laboratory diagnostics and any other services that the practice might offer. Questions 43.0-45.0. Section 4.2.1).

#### **3.7.2 Storage Conditions and Containers Used for Veterinary Waste**

Waste storage was explored from three perspectives. The 'type of containers', the 'frequency of use' for that container and whether the waste was 'refrigerated or not' (Questions 51 in Appendix 4). Types of containers used to store waste include plastic

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<sup>25</sup> For example those discussed in the Proposed Regulations for the Control of Environmental Conditions Constituting a Danger to Health or Nuisance (DoH, 2000) and Nowlan (1997), listed in Table 1.

bag, plastic container, type of container not indicated (respondents left this section blank), other containers<sup>26</sup>, no specific container and metallic container (section 4.2.2).

### **3.7.3 Correlation with Total Amount of Waste Generated**

Correlations (using Spearmans Rank ( $\rho$ )) were calculated to determine the degree of association or the strength of the relationship that exists between two variables as indicated in Appendix 7 (Robinson, 1998). A positive correlation occurs where the value of one variable increases as the value of the other increases until  $\rho = +1$ . A negative correlation occurs when one variable increases and the variable that it is being compared with decreases until  $\rho = -1$ . If there is no relationship between the two variables, this is known as zero correlation ( $\rho = 0$ ). The SPSS includes this function. Using the Wilcox-Mann-Whitney test, SPSS is able to determine the level of significance for each correlation. These are indicated with an \* or \*\* (Appendix 7). Non-parametric statistics were used because the variable explored in the above correlations were not normally distributed. Robinson (1998), Shaw and Wheeler (1994) recommend the use of non-parametric statistical tests in this case.

### **3.7.4 Seasonal Variations in Waste Produced and Injections Administered**

In order to calculate the total amount of waste generated for the year (by the practices sampled) the seasonal variations in the caseload reported by practices was used. Respondents were asked to estimate the mass of waste generated (for each category given in question 40-41) by the practice in the week before completing the questionnaire. Each practice was also asked to estimate a seasonal variation in its caseload (The term caseload is used to indicate how busy a practice is, this could be interpreted as being the number of patients treated or the number of injections

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<sup>26</sup> For 'other Containers' indicated by some practices these include, being flushed down the drain (chemicals and infectious waste), the rubbish bin (practices indicated that this was used for domestic, anatomical, waste with blood and infectious waste). In the case of one large animal practice animal carcasses are loaded on to the back of a flatbed truck and transported for disposal or may be put straight into a freezer (small animal carcasses) without being placed in a plastic bag first

administered). It was assumed that this variation would correlate positively with the amount of waste produced. Since this data was collected in spring (September, October and November, approximately 92 days); the amount of waste generated in this season was estimated by applying the formula,

$$\text{Spring waste generated}^{27} = \text{Waste estimated}^{28} \times 92/7 \text{ days}^{29}$$

For the other seasons, the amount of waste generated was calculated by applying the ratio the respondent estimated for the seasonal variation in waste produced for spring. In order to calculate the annual waste produced the sum total for each season was added to arrive at an estimated annual figure for waste generated.

A similar method was used to calculate the total number of injections administered per year. The estimated number of injections administered per day (reported by the veterinary practice sampled) was multiplied by the number of days in spring (92 days). Using the seasonal ratio, it was then possible to estimate the total amount of waste produced for the year. There was a positive correlation between the total number of patients seen and the total number of injections administered (Appendix 7)<sup>30</sup>.

### **3.7.5 Potentially Hazardous Wastes Mixed with Domestic Waste**

The amount of potentially hazardous waste mixed with domestic waste was determined from Appendix 6. Once the different types of wastes generated at veterinary practices were identified, these were analysed with the intention of separating out records where domestic waste was included with other categories of veterinary medical waste.

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<sup>27</sup> To arrive at the total amount of waste estimated for that season.

<sup>28</sup> This was the sum of all waste that the respondent estimated was produced in the seven days before the survey.

<sup>29</sup> The total number of days in the season (e.g. 92) divided by seven days during which the data was collected.

<sup>30</sup> It was assumed that all of the veterinary practices operated seven days a week, in order to arrive at the seasonal waste generated or injections administered.

From each of the entries indicated in Appendix 6, where domestic waste was combined with other categories of waste, (e.g. with anatomical, pharmaceutical, blood, infectious or chemical waste), this was considered to be poor separation of waste and is discussed under section 4.2.1. These records are presented together with their mass components and these data were then presented in tabular form as potentially hazardous waste mixed with domestic waste (section 4.2.1 of this dissertation).

### 3.8 CONCLUSION

Veterinary practices initially invited to participate in the study were chosen based on three characteristics. These Veterinary practices were approached to participate in the study. When these practices had committed themselves to participating (by returning a completed questionnaire), the remaining practices were invited to participate, until approximately 50% of all the practices in the Durban Unicity were sampled.

The majority of practices that agreed to participate in the study, however, can be classified as clinics (81.3%). Most of these were located in low poverty areas (78.1%) and treat mostly small animals (90.6%, Table 3, 4, and 5). The response to question 62 (Appendix 4) formed the basis from which companies disposing of waste were drawn to participate in this survey. A veterinary diagnostics laboratory was invited to participate since it fitted the criteria set for a waste disposal company<sup>31</sup>, but did not actually dispose or treat any of the waste it collected. The results are presented in Chapter 4.

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<sup>31</sup> It was identified as removing waste from veterinary practices by the veterinarians.

## CHAPTER 4 - RESULTS

### 4.1 INTRODUCTION

This chapter presents the results of a questionnaire and interviews with people involved in the generation and disposal of wastes at veterinary practices. There are three major sections to this chapter. The first section presents the results from a survey of veterinary practices in the study area. The second section presents a veterinary diagnostics laboratory that removes waste from veterinary practices. The third section presents the results from waste disposal companies as case studies. Veterinarians and waste disposal companies agreed to participate in this study on condition that their names be withheld.

### 4.2 VETERINARY PRACTICES SAMPLED

Of the 61 practices in the sample, 42 were invited to participate in the survey. Ten practices declined. In total, 32 practices participated in the survey. There appears to be differences in the various responses to the questionnaire when analysed in the light of practice size (e.g. clinic or hospital) and patients seen. Practices classified as veterinary hospitals produce more waste (per week) than those listed as veterinary clinics ( $303.6 \text{ kg} \pm 245.1$ , compared with  $97.7 \text{ kg} \pm 84.0$ ). Hospitals appear to spend more money per month on waste disposal ( $\text{R}1127.8 \pm 972.6$  compared with  $\text{R}686.6 \pm 389.4$  for clinics), for the same period (Appendix 8). It was not possible to test these differences statistically, as there were not enough practices sampled as hospital or other. Hospitals also have more people employed and charge clients less for disposal of cadavers. The total number of animals seen as patients (including both in- and outpatients), the total number of animals seen in the week before the survey and the average number of days inpatients are admitted are all higher for practices described as Hospitals (Appendix 8 and Appendix 9).

A comparison of the results for small, mixed and large animal practices based on selected variables can be seen in Appendix 9. Large animal practices treat on average more patients than small animal practices. There are also more general workers at large animal practices, which also produce more waste. It is not possible to test how

significant these differences are as the results for the large and mixed animal practices are only based on three practices (Appendix 9).

4.2.1 Types of Waste Generated

Veterinarians reported various categories of waste that left the practice (Appendix 6). These groups can be reclassified into categories of waste similar to those described by Nowlan (1997). Table 8 presents these waste categories and the estimated mass generated for each in the week during the period survey.

Table 8. Waste Streams Re-arranged into Medical Waste Categories.<sup>32</sup>

CATEGORIES OF WASTE GENERATED AT PRACTICE LEVEL	MASS (kg)	MASS % OF TOTAL WASTE
Anatomical waste (Including cadavers and biological waste)	3551.0	65.4
Infectious waste (Including any articles so contaminated)	1425.0	26.2
Domestic waste only (Paper or plastic wrapping)	274.0	5.0
Other waste not easily classified	77.0	1.4
Pharmaceuticals chemicals, (Including some domestic waste)	59.9	1.1
Sharps only	46.2	0.9
Radioactive (Including any other wastes)	0.0	0.0
Total	5433.0	100.0
'OTHER WASTE NOT EASILY CLASSIFIED' AS LISTED ABOVE INCLUDES THE FOLLOWING	MASS (kg)	MASS % OF TOTAL WASTE
Domestic, anatomical, pharmaceuticals, with blood, infectious, chemicals	30.0	0.6
Domestic, pharmaceutical, with blood	41.0	0.8
Empty bottles	0.0	0.0
Sharps, pharmaceutical, chemicals	1.0	0.0
Sharps, pharmaceuticals	5.0	0.1
Stable waste	0.0	0.0
Total	77.0	1.4

The greatest amount of waste produced at veterinary practices is anatomical waste. This makes up 65.4% of the entire waste stream and is composed mainly of cadavers. This was followed by infectious waste at 26.2%. A considerable proportion of infectious waste is mixed with cadavers and anatomical waste (Appendix 6). Infectious waste on its own and not mixed with any other waste represents 0.2% of the total waste stream. Domestic waste (Appendix 6) is included in most of the waste categories that leave the

<sup>32</sup> Similar to those discussed in the 'Proposed DoH Regulations' for the Control of Environmental Conditions Constituting a Danger to Health or Nuisance (DoH, 2000) and Nowlan (1997).

veterinary practice, although all of the veterinarians who participated in this study indicated that they practised some separation/sorting of waste before disposal.

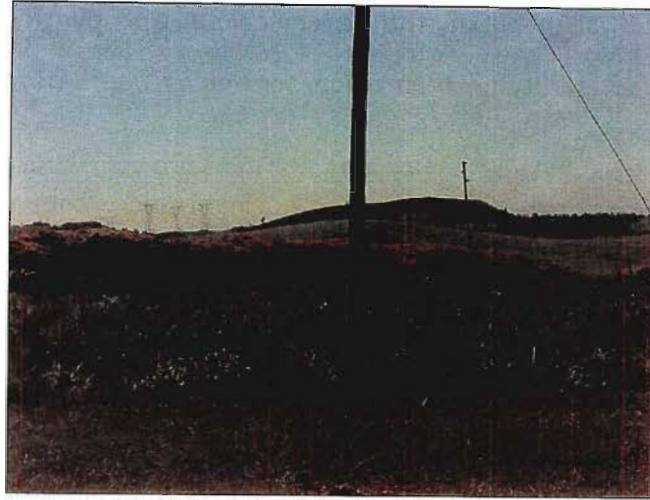
Only two (6.3%) veterinary practices reported having a colour coding system in place for managing waste. Both practices indicated that they used yellow containers for sharps and black for domestic waste. Incorrectly grouped waste (where domestic waste is mixed or grouped together with hazardous waste) formed 12.0% (650.00 kg) of the total waste stream for all practices for the week prior to the questionnaire being completed (Table 9).

**Table 9. Potentially Hazardous Wastes Mixed in with Domestic Waste.**

DOMESTIC WASTE MIXED WITH OTHER WASTE	MASS (kg)	MASS % OF TOTAL WASTE
Domestic waste only	274.0	5.0
Domestic, Cadavers, With Blood, Infectious	200.0	3.7
Domestic, Anatomical, With Blood, Infectious	171.0	3.2
Domestic, with Blood	70.0	1.3
Domestic, Pharmaceutical, with Blood	41.0	0.8
Domestic, Pharmaceutical, With Blood, Infectious	40.0	0.7
Domestic, Pharmaceutical, With Blood, Infectious, Chemicals	40.0	0.7
Domestic, Anatomical, Pharmaceuticals, With Blood, Infectious, Chemicals	30.0	0.6
Domestic, Anatomic, With Blood	26.0	0.5
Domestic, Pharmaceuticals	15.0	0.3
Domestic, With Blood, Infectious	15.0	0.3
Domestic, Pharmaceutical, Chemical	2.0	0.0
Total Weight	924.0	17.0
TOTAL (Less domestic waste correctly segregated)	650.0	12.0

The number of glass bottles and the amount of stable waste generated, including manure and hay, (Plate 5) were indicated as a source of concern by one veterinarian. The amount of glass and faecal matter from hospitalised patients at large animal practices was also a matter of concern. This is indicated in Appendix 6 and Table 8 as zero, because respondents were unable to estimate the amount of waste generated per week. There were three practices (two large animal and one mixed animal practice) that produce stable waste in the survey





**Plate 5. Storage of Manure before Composting.**

Developer, fixer and X-ray film from radiographic equipment constitute another sources of waste. Twenty-two veterinary practices offer radiographic diagnostic services to the public. This was compared with ten practices that referred clients to other veterinarians with these facilities. Three of the 22 practices indicated that they did not identify any waste. Nineteen respondents together estimated that they produced  $\pm 325$  litres of developer and fixer chemicals in total from radiographic equipment per month. Four practices (out of 22) commented that they produced waste X-ray film for disposal. Only one veterinarian reported that old radiographs were sold to an outside company that extracted silver.

Other forms of waste reported included waste from laboratory diagnostics, boarding and kennelling. Nineteen veterinary practices provide a laboratory diagnostic service to their clients, while 13 outsourced or referred client's samples to clinical pathologists or other diagnostic laboratories. There were a number of significant positive correlations between the total amount of waste generated, the total inpatient space available, the total number of patients seen (in- and outpatients), the total number of injections administered per day and the amount of money spent on the disposal of waste (Appendix 7). There was no significant correlation between the average number of days the

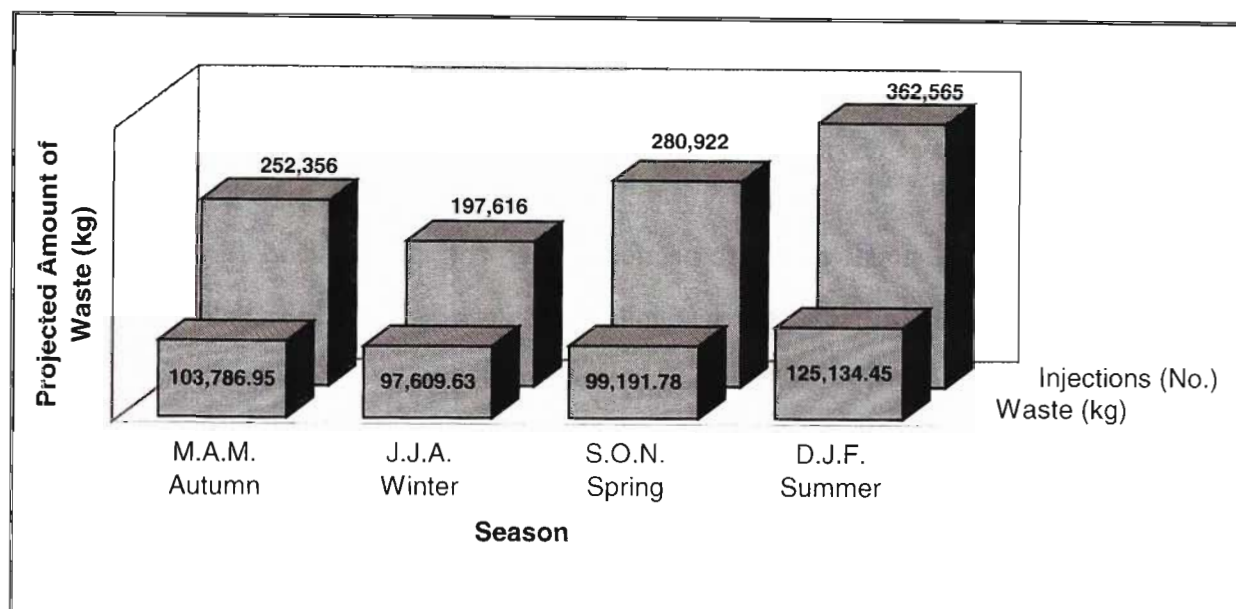


patients were admitted or the total number of animals seen in the previous week at the practice (Appendix 7) and total waste generated.

The projected total amount of waste produced over the 2002 period for all veterinary practices and including all categories (Similar to those discussed in the 'Proposed DoH Regulations') of veterinary waste was approximately 425.7 tonnes. All respondents indicated that there was a seasonal variation to their caseload. This is highest in the summer, followed by the autumn months; in the winter, the caseload is lowest. Both of the large animal practices reported greater case loads in autumn and winter, a pattern opposite to that reported for small animal practices<sup>33</sup>. There is already an established positive correlation between the amount of waste produced with the total number of (in and out) patients seen and the number of injections administered per day (section 3.7.3 of the Methodology). It was also possible to estimate how many injections would have been administered in each season and for the year. These data are presented in Figure 4. A total of 1 093 459 injections were projected for the period of one year, covering all four seasons, with more injections being administered in the summer, followed by spring, and autumn.

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<sup>33</sup> An explanation for this given one of the respondents was that this was the part of the horse racing season and the increased cases seen are related to this.



**Figure 4. Seasonal Variations in Waste Produced and Injections Administered**

#### **4.2.2 Storage Conditions and Containers Used for Veterinary Waste**

No practices reported using cardboard boxes for the storage of any waste, although some were seen at three practices (Plate 6). The majority of veterinary waste is reportedly stored in plastic bags (36.5% of the total waste stream), followed by 'no specific containers' (29.8%). Metallic containers are the least (reportedly store 0.2% of the entire waste stream) used to store waste (section 3.7.2). Veterinarians reported that in some cases no specific containers were used. These include pharmaceutical, chemical, infectious, cadaver, anatomical and stable waste (Figure 5).



**Plate 6. Cardboard Boxes for Storage of Bio-hazardous Waste.**

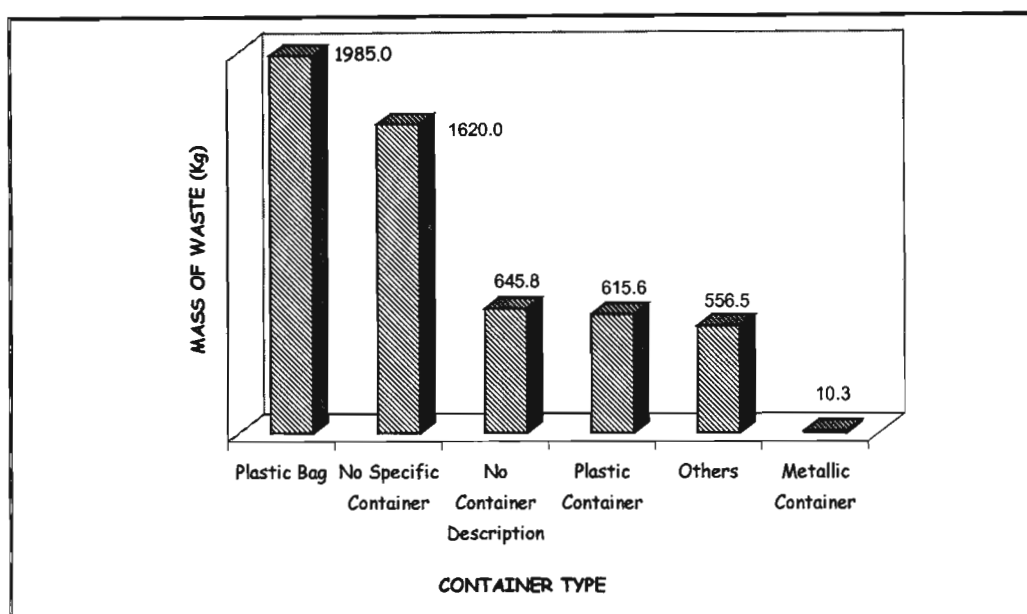


Figure 5. Types of Containers Used to Store Waste at Practices.

