

Sustainable Waste Management in Gauteng

Draft Summary of Findings from the Pilot Test

(12 weeks)

NOTE: This document is a draft only of the findings from the pilot test at 12 weeks and as such will form the basis of a final report to be completed at the end of June 2003

INDEX

Executive summary of findings and recommendations

1. Introduction

Background

Monitoring and evaluation framework

2. Research Results

2.1 Component 1(a) - Operational Systems and Document Control

2.2 Component 1(b) – Equipment

2.3 Comparisons between the two systems

2.4 Costs of equipment

2.5 Component 2 – Capacity Building

2.6 Component 3 - Segregation

Executive Summary of Findings and Recommendations

The executive summary gives a brief overview of the findings of the research conducted in the pilot projects carried out at Leratong and Itireleng. It highlights the critical issues and problem areas and gives some recommendations to address these. More details about the findings will be found in the section 2 – Research Results

General Overview

In general, the implementation of a new waste management system was very positively received and has become well integrated into the day to day activities of the hospital and the clinic. This has resulted in significant improvements in the segregation and management of the waste streams at both Leratong and Itireleng.

The designation of the HCW Officer and two assistants had a major impact on the success of the pilot project and the cascaded training heightened the awareness throughout the hospital emphasizing the importance of everyone's involvement in the successful and safe management of the waste.

Significant and very positive changes have been experienced in the transportation of the waste through the introduction of new equipment. This has had a positive impact on the motivation and awareness of the importance of the role that this department plays in the safe management of the waste stream.

The Central storage area has been improved with the introduction of a new scale, electricity, better security arrangements and the regular use of protective equipment. The removal of the waste food, the elimination of rodents through a regular rodent control programme and the introduction of more regular cleaning of the whole area have contributed to higher hygiene standards.

The introduction of environmentally friendly and colour coded reusable containers and the introduction of safer, more durable and colour coded consumables such as sharps containers and plastic liners has ensured that the exposure to needlestick injuries is reduced.

The standards for the transportation of the waste from the facilities to the incineration plant were improved with the installation of a tail gate on the transportation truck, mechanical lifting of the wheelie bins to tip the waste into the incinerator and the installation of a cleaning bay for the cleaning of the reusable bins.

Conclusions drawn from the findings

Some conclusions have been drawn from the results of the research. These are discussed under the headings of operational systems, equipment and capacity building

Operational Systems and Equipment

A sustainable waste management system is not only about equipment. The supply of the correct specifications for equipment is an important aspect that must be supported by operational systems and documentation controls that include a code of practise and other critical working procedures. Ongoing enforcement of these systems against these standards and procedures is essential for the effective implementation and smooth running of the waste management system.

The waste management system should not be run in isolation, but should be integrated with the day-to-day running of the hospitals and clinics, involving all departments.

Critical Operational systems: Critical operational systems such as stock ordering, distribution and stock control played an important role in the success of the system. This was well managed at the central level by the stores personnel. Shortages were experienced due to late ordering and inadequate control of stock in the units and departments. In the clinic there is no defined method for the ordering of equipment and the control of the stock was not done.

The control of the reusable containers has been problematic. Although no significant losses have been reported (2 missing from Itireleng) the only way to take stock is to physically count the containers as no ongoing record has been kept of the containers leaving and returning to the facilities.

The internal transportation routines have operated well, even though this required additional input from the transporters for the two systems. The external collection from the Service Provider was at times difficult when the collection times were not adhered to. The return of the clean containers was not done on several occasions due to containers not cleaned in time, rain delaying the return or a break down of the tail gate.

Waste recording is carried out regularly and fairly accurately by the Leratong staff. The weighing is repeated at the treatment plant. This ensures that there is a cross-check of the statistics. The system is manually driven and depends on the accurate recording of the information by different people in the cycle. Human errors have been detected. It is recommended that the weighing and recording of the quantities relies less on human error.

Critical Procedures: There were three critical procedures that were identified and require particular attention by the Gauteng Department of Health. These are:

- a) The mass dressing procedure presently used by some of the hospitals does not support good infection control principles. The disposal of contaminated dressings into the dressing or injection trolley basket or bin could pose a potential infection control risk when moving to the next patient if it is not properly sealed. Other aspects of this procedure such as the extensive use of linen in the sterile packs may provide an opportunity for cost savings.
- b) The documented procedure for disposal of expired and unused medication is not carried out correctly and proof of destruction is not obtained
- c) The destruction of placentas and other body parts is a sensitive issue in South Africa. The beliefs of the different cultural groups must be acknowledged and when

placentas and other body parts are destroyed, provision must be made in the procedures for proof of destruction

Some important aspects not covered in the pilot test, but that will need to be addressed in the tender specifications are the disposal of chemicals, laboratory waste, cytotoxic waste and radio active waste.

The role of Infection Control: The pilot test has highlighted the important role that infection control plays in a successful and effective waste management system.

- a) The infection control aspects of the mass dressing procedure has been extensively debated during the pilot test as the equipment provided on the dressing and injection trolleys is central to the disposal of health care risk waste within the ward areas. The revision of the mass dressing protocol was outside of the scope of the pilot project. However, if the contaminated dressings and associated waste is properly contained prior to disposal into the dressing trolley basket or bin, no cross contamination can occur.
- b) The movement of the wheelie bins and cage trolleys into the ward area, although not posing any greater risk than people entering the area, is perceived to be undesirable. The importance of good cleaning and personal hygiene of the transporters is highlighted.
- c) The potential microbial contamination of the reusable bins was identified in the pilot test as an important aspect to consider and test. Swab tests were conducted by an improved inspection authority. The brief given was to determine the efficacy of the soap used for the cleaning of the reusable bins and to identify the extent of the potential risk with regard to bacteria and fungi. The results of the swab tests have indicated that:
 - 3.5% Sodium hypochlorite solution is the recommended solution as only scanty growth of bacillus species was detected in 50% of the samples taken. The bacillus species isolated falls into the Group 1 category that is unlikely to cause human disease.
 - Sodium hypochlorite is cheaper than the alternative soap solution tested
 - No fungal growth was detected in any of the samples
 - The reusable bins samples showed an increase in bacillus species during the handling and transportation of the reusable bins. This has highlighted the need to concentrate on the personal hygiene and the use of protective clothing of the transporters, both external and internally. The regular cleaning of the reusable containers within the units is also emphasized.

The Equipment: With only a few exceptions, both the consumable and non-consumable equipment provided in the pilot test has been excellent. On the consumable side, the quality of the medium black liners was below the specifications ordered, the small red liner was a little too small on the circumference and the speci-cans for the anatomical waste were totally inadequate. On the non-consumable equipment, the newly designed cage trolley gave some initial problems and these were addressed.

The 8 litre horizontal loading sharps container was in most instances found to be sufficiently large enough and helped to prevent the build up of sharps within the ward areas. The glass vials were separated out from the sharps containers in order to ensure a more efficient use of the expensive sharps container. The vials were to be collected

for recycle or disposal to landfill. Some significant savings have resulted from this practise. However, the practise does rely on good segregation as no broken glass, expired medication or sharps must be found with the glass vials. An alternative method of disposing of the glass vials into a cheaper disposable container for destruction until an approved method for recycling or disposal to landfill is recommended.

Anatomical Waste Specicans: The specicans used for the disposal of placentas in the pilot test were the existing containers provided. They proved to be totally inadequate for the task and it is strongly recommended that better sealing containers be used. Two sizes of disposable containers for other body parts are also recommended.

Capacity Building

There are six significant conclusions arising out of the capacity building research and evaluation. These are;

- Better segregation practice at Leratong Hospital is not associated with knowledge or awareness gaps. It is therefore critical that HCWM training in the province does not overemphasize information at the expense of promoting appropriate attitudes, team work and improved practice.
- The cascade system of training using a teaching pack has been highly successful in the hospital and certainly succeeded at contributing to the smooth introduction of new equipment and procedures. Although this system of training was initially selected because of the numbers of people who needed to receive training it has in fact exceeded expectations by also overcoming problems of training being done by outsiders and by equipping the supervisors conducting training to also play a more effective supervision role. At the clinic the cascade system has been less successful. Only the HCW Officer managed to conduct training sessions. Regional support for a cascade training programme would help promote this approach for the future.
- Designated HCW Officers and Assistants have made a major contribution to improved management of health care waste in the absence of full-time dedicated staff.
- All the print materials have been well received. Most comments were made about the Code of Practice that would benefit from being in a more user friendly style with plenty of illustrations
- Ongoing training and supervision will be critical to secure segregation gains. This is a very important point. The remark made by one of the HCW Officers is very telling. The system is there, now what is needed is quality management. Once the new system is in place it will take sustained attention to secure segregation improvements for the future. Ultimately the supervision and enforcement of standards for waste management is a line function of area, unit and department heads. Their task is not easy because a sustained culture change in relation to waste will take time. It is essential that supervisors are supported by the service providers, HCW Officers and the DoH in this task. In service training for supervisors to strengthen supervision practice and the enforcement of standards would strengthen the DoH response to waste management and should be considered by the provincial DoH for action.
- Incident and accident reporting through the OH&S committee has not been successful. The pilot project has not succeeded in establishing a facility level

reporting system. It had been planned to develop a waste reporting system on the back of a minimum reporting system prescribed in the OH&S Act. The Gauteng Sustainable Health Care Waste Management Project is concerned that waste reporting at the pilot sites has proved so difficult. The OH&S infrastructure at facility level is extremely weak and raises questions whether the DoH complies with minimum reporting standards required by Section 24 of the Occupational Health and Safety Act and the Compensation for Injuries and Diseases Act.

Recommendations

A summary of recommendations is given below:

Comparisons between the two systems

The main purpose of the research was to compare and contrast the two systems through the entire waste cycle.

In order to inject a small level of objectivity into the equation, five aspects were used to compare the equipment of the two systems and input was obtained from the waste management teams at Leratong, Itireleng, the treatment plant and the transporters. The aspects were also weighted by the consultant team. The scores allocated are **not** to be used as the definitive measure of one system in preference to the other. It is meant only as a guide in coming to decision as to the optimum system to be recommended for the Gauteng Department of Health tender.