Anatomical waste forms 65.4% of the total waste stream, and this is mainly stored in no specific container (38.0% of anatomical waste) and not refrigerated. Some anatomical waste was reportedly stored in multiple use containers (28.2% of anatomical waste) and these were either refrigerated or frozen (Figure 6). Some anatomical waste (42.7%) is however, neither refrigerated nor frozen. The total mass for all waste streams (including anatomical, infectious, sharps, domestic, chemical, pharmaceutical and others not easily categorised) was 5433.2 kg.

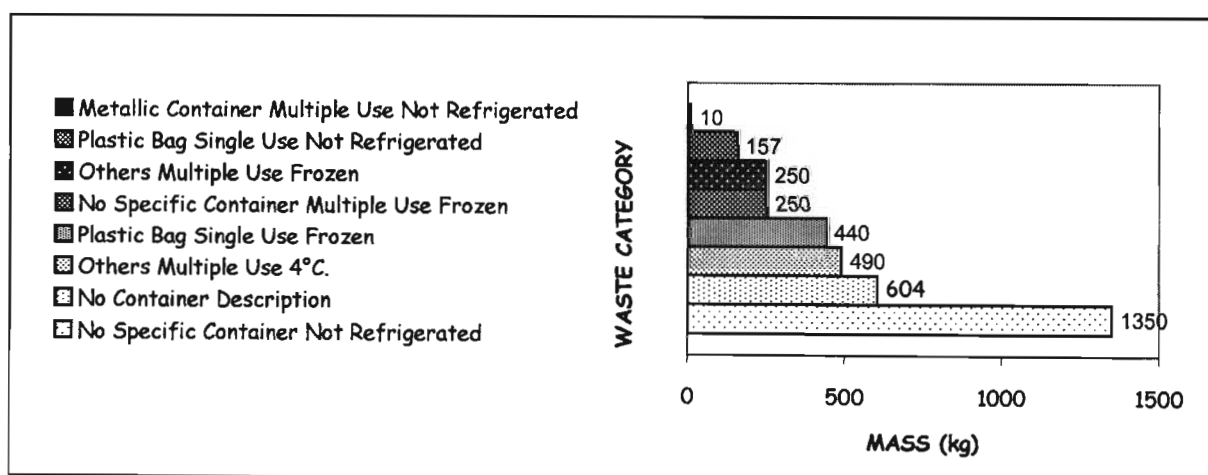


Figure 6. Storage Conditions Reported for Anatomical Waste.

Domestic waste forms 274.0 kg (5%) of the entire waste stream. Most domestic waste is stored in plastic bags that are not refrigerated (83.4% of all the domestic waste, Figure 7). Multiple use, containers (12.8%) reported include dustbins, which were not refrigerated.

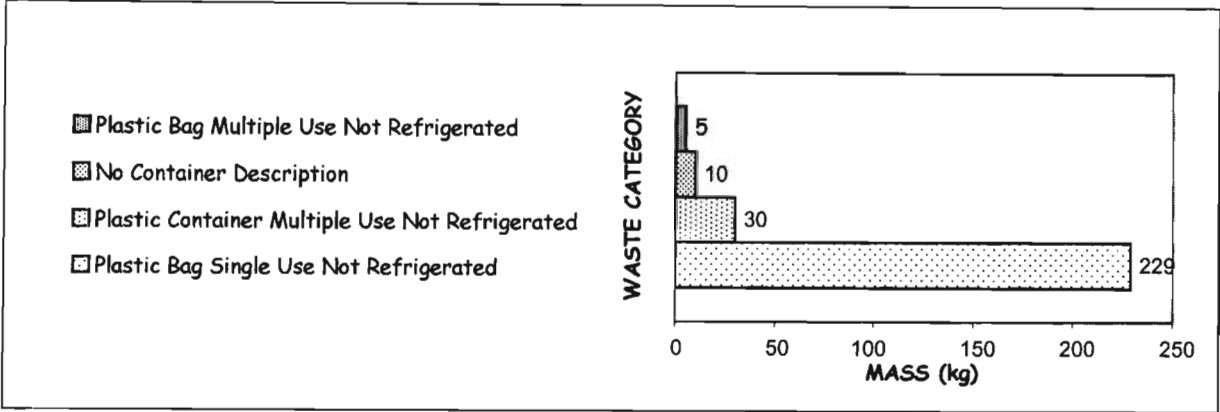


Figure 7. Storage Conditions Reported for Domestic Waste.

Infectious waste forms 1425.0 kg (26.2%) of the total waste stream. Most of this infectious waste (71.3%) is frozen or refrigerated in plastic bags or containers. Twenty six percent of the infectious waste stream is not refrigerated or frozen before disposal (Figure 8). Up to five percent (79 kg) of the infectious waste stream is stored in multiple use containers.

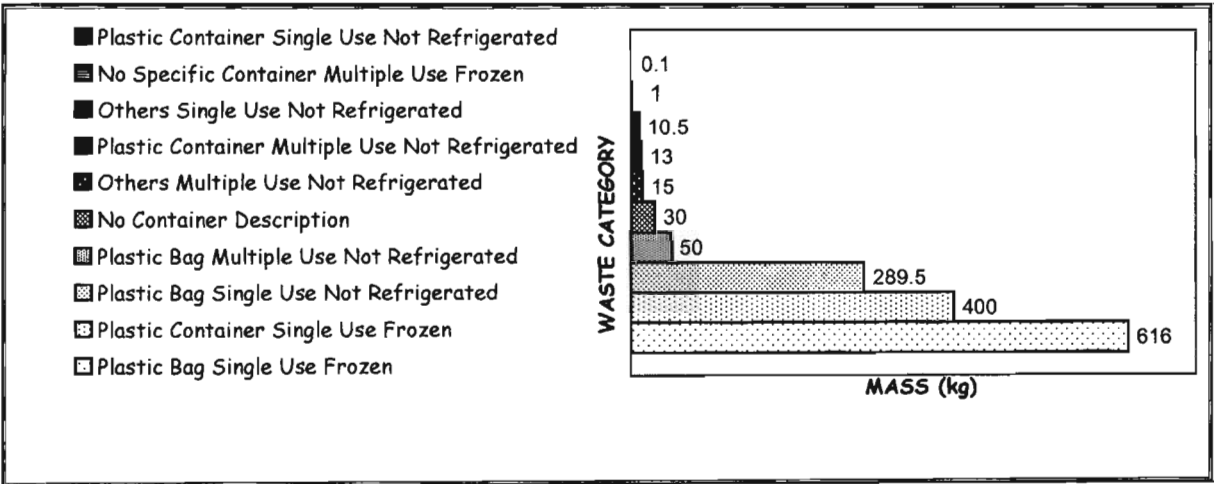


Figure 8. Storage Conditions Reported for Infectious Waste.

Other waste not easily classified forms 77.0 kg (1.4%) of the total waste stream (Figure 9). This is reportedly stored in plastic bags or containers that are not refrigerated. From Appendix 6, it is apparent that this category of waste also contains anatomical, infectious and sharps waste.

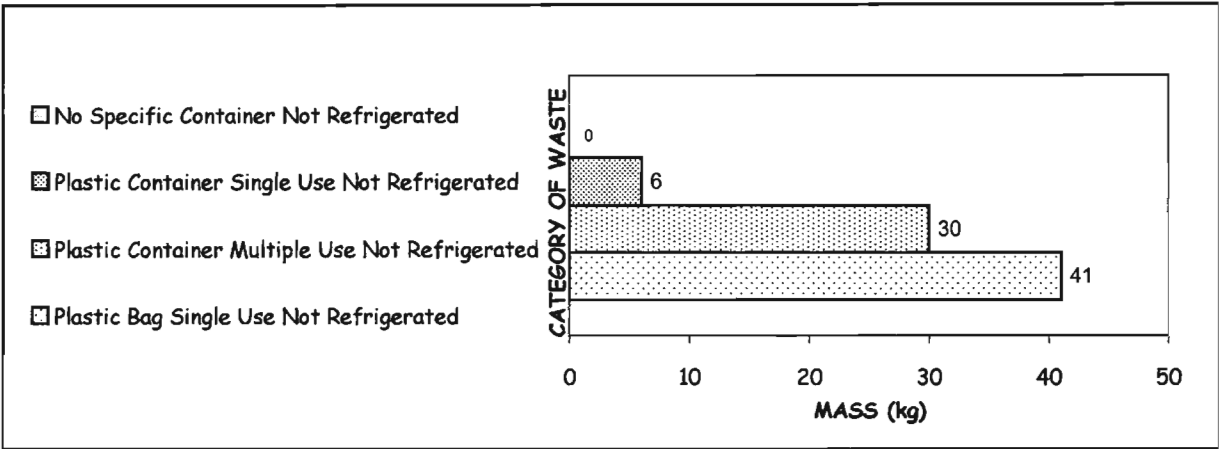


Figure 9. Storage Conditions Reported for Other Waste Not Easily Classified.

Pharmaceutical waste makes up 59.9 kg (1.1%) of the total waste stream. Most of this is stored in plastic bags and plastic containers (Figure 10). Sharps only make up 46.2 kg (0.9%) of the entire waste stream. Most sharps are disposed of in single use, plastic containers. Some sharps (3.7%) are, however, being disposed of in multiple use, plastic bags or containers (Figure 11).

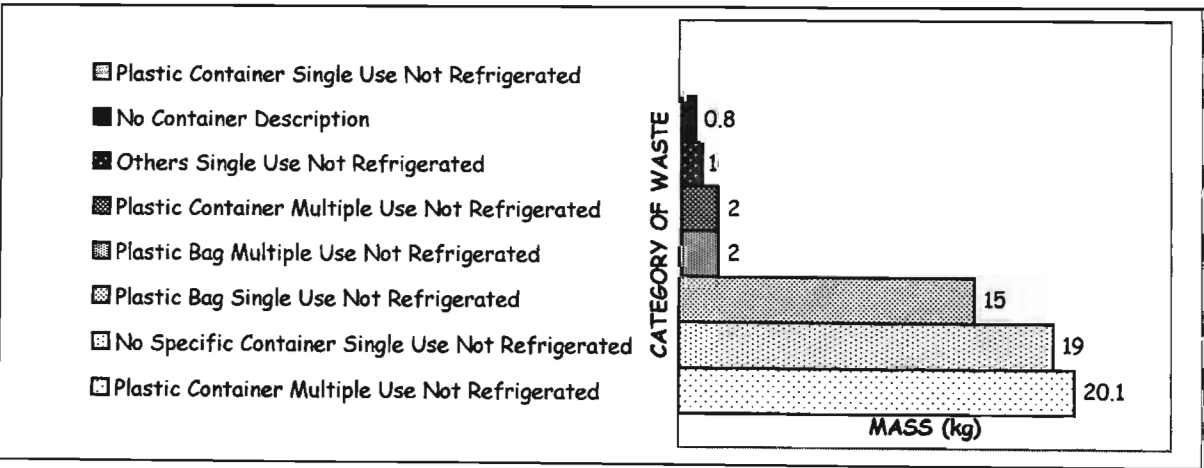


Figure 10. Storage Conditions Reported for Pharmaceuticals and Chemicals.

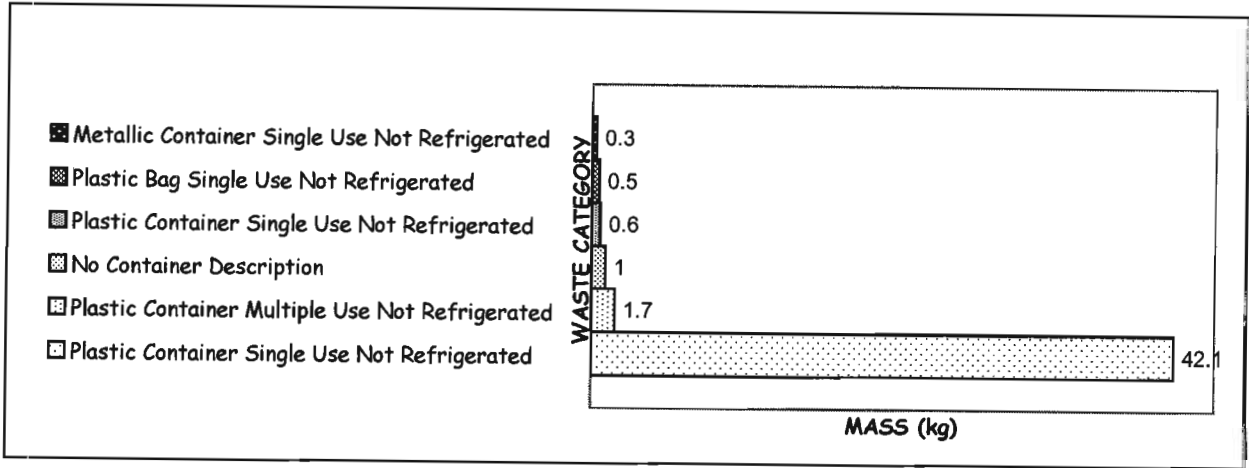


Figure 11. Storage Conditions Reported for Sharps.

4.2.3 Collection of Veterinary Waste

Seventeen (53.1%) practices reported that there was some form of control measures in place for collection of waste, this included record keeping. Records were reported to be in the form of invoices, signed collection forms, waste manifest forms, signed transportation forms and receipts (Table 10). Fifteen practices (47%) reported that there were no such control measures.

Table 10. Record-Keeping in the Veterinary Practices.

Questions	Response (%)	
	Yes	No
Is there any control before removal of waste from the practice?	53.1	46.9
Do you keep any records of health care waste generated at your practice?	43.8	56.3

When asked if there were any records kept about the waste generated by the practice, 14 (43.8%) practices indicated that they did keep records. These included records of cadavers, bills and statements from waste disposal companies for waste disposal, invoices for waste collected, the number of animals sent for cremation, details of the number of animals euthanased and the drugs used for euthanasia. When asked when

practice records were last inspected, seven practices indicated that they were inspected more than five years ago.

#### 4.2.4 Waste Treatment, Recycling and Disposal

Twenty-nine (90.6%) respondents reported not treating any waste at the veterinary practice<sup>34</sup> before disposal. Two practices that did report treating infectious material were referring to disinfecting areas contaminated with faecal matter from suspected or confirmed Parvovirus cases (infectious waste). This included the use of chemical disinfectants over surfaces contaminated with such waste but not the treatment of waste using methods outlined in section 2.8.4. One practice reported burning its anatomic, infectious and blood-soaked waste, while its cadavers and sharps were disposed of through a waste disposal company.

Twenty-one (65.6%) practices reported reusing syringes (Plate 7). Other articles reused include needles, blades, drip administration sets and drip bags (for poultices). The principle method of treatment before re-use in most cases was washing and boiling, followed by autoclaving. In one case, UV-radiation was used and in another, formalin fumes were used to sterilise syringes.

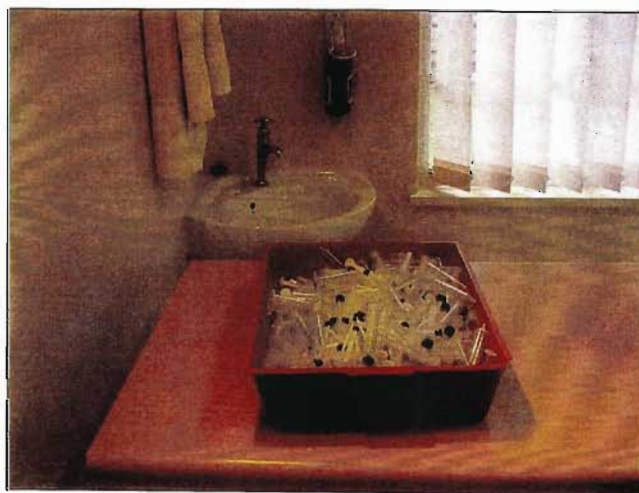


Plate 7. Syringes Cleaned and Ready to be Autoclaved (Before Re-use).

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<sup>34</sup> Treatment was understood to include autoclaving or incinerating waste before disposal.



Currently 28 (87.5%) practices report using the services of private waste disposal companies and the municipality for their waste disposal. Two practices report disposing of all their waste themselves, while another two practices made use of the services of a private company but also disposed of some waste themselves. Thirty-one practices surveyed (96.9%) indicated that they were satisfied with the services provided by waste disposal companies.

#### 4.2.5 Staff Profile of Veterinary Practices

Staff levels for the 32 practices are provided below (Figure 12). General workers formed the majority of staff in veterinary practices. Locums are usually employed in a practice only when a veterinarian is away or on leave.

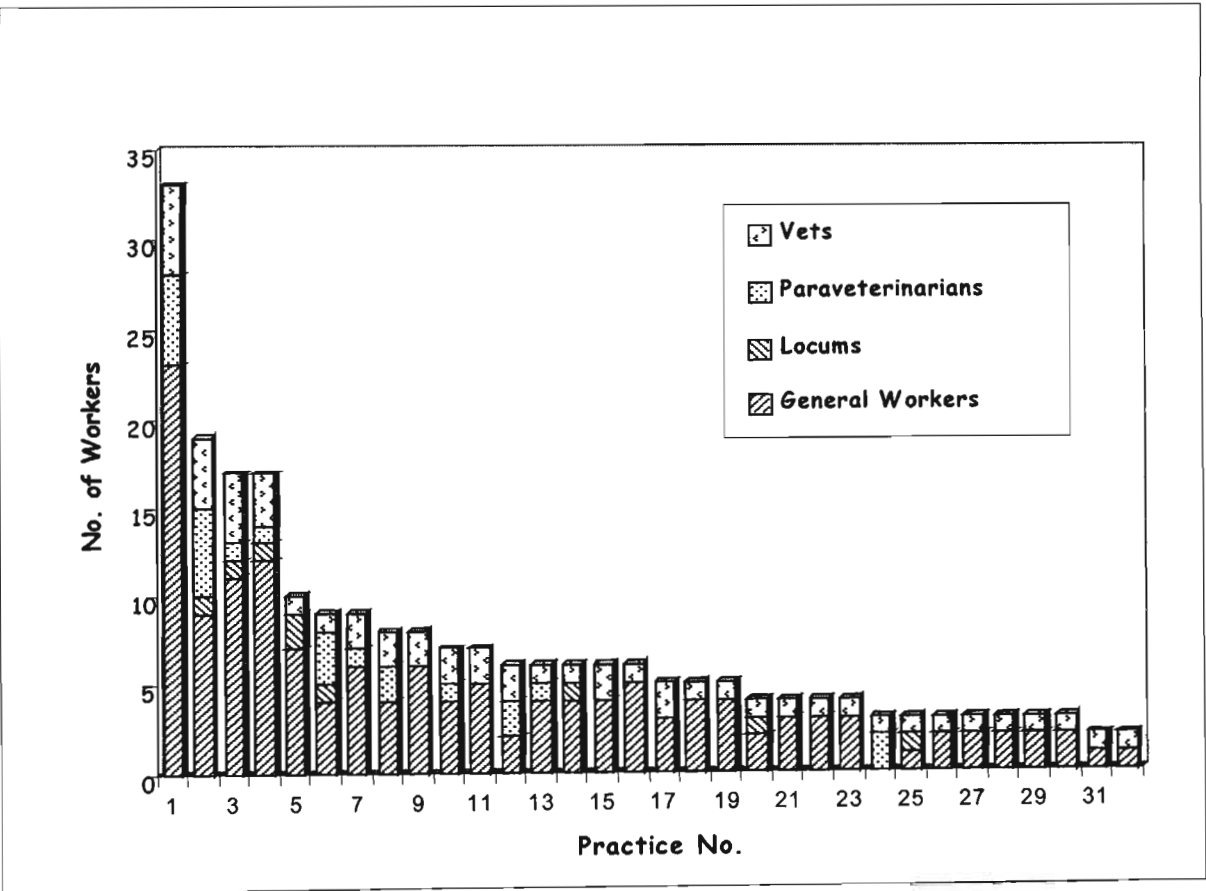
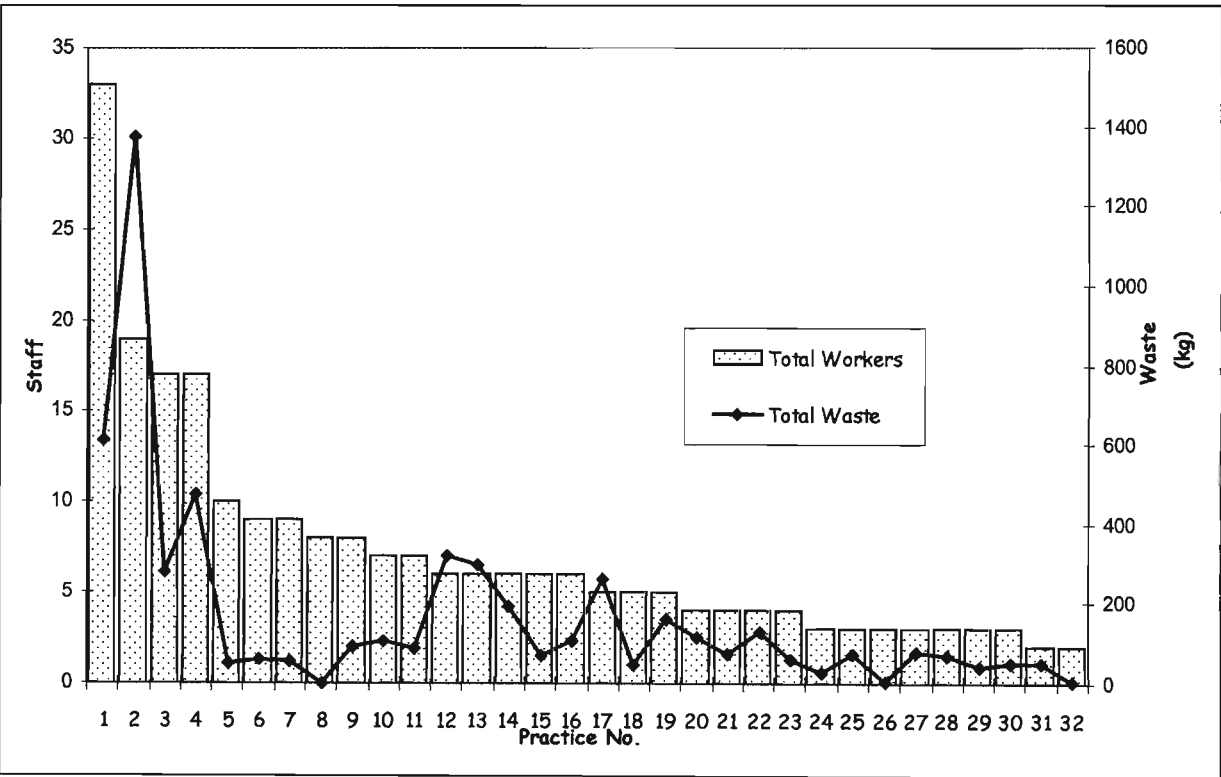


Figure 12. Staff Profile of Practices that Participated in the Survey.

There is a positive correlation between the amount of waste a practice produces and the total number of staff at that practice (Figure 13, and Appendix 7). Twenty



practices reported that general workers were the largest group of staff, either solely responsible for waste disposal or indicated as sharing responsibility for waste disposal with the veterinarian or other staff at the practice. At five practices, general workers have sole responsibility for waste disposal despite having had no training in waste management.



**Figure 13. Relationship between the Personnel and Waste Produced.**

In terms of the responsibility for the waste generated, the following responses were received. Four (12.5%) respondents indicated that this was the responsibility of paraveterinary staff, five (15.6%) indicated the general worker, and two (6.3%) the veterinarian and general workers. Eight respondents (25.0%) indicated it was the veterinarians responsibility and 13 (40.6%) reported that it was the responsibility of all of the above.

Ten (31.3%) practices reported that staff were not vaccinated against any diseases. Three of these ten reported that paraveterinary staff were responsible for waste

disposal. Three practices reported that all staff at the practice were responsible for waste disposal. Three respondents reported that veterinarians were solely responsible for waste disposal and one practice reported that the general workers were responsible for waste disposal.

Twenty-two (68.8%) practices reported that staff were vaccinated against diseases. These included rabies ( $n = 22$ ), tetanus ( $n = 4$ ), influenza ( $n = 2$ ) and hepatitis ( $n = 1$ ). Ten of these practices reported that all staff were responsible for veterinary waste management. Four practices reported that waste disposal was the responsibility of the general workers. Two practices reported that waste disposal was the responsibility of the veterinarian and the general workers. Five practices reported that this was the veterinarian's responsibility and one reported that it was the responsibility of paraveterinary staff at the practice.

Ten (31.3%) practices reported that staff had never received training in waste management. Twenty (62.5%) practices report that their staff had some training in waste management (Table 11), this included in-house training from the veterinarian, training from medical waste disposal companies and continuing education at University of Pretoria, School of Veterinary Medicine. All respondents indicated that they would welcome any training in waste management.

**Table 11. Practices Reporting on Staff Waste Management Training.**

TRAINING IN WASTE MANAGEMENT	NO. OF PRACTICES
Never trained	10
Training >5 years ago	12
Training <1 year ago	7
Training <6 months	1
No Response	2
<b>Total</b>	<b>32</b>

A summary of the protective equipment used by staff handling waste at veterinary practices is given below (Table 12). Two (6.3%) practices reported that workers do not use any protective equipment. Twelve (37.5%) practices reported incidents of needle

stick or cuts from sharps within the last year. These respondents reported that there were 69 such incidents occurring in the last 12 months. Only seven (21.9%) practices reported that they had a 'written down' or 'well communicated' procedure in case of an emergency incident such as a needle stick injury.

**Table 12. Protective Equipment used by Staff Handling Waste.**

SAFETY EQUIPMENT PROVIDED	FREQUENCY <i>n</i>	PERCENT %	CUMULATIVE PERCENT
Gloves	4	12.5	12.5
Gloves, Boots	7	21.9	34.4
Gloves, Boots, Apron	5	15.6	50.0
Gloves, Boots, Apron, Mask	4	12.5	62.5
Gloves, Apron, Mask	4	12.5	75.0
Gloves, Apron, Trousers	1	3.1	78.1
Apron	4	12.5	90.6
Apron, Trousers	1	3.1	93.7
None	2	6.3	100
<b>Total</b>	<b>32</b>	<b>100</b>	

#### 4.2.6 Legislation and General Comments

A total of 31 practices responded to questions 70.0-71.2 of the questionnaire (Appendix 5) which probed knowledge of the laws and policy related to waste management. Only three practices (9.3%) indicated that they were aware of the 'Proposed DoH Regulations'. Ten practices (31.3%) indicated that they were aware of their responsibilities as generators of veterinary waste in terms of the ECA and the NEMA. Fundamental to these regulations is the question of who is responsible for waste generated at a practice? Of the above ten practices, four indicated that this was the responsibility of the veterinarian in the practice, four indicated that this was the responsibility of all workers (the veterinarian included). One practice indicated the paraveterinary staff and the last one indicated that it was the general workers' responsibility. In addition, eight of the above ten respondents indicated that they vaccinated staff against various diseases. All of these respondents indicated that they segregated their waste.

### **4.3 COMPANIES REMOVING WASTE FROM VETERINARY PRACTICES**

The results presented are from companies removing waste from veterinary practices. These results were divided into two sections. A veterinary diagnostics laboratory and waste disposal companies agreed to participate in this survey. These results are as case studies below.

#### **4.3.1 A Veterinary Diagnostic Laboratory**

This case study explores veterinary waste from the perspective of a veterinary diagnostic laboratory. Although the company is based in Pietermaritzburg, it reportedly services 52 Durban veterinarians. Results for this section were obtained with the questionnaire indicated in Appendix 6. The company provides a diagnostic service, and consequently receives samples such as blood, tissues and swabs from veterinary practices. In addition to this, the company removes full sharps containers (free of charge) from practices for disposal. It is the management and disposal of these samples and sharps containers that forms the basis of this case study.

The company has been operating in its core business for over five years. Samples are received six days a week and are usually processed within one hour of arrival at the laboratory. A courier transports samples for analysis and sharps containers for disposal to the laboratory. Veterinarians are provided with bags and containers in which to package samples for diagnosis/analysis. If not processed immediately, samples are refrigerated or frozen, depending on the tests to be performed. In addition to diagnostic samples, the laboratory also receives cadavers for rabies diagnosis. The brains are normally removed and sent to the Regional Veterinary Laboratory for testing, while cadavers are sent for incineration.

Wastes produced in the laboratory are separated and disposed of. The municipality collects domestic waste. A private waste disposal company disposes of all of the anatomical waste, sharps, pharmaceuticals, waste with blood, infectious waste and chemicals. The cadavers are sent to the Regional Veterinary Laboratory or the SPCA

incinerator in Pietermaritzburg. Carcasses collected for October (2002) reportedly weighed 300 kg. To minimise costs, sample bottles are reused. Records kept include details of the referring veterinarian, a description of the samples received and cost details for the account. Records are not kept for inspection purposes by any government authority.

The respondent indicated that there was a need for legal obligations concerning waste management to be circulated to veterinarians, and other producers of waste. There was also a need for continuing education of all staff as regarding proper waste management, as currently management was not aware of its responsibilities in terms of NEMA and ECA (Table 13).

**Table 13. Summary of Findings for Companies that Dispose of Veterinary Waste.**

	DIAGNOSTIC LABORATORY	CASE STUDY A	CASE STUDY B	CASE STUDY C	CASE STUDY D
TOTAL STAFF EMPLOYED	13	12	64	4	1600
STAFF COMING INTO CONTACT WITH WASTE	9	2	48	2	250
PROTECTIVE EQUIPMENT PROVIDED TO STAFF	Gloves boots, aprons and surgical masks.	Gloves, boots, apron, mask and an overcoat.	Gloves, boots, facemasks, protective glasses and in some cases aprons.	Gloves, boots, overalls.	Gloves boots and trousers.
DO STAFF RECEIVE FORMAL TRAINING IN WASTE MANAGEMENT?	Yes (In-house, handling samples and wastes generated -attention to zoonoses). Staff are made aware of the risks associated with handling wastes	Yes (Hazards of handling waste, waste storage and how to use the incinerator).	Yes (Emergency preparedness, handling HCW, HAZCHEM training, health and safety, HIV/Aids, needle sticks).	No	Yes (vigilance and surveillance awareness)
DISEASES AGAINST WHICH STAFF ARE VACCINATED	Rabies	None	Hepatitis B	None	None
CLIENTS TRAINED IN HCW MANAGEMENT?	No (Sample packaging for transportation)	No	Yes (hazard awareness, segregation and packaging of waste).	No	Yes (Informal)
ARE RECORDS INSPECTED?	No	No	Yes	No	No
FINAL FATE OF WASTE	Domestic waste- MUNICIPALITY COLLECTS.  Anatomical waste, sharps, pharmaceuticals, waste with blood, infectious waste and chemicals- SEE CASE STUDY B  Cadavers - Regional Veterinary Laboratory or the SPCA INCINERATOR in Pietermaritzburg.	INCINERATED- ash disposed in domestic waste stream.	Domestic waste- to LANDFILL.  Anatomical waste - INCINERATED  Sharps, and other waste - AUTOCLAVED	Anatomical waste, cadavers, bloodied swabs - INCINERATED	Domestic waste- LANDFILL
AWARE OF RESPONSIBILITIES IN TERMS OF NEMA AND ECA	No	No	Yes	Yes	Yes

#### **4.3.2 Veterinary Waste Disposal Companies – Case Studies**

The following section presents the results of a study of waste disposal companies (four) that offer a service to veterinary practices. Information was obtained through a standard questionnaire (Appendix 5), similar to that used to study veterinary practices. In certain instances, this information was supplemented with interviews, with essential personnel in the practice to clarify some of the information provided. The information from each waste disposal company is presented as a case study below.

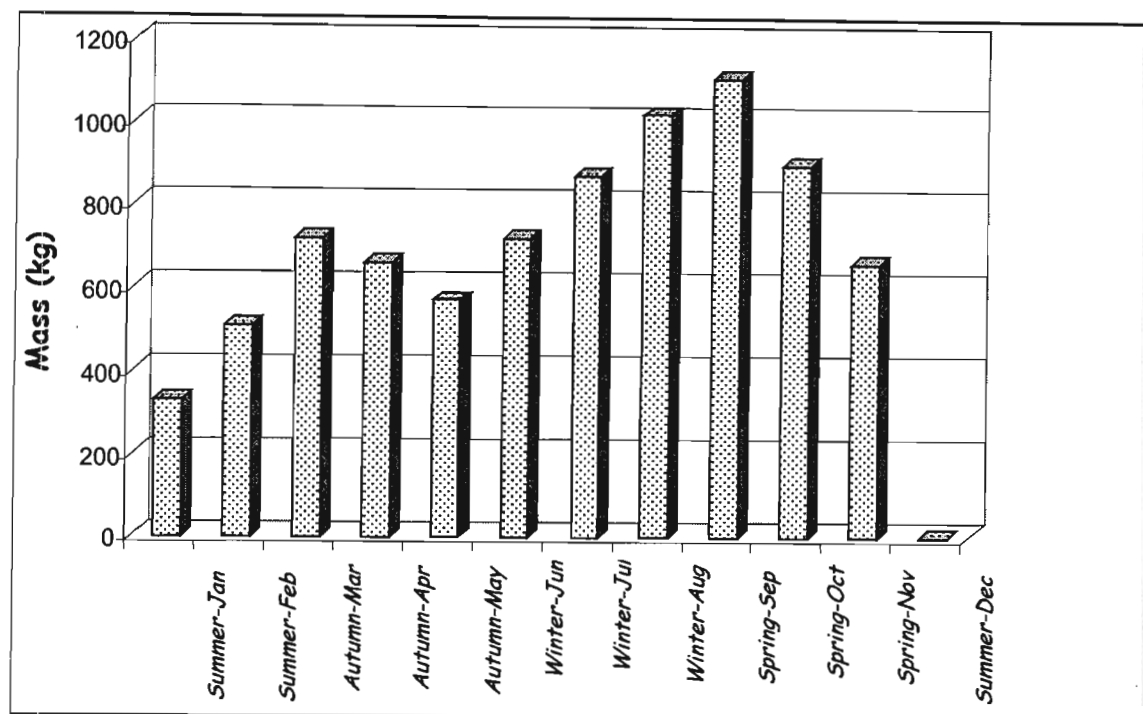
##### **4.3.2.1 Case Study A. A Medical Research Centre with Incinerator**

This case study focuses on a laboratory animal production Centre and research facility located in Durban. The Centre produces animals for research purposes, it also runs an incinerator, which is used for the disposal of biomedical material. The activities centred on the incinerator formed the basis of the case study, and will be presented below.

The Centre has been collecting waste from veterinarians for just under five years. This is done over a five-day week. The Centre operates two services for veterinarians. The first involves a mass incineration of animal carcasses (usually several carcasses at any one time). The second service involves a single cremation and the return of the ashes back to the practice, for collection by the owner usually for private burial or disposal. The facility also incinerates 'in-house' biomedical material.

The Centre currently services five regular clients (veterinarians in the Durban area), although it also accepts cadavers transported to the Centre for incineration by individuals. The number of carcasses collected varies with the season (Figure 14).





**Figure 14. Variations in Mass (kg) of Cadavers Disposed of by the Centre.**

The Centre does not accept any plastic, sharps, chemicals or pharmacological material. Infectious anatomical material may be included for incineration. The Centre relies on the co-operation of the veterinary practice to ensure that these are not included in the waste. Veterinary practices normally freeze cadavers and accumulate them until the number justifies a collection. Ashes are not returned unless a specific request is made. The Centre normally collects the cadavers from the client in thermally insulated and lockable vehicles. There is, however, no safety or special emergency equipment, e.g. a spill kit on board in case of an accident or other emergency. A log of the vehicle's movements is kept (recording pick up points, mileage and time). There is, however, no waste manifest system in place. The veterinarian does not sign any release for the waste that leaves his practice. His only proof is an invoice at the end of the month stating the number of cadavers and a list of charges (section 4.5 of this dissertation). With regards to records, these have never been inspected by any government departments and the waste disposal company does not keep them for this purpose.

On arrival at the Centre, the waste may be stored in cold rooms at 5 °C for up to two days before incineration. The cold room used is specifically for the storage of waste to be incinerated and access is restricted to staff only. Before incineration, the plastic bags containing the cadavers are opened and the carcasses are placed inside the incinerator. The plastic bags are not incinerated, but are disposed of via the domestic waste stream, as is the ash residue from the incinerator.

The incinerator is a diesel-powered Macroburn incinerator, with a capacity of 120 kg per run (this approximates to about four large 30 kg dogs) and a maximum number of two runs per working day. The incinerators daily capacity is approximately 240 kg. A major problem experienced is shutdown of the incinerator due to burner problems. These are usually caused by the accumulation of carbon on the burners or in the stack. If the incinerator is overloaded or burning does not take place efficiently, an oily residue is left at the bottom of the furnace, which can sometimes be difficult to remove. Management at the facility highlighted the need for appropriate guidelines and regulations for various aspects of veterinary waste. They are not, however, aware of their responsibilities regarding disposal of waste with regard to the ECA or the NEMA (Table 13).

#### **4.3.2.2 Case Study B. Medical Waste Disposal Company**

This case study focuses on a company that has installed new medical waste disposal technology at its Durban plant. This is based on the autoclaving process and is the first of its kind in the province of KwaZulu-Natal. The company is also one of the largest medical waste disposal companies in the province, handling up to 90% of the waste from the DoH's provincial hospitals and clinics. In addition to medical institutions, the company also provides a service to veterinarians. Veterinary waste forms a very small part of the total medical waste stream that the company handles on a monthly basis (0.5-1%).

In relation to veterinary waste, for the month of October, the company collected approximately 1130 kg (Table 14). This included cadavers, anatomical waste, waste with blood, infectious waste (contaminated with excretions or secretions from infected animals) and sharps.

**Table 14. Waste Collected from Veterinary Practices for October 2002.**

VETERINARY PRACTICE	WASTE GENERATED	MASS (kg)	SUB TOTALS
Veterinary practice 1	5 Litre sharps box x 2	3.0	131.0
	4 Litre sharps box x 1	1.0	
	90 Litre bag x 3	62.0	
	50 Litre bag x 1	27.0	
	Grey bag x1	38.0	
Veterinary practice 2	5 Litre sharps box x1	1.0	1.0
Veterinary practice 3	10 Litre sharps box x 4	18.2	18.2
Veterinary practice 4	142 Litre x 2	65.5	113.5
	90 Litre bag x 2	48.0	
Veterinary practice 5	90 Litre x 1	37.0	180.4
	90 Litre x 1	35.9	
	90 Litre x 1	44.5	
	90 Litre x 3	63.0	
Veterinary practice 6	90 Litre x 2	63.0	336.0
	90 Litre x 2	55.0	
	90 Litre x 2	67.0	
	90 Litre x 3	69.0	
	90 Litre x 3	82.0	
Veterinary practice 7	5 Litre sharps box x1	3.0	347.3
	142 Litre x 2	57.0	
	90 Litre x 1	29.3	
	90 Litre x 5	167.0	
	90 Litre x 2	91.0	
Veterinary practice 8	5 Litre sharps box x 2	2.0	2.0
Veterinary practice 9	25 Litre sharps box x 1	1.0	1.0

Technology for waste treatment includes incineration, using a Toxic 400 incinerator and autoclaves. According to current legislation, all human tissue, cadavers (animal and human) and anatomical waste must be incinerated. This waste is packaged separately from other waste generated at health care institutions and is logged before transportation to the incinerator in Ixopo. There are plans to de-list anatomical waste

so that the company can switch from using the incinerator to autoclaving all biomedical waste.