The aspects considered were:

- Ease of implementation
- User friendliness
- Occupational Health and Safety
- Suitability and durability
- Costs

The results of this exercise showed that:

- Without the costs, the stackable box system has the edge on the wheelie bin
- When the cost factors are added, the wheelie bin scores well.

In the stackable box system using the cage trolley, the cost of the transportation was increased due to the inefficient use of the available space in the transportation vehicle. The comparison of the costs of the two systems is a critical aspect to be considered in the decision of what is to go into the tender specifications to be used for the Gauteng Province

Costs impacts on the model in the feasibility study

Experiences gained during the pilot test have now facilitated adjustment of the assumptions incorporated into the Model of the feasibility study thus reflecting a more accurate 'real life' scenario. The significant changes included:

- The increased cost of the in-hospital labour required for the re-usable box system in relation to the wheelie bin system

- The increased number of 'sets' required of reusable container to sustain each system
- Adjustments to the HCRW 'mass per container' figures in line with actual recorded average masses
- Adjustments to the transport costs to reflect the actual size of the cage trolley in the stackable box system
- Adjustments to the number of consumables used to match recorded figures and reflect actual prices used.

The result of these adjustments has shown that the 770 wheelie bin/liner system now offers the lowest monthly 'all-in' cost and is approximately 13% cheaper than the stackable box system. The relative advantage of the 770 wheelie bin/liner system lies in the lower containerisation and transportation costs. It is therefore recommended that the 770 wheelie bin/liner system offers the more cost effective solution.

HCW Officers and Assistants

Given the successful introduction of HCW Officers and Assistants the following is recommended.

- a) HCW Officers are designated in all Gauteng Provincial health facilities.
- b) One/two Assistant HCW Officers are appointed in all hospitals
- c) One Assistant HCW Officer is appointed in all Community Health Centres (CHCs)
- d) All HCW Officers and one Assistant from hospitals and HCW Officers from CHCs attend a 5 day intensive training programme in August/September to prepare them for their role. This will be financed by the Gauteng Sustainable Health Care Waste Management Project
- e) The 5 day intensive training programme for HCW Officers will be offered from 2004 by the DoH to DoH staff
- f) Meetings are held with the key stakeholders and designated HCW Officers in all Gauteng hospitals and CHCs during the roll out period to prepare health facilities for the introduction of the new system.

Cascade training

Given the success of cascade training at Leratong in particular the following is recommended

- a) The service provider is required in the tender specifications to deliver training in all health facilities utilizing a cascade approach
- b) That the service provider will work with Regional managers to effectively introduce cascade training in the clinics
- c) Service providers will be required to submit annual training plans to the DoH so that there can be flexibility to meet the training needs in different areas
- d) That the quality of training offered by the service provider be monitored by the DoH

Training materials

Positive feedback was received about all the training and print materials. It is therefore recommended that

- a) The teaching pack including the teaching posters, skills posters, the teaching notes, the waste game, segregation table and skills checklist are revised to support the final equipment choice. These materials are made available to service providers for their adaptation and implementation.
- b) The Code of Practice is revised into a user friendly format to support the final equipment choice. This is then distributed widely in the DoH and through the service provider.
- c) A handbook of awareness activities that could not be produced in time for testing at the pilot sites is prepared to support the training and awareness activities of the service provider.

Provincial support for capacity from the Provincial Capacity Building Report July 2002

It is essential that the three recommendations made above are supported by the appropriate actions at the provincial level. These actions have been discussed in the provincial capacity building report but are listed here again to ensure timeous action.

The province should

- Ensure the designation of HCW Officers and Assistants in all health facilities by July 31 2003
- Ensure that designated HCW Officers in hospitals and CHCs and one Assistant HCW Officer have permission to attend a 5 day training programme during August and September 2003
- Identify 1 Regional environmental health practitioner and 1 Regional OH&S to attend the 5 day training programme for HCW Officers to build Regional capacity and role
- Ensure that the 5 day training programme for HCW Officers is integrated into the DoH training programme from 2004
- Establish a provincial HCWM forum to participate in the roll out of the new system, support for HCW Officers and Assistants, provide a central location for feedback from facilities and participating provincial departments.
- Support an audit of provincial and regional policies relating to HCWM

Provincial support for capacity building arising from the findings of the pilot sites

The following two points are raised with the province as a direct outcome of the pilot site studies.

- That the development of an in-service training programme to promote better supervision and enforcement of standards be developed for supervisors to support an ongoing programme of developments in HCWM in the Gauteng DoH
- That an urgent review is made of capacity in OH&S at a facility level to ensure that the DoH meets minimum reporting requirements. The intervention necessary to establish waste reporting in the DoH is beyond the parameters and resources of the Gauteng Sustainable Health Care Waste Management Project.

1. INTRODUCTION

1.1 Background

The Pilot Test formed part of the Project “Sustainable Health Care Waste Management in Gauteng”. During the test period two new systems based on reusable containers were introduced.

- A system based on the use of 770 wheelie bins with strong plastic liners of various sizes and strengths
- A system based on reusable, stackable plastic boxes of 50 and 100 litre capacity.

The test period is for a 24 week period starting the 3rd February.

The results of both the onsite and off site components of the test will inform the final tender specifications for Health Care Risk Waste (“HCRW”) for the Gauteng DoH. Lessons learnt from the pilot test will also be integrated into the Guidelines and the Health Care Waste Management Strategy.

1.2 The monitoring and evaluation framework

A document entitled the “Monitoring and Evaluation framework for extracting experiences and learning lessons from the pilot projects” describes the purpose and the methodology of the proposed monitoring and evaluation framework to be applied at the pilot sites. The research at the pilot sites has both an on-site and off-site component.

1.2.1 The overall purpose of the research

The purpose of the research was to **compare and contrast** the implementation and running of two health care waste management systems based on the use of reusable containers both within the health care facilities, off-site with the service provider and at the treatment facility.

The results of the first three months of the research are to be used to inform the tender specifications by the end of May 2003. The research will continue for the second three months until the end of the test period in June 2003 and the final results will be used to inform the guidelines and strategy.

1.2.2 Methodology and Research Tools

The research applied qualitative and quantitative methods. The qualitative research involved focus group discussions, observation and key-informant interviews with important role players, physical inspections, checklists and questionnaires. The quantitative research involved time-logs/report forms, incidence analysis, laboratory results, detailed costs, estimates of quantities and information obtained from the waste composition study.

Inspections and interviews were conducted at three levels.

- Level one - Supervisors (mainly during the first 3-4 weeks)

- Level two - Waste Management Officers at the hospital and clinic
- Level three - External consultants and persons not directly involved with the pilot test

The waste composition study

In addition to these methods two waste composition surveys are planned. The baseline survey was conducted in August/September 2002 with the second one planned to take place in May/June 2003. A comparison of the two surveys will give some indications of any improvements in segregation.

1.2.3 Outline of research framework.

In order to facilitate the collation of the research results the format for this report will follow the monitoring framework research in three components.

2. RESEARCH RESULTS

The research results have been reported in detail in this section under the three main components of the monitoring framework as follows:

- a) Component 1- Operational Systems and Equipment including the comparison between the two systems and the costs of the equipment
- b) Component 2 - Capacity Building
- c) Component 3 - Segregation

2.1 Component 1(a) - Operational Systems and Document Controls

The operational systems and document controls introduced were common to both systems and they will be discussed as they impacted on both systems. Where differences were experienced in the two systems, these will be highlighted.

2.1.1 Equipment Procurement and Storage

The delivery times for the consumables were staggered over the first three months and no problems were experienced. Some delays were experienced with the non-consumable manufactured items such as the stands, baskets and brackets. The special brackets and sharps brackets were delivered at the beginning of April.

The central warehouse took delivery of all the equipment. The consumable equipment remained under the control of the stores staff and the reusable equipment was the responsibility of the Inventory Department.

Strict stock control on the consumable items is the responsibility of the Stores personnel with help from the Health Care Waste Officer. The estimates and quantities of usage were derived from the figures supplied by the Central Warehouse.

Reusable items

These were individually identified and placed into a temporary listing with the inventory department. All these items remain the property of Leratong and Itireleng and will continue to be utilized until the tender has been awarded.

Consumable Items

The table below shows the summary of the estimated total against the amounts ordered.

		Overall Total	Order Quantity per RFQ		
			Leratong	Itireleng	Total
CONSUMABLES					
	8 L sharps	1,750	1,630	170	1,800
	Tall sharps	34	40	0	40
1	46 x 54 x 50 mic. red (kickabout trolley)	25,536	26,000	0	26,000
2	56 x 66 x 60 mic. red (30 boxes & baskets)	24,696	26,000	4,000	30,000
3	75 x 95 x 50 mic. red (50 L box)	5,376	3,200	2,800	6,000
4	75 x 95 x 80 mic. red (stands)	8,736	9,000	0	9,000
5	100 x 95 x 50 mic. red (100 L box)	3,360	3,600	400	4,000
6	46 x 54 black 30 micron (12 L Pedal or other)	119,520	120,000	0	120,000
7	56 x 66 black 30 micron (Small Hanging Bag)	157,248	136,800	23,200	160,000
8	75 x 95 black 60 micron (Hanging Bag)	13,440	14,000	0	14,000

From the figures supplied by the central warehouse as at the 8th April a new “best estimate of total usage” for Leratong up till 30th June (22 weeks) has been calculated. There has been an overestimation of the numbers on all liner sizes, particularly with regard to the black sizes. The projected usage from 1st July until 31st December (26 weeks) has revealed that the GDoH will have to spend approximately R17 000 (incl VAT) for the period. Approximately half of this is for the sharps containers and the balance for liners.

The cost of the sharps containers at R 664.82 / week is just under half of the total cost of all the consumables (including the black liners). The sharps usage has been based on the separation of the glass vials. On the figures obtained from Leratong, over a period of 9 weeks, 590 kgs (1009.8 litres) of glass vials were collected. This has translated into a saving of 200 sharps containers (23/week.) If this practice is discontinued, it will increase the weekly total of sharps containers to 84/week, increasing the weekly cost to R903.84. (This will translate into a total weekly cost including all liners of R2,300.65, with the sharps containers contributing just on 40% of the total cost.)

The costs for the consumables of the two systems calculated on the actual usage over a periods of 5 and 7 weeks shows that there is a very small difference in favor of the stackable box system (The Wheelie bin system is only R42 more expensive on consumables per week than the stackable box system.)

The tall sharps container is used very infrequently and the average is therefore difficult to estimate from only a 7 week period. The weekly average usage is expected to drop further. There has been no reissue since the first issue.

Summary and Recommendations:

- Good stock figures on both reusable and consumable items assists in managing the budget over the long term
- There is no big difference in the consumable costs between the two systems with the wheelie bin system being only R42 / week more expensive
- The cost of sharps containers is the single biggest consumable cost. This will

- increase if glass vials are included to over 40% of the consumable cost.
- It is recommended that the viability of separation of glass vials be further investigated

2.1.2 Control of stock and unit stock levels

At Leratong, the central warehouse has control over the consumables and this is well done. Orders are placed fortnightly by the unit supervisors using a VA2 form. Stock levels for each of the departments and wards have been determined. Shortages were experienced during the first 5 week period. The stock levels were therefore adjusted upwards and the increase can be seen in the quantities ordered in the 7th week. The unit supervisors have been given their stock levels and they are required to only order stock to replenish to their maximum stock level. Difficulties have been experienced with the ordering of stock due to:

- Changes in the shifts of unit supervisors resulting in lack of accountability
- Not ordering on time or not ordering at all
- Negligence leading to both over and under ordering
- Not keeping the unit tally sheets up to date
- Disregard for the stock limits

The Central warehouse staff has copies of the maximum stock limits per department or ward and they keep a strict control guided by these figures. This does not, however, prevent the units from stocking above their limits.

The quantities of reusable containers, stands, brackets and baskets are also tabulated. A stock take was conducted on 10th April and revealed that all the wheelie bins, stackable boxes and cage trolleys are accounted for. Sufficient quantities of all reusable items have been supplied.

At Itireleng clinic there is no central warehouse and the stock is controlled directly by the Health Care Waste Officer. A dedicated room was identified and stock is given out on demand. The distribution of the stock has not been well documented and it has been difficult to calculate the weekly usage. A stock take was conducted on the 17th April and two of the 50 litre stackable boxes are missing.

Itireleng decided not to use the open Addis Bins and the medium red liners as the open bins attracted flies. The number of 50 litre stackable boxes was overestimated for Itireleng but they were only supplied with 2 cage trolleys and they have requested an additional cage trolley. Equipment was transferred from Itireleng to Leratong (10 Addis bins, medium red liners and 30 x 50 litre stackable boxes.)

Summary and Recommendations:

- There has been no loss to date of reusable items at Leratong.
- Itireleng have experienced the loss of 2 x 50 litre containers
- There was over stocking of 50 litre containers at Itireleng and these have been moved to Leratong

- Leratong has the capacity to adequately control their stock, whereas Itireleng does not
- Stock levels in the units are not well managed and this results in shortages. This is mainly attributed to a lack of management control and supervision, aggravated by frequent changes in shift and no individual accountability.

2.1.3 Equipment and waste storing space

When the equipment was first delivered to the hospital and the clinic, there was no dedicated storage area for the equipment, both reusable and consumable. Once the reusable items were deployed and a dedicated, secure area provided for the consumable items, it was easier to manage and control.

The security of the central storage area for the waste was improved with the installation of security gates on the clean area and by providing locks for the main gate. This is now well managed by the cleaning department. There is a division between the clean stackable boxes and the dirty area. The rodent control in this area also has improved and this will have to be maintained. Rodent droppings are a potential source of infection on the reusable containers. Access to this area has also improved by moving the general waste skip to allow the Buhle truck to reverse up to the edge of the apron. Electricity was also installed.

The intermediate storage areas for the wards are the sluice room and this area is overcrowded, particularly in the morning with the sorting of linen and in some instances, the rinsing of the linen. The areas are not well managed and the cleaning of these areas and the containers in the areas will need to improve. (see paragraph on Infection Control)

Summary and Recommendations:

- Dedicated storage areas with allocated responsibility and accountability is essential
- Security in all the storage areas is essential
- The intermediate storage areas are over utilized, especially in the morning with excess amounts of linen
- Regular rodent control must be maintained

2.1.4 Distribution of Consumables

The distribution of consumables is handled by the central warehouse staff. The VA2 forms are completed fortnightly by the unit supervisors using the code numbers allocated by the warehouse. The VA2 are checked and adjusted according to the stock limits. This takes 2-3 days. The stock is then distributed on the Wednesday or Thursday by the warehouse staff.

The liners are counted out into units of 20. The sharps containers are capped by the store staff and the label is stuck onto the containers before distribution.

Difficulties were recorded of incorrect ordering and late/no orders placed resulting in delays in distribution of stock.

Difficulties were initially experienced with the ordering and distribution of the different liner sizes. This was aggravated by the different liners for the two systems and has now been addressed.

At Itireleng, the distribution of stock is carried out on demand and there has been limited recording of items distributed. No formal forms are completed when stock is issued

Summary and Recommendations

- Distribution of equipment at Leratong is well controlled.
- Delays and shortages were experienced due to incorrect ordering at Leratong
- Different sizes in the liners created some confusion, especially with the two systems running in parallel
- There is no clearly defined system of ordering at the Itireleng Clinic
- The inclusion of the stores staff in the waste management system is essential for the continuous supply of equipment and to reduce the incidence of shortages.
- There is clearly more difficulty in the control and distribution of stock at the clinic. A better system for the control of stock at the clinics is required

2.1.5 Identification, labeling and numbering

All the cage trolleys and wheelie bins are individually numbered with plaques placed in easy to read places. Each of the stackable boxes was embossed with a unique number on both sides. These numbers were used on the weighing forms to trace the movement of these items from the hospital / clinic, the transporters, the treatment plant and back to Leratong. This recording was well done.

The pedal bins and Addis bins were engraved with the department or ward number. Sticky labels were printed for sharps container, vial buckets and anatomical waste.

The labeling of the wheelie bins, stackable boxes and cage trolleys facilitated the movement and recording of these reusable items. The sticky labels supplied for the glass vial buckets and anatomical waste was not always applied and it relied on the degree of supervision carried out in the departments and wards. The labels supplied for the sharps containers were affixed by the stores personnel.

Summary and Recommendations

- The identification of the reusable equipment as hazardous is a legal requirement. The individual numbering of each container was important to be able to trace the movement.
- Relying on staff to place the labels is not ideal and it would be more effective to have the equipment manufactured or at least distributed with the required labels.

2.1.6 Internal collection and transportation routines

The internal collection of the waste was carried out by the Cleaning Department. Two collections of HCRW per day, 7 days per week were introduced. The morning collection from 07h30 – 9h00 collected waste from every area in both the systems. The afternoon collection from 13h30 – 15h00 collected the waste from identified areas that produce the higher volume of waste. The general Waste was collected in the morning either simultaneously with the risk waste or after the risk waste collection. This depended on the number of transporters on duty. Two transporters are required for the collection of waste in the stackable box system, one for the clean trolley and one for the dirty trolley.

There are five General Assistants on duty from Monday to Friday and three over the weekends.

During the collection rounds, the transporters were required to record the number of sharps containers, thick liners, 50 litre and 100 litre boxes removed. The recording of this information was done reasonably well. Some books have, gone missing, and the recording of the waste collected over the weekends was not complete. It is impossible to record the number of smaller liners as they are placed inside the larger liners. No records have been kept of the collection of full black liners. These recorded figures have been collated and can be compared with the weekly liner usage indicated above. There is a small percentage error, but there does not appear to be any huge disparity.

Summary and Recommendations:

- The wheelie bin system requires one transporter, and the stackable box, 2 transporters. This has significantly increased the running costs for the stackable box system
- The cleaning department plays an essential role in the smooth running of the waste management system
- The recording of collections done by the transporting staff has not been consistent. Where it is possible, some comparisons have been done on the quantities of sharps containers and liners distributed with the quantities collected. The disparity in these figures is not a cause for concern.
- The waste transporters should be viewed as team members

2.1.7 Cleaning and general infection control routines

Three important infection control issues were raised during the pilot test.

- a) The use of the dressing / injection trolley for disposing of waste
- b) The movement of cage trolleys and wheelie bins into the ward areas
- c) The reusable containers being a potential source of microbial infection

The use of the dressing / injection trolley (generally known as the nursing trolley)

The placing of a disposal unit (open basket or box with liner) on the dressing and injection trolley has been used in the pilot test as important in the disposal of the contaminated waste at source. In order to reduce time and with staff shortages, a mass dressings protocol is used by Leratong.

At an infection control workshop it was agreed that the mass dressing concept presently used at Leratong is also used in other hospitals. The unprotected disposal of contaminated dressings into an open disposal unit attached to the trolley is not a good infection control practice.

The group agreed that the present practice followed at Leratong can be streamlined and infection control principles applied. At the same time costs savings could be achieved by:

- a) Eliminating the use of linen in the sterile packs thus reducing the need for washing of linen.
- b) Introducing a small plastic disposal pack with a sticky closing device for the contaminated dressing and other items such as the protection sheet, gauzes, gloves and masks before sealing and placing into the larger red container or basket on the dressing trolley.
- c) Spray bottles with saline solution are a source of contamination and should not be used. Each dressing pack should be equipped with 20-30 ml. bottle of saline solution.

The movement of Cage Trolleys and Wheelie bins into the ward areas.

The wheelie bins and trolleys are taken into the wards in order to reduce the manual handling of the bags and bins. The risk of cross infection from the wards was raised by the staff, particularly in the isolation wards, renal and ICU.

The infection control group agreed that the movement of the wheelie bins or trolleys into the ward areas does not pose any greater risk than staff, patient and visitor movement does. The objection was more from an aesthetics point of view. All transportation vehicles must be subject to a rigorous cleaning at the treatment plant before being returned to the hospital or clinic.