The current capacity of the autoclaves is approximately 1000 tonnes per month. Restricted substances include radioactive material, toxic chemicals and heavy metals (e.g. cadmium, lead, and mercury). Mechanisms in place to avoid collecting this waste include the use of a Geiger counter to screen waste. Staff are instructed that they are not to collect any chemicals from clients and clients are advised that chemicals will not be collected. The company relies on clients to sort and segregate the waste appropriately. This includes the use of the right receptacles or containers for the task at hand (Table 15). The cost of the grey veterinary carcass bags is R8.20 per bag and the charge for disposal is R2.50 per kg (includes pick up and disposal). In general, the company is satisfied with the level of co-operation received from veterinary practices, (sorting/separation of wastes at source). A general comment (pertaining to medical and veterinary waste segregation), however, was that incorrect packaging at source is a problem (e.g. sharps are sometimes found in plastic bags and plastic sharps containers are sometimes overfilled. Domestic waste, including cans and sometimes food wrappers are placed inside medical waste bags and there are sometimes no cable ties on bags containing medical waste. It is difficult to assess the exact levels of incorrectly packed waste). Bags are not opened for inspection but the original contents can sometimes be determined by looking at the final, processed waste and it is reported that a considerable amount of domestic waste is included in the waste stream.

**Table 15. Medical Waste Containers Supplied to Veterinary Practices.**

CONTAINER TYPES	CONTAINERS	
	VOLUME	OTHER SPECIFICATIONS
Rigid Plastic Containers	2.5, 5, 10 and 25 litre containers	Including sharps containers and 'Specibins' (Specimen bins)
Red medical waste Plastic Bags	30, 50, 90 and 142 litre bags	25, 30, 40, 50 and 100 Micron Bags
Fibre board boxes	50 and 142 litre boxes	Base and Lid
Medical waste box sets	50 and 142 litre boxes	Including 50 Micron Red Plastic Bags
Various miscellaneous items		Cable Ties, Security Tags, Adhesive Biohazard Tape, Heavy Duty Staples and staple Gun

The company is responsible for the transport of wastes from the client (medical and veterinary) to the processing/treatment plants. Vehicles are equipped with spill kits in case of an accident, and to facilitate good communication at all times, drivers have cellular phones. Vehicle location and status (speed and direction) can also be checked as the vehicles are monitored through satellite tracking. Emergency plans are also in place to anticipating various emergency scenarios. Loading compartments of vehicles are lockable, but the vehicles are not thermally insulated at 4 °C. Other specifications for the vehicles include leak proof compartments. Documentation for the pick up of a load includes waste manifest documents (which details the type and source of the waste collected) invoices and sundry notes. The veterinarian or other person so charged with that responsibility at the practice is required to sign a form itemising what containers were collected, including the mass and the content. The company's records have been inspected in the last six months as a condition for licensing for the new plant.

No medical waste is stored on arrival at the treatment plant, as a rule. Wastes are normally processed immediately. A power failure or mechanical fault might cause a delay in the waste being processed, but an alternative power source is available. Access to the waste is restricted to workers at the practice. The area is also separated from the general public by walls and security fencing. All doors are lockable, and have armed guards who restrict access to the facility, which is also protected by a security alarm. There are no special storage arrangements made for the facility (e.g. cold rooms). All anatomical waste (including cadavers and human tissue) is sent to the incinerator.

Records of exactly what wastes have been treated are also kept, to complete the audit process. This includes records in the form of spreadsheets, invoices and waste manifest documents. Concerning legislation, the company is aware of its responsibilities as a medical waste disposal facility (Table 13).

#### 4.3.2.3 Case Study C. Specialists in Animal Carcass Disposal

The third case study presents results of a company that deals exclusively in the disposal of animal cadavers. The company does not handle any human medical waste, sharps, pharmaceuticals or other categories of waste. It has been operating in the waste sector for six and a half years. It has only been dealing with veterinary waste in KwaZulu-Natal for the last two years, operating an incinerator for this purpose.

Open six days a week (excluding Sunday), the company currently services 25 Durban veterinarians. In KwaZulu-Natal, the company's core business is the disposal of cadavers mainly from veterinary practices, but also from animal shelters and other sources. Also included with the carcasses is anatomical waste and waste with blood (including swabs or bandages).

With regard to transporting waste, cadavers are normally collected from veterinary practices by the company, although they will also accept cadavers delivered to their premises. Collection is normally pre-arranged with the client; because of the overheads involved practices prefer to accumulate carcasses and dispose of them in batches. Vehicles used are not thermally insulated and cadavers are usually incinerated on the same day as they arrive at the plant.

The method of treatment used is the 'Furntech P100' incinerator. This is a recently installed diesel powered incinerator, which replaced the older paraffin burning Macroburn incinerator. The incinerator is capable of processing 80 kg of waste per hour, (a similar burn rate to the old Macroburn incinerator) usually overnight and the ashes are removed in the morning. The company has taken over the licence from the previous owner of the incinerator.

Concerning security, access to the premises is restricted. The premises are walled and guarded. There are no special arrangements made for storing veterinary waste on site as carcasses are normally processed immediately they arrive. In some cases, however, the company does share the costs of installing freezers at veterinary practices so that

cadavers can be frozen and stored over a few days, eliminating the need to collect carcasses daily. Charges for incineration are R70 per carcass, irrespective of the size or whether delivered to the plant by the client. There is no charge for the disposal of strays, animal foetuses or anatomical waste. To have the pets' ashes returned costs R450 and these costs are normally passed on to the pet owner by the veterinarian. Veterinarians are supplied with bags for cadavers at R220 per 20 bags (100 cm X 80 cm). There is reportedly no seasonal variation for waste being incinerated. Plastic bags are normally opened at the veterinary practice, as the carcasses are counted for billing and invoicing purposes. No veterinary waste is handled, sorted or separated at the plant and so far, the level of co-operation regarding separation and sorting of waste is reportedly very good.

Records of the animal carcasses incinerated every month are kept on site. These include the number of animals, the origin (from which practice) and the total cost for disposal. These records are kept to facilitate good business practice and are not a condition of any licensing by relevant authorities. In terms of the NEMA and ECA, the company has indicated that it is aware of its responsibilities as a waste disposal company (Table 13). Some of the operational problems encountered by the plant include; lightning striking the incinerator, the costs of replacing the cracked or broken bricks lining the incineration chamber and the costs of replacing incinerator thermocouples (which operate at temperatures of 800 °C).

In conclusion, there is a concern related to the cost implications of introducing a waste manifest system, as this will be passed on to the veterinarian. In order to keep running costs down the company has decided not to engage in the disposal of other waste (e.g. sharps, chemicals and pharmaceuticals), as these require different and often specialised containers. This would increase the costs of disposal to veterinarians. Instead, emphasis is placed on the core business, the disposal of cadavers. Finally, as a general comment the respondent indicated that veterinary waste had a lower level of



concern or risk compared with human medical waste as there was no risk associated with the transmission of HIV.

#### **4.3.2.4 Case Study D. Municipal Waste Disposal**

Durban Solid Waste (DSW) is responsible for domestic waste disposal in the Durban Unicity. The company has been operating for more than five years. The company formerly operated a medical waste incinerator, which was used for the disposal of medical and veterinary waste, however, the incinerator was closed more than two years ago. Currently, DSW collects domestic waste from households and veterinary practices weekly. Animals killed on the road are also collected for disposal at landfills. No cadavers are collected from veterinary practices. Final disposal of waste is to a landfill site for general domestic waste.

When the company used to collect medical waste, staff would receive training on various aspects of medical waste management. This has however been scaled down to vigilance and surveillance awareness (Table 13). Staff are required to report if any medical waste is found in the domestic waste stream. This is done at monthly safety meetings. Staff used to be vaccinated against Hepatitis, but this is no longer done. Clients are normally supplied with plastic bags or wheely bins (240 litre. Plate 8) for disposal of waste. These wastes are normally collected once or twice a week from clients. This depends on the area serviced and the amounts of waste generated in that area. In case of any problems, vehicles are normally provided with a radio, a spade and brooms.

Any waste containing heavy metals, mercury or anatomical waste is not accepted at landfill sites where domestic waste is disposed. To ensure this, the DSW does not allow staff to collect medical waste. In addition, staff at landfill sites are instructed to keep an eye out for anything suspicious, by which is meant medical waste. The best way to prevent this waste being included is through client education. When any restricted waste is found included in the domestic waste stream and the culprit can be traced,

s/he is warned about the implications of these actions. This normally discourages any future incidents.



**Plate 8. Wheely Bins Used for Waste Storage at a Veterinary Practice.**

No records are kept for inspection purposes by any authorities. Records of service history for waste collection vehicles are kept. The DSW is reasonably happy with the level of co-operation from veterinary practices. There are however occasional incidents where sharps or anatomical waste are found included in the domestic waste stream. The best way to avoid this is to separate these wastes from domestic waste at the practice. DSW is aware of its responsibilities concerning waste disposal in terms of NEMA and ECA.

The results of these case studies are summarised in Table 13. This compares results from four waste disposal companies and one diagnostics laboratory removing sharps containers for disposal. A summary of the major findings from this chapter are presented (veterinary practices and case studies) in section 4.5.

#### 4.4 CONCLUSION

This chapter presented results of a study of veterinary practices and companies disposing of waste from veterinary practices in the Durban Unicity. The study indicated a number of findings, of which the main ones are summarised at the end of this chapter. Some of these findings reflect areas of concern and the need for guidelines or clarification. Concerning veterinary practices, guidelines are needed for how to minimise, separate and dispose of the various categories of waste from veterinary practices. Also there is need for veterinarians to know their responsibilities as generators of waste and what records they need to keep. They also need to know how to control the waste leaving their practices and how best staff can be protected from the dangers posed by veterinary waste, (Table 13).

Waste disposal companies as well as veterinarians need to be clear about their obligations with regards to disposal of waste. This includes responsibility for waste removed from veterinary practices. Does this waste pose a hazard to staff at waste disposal companies and how is it possible to protect staff against these hazards- is there a need for training and vaccination of staff as well as waste generators? There is a need to know what documentation is required by waste disposal companies to facilitate the tracking of waste and protocols for handling various categories of waste from veterinary practices. A summary of the waste produced and the quantities reported are provided in Table 8. Recommendations for the 'needs' that have been identified for both veterinary practices and waste disposal companies will be presented in Chapter 5. The main findings presented here (Table 16) will be discussed in the next chapter, and a set of guidelines and recommendations relating to the needs identified will be presented.

Table 16. Summary of Main Findings and Needs to be Addressed.

VETERINARY PRACTICES		
	ISSUE/MAJOR FINDINGS	NEEDS ARISING
RESPONSIBILITY FOR WASTE	Some veterinarians are not aware of their responsibilities as generators of veterinary waste, with respect to ECA and NEMA.	What are generator responsibilities as far as the laws are concerned?
	The majority of veterinary practices in the Durban area can be classified as veterinary clinics that treat small animals. These practices tend to be located in low poverty areas. This trend is also true for practices included in the sample.	
WASTE PRODUCTION	Practices maybe classified on practice size. Veterinary hospitals produce more waste and spend more money on waste disposal compared with veterinary clinics. The same is true for the number of staff working at a practice and the total number of animals seen as patients.	
	Based on the types of patient seen, most practices deal with small animals. Large animal practices produce more waste compared with small animal practices. Large animal practices also have more space for inpatients, see more patients and have more staff compared with small animal practices.	
SOURCE SEPARATION	Incorrectly disposed of domestic waste constitutes 12% of total clinical waste for this survey.	How to separate domestic waste from other clinical waste. for safety and to reduce costs.
	The majority of sharps are being disposed of via single use plastic containers. Some sharps were, however, disposed of in plastic bags and multiple use containers with what was described as domestic waste.	
WASTE STORAGE	The majority of veterinary waste is stored in plastic bags.	Guidelines for disposal of anatomical, infectious, domestic waste, sharps, containers, storage temperature. There is need for a protocol.
	Anatomical waste (cadavers and anatomical waste) is stored in non-specific containers and is not refrigerated.	
	Infectious waste forms a large part of the waste stream. most of this waste is stored in single use plastic bags that are then frozen. Some infectious waste was reportedly not frozen or refrigerated and was stored in multiple use containers.	

TABLE 16. Summary of Main Findings and Needs to be Addressed-Continued.

VETERINARY PRACTICES		
	ISSUE/MAJOR FINDINGS	NEEDS ARISING
RECORD-KEEPING	Some veterinary practices keep inadequate records of the wastes generated at their practices. Control measures for wastes leaving the practice vary from practice to practice and are often inadequate.	A guide as to what records needs to be kept by the veterinarian
	Waste management is not being monitored by any authorities. Records are not being inspected.	Whose responsibility is this?
RE-USE OF WASTE	Veterinary practices treat very little waste at their premises. Waste disposal companies are disposing of most waste. Waste that is reused by the veterinarian is normally disinfected before re-use. This includes used syringes, needles, blades, drip administration sets and drip bags. Treatment is usually through disinfection with steam, chemical agents or formalin.	What guidelines needed for veterinary practices and waste disposal companies with regard to re-use.
PROTECTION OF STAFF	Some staff are not vaccinated against any diseases.	There is a need for a list of some of the more important diseases and precautions to be taken, e.g. vaccinations.
	Some staff handling waste are supplied with inadequate equipment.	What basic safety equipment is required or proposed by the OHSA?
	Some staff at veterinary practices have poor or sometimes no training with regard to waste management (i.e. the risks involved and how to avoid them).	What training and follow-up is needed?

TABLE 16. Summary of Main Findings and Needs to be Addressed-Continued.

WASTE DISPOSAL COMPANIES		
	ISSUE /MAJOR FINDINGS	NEEDS ARISING
PROTECTION OF STAFF, ENVIRONMENT AND THE PUBLIC	Some waste disposal companies do not vaccinate staff handling veterinary waste against any diseases.	There is a need for a list of some of the more important diseases, precautions and vaccines.
	Some staff handling veterinary waste are not given any training (and may not be warned against the hazards of their work). Where this does happen, training maybe inadequate and there may not be any follow-up or refresher courses for staff.	What training and follow-up is needed, for staff and for clients (Waste generators)?
	Some veterinary waste disposal companies do not train clients in waste management practices.	
	There are no emergency procedures in place at some waste disposal companies.	What are regarded as emergencies and what action need to be taken?
	Some waste disposal companies open plastic bags from veterinary practices and inspect the contents for invoicing purposes before transportation. One waste disposal company does not incinerate plastic bags; instead it removes cadavers (which are incinerated) and disposes of the plastic bags through the local general solid waste disposal system.	Protocols or guidelines for handling infectious veterinary waste and waste from incinerators.
	Ash from biomedical and veterinary waste incinerators is being disposed of through the domestic waste disposal system.	
	Some waste disposal companies do not regard veterinary waste as being as hazardous as medical waste.	What is the hazard status of veterinary waste?
RECORD KEEPING	Waste disposal companies do not employ a standardised documentation system that will help track waste though all stages, from point of generation to final disposal.	What documentation is needed for waste disposal companies in this regard?
	Relevant authorities are not monitoring the activities of some waste disposal companies.	Who is responsible for monitoring the activities of these companies?
RESPONSIBILITY FOR WASTE	The management at some waste disposal companies are not aware of their responsibilities in terms of the Environmental Conservation Act and National Environmental Management Act.	What are generator responsibilities of waste disposal companies?

## **CHAPTER 5 - DISCUSSION**

### **5.1 INTRODUCTION**

This chapter discusses the results presented in Chapter 4. This will be done considering the literature reviewed in Chapter 2. Veterinary waste management will be discussed in relation to the types of waste generated by veterinary practices and how these wastes are disposed of by waste disposal companies. Veterinary waste management will be discussed in relation to the principles for waste management discussed in section 2.4 of this dissertation. In the case of waste generated, stored and collected from veterinary practices, this is discussed in relation to the principles of disease prevention, minimisation, separation at source and protection of people and the environment. The staff at veterinary practices will be discussed in relation to the OHSA. Legislation will be discussed in relation to section 2.3.

### **5.2 VETERINARY PRACTICES SAMPLED**

#### **5.2.1 Types of Waste Generated by Veterinary Practices**

Nowlan (1997) and the 'Proposed DoH Regulations' (2000) present a classification system for wastes produced at medical institutions. Applying this to the data collected, it was interesting to note that most of the different categories of waste were mixed with domestic waste (Appendix 6). This incorrectly separated waste forms 12% of the total waste stream for the study (Table 10). A cause for concern is how this waste is being disposed of, as it contains potentially hazardous and infectious materials.

If waste were being disposed of properly, considering the mixture of waste, the addition of infectious waste to domestic waste would render the entire contents 'infectious'. This would need to be incinerated, as recommended in the HPCSA Guideline document (HPCSA, 2002). The implications are higher costs for those veterinarians who do not separate their waste appropriately, if this were being monitored and carefully enforced.



An extreme view is that the waste is being disposed of via the local municipal system because it is misidentified as domestic waste. Municipal waste workers may notice cadavers if the contents are placed in a plastic bag. They may be more difficult to spot if placed in a plastic bag and then in a wheely bin, which is automatically emptied into a truck. It is very easy to dispose of small quantities of infectious or hazardous waste in this way as they are not easily noticed. Such concealment is unethical and in contravention of the OHSA. The contents are therefore a potential hazard for waste handlers and the public.

The amount of infectious waste being produced can be reduced through separation from cadavers and anatomical waste that are not considered infectious. Although recommended disposal methods for both are incineration, it should be recognised that infectious waste presents an occupational health and safety nightmare, especially if not handled or disposed of properly.

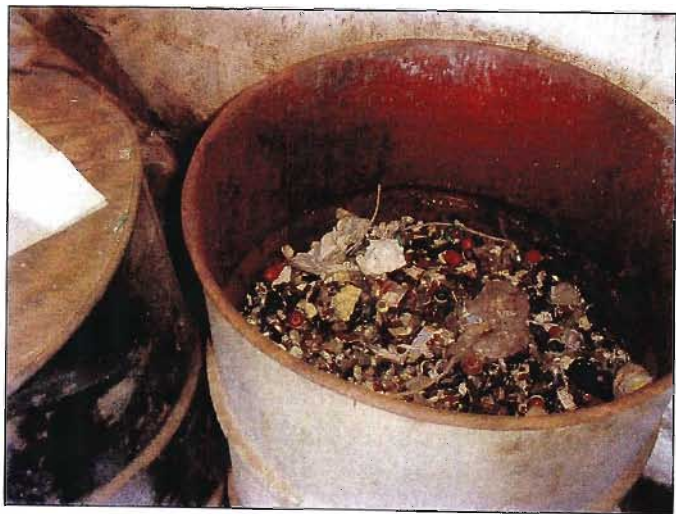
The best way to make the distinction would be the separation of these wastes. This can be done using distinct containers or an easily recognised colour coding system. Those involved in the waste management process must be made aware of the risks, the reasons for the separate containers and the colour coding applied to various waste containers. It is important that a certain standard of containers or colour coding be applied for all waste (this requires education of all the relevant stakeholders). This colour coding system needs to be standardised in terms of that used for human medical waste and veterinary waste. It is also important that the system be applicable to waste generators, waste transporters and finally waste disposal companies.

Other activities that generate waste at veterinary practices include laboratory diagnostics, radiography, boarding or kennelling. The disposal of glass (Plate 9) is an area of concern, especially in large animal practices. The quantities of medication that are normally required for a single patient can be very high. These might include dips and other insecticides (Meerdink, 2000). Because of the lack of guidelines, one of the

practices has been at a loss of how to dispose of these bottles. In a bid to save space, some practices have started to crush (Plate 10) some of the bottles in 210 litre oil drums. The glass waste consists of various colours of glass rubble. In crushing glass bottles, the practice might be liable to prosecution under the OHSA due to the risks posed to those involved, especially if no protective equipment has been issued. In addition, the crushed material may not have any commercial value, as glass recyclers prefer to have colours separated.