Reusable containers a potential source of microbial contamination

A summary of the findings contained in the article "Investigation of single-use versus reusable infectious waste containers as potential sources of microbial contamination" by Alice N. Neely, PhD, FAAM conducted at Shriners Burns Hospital (USA) indicated that:

- 99% of reusable boxes were found to be contaminated with bacteria or fungi. Most were of normal environmental or skin flora but some showed microorganisms that are potentially harmful to patients with compromised immunity.
- When the reusable box lids were wiped down with a phenolic disinfectant it decreased both the total microbial load and the variety of the microbes present. There was a significant decrease in the number of fungi but not bacteria.
- During the period of the investigation, infection rates dropped to 5.8 to 3.2/100 burn patients after frequent cleaning of the lids in the areas and a daily routine of cleaning the room.

The infection control group agreed

- a) That the reusable box or bin does pose a greater infection control risk than the cardboard boxes
- b) Scratches on the boxes or bins could harbor bacteria and fungi

- c) Phenol has a strong smell and can damage some plastics
- d) Hyper chlorite solution may give better results, however it does carry a greater environmental risk to the water systems

When taking a broader view of the problem of consumable containers (the cardboard box) the group agreed that:

- a) The use of reusable boxes / bins must be placed into the perspective of the whole process and reusable containers must be used. The cleaning of the wheelie bins, boxes and cage trolleys is extremely important. However, this must be backed up with a routine cleaning of the sluice rooms and all the waste containers.
- b) There must be a partnership between the departments and wards, the transporters and the treatment plants to ensure that the sanitisation of the bins is maintained.

Summary and Recommendations

Dressing Trolley Concept –

- Does facilitate segregation at source. Contaminated dressing, gloves, gauzes etc. are to be disposed of into a smaller ‘disposal pack’ before placing into the open liner or Addis Bin
- Savings could be made by re-evaluating the sterile pack and reducing the use of linen

Wheelie bins into ward areas –

- Wheelie Bins and trolleys going into ward areas does not pose a greater risk than the movement of people

Reusable containers a potential source of microbial contamination –

- Reusable containers do pose a risk of infection
- Reusable containers should still be used with better cleaning routines both inside the hospital /clinic and at the cleaning plant

The following infection control actions are recommended:

- The correct handling techniques of the reusable boxes and bins between the treatment plant, transporters and hospital/clinic staff must be carried out.
- The use of correct protective equipment at the facility to ensure that both hand washing techniques are regularly applied and that the reusable gloves are kept clean.
- The frequent use of alcohol sprays or gel, the frequent washing of hands and gloves by handlers, caution when handling both the dirty containers and the replacing of a clean box.
- Transporters at the central storage area would require additional training when handling both clean and dirty bins.
- Regular cleaning of all waste containers in the ward areas and the sluice rooms with an approved disinfectant is essential.

2.1.8 Results of the Swab Tests

A microbiological survey was conducted by an approved inspection authority to determine the extent of pathogenic micro-organism contamination of the cleaned reusable bins after cleaning was done at the treatment plant and again after the bins had been transported to Leratong.

The sampling was spread across four weeks with 12 swab samples obtained during each of the survey periods. A total of 16 swabs were taken from the reusable bins, 14 from the wheelie bins and 17 from the wheels of the wheelie bins. The number of samples taken allows for a 90% confidence level.

Tests were conducted to determine bacillus, staphylococcus and pseudomonas species as well as a fungal culture. Two cleaning agents were also tested – ‘Sterigent’ and a 3.5% sodium hypochlorite solution.

A summary of the results from the tests indicated:

- Scanty to profuse growth of bacillus species in 17 of the 22 swab samples (77.3%) in the first two weeks after using “Sterigent”
- Scanty growth of staphylococcus species in one of the 22 swab samples
- Only scanty growth of bacillus species was detected in 11 of the 22 samples (50%) in the second two weeks after using a 3.5% sodium hyper chlorite solution
- Three of these bins were contaminated during transport
- The remaining specimens yielded no trace of any bacterial contamination.
- No fungal growth was found in any of the samples conducted
- 8 swab samples taken from the bins after handling and transportation yielded growth of bacillus species only after handling and transportation
- A bulk water sample obtained from the wash bay yielded no detection of free chlorine in the run-off water as a result of using dilute sodium hypochlorite solution

No growth	=	microbial units on the culture media
Scanty growth	=	growth only in the primary streak
Moderate growth	=	growth in the primary and secondary streak
Profuse growth	=	growth in all areas

Summary and Recommendations

- The scanty growth found after cleaning with the sodium hypochlorite solution was bacillus subtilis belonging to the Group 1 micro-organisms and it is therefore unlikely to cause human disease
- 3.5% Sodium Hypochlorite solution is far more effective in dealing with the microbial contamination
- The dilution of Sodium Hypochlorite solution does not appear to be harmful to the environment
- The personal hygiene habits and protective clothing worn by the transporters plays an important role in combating the microbial contamination after the bins have been cleaned

2.1.9 Weighing of Waste

The waste was weighed at both the Central Storage area prior to leaving Leratong and Itireleng and again at the treatment plant. This ensures that there is a cross-check on the figures recorded. The recording of the information is done manually and does rely on a high level of accuracy. It is believed that the statistics recorded from both the facilities and the treatment plant have a high level of accuracy due to the cross checks that have been done. This information is valuable for budgeting and waste recording purposes.

The quantities of waste leaving the site have been used to reassess the information applied to the scenarios in the feasibility study.

The table below shows some of the averages for Leratong

	Feb	Mar
Total waste leaving the site	6253	7489.5
Average mass per wheelie bin	79	87.5
Average mass per cage trolley	60	61
Average waste per 100 litre box	6.3	6.8
Average waste per 50 litre box	5,7	5,0
Specicans leaving the site	245	501

The table below shows some of the averages for Itireleng

	Feb	Mar
Total waste leaving the site	93 .4*	241.3
Average mass per cage trolley	46.7	29.2
Specicans leaving the site		65.9

* Not a full month

2.1.10 External Transportation Routines

The Service Provider collects the waste from Leratong daily, from Monday to Friday between 09h00 and 14h00. The Leratong General Assistants finish their shift at 15h30 and it also allows sufficient time for the treatment plant to clean the containers in time for the next morning. Itireleng is serviced 2 x weekly. The clean reusable containers are delivered in a clean truck, separated from the waste. This can result in two trips.

There have been many difficulties with this routine. The Service Provider has been arriving late (15h00 – 15h30.) This leaves insufficient time for the anatomical waste to be picked up at the Mortuary, weighed and loaded. It is therefore left to accumulate. The late arrival at the treatment plant also does not allow sufficient time for the containers to be cleaned and dried by the next morning.

Regular liaison with the transport service provider is essential to ensure that communication links are maintained. If they are likely to arrive late, due to breakdowns, traffic etc. they should phone the WMO and inform them of the expected arrival time.

Summary and Recommendations:

- Agreed time parameters were not always adhered to. This created logistic problems with the collection and weighing of items and the turnabout return of clean reusable boxes, bins and trolleys. This also resulted in shortages of cage trolleys.
- Two trips are sometimes required to as clean and dirty items cannot be mixed
- Regular telephonic communication is required between the service provider and the hospital

2.1.11 Code of Practice and other special procedures

Code of Practice Booklet

General comments on the code of practice booklet were collected during the capacity building research. For details on this, refer to section 4.3 Component 2 – Capacity Building.

Procedures for injections and dressings using the dressing trolley

The ward staff members like the disposal arrangement of brackets or baskets on the injection or dressing trolley. Although the pilot test only catered for the disposal of the risk waste in this manner, many of the units have used an Addis Box or an additional basket both with black liners for disposing of the wrappings from the gloves, dressings etc.

For this concept to meet all the requirements of disposal at source, segregation and infection control principles, the mass dressing procedure will need to be reevaluated. The provision of a small red liner with a fold over flap and closing mechanism (sticky strip) provided with each dressing pack would ensure that the contaminated dressings from a single patient are properly contained and sealed before placing into the NT disposal unit. The reevaluation of the use of linen for dressing packs will give a substantial cost saving.

Summary and Recommendations

- Documented procedures for dressing (mass dressings) will need to be formulated by the Gauteng Department of Health

Procedure for the correct disposal and security of expired and unused medication

The hospital and clinic do not dispose of the expired medication in a correct manner. Although there is a procedure for writing expired medication out of stock, (SOP 13 DSM dated 15 May 2000) this procedure is not always followed and it does not give the guidelines of how the medication is to be disposed of. The hospitals are requested to

obtain three quotes for disposal. The personnel are unaware of the dangers of incorrect disposal, and the expired stock is left to accumulate in the dispensaries without any security.

There are no procedures in place in the GDoH for disposing of unused medication. In the pilot test, the unused medication is thrown into the sharps containers. At dispensary, the unused medication is collected into a 50 litre red container together with the expired medication. The containers are sealed when full, labeled "expired medication" and taken to the incinerator via the normal route. There is no special documentation and no proof of destruction at the incinerator.

Summary and Recommendations:

- Documented procedures for the collection and recorded disposal of all expired and unused medication will need to be formulated by the Gauteng Department of Health.

Proof of destruction and procedures for the disposal of anatomical waste

The anatomical waste collection is the weakest part of the pilot test and is presently not well managed. Apart from the equipment difficulties, (see component 1(b) Equipment) the documented procedures for the disposal of the anatomical waste within the GDoH are not done well. Again there is no documented proof of final destruction and there is ample opportunity for the waste to be miss-directed and used for muti.

Summary and Recommendations

- Documented procedures for the disposal of anatomical waste will need to be formulated by the Gauteng Department of Health and includes the documented proof of final destruction.

Procedures not covered during the pilot test

The pilot test did not cover the following disposal procedures:

- Chemicals (cleaning and disinfectants)
- Laboratory waste (contracted out privately)
- Cytotoxic waste (neither Leratong nor Itireleng deal with chemo-therapy)
- X-Rays (isotopes) (not used at Leratong or Itireleng)

Summary and Recommendations

- Documented procedures for the disposal of chemicals, laboratory waste, cytotoxic waste and radioactive waste will need to be formulated by the Gauteng Department of Health.

2.2 Component 1(b) - Equipment

2.2.1 Equipment common to both Systems

Sharps Containers

Two sizes of sharps containers were used.