**Plate 9. Sharps and Glass Stored at a Veterinary Practice.**



**Plate 10. Storage of Crushed Glass at a Veterinary Practice.**

Veterinarians reported seven different types of laboratory waste<sup>35</sup> (Table 17). The laboratory waste indicated in Table 17 is, however, not a reliable reflection of the waste produced. Most practices simply indicated 'minimal' or 'negligible' when they were asked to estimate a quantity for laboratory wastes. It might also have been difficult for veterinarians to report quantities, as these records are not kept by practices. The value is, however, an indication of the categories or different types of diagnostic waste that practices produce.

**Table 17. Categories of Veterinary Laboratory Waste (Weekly) Reported.**

TYPES OF LABORATORY WASTE	UNITS	QUANTITY
Diagnostic stains litres (fixers and other slide stains)	Litres	0.3
Egg floatation fluid	Litres	0.1
Glassware produced per month (including slides, sharps, haematocrit and test tubes)	kg	2.2
Multistix (glucose or urine)	No.	109
Sample bottles	No.	0.0
Slides (per month)	No.	250
Swabs	kg	0.1
Developer and Fixer (for processing radiographs)	Litres	323

The use of mercury in veterinary practices in England and the United States of America is being phased out because of problems disposing of heavy metals (Asplund, 1998). Six veterinary practices reported that they are still using mercury thermometers. The impact of mercury from veterinary practices was not investigated but with other conventional sources like fluorescent tubes, the discharge of mercury from thermometers as waste is unlikely to be significant. Educating the veterinary practitioner on the implications of the disposal of heavy metals would go a long way in eliminating as much mercury from the waste stream. Green purchasing (Kaiser *et al.*, 2001) could reduce this potential problem. Another area where green purchasing can be used to control the practitioner's costs and more importantly protecting the environment is in store management (section 2.4 of this dissertation).

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<sup>35</sup> Wastes generated through the diagnosis of disease, this would include infectious, sharps, chemical and pharmaceutical waste components.

One practitioner commented that certain sterile preparations including saline and other pharmacological preparations only come in large-volume packs. In most instances, only small volumes of these preparations are used. Once the seal on the sterile packs is broken, it is not possible to keep the contents for future re-use. The solution would seem obvious - purchase smaller quantities so that all the contents are used (Meerdink, 2000). The reality is that sometimes-small quantities are not easily available or purchasers are often misled by better discounts for bulk purchases. Where the true costs for the disposal of wasted chemicals are being borne by the waste generator, it will become obvious that there is a need to manage stores better.

The seasonal variation in the incidence of many diseases may account for the seasonal variation in waste produced (Figure 4). Bacterial, viral and parasitic infections escalate in the spring and may be responsible for the increase in waste at veterinary practices in these months<sup>36</sup> (Figure 4). Hospital medical waste estimates for Durban were 1764.82 tonnes per annum (TRPC, 2000:5). The projected waste from veterinary practices sampled from this study was estimated to be 425.7 tonnes per annum. In comparison, this represents 24.1% of the total medical waste, though the estimate remains approximate because only 52.5% of the Durban veterinarians were sampled.

#### **5.2.2 Storage and Containers Used for Veterinary Waste**

The HPCSA guidelines (HPCSA, 2002) state that all anatomical waste (including human and animal anatomical waste) can be stored at 4 °C for a week, or indefinitely if frozen. Similar conditions apply to infectious waste. It was reported in the study that anatomical waste was stored in non-specific containers and some of this waste was not refrigerated or frozen. The reasons for these guidelines are to halt or slow putrefaction of cadavers, and the growth of bacteria and other micro-organisms.

Anatomical waste was reported to be stored in non-specific containers, which were then refrigerated. Respondents reported that they placed cadavers directly into the

refrigerating unit without a barrier between the cadaver and the inside of the refrigeration unit. This is not acceptable if the freezer has other uses. The majority of veterinary practices normally reserve a deep freezer or possibly a cold for the sole purpose of storing cadavers. In some cases, it might not be practical to use rigid containers inside a refrigerator for the storage of cadavers as these may take up a lot of space. In addition, cadavers may be unusually large or awkwardly shaped to fit in the refrigeration unit. In these cases, the cadavers should, at the very least, be placed in a sealed plastic bag to prevent the escape of any fluids, which may contaminate the freezer. Failure to follow these recommendations may place staff or other individuals handling waste at risk of infection. The multiple re-use of containers (as indicated in the results section) without an adequate cleaning or disinfecting procedure will also increase these risks (especially for infectious waste which is being stored in non-refrigerated, multiple use containers). The questionnaire did not determine whether there was a cleaning or disinfection procedure in place for reused waste containers at veterinary practices.

Most veterinary practices dispose of sharps using single-use plastic bags. Sharps pose their own unique challenges for disposal. The danger is increased when sharps may be contaminated with infectious organisms, as is the case when there is a need to debride<sup>37</sup> an infected wound or when a blade may have become contaminated with micro-organisms in some other way. The HPCSA (2002) recommends that sharps be stored in containers appropriately marked as SHARPS or with a recognised hazard symbol. These must not be placed in plastic bags due to the risk of injury and subsequent exposure to infection, if the sharps should penetrate the plastic (Plate 11). The HPCSA guidelines do not specify what type of container should be used for the storage and disposal of sharps. This should comprise rigid material that will resist being punctured. The container should also be sealable to reduce the risk of sharps escaping during transportation. In addition, to reduce the risks of injury from refilling, the container should not be

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<sup>36</sup> <http://yp.bellsouth.com/sites/jeffersonanimalhospitals/page6.html> accessed 17th Dec. 2002

<sup>37</sup> Remove dead tissue from the wound.



reusable, as was the case with some of the receptacles used by respondents in the survey (Reinhardt and Gordon, 1991).



**Plate 11. Sharps Container at a Veterinary Practice.**

### **5.2.3 Collection of Veterinary Waste**

The importance of records can not be overstated, if the veterinarian in charge of a practice intends to implement, maintain and review a process such as waste management. Before s/he can take steps to correct a problem, baseline information must be gathered about the situation. This includes adequate records to inform the decision-making process.

Just under half (46.9%) of the veterinary practices in this study indicated that there were no control measures taken before removing waste from practices. In addition, only 43.8% of the veterinary practices kept records of the waste generated in the practice (Table 10). Records are not only a valuable tool for managing waste in the practice, but they may also be important where the responsibility for wastes generated by the veterinarian becomes a litigation issue (section 28, NEMA). Records can be used as a tool to show that the veterinarian has made every effort to have the waste that s/he has generated disposed of correctly. Being able to show what the clinic produces and how the wastes are disposed of (type and volumes of waste) might save the veterinarian from prosecution. These records may include documents that show exactly what and

how much waste was picked up, where it was taken, if it was processed in any way (e.g. incinerated or autoclaved) and details of disposal. There are plans in place to set up a waste database of generators, transporters and final disposal companies (T Fasheun, 2002, *pers. comm.*<sup>38</sup>). Currently, the types of records kept by waste generators are not standardised (S Beningfield, 2002, *pers. comm.*<sup>39</sup>). Provincial government is in the process of developing a waste manifest system which will introduce a culture of responsibility for human medical waste generated. This also needs to be applied to veterinary waste.

Brody (1993) recommends that an individual be appointed in the practice to take responsibility for the waste at the veterinary practice level. This individual will be responsible for keeping records of waste generated and for any training staff might require. The overall responsibility for the safe disposal of wastes, however, remains with the generator of that waste, the veterinarian.

#### **5.2.4 Waste Treatment, Recycling and Disposal**

There are currently very few veterinary practices that treat veterinary waste by incineration, autoclaving or any other means. Two practices indicated that they treated infectious waste (cases of suspected or confirmed parvovirus infection which require thorough disinfecting) on the premises and another practice indicated that it burnt some of its anatomical wastes.

Most (87.5%) of the veterinary practices used the services of a waste disposal company. The one veterinary practice that indicated that it was dissatisfied with the services offered complained that the collection of waste should be extended to cover the weekend, which is currently not the case.

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<sup>38</sup> Dr T Fasheun, Department of Agriculture and Environmental Affairs, Pietermaritzburg.

<sup>39</sup> Ms S Beningfield, SanuMed Health Care Waste, c/o EnviroServe Waste Management (Pty) Ltd, Durban.



Some other comments provided by veterinarians included the request for a protocol or guidelines for the management of wastes and appropriate training, which would be in line with current laws and regulations dealing with waste management. These practitioners were obviously not aware that these guidelines existed. Another concern was for adequate and standardised receptacles for veterinary waste. In general, most practices were also concerned with the costs implications of implementing an adequate waste management system. This included costs for waste disposal and record keeping.

#### **5.2.5 Staff Profile of Veterinary Practices**

'General workers' <sup>40</sup> make up the majority of staff at veterinary practices. They are also the largest group of workers responsible for waste at veterinary practices (section 4.2.5). In some cases, workers were not provided with any protective equipment, not vaccinated against any diseases nor are they provided with gloves or any other protective barrier against infection or disease. Some staff do not receive any training regarding waste management in the practice and in other situations there is no written down or well communicated procedure in case of emergencies like needle stick injuries.

The OHSA protects the health and safety of both staff and the public from the activities at a place of employment. Employers are bound by the Act to provide safety equipment and training, to prevalent ill health and poor safety conditions for workers and the public. Veterinary practices that allow the inclusion of sharps in plastic bags and which fail to provide safety equipment or training with regard to handling waste are thus in contravention of this Act. There are waste disposal companies that provide training about source separation of waste and waste handling. Veterinary practitioners should use these opportunities to manage their waste generating activities at their practices and ensure a safe working environment for their workers and the public.

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<sup>40</sup> These include personnel without a formal medical background (section 2.4).

### **5.2.6 Legislation and General Comments**

Most of veterinarians are not aware of their responsibilities as generators of veterinary waste. The best way to correct this situation is through education regarding best practice in waste management. Ignorance of the law is no excuse; it should be the responsibility of an overall registering body to ensure that its members are constantly updated concerning the laws that affect the profession. Training in the field of waste management should be ongoing and would probably be best achieved through the SAVC or the SAVA's regional branches.

### **5.3 VETERINARY PATHOLOGY LABORATORY DISPOSING OF WASTE**

The results of my survey of veterinary practices indicates that a veterinary diagnostics laboratory was disposing of sharps containers from those practices that used its services. Diagnostic samples can not be considered waste since these are used for disease diagnosis. Who is responsible for the waste when the diagnosis has been made and the sample has been put into a bin? In terms of NEMA this responsibility should fall on the shoulders of the producer of the waste (the diagnostic laboratory). In addition, the diagnostic laboratory would be in a better position to know which samples are contaminated, and to take the appropriate disposal precautions. It would also know what processes or toxic reagents were used to make the diagnosis and how to neutralise or deal with these afterwards.

The sharps containers collected from veterinary practices are collected by the company reviewed in case study B. The sharps containers are passed on from the diagnostic laboratory to the waste disposal company (case study B, Table 13). In this situation, responsibility for the sharps remains that of the veterinary practice that generated them. When samples are submitted by a veterinarian to a laboratory for diagnostic purposes, the question arises of responsibility for the final waste produced. I have stipulated that the producer of waste should take the responsibility for its disposal. In this case, samples become 'waste' at the moment when they are identified as such; that is after the testing process is complete. Responsibility for their disposal rests on the

proprietor of the laboratory, who must build this in to their costs. It becomes very difficult to establish responsibility if the origin of this waste cannot be traced. This is where a properly functioning waste manifest system comes into play. The origin of the waste is recorded as well as intermediate handlers and transporters of the waste, through to the final disposal details.

#### 5.4 VETERINARY WASTE DISPOSAL COMPANIES

Staff at waste disposal companies handling veterinary waste are generally not inoculated against any diseases, nor do employers provide them with any training regards risks associated with their occupations. In addition, some waste disposal companies do not provide adequate safety equipment for staff. These staff are also opening plastic bags in which cadavers are being transported and disposing these into plastic bags in the general domestic waste stream, (exposing waste workers to possible infection). In addition, the ash from waste incinerators must be disposed of at a designated landfill site (H:H or H:h sites) and must not be included in domestic waste.

It is important that waste disposal companies provide adequate initial training and follow-up training to their clients, which would include veterinarians. They should inform them concerning inappropriate practices that may be putting staff or the public at risk from infection or injury (e.g. sharps in plastic bags). There is also a need for emergency planning and preparedness in the workplace. More specifically, there should be emergency plans and procedures dealing with needle stick injuries and road accidents (e.g. providing gloves and other safety equipment to facilitate safe removal of waste from an accident scene).

There is also a need for a standardised waste manifest system. This might be a way to trace waste generated from source until final disposal (S Msimang, 2002, *pers. comm.*<sup>41</sup>). Some waste disposal companies merely issue receipts for payments. Some of these receipts do not describe the types and quantities of wastes collected. Veterinary

practices need to receive some assurance from waste disposal companies that their waste is being disposed of appropriately, so that they are not liable for improper disposal of wastes. The Department of Environmental Affairs and Tourism (DEAT) is currently working on a waste manifest system to be introduced in the province. Such a system should indicate the source of the waste, any intermediate handlers and the final destination and fate of the waste. This manifest system could be linked to a provincial database to facilitate analysis of trends and management of veterinary waste. Pratt (1994) indicates that in addition to a manifest system, an agreement with the transporter should include details of the wastes to be removed, the frequency and the type of vehicle to be used. These agreements should be kept for a minimum of three years after the termination of the contract (Pratt, 1994).

This survey has demonstrated that very few waste disposal companies or veterinary practices that have had their waste records inspected. Adequate supervision by the authorities concerned will help to maintain a culture of responsibility as far as proper waste management is concerned. It is important to have the laws, but it is even more important to enforce them.

There is a move to de-list biological/anatomical waste. Instead of incineration being the only permissible method of disposal, autoclaving or other technology can also be used, as is the case overseas (S Msimang, 2003, *pers. comm*<sup>42</sup>). This would help to pave the way for alternate technologies to incineration, since there is only one licensed medical waste incinerator in KwaZulu-Natal (WD Khanyile, 2003, *pers. comm*<sup>43</sup>).

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<sup>41</sup> Mr S Msimang, Deputy Director, KwaZulu-Natal Department of Health, Pietermaritzburg.

<sup>42</sup> *Op. cit.*

<sup>43</sup> Mr WD Khanyile, Director Environmental Health, Department of Health, Pietermaritzburg.

## 5.5 CONCLUSION

The management of certain categories of veterinary waste is a source of concern. These include sharps, infectious and anatomical waste. Each of these waste streams poses a particular challenge in terms of management and disposal. These challenges include the appropriate storage containers and conditions for the waste including training for staff at veterinary practices and waste disposal companies. This discussion has highlighted the need for clarification of certain issues concerning veterinary waste management. These needs are summarised in Table 16, and include the issue of responsibility for wastes generated and the problems of separation of waste at source. These shortfalls were pointed out in the literature (section 2.9) and have become apparent once more from the responses veterinary practices have provided. The new veterinary waste management guidelines will need to be revised in terms of waste management principles. There is clearly a need for a set of enforceable veterinary waste management guidelines that are effective at practice level (section 6.4).

## **CHAPTER 6 - RECOMMENDATIONS AND GUIDELINES**

### **6.1 INTRODUCTION**

A summary of the major findings can be found in Table 16. It is apparent that a number of needs arise concerning veterinary waste management. Some clarity is provided for the responsibility for wastes generated and the separation of veterinary wastes at source (section 6.2 and 6.3). Section 6.4 provides some guidelines for waste disposal in the practice, as identified in Chapter 4, and alluded to in Chapter 2. In addition, some information about the records to be kept (section 6.5) and some insight into the OHSA are provided.

### **6.2 RESPONSIBILITY FOR WASTE**

Responsibility for waste generated lies with the producer. In terms of section 2 of NEMA (section 2.4), responsibility for the adverse effects of a product or service, the cost of clean up or remedying the effect of pollution lie with those who cause the harm. In terms of the OHSA, employers have a duty to provide a safe working environment for workers and for people other than employees who may be affected by the activities at a work place. Related to this is 'duty of care' contained in the White Paper on Integrated Pollution and Waste Management (DEAT, 2000), which indicates that responsibility for waste generated lies with the generator, including responsibility for the entire life cycle of the waste. Waste disposal is recognised by the ECA as an activity that has the potential to cause harm to the environment.

### **6.3 SEPARATION OF WASTE AT SOURCE**

Separation should ideally be done at source, where the waste is first produced (e.g. in the consulting room or theatre). Nowlan (1997) recommends that this is best done with containers placed at source. Segregation of waste as early as possible can be a useful tool to reduce costs for waste disposal. Considering that domestic waste disposal is cheaper than that of sharps, infectious and anatomical waste, it would make sense to exclude domestic waste from these other waste sources. It is important therefore that

an appropriate colour coding system be applied and be recognisable at all stages of the waste management process, from the generators and transporters to the waste disposal companies. Colour coding used for human medical waste and veterinary waste needs to be harmonised. Currently only two practices reported having a colour coding system in place.

#### **6.4 GUIDELINES FOR DISPOSAL OF VETERINARY WASTE**

For anatomical waste, the preferred HPCSA method for final disposal is incineration (Appendix 1). There is, however, currently a move away from incinerator technology, due to its harmful effects on the environment. Only incinerators that meet minimum requirements should be used for infectious waste. The HPCSA also indicates that on-site incineration is preferable. This is not practical, considering that no veterinary practices in this study indicated such facilities on-site. The costs to install and maintain incinerators are relatively high and some veterinarians were not willing to outlay this expenditure (O'Flynn, 1992). It would also be more difficult to control waste incineration if this function was carried out at practices, not to mention the increase in focal sources of pollution. Authorities would have the increased burden of policing many small incinerators. It is therefore preferable for such wastes to be collected by a waste disposal company that manages a large incinerator. Storage conditions for infectious wastes should be similar to that of anatomical wastes (either freezing or refrigerating for a maximum of one week). These are, however, not indicated in the HPCSA guidelines.

Containers for sharps should be rigid and puncture-proof to prevent them from penetrating the container and causing injury. This matter is not addressed in the HPCSA guidelines. These containers should be disposed of as soon as possible after they are filled. They should also have provision to be sealed once filled. Pruss *et. al*, (1999) recommended that sharps be incinerated, where possible.



The HPCSA (2000) provides an 'end pipe' solution to the management of chemical and pharmaceutical waste. Wherever possible, the volumes of chemical and pharmaceutical waste should be first reduced through 'green purchasing' (Kaiser *et al.*, 2001). This should be followed by good stores management to ensure there is no wastage. A system of 'first-in-first-out' should be used. The diverse nature of the chemicals and pharmaceuticals used at practices dictates the final disposal technology used. General guidelines for the disposal of chemicals and pharmaceuticals are indicated below.

In general, the disposal of small quantities of some wastes via the local sewage system seems to be acceptable (Pruss *et. al*, 1999). It is, however, important that the practice informs or gets permission from the local authority. Petroleum spirit and hazardous organic solvents should not be disposed of this way; neither should other hazardous chemical waste. Wastes with a high heavy metal content should not be incinerated or disposed of in general landfills due to the risk of atmospheric or groundwater pollution. Alternatives for the disposal of pharmaceuticals given by Pruss *et. al* (1999) are landfill, encapsulation and discharge to sewer. The option to return to the manufacturer for disposal should also be considered (Meerdink, 2000).

The HPCSA guideline document colour coding system does not provide for a differentiation between general (office and domestic), chemical and pharmaceutical waste. The guidelines indicate that these should be stored in black or dark green colour coded containers. It is inappropriate to have the same colour for general, domestic waste, pharmaceuticals and chemicals. Domestic waste should have a different colour (Table 18). This study has shown that a large amount of domestic waste is included with other more potentially hazardous waste streams. Allocating a separate colour to general waste containers and separation at source would alleviate this problem (Table 18).

Table 18. Summary of Guidelines and Recommendations.<sup>44</sup>

WASTE STREAM	PROPOSED COLOUR	FINAL STORAGE CONTAINER	FINAL DISPOSAL
ANATOMICAL WASTE (biological waste including cadavers)	YELLOW	<ul style="list-style-type: none"> <li>Leak-proof containers especially plastic bags that contained anatomical waste should not be reused.</li> <li>To be frozen indefinitely or refrigerated for approximately one week.</li> <li>Regularly disinfect fridge or cold rooms.</li> <li>Not to be excessively handled.</li> <li>Fridge located in a secure area.</li> <li>Vector control in the storage area.</li> </ul>	<ul style="list-style-type: none"> <li>Incinerator (or autoclave, if regulations are changed)</li> </ul>
INFECTIOUS WASTE	RED AND/OR HAZARD SYMBOL	<ul style="list-style-type: none"> <li>As for anatomical waste.</li> <li>Ensure workers have adequate protective equipment when handling this waste.</li> <li>Not to be excessively handled.</li> <li>Must not include domestic or general waste.</li> <li>Fridge in a secure, safe area.</li> <li>Area in which waste is stored is to be separate from other working areas or should have restricted access.</li> <li>Storage areas only accessible to authorised personal.</li> <li>It should be possible to disinfect the storage area.</li> <li>Vector control in the storage area.</li> </ul>	<ul style="list-style-type: none"> <li>As for anatomical waste.</li> </ul>
SHARPS	RED AND/OR HAZARD SYMBOL	<ul style="list-style-type: none"> <li>Rigid puncture-proof (not plastic bags) sealable containers.</li> <li>Remove as soon as full to lockable secure are before disposal.</li> <li>Not to be excessively handled.</li> <li>Storage areas to be accessible to authorised personal only.</li> </ul>	<ul style="list-style-type: none"> <li>Incineration</li> <li>Autoclave and Macerate.</li> </ul>
PHARMACEUTICALS OR CHEMICALS	YELLOW	<ul style="list-style-type: none"> <li>Where possible stored in original container.</li> <li>Use 'green purchasing' and first-in-first-out systems to manage.</li> <li>Always refer to disposal suggestions in accompanying packaging.</li> </ul>	<ul style="list-style-type: none"> <li>Always consult local authority before sewage disposal.</li> <li>Containers must be punctured or damaged to prevent re-use.</li> </ul>
GENERAL OR DOMESTIC WASTE	BLACK OR GREY	<ul style="list-style-type: none"> <li>Keep separate from other waste.</li> <li>Vector control in the storage area.</li> <li>Container/bags may be reused if not soiled.</li> </ul>	<ul style="list-style-type: none"> <li>To a general landfill site.</li> </ul>
GENERAL	<ul style="list-style-type: none"> <li>Appoint an individual from within the practice to be responsible for the overall management and co-ordination of training and other waste management functions.</li> </ul>		

<sup>44</sup> Written taking into account principles from DoH, 2000; NEMA; Occupational Health and Safety Act and the White Paper on Integrated Pollution and Waste Management.

## **6.5 RECORD KEEPING**

Considering that responsibility for waste produced lies with the generator, it is important for the veterinarian that the adequate records be kept. These records could help prove that the veterinarian had done all s/he could to safely dispose of the wastes generated. Pruss *et al.* (1999) indicates that this 'consignment note' should originate from the producer of the waste. It should include the waste category, the quantities and how the waste was generated. There should be provision for all that handle the waste to include their particulars and also where or to whom the waste was passed. After the waste has been destroyed, it is important that a copy of this consignment note (British Veterinary Association, 1998) be sent to the originator of the waste. All those involved in the waste management process should be registered with the appropriate authorities. This includes generators, transporters and final waste disposal companies. A waste manifest system is currently being developed (S Msimang, 2002, *pers. comm.*<sup>45</sup>), which should address this issue.

## **6.6 OCCUPATIONAL HEALTH AND SAFETY CONSIDERATIONS**

Considered under this heading is the training of staff regarding waste management, safety equipment and possible vaccinations. The OHSA provides guidelines for health and safety in the workplace. These guidelines also provide for the protection of people outside the place of work (the practice) from hazards. Under this Act, it is the duty of the employer to provide workers with training about how to avoid hazards at a place of work. It is also the duty of the employer to provide protective equipment and take reasonable precautions (before the use of protective equipment) for the health and safety of employees. This would also include vaccinations for zoonotic diseases.

### **6.6.1 Protection of Employees and the Environment**

The OHSA provides an indication of what protective equipment staff are to be provided. The Act recognises five main routes of transmission. These include contact, droplet, air-borne, common vehicle and vector-borne infection routes. Normally, if the

route of transmission for the hazardous biological agent is known, then precautions or, controls can be taken against infection. Protective equipment includes gloves, protective clothing (where the risk of soiling clothing exists), masks, boots, goggles and other protective eyewear. Brody (1993) recommends that as a minimum, workers should be provided with gloves and eye protection. Equipment used should, however, relate to the hazard posed. In addition to protective equipment, the OHSA also gives an indication of what vaccinations are available for staff exposed to HBA. On the list are a number of zoonoses. Reasonable measures including vaccination should be applied where HBA (such as rabies) are encountered. Out of the approximately 200 listed agents, 133 of these are encountered in veterinary practice as zoonoses and have the potential to infect both humans and animals (Appendix 10).

#### **6.6.2 Training about Hazards**

Training is a first step towards protecting people against hazards encountered in the workplace. A system to ensure that all people who are exposed to HBA's are properly trained needs to be put into place. This includes the use of precautions and the assignment of responsibility to each person. It is important to review from time to time how effective the precautions are. In addition to the above, it is also important that veterinary waste disposal companies advise their clients about good waste management. This includes separation of waste at its source and the use of appropriate containers for different waste (Nowlan, 1997; Baldwin and Ball, 2000). Brody (1993) advocates a similar approach: veterinarians need to write down a hazards communications programme. This programme includes a written hazard communication plan, a training programme and a list of hazardous substances in the practice.

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<sup>45</sup> *Op. cit.*

## CHAPTER 7 - CONCLUSION

The main aim of this study is to describe the status and management of veterinary waste in the Durban Unicity. Private veterinary practices, a veterinary diagnostics laboratory and waste disposal companies were used in the study. There are other sources of veterinary waste, which include state veterinary services and welfare organisations like the Society for the Prevention of Cruelty to Animals and animal kennels, which were not included in this study.

In published literature and national legislation, veterinary waste is not given the same priority or concern for its disposal, as is human medical waste. This is reflected in the gaps in the documents which lay down the minimum requirements for waste disposal, (DWAF, 1998) where veterinary practices are not acknowledged as producing medical waste. However, veterinary waste potentially contains diseases (zoonoses) which are fatal to both humans and animals if left untreated.

A major finding of this study is the perceived difference between veterinary and human medical waste. This distinction may be responsible for a careless attitude towards the ways in which wastes are managed in veterinary practices, which this researcher believes to be a potential source of danger. This perceived difference is justified by the 'respect' for human remains, and the fear of contracting HIV from poorly managed waste. The literature concerning waste management (in particular DWAF's (1998) minimum requirements), the responses to the questionnaires and discussions with veterinarians and waste disposal practitioners during this study all make this clear.

Veterinary waste (like human dental and medical waste) is still medical waste. This is apparent from the similar categories of waste produced (Table 1). Culture and sensitivities aside, these categories of veterinary waste will have the same impact in terms of environmental pollution and danger to staff and the general public through occasional exposure, especially where sharps or infectious waste has been mislabelled

'domestic waste'. Besides the risks of HIV, the Occupational Health and Safety Act lists over 130 zoonotic HBA (Appendix 10) which may possibly exist in wastes. Some of these zoonotic conditions are characterised by a relatively acute onset (compared to HIV) and rapidly become fatal, if nothing is done to prevent, diagnose and treat them. This study has shown that management of veterinary wastes is presently unregulated and dependent on the good sense of the producers. Unfortunately, disposal costs are relatively higher for smaller practices and might tempt some veterinarians to dispose of their wastes by dumping.

Bearing in mind the diverse nature of the wastes generated, stored and collected including the conditions under which waste may be generated, a set of guidelines for the management of veterinary waste have been proposed (Chapter 6). These guidelines include principles for sustainable waste management drawn from NEMA and other legislation and policy. It must be remembered that these guidelines assume that once waste has been separated at the practice, there are competent waste disposal companies who remove the different categories of waste for disposal. It is also recommended that these guidelines be communicated to the veterinarians through the SAVC or local branches of the SAVA. These same organisations, including the local municipalities and environmental bodies (DWAF and DAEEA) should also ensure that disposal is adequately supervised.

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## APPENDICES

### APPENDIX 1. SUMMARY OF HPCSA (2000) GUIDELINES FOR MEDICAL WASTE.

Waste Stream	Colour	Final Storage Container	Time Stored	Final Disposal
Anatomical <sup>46</sup>	RED ORANGE <sup>47</sup> BLUE	Rigid leak proof container	For one week at 0 °C, or Indefinitely if frozen <sup>48</sup>	Incineration preferred
Infectious, including live vaccines	YELLOW	Sealed single use container or else a rigid leak proof container <sup>49</sup>	Not indicated	Onsite incineration preferred. Offsite incineration acceptable. Sanitary sewer and other accepted technology
Sharps	Labelled as SHARPS Or Recognised symbol	Not Indicated	Not indicated	Onsite incineration is preferred. Offsite incineration acceptable. Land filled with local authority consent. Sewer and other accepted technology
Chemicals <sup>50</sup>	BLACK OR DARK GREEN	DISPOSAL BY QUALIFIED PERSONNEL ONLY	To comply with relevant legislation, as per to each waste	To comply with relevant legislation, as per to each waste
Pharmaceuticals	BLACK OR DARK GREEN	Appropriate packaging to absorb liquids in case of container breakage enroute, placed in sealable plastic bags		Refer to Medical and Related Substances Control Act (1965 Act 101) for Narcotics.
Cytotoxic	BLACK OR DARK GREEN And Toxic Hazard symbol	Prevent penetration & leakage. Seal liquids in containers Pack in absorbents material to absorb spills		Those pharmaceuticals that will not cause off gassing may be incinerated. If incineration not available, chemical destruction. Small amounts into landfill and sewers. Consult local authority
Radioactive	Radiation Hazard symbol		Subject to the Nuclear Energy Act, 1982 (Act No. 92 of 1982)	
Pressurised containers	BLACK OR DARK GREEN		Indefinitely	Shall not be incinerated or autoclaved
General or Domestic	BLACK OR DARK GREEN	Office waste Kitchen waste All other similar wastes	Stored in accordance with regulations governing food premises	Placed in a suitable container and then disposed of as appropriate
General Comments	Waste from hospitalised patients needs to be disposed of separately from boarding or kennel facilities waste.			

<sup>46</sup> Including human, infectious animal and non infectious animal biological waste

<sup>47</sup> Animal anatomical waste may be placed in red bags but human and animal anatomical waste is not to be mixed. This is out of respect for human dignity. The decision to incinerate them together is left up to the discretion of the institution in accordance with legislation.

<sup>48</sup> Where they are frozen, the maximum storage time is left to the discretion of the institution

<sup>49</sup> For liquids in fragile containers

<sup>50</sup> Including toxic, corrosive, flammable, reactive, genotoxic material



## APPENDIX 2. VETERINARY PRACTICES IN DURBAN.

No.	Veterinary Practice	Practice Size	Patients Seen	Affluence or Poverty Index
1	Amanzimtoti Clinic	Clinic	Small	Low
2	Ballito Clinic	Clinic	Mixed	Medium
3	Brighton Beach Clinic	Clinic	Small	Low
4	Blair Atholl Clinic	Clinic	Small	Low
5	Bluff Clinic	Clinic	Small	Low
6	Chatsworth Animal Clinic	Clinic	Small	Low
7	Cowies Hill Clinic	Clinic	Small	Low
8	Doonside Clinic	Clinic	Small	Low
9	Dr. N. Roos Animal Room	Clinic	Small	Low
10	Drs. Baker And McVeigh	Other	Large	Medium
11	Durban North Clinic	Clinic	Small	Low
12	Durban Clinic	Clinic	Small	Low
13	Essenwood Hospital	Hospital	Small	Low
14	Everton Clinic	Clinic	Small	Low
15	Gillitts Hospital	Hospital	Small	Low
16	Glenashly Clinic	Clinic	Small	Low
17	Glenwood Clinic	Clinic	Small	Low
18	Grays Inn Clinic	Clinic	Small	Low
19	Highway Hospital	Hospital	Small	Low
20	Hillcrest Hospital	Hospital	Mixed	Low
21	Isipingo Clinic	Clinic	Small	Low
22	Kingsburgh Clinic	Clinic	Small	Low
23	Kloof Hospital	Hospital	Small	Low
24	La Lucia Clinic	Clinic	Small	Low
25	Link Hills Clinic	Clinic	Small	Low
26	Malvern Clinic	Clinic	Small	Low
27	Maryvale Clinic	Clinic	Small	Low
28	Merebank Clinic	Clinic	Small	Low
29	Merryfield Clinic	Clinic	Small	Low
30	Montwood Park Clinic	Clinic	Small	Low
31	Mount Edgecomb Clinic	Clinic	Small	Medium
32	New Germany Clinic	Clinic	Small	Low
33	Newlands City Clinic	Clinic	Small	Low
34	Northdene Clinic	Clinic	Small	Low
35	Northway Clinic	Clinic	Small	Low
36	Phoenix Clinic	Clinic	Small	Low
37	Pinetown Clinic	Clinic	Small	Low
38	Queensburgh Clinic	Clinic	Small	Low
39	Reservoir Hills Clinic	Clinic	Small	Medium
40	Rinaldo Clinic	Clinic	Small	Low
41	Riverside Clinic	Clinic	Small	Low
42	Seadoone Clinic	Clinic	Small	Low
43	Seaview Clinic	Clinic	Small	Low
44	Shallcross Clinic	Clinic	Small	Medium
45	Sheerwood After Hours Clinic	Clinic	Small	Low
46	Silverglens Clinic	Clinic	Small	Low
47	St. John's Clinic	Clinic	Small	Medium
48	Summerveld Equine Hospital	Hospital	Large	Medium
49	Tongaat Clinic	Clinic	Small	Low
50	Umbilo Clinic	Clinic	Small	Low
51	Umhlanga Hospital	Hospital	Small	Low
52	Umhlatuzana Clinic	Clinic	Small	Low
53	Verulam Clinic	Clinic	Small	Low
54	Vetcare Animal Hospital	Hospital	Small	Low
55	Vetcor Clinic	Clinic	Small	Low
56	Village Clinic	Clinic	Small	Low
57	Wandsbeck Clinic	Clinic	Small	Medium
58	Waterfall Clinic	Clinic	Mixed	Low
59	Westville Hospital	Hospital	Small	Low
60	Windermere Clinic	Clinic	Small	Low
61	Wood Road Clinic	Clinic	Small	Low

### APPENDIX 3. INDICATORS USED TO DETERMINE POVERTY LEVELS.

The Poverty Index developed by Singh (V Singh, 2002, *pers. comm.*) is the 0-1 Standardisation. It is an index based on seven indicators. Singh based his index on income, literacy, dependency, unemployment, electricity, sanitation and tap water. A description of these indicators follows.

#### *Per Capita Income*

For each particular enumerator area (EA), income is available as a range (e.g. those people earning between R0-R999 and R 1000-R1 999). The midpoint of each range was taken and multiplied by the number of people earning within that category. Thus, a value is obtained representing the average total sum within each category. The total was found for each EA and then divided by the total population to give an overall per capita income for each area.

#### *Functional Literacy*

This is taken to be a measure of people older than 18 years that have an educational level of grade six (Standard 4) or more.

#### *An Economic Dependency Ratio*

This is the economically active population divided by the economically inactive population. That is, for a particular area, the total population in the range 18-64 divided by the total population in the ranges 0-18 and 64 and above (V Singh, 2002, *pers. comm.*).

#### *Percentage of People Unemployed in A Particular Place*

Calculated as those people not working divided by the total amount of people that are available to work.

#### *Percentage of Households in a Particular Place with Electricity Access*

Calculated as the number of households with access to electricity divided by the total number of households in an area.

*Percentage of Households in a Particular Place with Access to Proper Sanitation*

The proportion of households with flush toilets expressed as a proportion of the total number of households.

*Percentage of Households in a Particular Place with Access to Tap Water*

The proportion of households with piped water available to them, as a proportion of the total number of households in a particular area.

**Developing the Composite Index: 0-1 Standardisation**

The composite index is a combination of all seven indicators in section 3.3.1. To create this index, Singh firstly expressed all values in the range as a proportion of the highest value. The highest value was given a score of one and the lowest zero. The direction for some of the indicators had to be reversed (unemployment and dependency). Scores for each of the indicators were then combined and then divided by the number of indicators (seven) thus weighting each variable equally in the 0-1 Standardised Index (V Singh, 2002, *pers. comm.*). The index was divided into 3, low, medium and high poverty the data ranges for the index were high poverty (0.04 - 0.41), medium poverty (0.41 - 0.79) and low poverty (0.79 - 0.94).

## APPENDIX 4. QUESTIONNAIRE FOR VETERINARY PRACTICES.

### Questions for Veterinary Practices

Research Area: Durban Metropolitan area  
Target group: Private Veterinary Practices

Supervisors: Dr. Helen Watson  
Prof. Michelle McLean

Dear Sir/Madame,

Thank you for agreeing to participate in this Veterinary Waste Management questionnaire survey. The findings of this questionnaire will provide data for my course work masters dissertation in the *School of Life and Environmental Sciences*, at the *University of Natal*.

If you have managed to complete the questionnaire before the agreed pick up date or if you have any questions regarding this survey please do not hesitate to call Dr. Aubrey P. Muswema (Cell. 083 9649161 or email [202513961@nu.ac.za](mailto:202513961@nu.ac.za)).

*All information will be treated in the strictest confidence.*

Thank you

Please *fill in* the answers in the clear spaces provided or *circle* the appropriate response where a choice is given.

Biographical Data-	
00.0	Respondent's Name
01.0	Title (i.e. Vet or Clinic manager, etc.)
02.0	Physical Address
03.0	Contact telephone numbers
04.0	Date
Practice Information-	
10.0	How long has the practice been running? Circle one [1] <1 yr. [2] 1-5 yr. [3] >5 yr.
11.0	Which phrase best describes the practice? Circle one [1] Small animal practice [2] Large animal practice [3] Mixed animal practice [4] Other (Name)
12.0	How many animals can you keep as inpatients at any one time? (i.e. No. of individual cages?) Number
12.1	Approximately how many (total) animals did you have admitted as inpatients in the last week? Number
12.2	Admission periods vary but approximately how long (on average) do animals stay admitted in the practice? Number
12.3	Approximately how many (total) animals did you see as outpatients over the last week? Number
13.0	How many days a week is your practice open? Number
Size of Practice-	
20.0	What % of time in your weekly routine is: [1] Major Surgery (OVH orthopaedics, etc.) (Give a %)
20.1	[2] Minor Surgery (wounds, castrations, superficial surgery etc.) (Give a %)
20.2	[3] Disease treatment (Antibiotic therapy etc.) (Give a %)
20.3	[4] Case management (weight mgt., etc.) (Give a %)
20.4	[5] Other (please name and give a %) (Give a Name and %)
21.0	How many Animals have you seen in the last week (total) as [1] Major Surgery cases? Give Number.
21.1	[2] Minor Surgery cases? Give Number.
21.2	[3] Disease treatment cases? Give Number.
21.3	[4] Case management (medicine or weight mgt. etc.)? Give Number.