- An 8 litre horizontal loader
- A tall sharps cylindrical sharps container.

A bracket for the 8 litre horizontal loader was provided in three different applications - viz. On the wall, on the nursing trolley and a special design for the ISU unit. No sharps containers are left in the ward areas or other places unless supervised by a nurse. Glass vials and bottles were separated out. (This does not include unused medication, ampoules, and other broken glass)

The results of the pilot test revealed that:

- The capping of the sharps containers is carried out well by the warehouse staff.
- The horizontal loader is liked by the staff, is easy to use and is economical and can be placed close to source
- The larger bottles (unused medication) do not fit into this container
- A smaller size is necessary for single injections so that the container can be taken to the bed
- The wide use of the 5-8 litre containers means a greater turnover of containers and they are not left for long period before being removed.
- In some high volume areas, a larger container can be used.

Separation of glass bottles and vials

Although the separation of glass vials has shown some costs savings, the disposal of the glass vials proved to be problematic. The recycle firms will only remove if they have the contract for the more lucrative cardboard boxes and paper. The hospital has a contract for the removal of cardboard that does not include recycled glass. The Mugale Municipality requires a certificate that the glass vials are not hazardous before they will dispose them to landfill.

The segregation of the glass vials has been good on the whole. However, miss-segregation of some sharps, unused medication and ampoules were been found with the vials. Re-sorting with protection has been carried out at the central storage area to ensure that the vials only are recycled. The continuation of this practice is not recommended. Separation of the vials must be good to reduce the risk of contamination by workers.

Summary and Recommendations:

- A smaller size sharps container is necessary for single dressings.
- Separation of glass vials from the sharps container for recycling is recommended provided segregation is good.
- The acceptance of the glass vials either for recycling or disposal to landfill will need

to be more actively pursued. In the meantime, it is recommended that the collection of glass vials continue and that a thinner, cheaper disposable container be used.

Fitting of equipment

Both systems required the fitting of either baskets or brackets to the walls, placing on trolleys or stands on the floor. The sizes of the brackets and stands were for the most part standardized for both systems.

The fitting of the small baskets and some brackets took a long time to complete. Difficulties were experienced with the labour to accomplish the task. Once fitted, this method of containment has been very successful as they cannot be stolen, sat on or damaged. No holders have come away from the wall. The long screws proved to be the most successful.

Summary and Recommendations:

- Baskets and brackets fitted to walls or trolleys have proved to be both cost effective and a safe means of containment for both risk waste and general waste

Anatomical Waste Containment

In the pilot test, the anatomical waste from maternity, casualty and theatre are handled by:

- Placing the placentas in a 10 litre speci-can with a blue lid. One seal is provided
- Small amputations can also be placed into the speci-can
- In the stackable box system, larger amputations are placed inside the 50 or 100 litre boxes with a liner and labeled "anatomical waste"
- In the wheelie bin system, the larger limbs double bagged and tied up securely

Maternity and casualty are on the stackable box system and theatre is on the wheelie bin system.

The specicans proved to be totally inadequate for the task. The lids did not seal and numbered seals were provided for only one side. The seals were also not properly applied by the users. This resulted in several incidents of placentas spilling out and leaking both at the hospital and at the treatment plant.

The double bagging system for the amputations has also proved to be inadequate as they frequently leak.

At Itireleng, a small deep freeze has been installed. A temperature of -4 degrees is recommended. The specicans do become more brittle when frozen.

The question of macerating of placentas is open to discussion. Although this does carry the advantage of quick disposal and reduces the risk of mis-use, the destruction must be documented and compared with the number of births on a regular basis. The cleaning

of the macerator and contingency plans should the macerator break down should also be considered.

Summary and Recommendations

- The disposal of anatomical waste is the weakest part of the system
- Containers are totally inadequate and liners leak
- Macerating of placentas is practiced in other hospitals and has both advantages and disadvantages
- Disposable containers in 2 or 3 different sizes, preferably of a different colour and with markings “anatomical waste” must be introduced for both systems
- There must be proof of destruction for anatomical waste

Liners

The liners were standardized wherever possible. The wheelie bin system had three sizes of red liners and the stackable box system had four sizes. The micron specification differed with the wheelie bin system having the greater thickness, resulting in more expensive liners.

Sizes:

- The size of the small red liner used in both systems was too small for the circumference of the kick about trolley.
- There was considerable confusion between the small black and medium black liners and this required more focused attention in the training
- The large red liner (thick) for the wheelie bin leaked at the seam.
- The red liners used for the amputations, although double bagged, did leak

Micron thickness

- No problems were experienced with the microns specified
- On testing the microns, the manufacture of some of the medium black liner was considerably below the specifications required. These were returned to the manufacturer for re-supply to the correct specification.

Summary and Recommendations

- No major problems were experienced with the liner
- The size of the small red liner will need to be increased to accommodate the loop of the handle on the kickabout trolleys
- A double seam is recommended for the large thick liner for the wheelie bin system
- Double bagging is recommended for the liners coming out of theatre

Liner closing mechanism

Rubber bands (size 34 or 35; 3 x 100/115 mm) are used to close the liners. This method is cheap and readily available, but does require a concerted effort with training and supervision.

The use of the rubber bands has been good and there has been a regular supply. The proper use of the rubber bands was, however, not always followed. It is difficult to close the liners while using latex gloves.

Summary and Recommendations

- Rubber bands are cheap and readily available, but require additional training
- Other recommended methods for closing are cable ties or wire.

Protective Clothing

The use of protective equipment was ensured with the distribution of green nitrile gloves to all the general assistants. Thicker gloves have been given to the transporters.

The gloves have been regularly worn when handling waste. The reissue of gloves when torn is monitored and recorded. The cleaning of the gloves, particularly with the transporters had to be introduced and encouraged.

A spill kit is required at the central storage unit.

Summary and Recommendations

- Gloves must be used when handling waste
- Reusable gloves must be washed with disinfectant soap and hung up to dry
- Regular hand washing must be encouraged for all who handle waste

External Transportation Equipment

A tail lift was supplied to the transportation truck. This worked very well for both systems and reduced the manual handling of the equipment. The tail lift has a legal requirement for annual load testing and inspections. The collection was delayed for a couple of days due to a malfunction of the lifting mechanism.

The trolleys and wheelie bins were not adequately secured inside the truck. Although the brakes on the wheelie bins and cage trolleys were applied, this was not sufficient to prevent damage to the truck.

The truck was not always cleaned properly before loading the clean equipment.

Summary and Recommendations

- A tail lift is essential for the safe loading and unloading of the equipment
- The tail lift will require the annual legal load testing and inspections
- The trolleys and wheelie bins must be secured during transport

Treatment Plant Equipment

The incinerator plant is licensed to incinerate the risk waste. The plant was fitted out with a wheelie bin lifting device for tipping the contents into the incinerator. There was no mechanical lifting device fitted for the stackable boxes.

The cleaning is done using a hand held steam cleaner and drying machine. The cleaning facility at the treatment plant was not ready at the start of the pilot project. Over the 8 weeks that the project was running the cleaning plant was improved by:

- The provision of a drying rack
- Mechanical lifting device for the wheelie bin
- Cemented and treated surface for the steam cleaning
- Cement pathway to the clean store area
- Roof provided over the cleaning area

The drainage is presently inadequate and the cleaning was done manually. A separate report on the swab tests conducted is available.

Summary and Recommendations

- The wheelie bin lifting device was very effective and functioned well
- The cleaning facility was inadequate and relied on the correct application and thoroughness of the cleaner.

2.3 Comparison between the two systems

The purpose of the research was to compare and contrast the implementation and running of two health care waste management systems based on the use of reusable containers both within the health care facilities, off-site with the service provider and at the treatment facility.

The comparison of the two systems was conducted with the Consultant Group, Leratong Hospital, the Treatment Plant and the External Transporters. Itireleng only had the stackable boxes, so no comparison could be made.

Five aspects for measuring were identified. Each aspect was broken down into identified sub-sections. Working within groups, the parties were asked to quantify the implementation and running of the two systems based on a simply scoring system of 1 = poor 2 = average and 3 = good.

The consultant group agreed on a weighting for each aspect. The scores given by the consultant group, Leratong and the Treatment plant are summarized below. No results have been obtained from the external transporters.

Aspects	Weight Factor	Consultants						Leratong						Treatment Plant					
		Wheelie Bin			Stackable Boxes			Wheelie Bin			Stackable Boxes			Wheelie Bin			Stackable Boxes		
		Score	%	Weight	Score	%	Weight	Score	%	Weight	Score	%	Weight	Score	%	Weight	Score	%	Weight
Ease of Implementation	8	6	67	533	7	78	622	9	75	600	6	50	400	15	100	800	15	100	800
User friendliness	13	9	75	975	7	58	758	10	83	1083	9	75	975	19	90	1176	19	90	1176
Occupational H & Safety	29	8	67	1933	9	75	2175	10	67	1933	13	87	2513	10	83	2417	9	75	2175
Suitability and Durability	14	10	56	778	15	83	1167	12	80	1120	10	67	933	14	78	1089	18	100	1400
Sub Total		33		4219	38		4722	41		4737	38		4822	58		5482	61		5551
Cost	36	3	80	2880	2.3	60	2160	3	87	3132	2.3	65	2340	3	102	3672	2.3	77	2772
Total		36		7099	40.3		6882	44		7869	40.3		7162	61		9154	63.3		8323

The scoring gives us a guide, but it is by no means a scientific calculation of the one system against the other and should not be used as the definitive measure.

Comments and Recommendations:

- The results show that **without the costs**, the stackable box system is preferred by all three of the groups
- **When the cost factors are added**, the wheelie bin scores better by all three groups
- The cost factors were determined by the consultant group only
- The costs of the two systems were determined by the actual costs incurred in the pilot project

2.4 Summary of equipment costs into the cost model

Costs associated with the existing and proposed new scenarios have been determined and compared.

Both **capital costs** (as represented by **depreciation** of the equipment over its useful life and **interest** on the amount invested in the equipment) and **operating costs** have been included, to arrive at **comparative 'all-in' monthly costs**.