#### APPENDIX 4. QUESTIONNAIRE FOR VETERINARY PRACTICES-Continued

21.4	[5] Other cases?		Name & Give Number	
22.0	Generally, does your caseload fluctuate with season?		YES/NO	
22.1	Give a Ratio to indicate seasonal weightings  (i.e. 2:1:2:1)		Autumn: MAM [ ] Winter: JJA [ ] Spring: SON [ ] Summer DJF [ ]	
Staff levels -				
30.0	How many vets does the practice employ (Permanent and Locum)?		Give number Permanent : Locum :	
31.0	How many Paraveterinary staff (nurses/technicians) do you have employed?		Give number	
32.0	How many general workers does the practice employ (including receptionist)?		Give number	
33.0	Are staff vaccinated against any diseases		YES/NO	
33.1	Which diseases?	List [1] [2]		
34.0	Who is responsible for waste disposal in the practice?		Circle one [1] Veterinarian [2] Paraveterinary staff [3] General worker [4] All of the above [5] Other Title:	
34.1	Has s/he received any training/instruction in health care waste (HCW) management?		YES/NO	
34.2	When was the last time staff attended a training course?		Circle one 1] <6 months. [2] <1 year. [3] >5 yr	
34.3	Are there any opportunities for training/instruction in HCW management for your staff?		YES/NO	
34.4	Who offers training?	List [1] [2]		
Types AND Segregation Of Waste-				
40.0	Do you separate/sort HCW prior to disposal? (Put into separate collecting vessels?)		YES/NO	
40.1	In order to establish what waste streams you produce, please select from the list below those components that you group together into each waste category.		Insert numbers into the boxes on the right to describe what waste is in each category.  i.e. category A contains [4] [6] [2] [ ]  CATEGORY CONTAINS A [ ][ ][ ][ ][ ][ ] B [ ][ ][ ][ ][ ][ ] C [ ][ ][ ][ ][ ][ ] D [ ][ ][ ][ ][ ][ ] E [ ][ ][ ][ ][ ][ ]	
	[1] Domestic waste (packaging, paper etc)			
	[2] Anatomical Waste from surgery etc)			
	[3] Cadavers			
	[4] Sharps			
	[5] Pharmaceuticals			
	[6] Waste with Blood (swabs bandages etc.)			
	[7] Infectious waste (Contaminated with secretions /excretions from infected animals)			
	[8] Radioactive waste			
	[9] Chemicals (Assume 1ltr = 1kg)			
	[10] Other (please specify)			

# APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

41.0	How much HCW from @ category do you produce per day/week. For each category you indicated estimate how much waste you produced within the last week (Kg) CATEGORY (from previous question) A B C D E	From the categories you supplied in Q 40.1 Estimate weight in Kg  CATEGORY A [ ] B [ ] C [ ] D [ ] E [ ]
42.0	Estimate how many injections you administer per day?	Give number
43.0	Do you offer radiology as part of your services?	YES/NO
43.1	What radiological wastes do you produce?	List [1] [2] [3] [4]
43.2	What volumes of radiological wastes do you produce? Specify the units produced per week/month	(Litres/month) [1] [2]
44.0	Do you offer laboratory diagnostics as part of your services?	YES/NO
44.1	What laboratory diagnostic wastes do you produce?	List [1] [2]
44.2	What volumes of laboratory diagnostic wastes do you produce? Specify the units produced per week/month	(Litres/month) [1] [2]
45.0	What other services do you offer? (That might generate HCW i.e. boarding/kennels etc.)	List [1] [2]
46.0	What protective equipment does staff sorting waste have?	Circle from list [1] None [2] Gloves [3] Boots [4] Apron [5] Mask [6] Trousers [7] Other ( )
47.0	Have you had any cases of needle stick/cuts from HCW in the last 12 months?	Circle one YES/NO,
47.1	How many cases were reported in the last 12 months?	Number
47.2	Do you have a 'written down' or well-communicated procedure to follow in case of such an emergency?	Circle one YES/NO
48.0	Do you use any mercury thermometers in your practice?	Yes/NO
Waste storage-		
50.0	Do you have a specific storage area for HCW at your practice?	YES/NO
50.1	Is the area secured/restricted access?	YES/NO



## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

51.0	What receptacle/containers do you store HCW in your practice?  Choose one from each column below for each category given previously. i.e. for category [A] 2, B, ii			From the categories you supplied in Q 40.1 Complete the following table. i.e. [A]        2   B ii			
	CONTAINER	FREQUENCY	REFRIGERATION	CONTAINER FREQUENCY REFRIGERATION (Given Previously)			
	[1] No specific container	[A] Single use container	[i] Refrigerated i.e. at 4 °C	A			
	[2] Plastic container	[B] Multiple use container	[ii] Frozen	B			
	[3] Cardboard		[iii] Not refrigerated	C			
	[4] Metallic container			D			
	[5] Plastic bag			E			
	[6] Others (please name)						
52.0	Do you have any colour coding system for HCW?			YES/NO			
52.1	Indicate colour for each Category CATEGORY (from previous question) A B C D E			From the categories you supplied in Q 40.1 Indicate colour used for each one CATEGORY        COLOUR A B C D E			
HCW Disposal-							
60.0	Do you treat any HCW at your practice before you dispose of it? (i.e. autoclave or incinerate, etc?)			YES/NO			
60.1	Which category of HCW do you treat before disposal?  CATEGORY (from previous question) A B C D E			From the categories you supplied in Q 40.1 Indicate by circling which categories you treat at your practice Select from the list  CATEGORY A B C D E			
60.2	What process do you use to treat it? (i.e. autoclaves, incinerate, burn, etc.)			From the categories you supplied in Q 40.1 indicate process used for each category CATEGORY        PROCESS A B C D E			
61.0	Do you recycle any HCW? (i.e. syringes or any form of reuse etc)			YES/NO			
61.1	Explain?	List [1] [2]					

## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

62.0	Who removes HCW for disposal from your clinic?	Circle one and provide detail [1] Self [where to?] [2] Private company [Name company/where to?] [3] Other [Name/where to?]
62.1	Are there any control measures before removal (i.e. transport or waste manifest forms to complete, etc.)	YES/NO
62.2	Please describe/list the control measures.	List /describe control measures [1] [2]
63.0	Are you happy with the services offered by HCW disposal companies?	YES/NO
64.0	Suggest how the services being offered by waste disposal companies can be improved	List [1] [2]
64.1	Any other general suggestions or comments?	List [1] [2]
Policy and Regulations		
70.0	Are you aware of the <i>Proposed Regulations For The Control Of Environmental Conditions Constituting A Danger To Health or A Nuisance</i> that was promulgated in January 2000?	Yes/No
70.1	What is your general opinion regarding the their adequacy?	List opinions [1] [2]
70.2	Are there any specific ones that you disagree with?	List [1] [2]
71.0	Are you aware of your responsibilities as a generator of medical waste in terms of <i>Environmental Conservation Act</i> (Act No. 73 of 1989) and the <i>National Environmental Management Act</i> 102 (1998)?	Circle one  Yes/No
71.1	What is your general opinion regarding the their adequacy?	List opinions [1] [2]
71.2	Are there any specific ones that you disagree with-please elaborate?	List [1] [2]
72.0	Do you keep any records on HCW generated at your practice?	Circle one YES/NO
72.1	Describe/list briefly what records you keep.	List [1] [2]
74.0	Are records kept for inspection purposes by authorities?	YES/NO
74.1	When was the last time that your records in Q 74.0 were inspected?	Circle one. [1] <6 months. [2] <1 year. [3] >5 yr.



## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

Budgeting/Finance		
80.0	How much do you charge for euthanasia?	Number
81.0	Do you charge separately for the disposal of cadavers?	YES/NO
82.0	How much do you charge for disposal of cadavers	Number
83.0	How do you dispose of cadavers? (i.e. incinerate, cremate, etc.)	List [1] [2]
84.0	How much did you spend on HCW disposal last month (i.e. payments to HCW disposal Company)?	Number
84.1	How much do you spend on general domestic waste removal from your practice?	Number
General comments		
90.0	Any other general comments concerning veterinary HCW?	List [1] [2]
81.0	Any other general comments about this questionnaire?	List [1] [2]

Thank you for your time!

## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES.

### Questions for Waste Disposal Companies

Research Area:  
Durban Unicity

Supervisors: Dr. Helen Watson  
Prof. Michelle McLean

Target group:  
Waste transporters  
Waste Disposal companies (Incinerators/Autoclave sterilisation etc)

Dear Sir/ Madam,

Thank you for agreeing to participate in this Veterinary Waste Management questionnaire survey. The findings of this questionnaire will provide data for my course work Masters dissertation in the School of Life and Environmental Sciences, at the University of Natal.

If you have managed to complete the questionnaire before the agreed pick up date or if you have any questions regarding this survey. Please do not hesitate to call Dr. Aubrey P. Muswema (Cell. 083 9649161 or email [202513961@nu.ac.za](mailto:202513961@nu.ac.za)).

All information will be treated in the strictest confidence.

Thank you

Please fill in the answers in the clear spaces provided or CIRCLE the appropriate response where a choice is given. Unless specifically stated, for the purposes of this questionnaire, medical waste will be assumed to include both veterinary and human medical waste.

Biographical data-					
1.0	Company		4.0	Contact telephone	
2.0	Respondent's Name		5.0	Fax	
3.0	Company Address		6.0	Respondent Email	
			7.0	Date and Time	
HCW disposal Facility-					
10.0	How long has your business been operating in the waste sector (Years)				CIRCLE one [1] <1 yr. [2] 1-5 yr. [3] >5 yr.
11.0	How long has your business been operating in disposal of medical waste (Years)				CIRCLE one [1] <1 yr. [2] 1-5 yr. [3] >5 yr.
12.0	How many days a week are you open for business to receive and process waste?				Please indicate how many days a week you are open.
13.0	How many times a week do you collect medical waste from your clients?		CIRCLE most appropriate answer. [1] Once a month [2] Twice a month [3] Three times a month [4] Four times a month [5] According to client specifications [6] Other-please indicate (.....)		

## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

14.0	What other services to medical facilities (Vet and human) besides waste disposal do you offer? (i.e. Waste disposal training, waste audits, etc.)	Please list [1] [2] [3] [4]
15.0	How many Durban veterinarians do you service?	Give Number
16.0	Is it possible to supply contact names and addresses? Staff-	CIRCLE one YES /NO
20.0	In total, how many Staff does your company employ?	Give Number.
20.1	How many of these come into contact or are directly involved in handling medical waste?	Give Number.
21.0	Does staff receive formal training in handling medical waste?	CIRCLE one YES /NO
21.1	What training (in medical waste management) do you give your staff?	List/describe [1] [2] [3] [4]
21.2	When last did staff receive training (in medical waste management)?	Give date of last training session dd/mm/yyyy / /
22.0	Do you offer training in waste disposal/medical waste management for your clients?	CIRCLE one YES /NO
22.1	What training (in medical waste management) do you offer your clients?	List /describe [1] [2] [3] [4]
23.0	Are staff coming into contact with medical waste vaccinated against any diseases?	CIRCLE one YES /NO
23.1	Please list/ name diseases staff are vaccinated against	List /describe [1] [2] [3] [4]
24.0	Are staff made aware of the risks associated with handling HCW?	CIRCLE one YES /NO
24.1	How are they made aware of this?	List /describe [1] [2] [3] [4]



# APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

Types of HCW															
30.0	<p>What categories of waste do you collect from medical institutions (vet and human)</p> <p>From the list below, select the waste types that would make up each of the separate categories on the right</p> <p>[1] Domestic waste (packaging, wrapping, paper, etc.)</p> <p>[2] Anatomical Waste (from surgery, etc.)</p> <p>[3] (Cadavers)</p> <p>[4] Sharps</p> <p>[5] Pharmaceuticals</p> <p>[6] Waste with blood (swabs bandages) etc.</p> <p>[7] Infectious waste (Contaminated with secretions/excretions from infected animals)</p> <p>[8] Radioactive waste</p> <p>[9] Chemicals (Assume 1 ltr = 1 kg)</p> <p>[10] Other (please specify)</p>	<p>For each separate category ( A, B, C etc) insert what it is supposed to contain on the right.</p> <table border="1"> <thead> <tr> <th>CATEGORY NAME</th> <th>CONTAINS</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>[ ][ ][ ][ ][ ][ ][ ][ ]</td> </tr> <tr> <td>B</td> <td>[ ][ ][ ][ ][ ][ ][ ][ ]</td> </tr> <tr> <td>C</td> <td>[ ][ ][ ][ ][ ][ ][ ][ ]</td> </tr> <tr> <td>D</td> <td>[ ][ ][ ][ ][ ][ ][ ][ ]</td> </tr> <tr> <td>E</td> <td>[ ][ ][ ][ ][ ][ ][ ][ ]</td> </tr> </tbody> </table>		CATEGORY NAME	CONTAINS	A	[ ][ ][ ][ ][ ][ ][ ][ ]	B	[ ][ ][ ][ ][ ][ ][ ][ ]	C	[ ][ ][ ][ ][ ][ ][ ][ ]	D	[ ][ ][ ][ ][ ][ ][ ][ ]	E	[ ][ ][ ][ ][ ][ ][ ][ ]
CATEGORY NAME	CONTAINS														
A	[ ][ ][ ][ ][ ][ ][ ][ ]														
B	[ ][ ][ ][ ][ ][ ][ ][ ]														
C	[ ][ ][ ][ ][ ][ ][ ][ ]														
D	[ ][ ][ ][ ][ ][ ][ ][ ]														
E	[ ][ ][ ][ ][ ][ ][ ][ ]														
31.0	For the categories you specified in Q30.0 how much do you charge for collection disposal?	<p>CATEGORY</p> <p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>	<p>CHARGE per tonne or kg (CIRCLE one)</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>												
32.0	From each category you specified in Q30.0, how much medical waste did you receive/collect from veterinarians in the last week?	<p>CATEGORY (units)</p> <p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>	<p>AMOUNT COLLECTED in the last week (state units)</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>												
32.1	From each category you specified in Q 30.0, how much medical waste did you receive from <u>all</u> medical facilities (i.e. from human path labs, medical clinics and vets, etc.) in the last week?	<p>CATEGORY</p> <p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>	<p>AMOUNT COLLECTED in the last week (state units)</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>												
32.2	For each category you specified in Q 30.0, what technology/means of disposal do you use to render? (i.e. incinerator/autoclave, etc.)	<p>CATEGORY</p> <p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>	<p>Technology Used</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>												
32.3	For each category indicated above what is the maximum daily capacity that you can handle/process? (i.e. tonnes/ day)	<p>CATEGORY</p> <p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>	<p>Maximum Daily Capacity (Tonnes/Day)</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p> <p>[ ]</p>												
32.4	Are there any restricted substances that might interfere with the waste treatment or disposal process?	CIRCLE one	YES /NO												

## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

32.5	List prohibited restricted substances.	List /describe [1] [2] [3] [4]
32.6	Do you have mechanisms in place to ensure that these substances are not included in the waste stream?	CIRCLE one      YES /NO
32.7	What mechanism do you have in place to ensure that they are not included in the waste stream?	Describe how you avoid substances listed above being included/mechanisms? [1] [2] [3] [4]
33.0	Does the volume of medical waste you collect vary with season?	CIRCLE one      YES /NO
33.1	Estimate a Ratio to indicate seasonal variation  (i.e. 2:1:2:1)	Autumn: MAM    [   ] Winter: JJA     [   ] Spring: SON    [   ] Summer: DJF    [   ]
33.2	Does the amount of veterinary waste you collect vary with season?	CIRCLE one      YES /NO
33.3	Estimate a Ratio to indicate seasonal variation  (i.e. 2:1:2:1)	Autumn: MAM    [   ] Winter: JJA     [   ] Spring: SON    [   ] Summer: DJF    [   ]
34.0	Do you sort/separate any medical waste at your premises (i.e. for recycling)?	CIRCLE one      YES /NO
34.1	Explain how/what you sort	List /describe [1] [2] [3] [4]
34.2	Why do you sort/separate that waste	List /describe [1] [2] [3] [4]
35.0	What protective equipment does staff handling medical waste wear/use?	CIRCLE one from list  [1] None [2] Gloves [3] Boots [4] Apron [5] Mask [6] Trousers [7] Other (Name.....)
36.0	Do you supply your clients with containers/bags for HCW?	CIRCLE one      YES /NO
36.1	List what containers/bags you supply to your clients.(i.e. volume, materials, use etc)	List /describe [1] [2] [3] [4]
37.0	Who is responsible for transporting waste from point of generation to your plant?	CIRCLE most appropriate ones and/or provide answers in the space provided.  [1] The medical facility [2] Municipality [3] your selves [4] Other intermediary transporters (Please name.....) [5] Other (Please indicate.....) [6] Combination of above .....



# APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

HCW transportation-		
40.0	Do you have/keep records of transportation of medical waste?	CIRCLE one YES /NO
40.1	What records do you keep (i.e. manifest forms, collection forms, invoices etc?)	List /describe [1] [2] [3] [4]
40.2	Are records kept for inspection by any local, provincial or national authorities?	CIRCLE one YES /NO
40.3	When was the last time these records were audited by the relevant authorities?	CIRCLE one. [1] <6 months. [2] <1 year. [3] >5 yr
41.0	Are loading compartments of transport vehicles for veterinary waste lockable?	Circle one YES /NO
42.0	Are vehicles equipped with some sort of emergency contingency in case of an accident?	Circle one YES /NO
42.1	Indicate what contingency measures are in place (i.e. 2 way radio, spill kits, etc.)	List /describe [1] [2] [3] [4]
43.0	Are vehicles thermally insulated and capable of maintaining a temperature of <4°C?	Circle one YES /NO
HCW treatment and storage-		
50.0	Does any waste treatment/disposals occur for this company at an address other than the one given above?	CIRCLE one YES /NO
50.1	Please give the address/contact details and indicate what happens at the other address	List /describe [1] [2] [3] [4]
51.0	Are you happy with the level of co-operation from veterinarians concerning sorting/segregation of wastes at source?	CIRCLE one YES /NO
51.1	Do you have any specific concerns/What would you like to see being done in relation to Q51.0 above?	List /describe [1] [2] [3] [4] [5]
52.0	Is the HCW processed immediately on arrival at your premises?	CIRCLE one YES /NO
52.1	If the veterinary waste is not processed immediately on arrival, what would normally be the reasons for delays in processing the waste?	List /describe most frequent reasons. [1] [2] [3] [4] [5]

## APPENDIX 5. QUESTIONNAIRE FOR WASTE DISPOSAL COMPANIES-Continued

52.2	Estimate on average how long would it normally be stored before it is processed	Number (i.e. hours stored before processing-indicate units)														
53.0	Is medical waste stored in an area with restricted/secure access?	CIRCLE one YES /NO														
53.1	Indicate what type of restriction applies.	List /describe restriction (i.e. area locked, wall, etc) [1] [2]														
53.2	Are there any special storage arrangements (i.e. refrigeration)?	CIRCLE one YES /NO														
53.3	Indicate what special arrangements	List /describe [1] [2]														
54.0	What top 5 operating problems concerning Medical waste (medical and veterinary waste) have you experienced in the last year?	List /describe [1] [2]														
55.0	From the categories you indicated in Q30.0 estimate what % of waste is incorrectly packaged at source? (i.e. contains waste that would not necessarily be classified as Medical waste)	<table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">CATEGORY</td> <td style="width: 40%;">% INCORRECTLY</td> </tr> <tr> <td>SORTED</td> <td></td> </tr> <tr> <td>A</td> <td></td> </tr> <tr> <td>B</td> <td></td> </tr> <tr> <td>C</td> <td></td> </tr> <tr> <td>D</td> <td></td> </tr> <tr> <td>E</td> <td></td> </tr> </table>	CATEGORY	% INCORRECTLY	SORTED		A		B		C		D		E	
CATEGORY	% INCORRECTLY															
SORTED																
A																
B																
C																
D																
E																
Policy and regulations																
60.0	Do you keep any records on HCW disposed of at your place of business?	CIRCLE one YES /NO														
60.1	Describe/list briefly what records you keep.	List [1] [2]														
60.2	Are records kept as a requirement for inspection purposes by authorities?	CIRCLE one YES /NO														
60.3	When was the last time that your records in were inspected?	Circle one. [1] <6 months. [2] <1 year. [3] >5 yr														
61.0	Do you accept animal carcasses transported by other individuals for disposal (i.e. from private)?	CIRCLE one YES /NO														
62.0	How much do you charge for disposal of a cadaver?	Number (Amount per cadaver/per kg- indicate units)														
62.1	How many cadavers have you accepted for disposal in the last week?	Indicate number of cadavers accepted.														
62.3	How do you dispose of cadavers? (i.e. incinerate, bury on the landfill, etc.)	List methods/describe [1] [2]														
63.0	Are you aware of your responsibilities as a disposer of medical waste in terms of Environmental Conservation Act (Act No. 73 of 1989) and the National Environmental Management Act 102 (1998)?	CIRCLE one YES /NO														
63.1	What is your general opinion regarding their adequacy?	List opinions [1] [2]														
63.2	Are there any specific ones that you disagree with (please elaborate)?	List [1] [2]														
64.0	Any other general comments concerning Veterinary HCW?	List [1] [2]														
65.0	Any other general comments about this questionnaire?	List [1] [2]														

Thank you for your time!