This has been done by means of a comprehensive **'Scenario Cost Model'**, developed specifically for this project.

The scenarios investigated and compared in the Model are as follows:

- **'Cardboard box'** system: this is an improved version of the system currently in use; ('improvements' include: the introduction of wall-mounted and nursing-trolley-mounted steel 'baskets' with polyethylene liners; wall- and nursing-trolley-mounted brackets for sharps containers; 'cage-trolleys' for transportation of full boxes, both internally within the health-care facility, and 'off-site' in the collection vehicle.);
- **'Liner + 240-litre wheelie-bin system'**: concept and equipment is similar to that used in the 'Liner + 700-litre wheelie-bin system' (see below), except that 240-litre wheelie-bins are used for on- and off-site transport of the HCRW. The 240-litre wheelie-bins (with light-duty polyethylene liners) are also used as HCRW depositories in the sluice-rooms, in place of heavy-duty liners on metal stands;

- **'Liner + 700-litre wheelie-bin system'**: this is the system as deployed in half the areas in Leratong Hospital, as part of the Pilot Study described elsewhere in this report;
- **'Re-usable or Stackable Box system'**: this is the system as deployed in the remaining areas in Leratong Hospital, as part of the Pilot Study.

Aspects **included in the Cost Model** are:

- The cost of HCRW **containerisation**; this element includes for:
 - consumable usage (sharps containers, polyethylene liners/bags)
 - The equipment necessary to each system, i.e. 'stands' for the large, heavy-duty liners (wheelie-bin systems), wall- and trolley-mounted baskets for medium-sized HCRW liners; wheelie-bins; re-usable boxes; cage-trolleys (box systems), etc. The capital cost of the necessary equipment has been translated into representative monthly charges representing (i) depreciation of the equipment over its expected life-span, and (ii) an interest cost on the capital investment involved;
 - The in-hospital labour cost associated with deployment of empty and/or collection of full HCRW containers/liners. (This cost is limited to the labour required between central HCRW storage area and the ward sluice-rooms, i.e. only waste-worker costs are included; health-care worker costs are excluded.)
- The cost of **transporting** the full HCRW containers to the treatment facility, and the cost of transporting clean, empty HCRW containers from treatment facility back to the health-care facilities. This element includes for:
 - all capital and operating costs (including crew costs) associated with the operation of the necessary fleet of trucks; (trucks are equipped with tail-lifts);
 - a profit mark-up of 25% on the cost of the service, on the assumption that this service will be outsourced to the private sector;
 - Transport to one regionalised facility, or three regionalised facilities, or 10 or 20 decentralised facilities. (The more facilities available in the province, the shorter the average transport distance from health-care institution to treatment facility, the smaller the truck-fleet required and the lower the transportation cost. Note, however that **treatment** costs increase in inverse proportion to the transport costs {see below}).
- The cost of **cleaning/disinfecting** the re-usable HCRW containers at the treatment plant;
- The cost of **treating** the HCRW and disposing of the residues. This element includes for:
 - all capital and operating costs associated with the treatment (microwave, incineration or autoclaving);
 - 'economies of scale' associated with plant size, i.e. the **per-kilogram** treatment costs for a small, decentralised facility are **higher** than for a large, regionalised facility;
 - A profit mark-up of 25% on the cost of the service.

The basic model was developed during 2002, and preliminary results indicated that, of the various scenarios considered, those based on polyethylene liners + 700-litre wheelie-bins, and on re-usable boxes, had similar costs.

Experience gained during the Pilot Study has now facilitated adjustment of the assumptions incorporated into the Model, making them more representative of 'real life'. Adjustments that have been made include:

- Increasing the cost of the in-hospital labour required for the re-usable box system in relation to the wheelie-bin system;
- Increasing the number of 'sets' of re-usable containers required to sustain each system; (the number of 'sets' of equipment necessary for each system is now: 700-litre wheelie-bins: 8 sets (previously, 4 sets assumed); re-usable boxes: 8 sets (same as previously); cage-trolleys: 5 sets (previously 3 sets);
- Adjusting the HCRW 'mass per container' figures to bring them into line with actual recorded average masses;
- Adjusting the transport costs to reflect the actual size of the cage-trolley as used for the box system;
- Adjusting the number of consumables used to match recorded figures, and reflecting the prices as actually paid for these items.

(Note: The unit-costs that have been used in the Model for the *non-standard equipment* used in the Pilot Study {i.e. re-usable boxes and cage-trolleys} are reasonable estimates of costs that could be expected if and when these units are procured in the quantities that would be required for full-scale deployment. The use of these costs in place of the higher *actual* prices as paid for the 'prototype' units reduces the monthly cost of the re-usable box option by approximately 6 %.)

Incorporating the adjustments referred to above, the liner + 700-litre wheelie-bin system now offers the lowest monthly 'all-in' cost; this scenario is now **approximately 13 % cheaper** than the re-usable box system (assuming three incineration facilities {see below}; for 10 facilities, the relative advantage drops to 7.4 %, due to the smaller influence of transportation costs.)

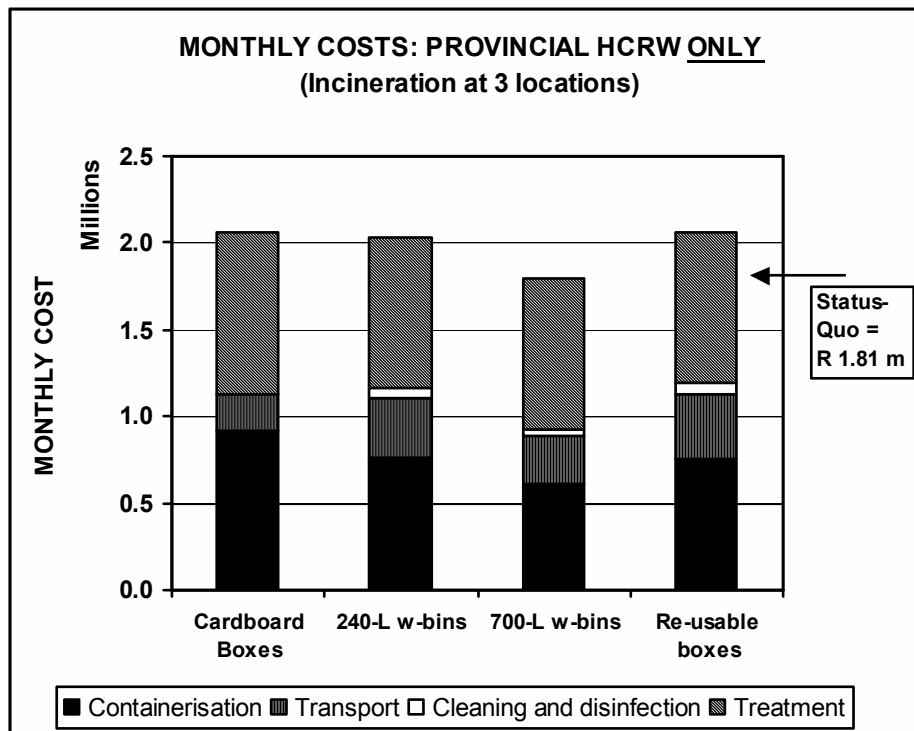
For illustrative purposes, and assuming that treatment is by incineration at the closest of 3 regional facilities, the estimated **total monthly costs** for HCRW originating from **all Gauteng Provincial health-care facilities** are as follows:

Cost element:	Scenario				
	Cardboard Boxes	240-L w-bins	700-L w-bins	Re-usable boxes	Status-Quo (estimated)
Containerisation	R 919,500	R 766,700	R 614,400	R 749,700	
Transport	R 210,000	R 343,000	R 271,000	R 372,000	
Cleaning and disinfection	R 0	R 52,000	R 40,000	R 67,000	
Treatment	R 933,000	R 872,000	R 872,000	R 872,000	
Totals	R 2,062,500	R 2,033,700	R 1,797,400	R 2,060,700	R1,809,000

Note: Labour cost (within institutions) included in the containerisation costs above are:

	180,000	300,000	180,000	330,000	264,000
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Graphically, this can be represented as follows:



The above graph highlights the fact that the relative advantage of the liner + wheelie-bin system lies in its **lower containerisation and transport costs**.

Introduction of a **multi-floor system** in the transportation vehicles would **further reduce** the transportation cost component in the wheelie-bin scenarios. (The estimated cost reduction would be approximately R 80,000 per month in the case illustrated above; the use of a multi-floor system would, however, not be possible in the case of the re-usable box system as implemented at the Pilot sites, due to the large overall height of the cage-trolleys.)

2.5 Component 2 – Capacity Building

2.5.1 Background information

The information in this section describes the background to the capacity building plans and research.

Capacity Building Plans at the Pilot Sites

Based on the findings of the two survey reports conducted at Leratong Hospital and Itireleng Clinic the capacity building plan at the two pilot sites included the following:

- The introduction of new policies and procedures collated in a Code of Practice booklet.

- The introduction of a Health Care Waste (HCW) Officer at both pilot sites and two Assistants at Leratong hospital. These are designated staff that performs the functions of a Health Care Waste Officer in conjunction with other responsibilities.
- The introduction of knowledge and skills training using a train the trainer/cascade training approach utilizing a training pack with teaching posters and other interactive teaching tools and skills posters.
- The introduction of improved monitoring and reporting through the occupational health and safety (OH&S) committee.

Research aims and methodology

The aim of the research was to measure the effectiveness of the capacity building interventions. This research included the following components:

- Formative and evaluative focus groups discussions about the print materials and training process
- Record sheets of the training and skills teaching
- Time sheets for HCW Officers and Assistants
- Key informant interviews with health care waste officers and assistants and with counterparts off site at the treatment facility and service provider
- Knowledge, attitudes and practice (KAP) study to assess learning.

This information was collected during the first two months of the pilot period because the capacity building interventions largely preceded the introduction of the equipment and therefore could be assessed earlier in the pilot period.

All components of the research were conducted at Leratong. At Itireleng training and skills records were kept, but no KAP study conducted. The formative and evaluative focus groups with regard to the print materials and the training process were also only conducted at Leratong.