**APPENDIX 6. WASTE STREAMS LEAVING VETERINARY PRACTICES.**

WASTE STREAM	MASS (kg)	MASS % OF TOTAL WASTE
Cadavers	1780.0	32.8
Anatomical, Cadavers	1570.0	28.9
Anatomic, Cadavers, Infectious	400.0	7.4
Anatomical, Cadavers, with Blood, Infectious	340.0	6.3
Domestic Waste	274.0	5.0
Domestic, Cadavers, with Blood, Infectious	200.0	3.7
Domestic, Anatomical, with Blood, Infectious	171.0	3.2
Anatomic, Cadavers, Sharps, Infectious	150.0	2.8
Anatomical, Cadavers, with Blood	100.0	1.8
Domestic, with Blood	70.0	1.3
Sharps	46.2	0.9
Chemicals	41.9	0.8
Domestic, Pharmaceutical, with Blood	41.0	0.8
Domestic, Pharmaceutical, with Blood, Infectious	40.0	0.7
Domestic, Pharmaceutical, with Blood, Infectious, Chemicals	40.0	0.7
Anatomic, with Blood, Infectious	37.0	0.7
Domestic, Anatomical, Pharmaceutical, with Blood, Infectious, Chemicals	30.0	0.6
Domestic, Anatomic, with Blood	26.0	0.5
Cadavers, Infectious	20.0	0.4
Domestic, Pharmaceuticals	15.0	0.3
Domestic, with Blood, Infectious	15.0	0.3
Infectious waste	11.5	0.2
Anatomical, with Blood	5.0	0.1
Sharps, Pharmaceuticals	5.0	0.1
Domestic, Pharmaceutical, Chemical	2.0	0.0
Pharmaceuticals	1.0	0.0
Sharps, Pharmaceutical, Chemicals	1.0	0.0
Infectious, Chemicals	0.5	0.0
Empty Bottles	0.0	0.0
Pharmaceutical, Chemicals	0.0	0.0
Radioactive waste	0.0	0.0
Radioactive, Chemicals	0.0	0.0
Stable waste <sup>51</sup>	0.0	0.0
<b>Total</b>	<b>5433.0</b>	<b>100.0</b>

<sup>51</sup> Indicated as a source of concern by the respondents, but difficult to quantify. The same is true of the category labelled "Empty Bottles" above.



## Correlations

			Level of Affluence (Index 0-1)	Total No. Of Patients (In and Out Patients)	Out Patients seen last week	Total Amount of Waste Produced (kg)	Total Inpatients Space Available	Total No. Of Workers	injections per Day	Ave. No. of Days Patient is Admitted	Spent on Health Care Waste last Month	Control Measures Befor Removal	Keep HCW Records
Spearman's rho	Level of Affluence (Index 0-1)	Correlation Coefficient	1.000	.308	.378*	.119	.037	.202	.256	.102	-.131	-.194	.162
		Sig. (2-tailed)	.	.097	.039	.518	.841	.267	.157	.577	.498	.287	.376
		N	32	30	30	32	32	32	32	32	29	32	32
	Total No. Of Patients (In and Out Patients)	Correlation Coefficient	.308	1.000	.964**	.521**	.695**	.711**	.714**	.035	.513**	-.050	.149
		Sig. (2-tailed)	.097	.	.000	.003	.000	.000	.000	.855	.006	.792	.431
		N	30	30	30	30	30	30	30	30	27	30	30
	Out Patients seen last week	Correlation Coefficient	.378*	.964**	1.000	.482**	.639**	.621**	.618**	.053	.424*	-.105	.146
		Sig. (2-tailed)	.039	.000	.	.007	.000	.000	.000	.781	.027	.681	.440
		N	30	30	30	30	30	30	30	30	27	30	30
	Total Amount of Waste Produced (kg)	Correlation Coefficient	.119	.521**	.482**	1.000	.362*	.600**	.521**	.162	.501**	-.166	.038
		Sig. (2-tailed)	.518	.003	.007	.	.042	.004	.002	.376	.006	.363	.838
		N	32	30	30	32	32	32	32	32	29	32	32
	Total Inpatients Space Available	Correlation Coefficient	.037	.695**	.639**	.362*	1.000	.710**	.656**	.125	.479**	.313	.089
		Sig. (2-tailed)	.841	.000	.000	.042	.	.000	.000	.496	.009	.082	.629
		N	32	30	30	32	32	32	32	32	29	32	32
	Total No. Of Workers	Correlation Coefficient	.202	.711**	.621**	.600**	.710**	1.000	.701**	.191	.627**	.041	-.034
		Sig. (2-tailed)	.267	.000	.000	.004	.000	.	.000	.295	.000	.823	.852
		N	32	30	30	32	32	32	32	32	29	32	32
	Injections per Day	Correlation Coefficient	.256	.714**	.618**	.521**	.656**	.701**	1.000	.256	.538**	.068	.127
		Sig. (2-tailed)	.157	.000	.000	.002	.000	.000	.	.158	.003	.710	.487
		N	32	30	30	32	32	32	32	32	29	32	32
	Ave. No. of Days Patient is Admitted	Correlation Coefficient	.102	.035	.053	.162	.125	.191	.256	1.000	-.286	-.127	-.060
		Sig. (2-tailed)	.577	.855	.781	.376	.496	.295	.158	.	.132	.487	.742
		N	32	30	30	32	32	32	32	32	29	32	32
	Spent on Health Care Waste last Month	Correlation Coefficient	-.131	.513**	.424*	.501**	.479**	.627**	.538**	-.286	1.000	.029	-.195
		Sig. (2-tailed)	.498	.006	.027	.006	.009	.000	.003	.132	.	.882	.310
		N	29	27	27	29	29	29	29	29	29	29	29
	Control Measures Befor Removal	Correlation Coefficient	-.194	-.050	-.105	-.166	.313	.041	.068	-.127	.029	1.000	.450**
		Sig. (2-tailed)	.287	.792	.581	.363	.082	.823	.710	.487	.882	.	.010
		N	32	30	30	32	32	32	32	32	29	32	32
	Keep HCW Records	Correlation Coefficient	.162	.149	.146	.038	.089	-.034	.127	-.060	-.195	.450**	1.000
		Sig. (2-tailed)	.376	.431	.440	.838	.629	.852	.487	.742	.310	.010	.
		N	32	30	30	32	32	32	32	32	29	32	32

\*, Correlation is significant at the .05 level (2-tailed).

\*\*, Correlation is significant at the .01 level (2-tailed).

**APPENDIX 8. SELECTED VARIABLES BASED ON PRACTICE SIZE.**

Variable	Statistics	Size of Practice			
		Clinic	Hospital	Other	Total
Total Inpatients Space Available	Mean	14.3	23.2	20.0	15.9
	Std. Deviation	7.9	21.0	.	10.9
	n	26	5	1	32
Outpatients Seen Last Week	Mean	85.0	86.3	500.0	99.0
	Std. Deviation	48.7	77.6	.	91.2
	n	25	4	1	30
Inpatients Seen Last Week	Mean	14.8	14.5	10.0	14.6
	Std. Deviation	15.7	10.4	.	14.7
	n	25	4	1	30
Total Patients (In and Out Patients)	Mean	99.8	100.8	510.0	113.6
	Std. Deviation	61.2	75.0	.	96.4
	n	25	4	1	30
Average No. of Days Patient Is Admitted	Mean	2.3	3.6	30.0	3.3
	Std. Deviation	1.2	1.9	.	5.0
	n	26	5	1	32
Total Animals Seen In Previous Wk	Mean	81.2	100.7	224.0	92.4
	Std. Deviation	45.0	89.2	.	60.2
	n	14	3	1	18
No. of Veterinarians	Mean	1.3	2.8	4.0	1.6
	Std. Deviation	0.5	1.8	.	1.0
	n	26	5	1	32
No. of Locums	Mean	0.2	0.6	1.0	0.3
	Std. Deviation	0.5	0.5	.	0.5
	n	26	5	1	32

APPENDIX 8. SELECTED VARIABLES BASED ON PRACTICE SIZE

Variable	Statistics	Size of Practice			
		Clinic	Hospital	Other	Total
No. of Paraveterinary Staff	Mean	0.5	1.4	5.0	0.8
	Std. Deviation	0.9	2.1	.	1.4
	n	26	5	1	32
No. General Workers	Mean	3.3	10.0	9.0	4.5
	Std. Deviation	1.7	8.7	.	4.3
	n	26	5	1	32
Total No. of Workers	Mean	5.3	14.8	19.0	7.2
	Std. Deviation	2.3	12.2	.	6.4
	n	26	5	1	32
Total Waste Produced (kg)	Mean	97.7	303.6	1375.0	169.8
	Std. Deviation	84.5	245.1	.	260.0
	n	26	5	1	32
Injections per Day	Mean	61.7	64.0	50.0	61.7
	Std. Deviation	171.7	35.1	.	154.7
	n	26	5	1	32
Charge for Disposal	Mean	119.8	79.1		113.0
	Std. Deviation	86.2	53.8		82.4
	n	25	5		30
Money Spent on HCW in Previous Month	Mean	686.6	1127.8		762.7
	Std. Deviation	389.4	972.6		537.1
	n	24	5		29

# APPENDIX 9. SELECTED VARIABLES BASED ON PATIENTS SEEN.

Variable	Statistics	Patients Seen			
		Small	Large	Mixed	Total
Total Inpatients space Available	Mean	15.6	18.0	20.0	15.9
	Std. Deviation	11.4	2.8	.	10.9
	n	29	2	1	32
Outpatients Seen Last Week	Mean	79.7	350.0	120.0	99.0
	Std. Deviation	47.9	212.1	.	91.2
	n	27	2	1	30
Inpatients Seen Last Week	Mean	14.6	9.0	25.0	14.6
	Std. Deviation	15.3	1.4	.	14.7
	n	27	2	1	30
Total No. of Patients (In and Outpatients)	Mean	94.3	359.0	145.0	113.6
	Std. Deviation	59.6	213.5	.	96.4
	n	27	2	1	30
Average No. of Days Patient is Admitted	Mean	2.4	18.5	1.0	3.3
	Std. Deviation	1.1	16.3	.	5.0
	n	29	2	1	32
Total No. Animals Seen in Previous Week	Mean	77.3	213.5		92.4
	Std. Deviation	43.4	14.8		60.2
	n	16	2		18
No. of Veterinarians	Mean	1.5	3.5	2.0	1.6
	Std. Deviation	0.9	0.7	.	1.0
	n	29	2	1	32
No. of Locums	Mean	0.2	1.0	0.0	0.3
	Std. Deviation	0.5	0.0	.	0.5
	n	29	2	1	32
No. of Paraveterinary Staff	Mean	0.6	3.0	1.0	0.8
	Std. Deviation	1.2	2.8	.	1.4
	n	29	2	1	32
No. General Workers	Mean	4.1	10.5	4.0	4.5
	Std. Deviation	4.2	2.1	.	4.3
	n	29	2	1	32
Total Workers	Mean	6.4	18.0	7.0	7.2
	Std. Deviation	6.0	1.4	.	6.4
	n	29	2	1	32
Total Amount of Waste Produced (kg)	Mean	119.7	927.0	107.5	169.8
	Std. Deviation	129.7	633.6	.	260.0
	n	29	2	1	32
Injections per Day	Mean	61.3	75.0	45.0	61.7
	Std. Deviation	162.6	35.4	.	154.7
	n	29	2	1	32
Charge for Disposal	Mean	118.6	0.0	70.0	113.0
	Std. Deviation	81.9	.	.	82.4
	n	28	1	1	30
Spent on HCW Last Month	Mean	751.0	240.0	1600.0	762.7
	Std. Deviation	522.5	.	.	537.1
	n	27	1	1	29

## APPENDIX 10. ZOONOSES ENCOUNTERED IN VETERINARY PRACTICE.<sup>52</sup>

No.	Biological Agent	No.	Biological Agent
1	<i>Aeromonas hydrophila</i>	48	<i>Fasciola hepatica</i>
2	<i>Ancylostoma duodenale</i>	49	<i>Fasciolopsis buski</i>
3	<i>Angiosironyglus cantonensis</i>	50	Francisella tularensis (Type A)
4	<i>Angiostrongylus costaricensis</i>	51	Francisella tularensis (Type B)
5	Arizona spp	52	<i>Giardia lamblia</i> ( <i>Giardia intestinalis</i> )
6	<i>Ascaris suum</i>	53	Hantaviruses [contact National Institute of Virology]
7	<i>Babesia divergens</i>	54	Hepatitis C
8	<i>Babesia microti</i>	55	<i>Hymenolepis diminuta</i>
9	<i>Bacillus anthracis</i>	56	<i>Hymenolepis nana</i>
10	<i>Balantidium coli</i>	57	Influenza types A
11	Bartonella spp (Rochalimaea spp)	58	Lagos bat
12	Blue tongue serogroup L	59	Lassa fever
13	<i>Borrelia burgdorferi</i>	60	<i>Leishmania brasiliensis</i>
14	Borrelia spp	61	<i>Leishmania donovani</i>
15	Brucella spp	62	<i>Leishmania major</i>
16	Brugia spp	63	<i>Leishmania</i> spp
17	Campylobacter spp	64	<i>Leishmania tropica</i>
18	Canine distemper	65	<i>Leptospira interrogans</i> (all serovars)
19	Capillaria spp	66	<i>Listeria monocytogenes</i>
20	<i>Chlamydia psittaci</i> (avian strains)	67	Loa loa
21	<i>Chlamydia psittaci</i> (non - avian strains)	68	<i>Lymphocytic choriomeningitis</i>
22	Clonorchis - see Opisthorchis	69	Makola
23	<i>Clostridium botulinum</i>	70	Marburg
24	<i>Clostridium perfringens</i>	71	Milker's nodes
25	<i>Clostridium</i> spp	72	<i>Mycobacterium africanum</i>
26	<i>Clostridium tetani</i>	73	<i>Mycobacterium avium/ntracellulare</i>
27	<i>Corynebacterium pseudotuberculosis</i>	74	<i>Mycobacterium bovis</i>
28	Cowpox	75	<i>Mycobacterium bovis</i> (BCG strain)
29	<i>Coxiella burnetii</i>	76	<i>Mycobacterium leprae</i>
30	Creutzfeldt - Jakob disease	77	<i>Mycobacterium paratuberculosis</i>
31	Crimean Congo haemorrhagic fever	78	<i>Mycobacterium tuberculosis</i>
32	Cryptosporidium spp	79	Newcastle disease
33	<i>Diphyllobothrium latum</i>	80	<i>Onchocerca volvulus</i>
34	<i>Dracunculus medinensis</i>	81	<i>Opisthorchis felinus</i>
35	Duvenhage	82	<i>Opisthorchis sinensis</i> ( <i>Clonorchis sinensis</i> )
36	Ebola Ivory Coast	83	<i>Opisthorchis</i> spp
37	Ebola Reston (Siena)	84	<i>Opisthorchis viverrini</i> ( <i>Clonorchis viverrini</i> )
38	Ebola Sudan	85	Orbiviruses (includes - African horse sickness serogroup L)
39	Ebola Zaire	86	Orf 2
40	<i>Echinococcus granulosus</i>	87	Other Bunyaviridae known to be pathogenic
41	<i>Echinococcus multilocularis</i>	88	Other Flaviviruses known to be pathogenic
42	<i>Echinococcus vogeli</i>	89	Paragonimus spp
43	<i>Ehrlichia sennetsu</i> (Rickettsia sennetsu)	90	Pasteurella spp
44	<i>Entamoeba histolytica</i>	91	<i>Plasmodium falciparum</i>
45	<i>Erysipelothrix rhusiopathiae</i>	92	<i>Plasmodium</i> spp (human & simian)
46	<i>Escherichia coli</i> (except of non - pathogenic strains)	93	<i>Pseudomonas mallei</i>
47	<i>Fasciola gigantica</i>	94	<i>Pseudomonas pseudomallei</i>

<sup>52</sup> Modified from OHS A Regulations (Act No. 85 of 1993)

# APPENDIX 10. ZONOSSES ENCOUNTERED IN VETERINARY PRACTICE-Continued

No.	Biological Agent (Continued)	No.	Biological Agent
95	Rabies	115	<i>Streptococcus</i> spp
96	<i>Rickettsia</i> spp	116	<i>Strongyloides</i> spp
97	Rift Valley fever	117	<i>Tania saginata</i>
98	Rinderpest	118	<i>Taenia solium</i>
99	<i>Salmonella</i> (other serovars)	119	<i>Toxocara canis</i>
100	<i>Salmonella arizonae</i>	120	<i>Toxocara cati</i>
101	<i>Salmonella enteritidis</i>	121	<i>Toxoplasma gondii</i>
102	<i>Salmonella paratyphi</i> A, B, C	122	<i>Trichinella spiralis</i>
103	<i>Salmonella typhi</i>	123	<i>Trichostrongylus</i> spp
104	<i>Salmonella typhimurium</i>	124	<i>Trichuris trichiura</i>
105	<i>Sarcocystis suihominis</i>	125	<i>Trypanosoma brucei rhodesiense</i>
106	<i>Schistosoma</i> spp	126	<i>vibrio cholerae</i> (including El Tor)
107	<i>Shigella boydii</i>	127	<i>vibrio parahaemolyticus</i>
108	<i>Shigella dysenteriae</i> (other than Type 1)	128	Wesselsborn
109	<i>Shigella dysenteriae</i> (Type 1)	129	West Nile fever
110	<i>Shigella flexneri</i>	130	Yellow fever
111	<i>Shigella sonnei</i>	131	<i>Yersinia enterocolitica</i>
112	<i>Simian immunodeficiency virus</i>	132	<i>Yersinia pestis</i>
113	<i>Staphylococcus aureus</i>	133	<i>Yersinia pseudotuberculosis</i>
114	<i>Streptobacillus moniliformis</i>		