The KAP study

The KAP study was the most involved piece of research for capacity building at the pilot sites. The aim of the KAP study was:

- To establish baseline information about health workers knowledge, attitudes and practice in HCWM at Leratong Hospital
- To provide feedback on the effectiveness of the training intervention.

The baseline study conducted in early January 2003 involved the random selection of 100 participants. These were both medical and non medical staff and represented approximately 10% of the hospital population. Fifty participants were general assistants because they are a particularly significant target group. Medical staff and non-medical staff completed the same questionnaires that asked for basic information on health care waste disposal, procedures and segregation practices. Questionnaires were in English. For medical staff, questionnaires were self-administered and returned to the researcher after completion. For non-medical staff most of whom were general assistants questionnaires were handed out in groups of tens and a researcher explained questions in seTswana as necessary.

A follow-on study was conducted with 50 participants. The same random method of sampling was used. Participants were not selected on the basis that they had completed the baseline survey. The questionnaire was modified but some questions were a repeat of the baseline survey.

Consultant led training input at the pilot sites

At the pilot sites there were a total of three train-the-trainer sessions led by the capacity building consultant. In these sessions supervisors were trained to train their staff in the wards and departments. To support their training supervisors were given a teaching pack with three teaching posters, a waste game with dice and counters and a table to promote good waste segregation. Supervisors were also given a Code of Practice. Supervisors were expected to transfer important information to their staff and also teach new skills. Skills’ teaching was supported by a set of skills posters and a skills checklist in the teaching pack. All supervisors were requested to complete monitoring and record forms for training and skills demonstration. The train-the-trainer sessions took 2.5 hours each.

To ensure the implementation of the new equipment systems it was necessary for some complementary training to take place alongside the training that was being conducted by the supervisors in the wards and departments. This training was mainly with cleaning staff, but also with some nurses and doctors.

In addition to this there was also 2.5 days of training held jointly for the OH&S committees at both pilot sites to introduce their role in HCWM and to introduce new incident and accident reporting.

The service provider Buhle waste also requested two training sessions for their staff.

Table 1 summarises the consultant led training conducted at the pilot sites to support the introduction of new equipment.

Table 1: SKILLS AND KNOWLEDGE TRAINING

		Leratong Hospital	Itireleng Clinic	Buhle Waste
No. of staff trained	Supervisors trained as trainers	65	7	
	Doctors	24		
	General assistants/ ward helpers	41	8	
	Nursing staff		14	
	OH&S committee	2.5 days of training	2.5 days of training	
	Social worker/ health promoter		2	
	Drivers and Collection Staff			12
	Education Volunteers			1

2.5.2 Research Findings for Capacity Building

Training records for cascade training

Training records were regularly collected from all wards and departments. Although there were inevitably gaps in the information collected the results showed a remarkable training effort by Leratong. Table 2 summarises these results. The results show that from the initial 5 hours training input by the consultant a total of 6 days training occurred throughout the hospital within the first 5 weeks of the pilot project. Also the results show that on average 8/9 people attended a training session. The teaching posters were used at almost every training session and there was also high level of reported use of the waste segregation table and the waste game. The results from Itireleng are less good and suggest that the cascade system of training will be less successful in smaller institutions. At Itireleng there were 4 training sessions, all facilitated by the HCW Officer. In total 13 people were trained including the clinic manager. Each session lasted one hour and all teaching materials were used.

Table 2: CASCADE TRAINING RECORDS FOR LERATONG HOSPITAL

	Wheelie Bins	Stackable Bins
No. of training sessions	46	50
No. of participants	422	417
Average attendance per training session	9	8
Teaching time (in minutes)	1403	1554
Use of Training Posters (%)	100%	96%
Use of Segregation tables (%)	94%	79%
Use of Waste game (%)	63%	50%

Skills records

Records were kept by the wards and departments at Leratong about the skills demonstrations they had completed. Although these records were sometimes confused with the training forms it was possible to identify the major skills that needed reinforcing in each equipment system. In particular the fitting of the correct size liner into the appropriate stand or container needed consistent reinforcement as did the correct method to close the liners using a rubber band. (Refer to Table 3) General assistants reported that it is difficult to close the liners with a rubber band when wearing gloves. At Itireleng where one equipment system was implemented record keeping about skills demonstration was incomplete.

Table 3: SKILLS RECORDS FROM LERATONG HOSPITAL

	Wheelie Bins	Stackable Bins
Closing liners with rubber band	x	x
Correct liner in red box, closing and stacking boxes		x
Put correct size black liner in basket	x	x
Horizontal loading of sharps	x	x
Put correct size and thickness of red liner in all stands & containers	x	
Correct size liner on box in nursing trolley		x
Closing sharps container		x

The skills records also showed that multidisciplinary training was happening in the wards and departments. Nurses and general assistants were often trained together. Also doctor participation in the wards appeared to increase at the Leratong over time. This was a pleasing result, one of the criticisms about HCWM communication prior to the pilot site intervention was that separate meetings fuelled an underlying resentment,

“I wish the meetings where these things are explained could include all staff so we all get the same message at the same time instead of the separate meetings that we normally hold. Then there will be no need for the resentment that we have against the nurses and doctors for carelessly exposing us to hazards.” General Assistant¹

Results from the KAP study

The follow-on study found that 91% of the sample had been trained about the new waste system. This high figure suggests that the coverage for training had been high in the hospital. Of this 91%, 73% found the training very useful and 24% useful and only 2% not useful. 51 % reported that they would like further training. Segregation, protective clothing, how to close filled liners and inspecting a hazardous situation were given as important training areas for the future. 49% of people reported that they did not wish further training, which suggests that for some people the present information load is sufficient.

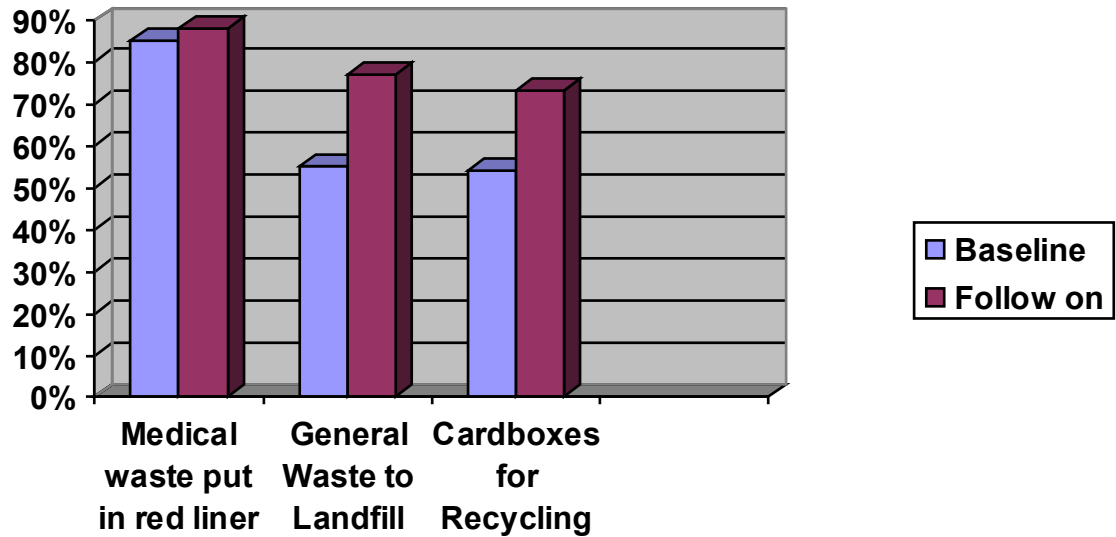
a) Knowledge levels

The KAP study provides interesting information about knowledge levels. Cascade training did seem to have been effect at increasing knowledge levels in some areas for example, in the baseline survey only 54% of respondents knew that cardboard went for recycling and 73% of respondents knew this in the follow-on study. Likewise

¹ Survey Report Leratong Hospital Gauteng Sustainable Health Care Waste Management Project April 2002

in the baseline survey 55% of respondents knew that waste goes to landfill and 77% in the follow-on survey. However the survey also showed that at Leratong knowledge levels are not the critical gap in terms of segregation practice. For example, 85% of respondents knew that medical waste is put into red liners in the baseline survey and 88% in the follow-on survey. This is an important finding because often knowledge gaps are overemphasized in relation to poor segregation practice.

Diagram 1: RESULTS OF THE KAP STUDY: KNOWLEDGE LEVELS



b) Attitudes

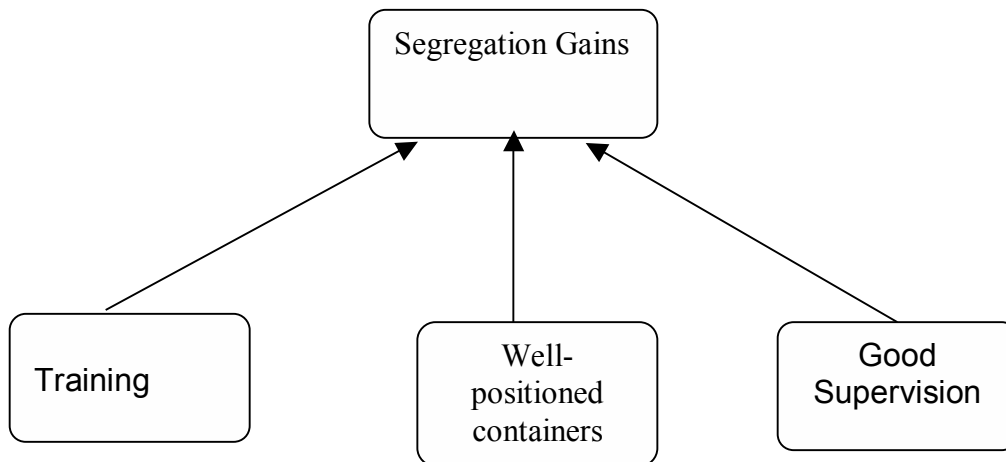
The KAP study also suggests that most health workers (medical and non-medical) have helpful attitudes to disposing of health care waste correctly. For example in the baseline and follow-on survey 93% of respondents reported that it was their responsibility to dispose of waste correctly. Also 84% of respondents in both surveys reported that general assistants play a very important role in waste management.

c) Segregation practices

The baseline survey asked respondents to rate segregation at Leratong, a score of 1 was very poor and 10 very good. The baseline result was 6.5. Post training and the introduction of new equipment the score was 8.3 which shows that respondents themselves saw an improvement in segregation practice at the hospital. Although the removal of medical waste from black liners by general assistants was thought to be a common practice at the hospital, the results of the survey showed that only 20% thought this correct and post intervention 15%.

When asked in the follow-on survey about their own segregation practices 68 % of respondents said that they always segregate waste correctly and 20 % sometimes they segregate waste correctly. When asked what helps better segregation 80% said that training helps, 53% well positioned containers and 46% good supervision. This is significant because it shows that segregation gains will not be made through training alone.

Diagram 2: WHAT IS NEEDED TO SUPPORT IMPROVEMENTS IN SEGREGATION



d) Reporting

The cascade training was effective at encouraging health workers to report unsafe incidents. In the baseline survey only 39% of respondents said that they would report an over filled sharps container to a supervisor or safety representative in the follow-on survey 77% said that they would. Thirteen percent of respondents in the follow-on survey reported that they had requested that a yellow or red (incident and accident) form be completed. Despite this result the general practice of reporting was found to be weak as discussed in the following paragraph.

Reporting and the OH&S committee

Although the OH&S committees at both pilot sites received 2.5 days of training, reporting through the OH&S committee has been limited. In the three month pilot period a total of 14 incident report forms and 1 accident report forms have been completed for both pilot sites. Three of these incidents occurred off site at the treatment facility and with the service provider. The accident report form was for a needle stick injury that was not directly related to waste. These forms were brought to the attention of the HCW Officers and consultants but never received attention from the OH&S committee. This means that these reports are then not brought to the attention of senior hospital and clinic management as is required in the OH&S Act.

Safety representatives were involved in one inspection round at Leratong hospital. During the final training sessions with the OH&S committee the committees were asked

to comment on their own performance and listed a number of factors that impact on their performance. These are:

- poor communication
- safety representatives not understanding their role
- non-attendance of workshops
- shortage of staff
- lack of regular meetings
- sick leave/off duties impacting on staff availability

Focus group research

One focus group was conducted with twelve trained supervisors. These supervisors were randomly chosen from the attendance registers.

The focus group discussed:

- How trainers went about the training
- The effectiveness of training
- How prepared the trainers felt for the training
- The teaching posters
- The skills posters
- The waste game and segregation table that were also part of the teaching pack
- The Code of Practice
- How to sustain training over time

a) The effectiveness of training

Overall the training was found to be effective,

“From observation of how our staff responded to the training, it was an effective method of training.”

“All in all the training and training materials were well structured.”

It was felt that there was lots of improvement after staff had been trained. Generally the participants felt that the cascade method of training had worked because their staff has a tendency to respect their seniors more than “outsiders.” It was said that most people co-operated because the trainers were the unit managers and because unlike an outsider they would also be supervising. It was also felt that no one misses training using this method because the training can be easily repeated. Although staff reported that they are busy it was possible to find time to conduct the training. From the tone of comments it was clear that the supervisors felt some responsibility to make the programme work, which may be a reflection of nursing management’s involvement in the HCWM task team at Leratong. They felt the training has become continuous and said,

“Staff members are also teaching patients and patients are also teaching newly arrived patients the correct way to dispose of waste.”

It was said that some people in the wards and departments already felt that they knew how to segregate waste and therefore believed the training to be a waste of time. However it was believed that because the training put emphasis on attitude and practice rather than just revisiting familiar knowledge that this may then have reinforced for participants the importance of segregating and disposing of waste correctly. The KAP study found that 73% of respondents who had been trained found the training very useful.

b) The trainers

The participants reported that they felt well prepared for the training and that the training they had received was well presented.

“The training was thorough and intensive, we understood very bit of it.”

They also stated that they knew from the beginning that they were going to train other staff members so they came out being prepared and ready to pass on information. When participants were unsure of information they consulted the posters and teaching notes. The participants felt that they did not need further training.

c) Teaching materials

All the teaching posters were found to be appropriate, but more especially the poster covering segregation. It was felt that the posters summarized everything and were useful for those who cannot read.

“We loved everything in the posters, they are appropriate and we also identify with the characters/people used in the posters.”

It was recommended that the posters contained enough information and that there was no need to provide additional or less teaching aids. However it was recommended that an additional poster be produced for kitchen staff.

To support the teaching posters the trainers were also given a set of teaching notes. Almost everyone reported that they had been through the training notes before their training sessions. The teaching notes were found to be very helpful because they reminded participants of information they had missed or forgotten in the train-the-trainer session and because they were useful as a reference.

The skills posters were thought to be effective tools.

“They are educative and easy to read, the colouring is also good that even pre-school kids will find them easy to interpret.”

The small A3 size was made it easy to find somewhere to paste them on the wall.

The segregation game was said to have helped because *“some people learn effectively in an informal way.”* The segregation table was considered to be part of the training and that everyone had to complete it because otherwise the training is not *“complete.”* It was suggested that some of the words used in the segregation

table were difficult to understand and that for the future simple words should be used.

Although very few people had read the Code of Practice it was agreed that it is important because it acts as a guide. It was proposed that the Code of Practice should be made more user-friendly and that the language used should be easy to understand.

d) How to sustain training over time

It is recognized that training will need to be flexible and ongoing because waste problems cannot be solved over night. It was felt that it will be necessary to do this training every time there is new staff intake in the hospital and also when there are changes or developments in the waste system.

e) Recommendations about training

The following recommendations were made with regard to training:

- That the training hadn't effectively reached doctors and that they should be reached through senior hospital management. It was felt that doctors and other senior staff members still do not take the waste problem seriously
- That other senior nursing staff be trained as trainers
- That it is essential that there is follow up on the wards to see how things are progressing
- That simple language is used for everyone's benefit in all the print materials.

Key informant interviews

Key informant interviews were conducted with the following people:

- The two Health Care Waste Officers at the pilot sites
- The two Assistant Health Care Waste Officers at Leratong
- A representative from Buhle Waste (the service provider)
- A representative from EnviroServe (the treatment facility)

Their comments were collected with regard to the implementation of the equipment as well as the capacity building programme. The comments recorded here concern the capacity building programme only.

a) Feedback from the health facilities

All of the HCW Officers reported that the implementation of the new HCWM system had went well and that there had been great improvements.

"There is better organization in the collection of waste."

Their comments with regard to the capacity building programme concerned the role of the Code of Practice, their role as HCW Officers, training and how to secure improvement in segregation.

b) The Code of Practice

The Code of Practice was felt to promote team work, sets standards and helps in handling situations when problems arise.

"We are no longer allowed to handle waste like in the past. If waste goes into the wrong container, for example, if medical waste goes into a black bag we have to regard all that waste as medical waste, put it into the red liner and send it for incineration."

"Helps in handling situations, what to do in the process of collecting waste if something goes wrong, for example, needle stick injuries or spillage."

Although one respondent reported that the Code of Practice is "easy to read" another respondent felt "guilty" about not having the time to read it. A suggestion was made that critical sections of the Code of Practice should be read and discussed at ward assemblies. It was stated that the Code of Practice must become "second nature to all."

c) The role of HCW Officer

The extent to which the designated HCW Officers at the pilot sites have become involved with waste are reflected in the statements below,

"Have been involved with the process from the beginning and it has become second nature."

The other HCW Officer described waste management as being "in her blood." Both of these comments reflect the preparedness of the HCW Officers for their task and emphasize the importance of a preparatory process for this role. The HCW Officers and Assistants spoke about their role being a "challenge". Since all participants are seniors in their own areas the primary challenge is time management rather than the job per se. It was thought to be essential that the HCW Officer and Assistants work as a team which has been happening at Leratong. At Itireleng the HCW Officer also felt that it was desirable to have a deputy who could cover for her role in her absence. At Itireleng it was stated that the role was sustainable over time with "motivation and incentives."

d) Training

It was felt that training needs to be continuous to help ensure compliance. How to secure the visible improvements for the long term was an overriding concern of all interviewed.

At Itireleng where the cascade training was less successful it was felt that,

"Supervisors are overworked and don't have time to train their subordinates."

It was also felt necessary to train clinic managers, regional managers and the broad "community" about HCWM.

e) Securing segregation gains

Great improvements were reported by all respondents. At Itireleng it was stated that the,

“Ward looks like that of a private hospital.”

However it is felt that segregation is the biggest challenge, particularly at the point of generation. The researcher who conducted these interviews picked up that “compliance and reinforcement” are the buzz words to get the project to work.

“Teach, talk and talk, compliance should be reinforced. The project is not difficult just have to follow procedures.”

It was felt that the systems are now in place and that it is “*quality management*” that will make the difference especially supervision and enforcement of standards.

Feedback from the interviews conducted off site

The service provider reported that they would have liked to have received training prior to the introduction of the pilot. The start up period was confusing and they felt they learnt by trial and error.

Timesheets for HCW Officer and Assistants

The timesheets for HCW Officers and Assistants have not been successfully kept during the first three months of the pilot period. Instead the HCW Officers and Assistants will be formally interviewed about their work load and time management as part of the preparation for the curriculum for 5 day intensive training programme being planned for HCW Officers to start in August 2003.

2.5.3 Recommendations from the pilot sites

The pilot site task teams were asked to formally give their recommendations for capacity building. Each task team was asked to comment on:

- HCW Officers and Assistants
- Cascade training
- The Code of Practice
- Monitoring, supervision and enforcement
- Reporting through the OH&S committee

Both pilot sites recommended that HCW Officers be introduced to all other Gauteng health facilities. Leratong recommended that there should be two Assistant HCW Officers, one from the medical section and one from the cleaning department which is their model of working. Both pilot sites said “yes” to cascade training and the use of the teaching pack. Likewise the pilot sites recommended that the Code of Practice is essential and should be introduced at all other health facilities because it “*serves as a guide to the team.*” However it is felt that it would benefit from more illustrations.

Monitoring, supervision and enforcement is recognised as an integral component of HCWM. It needs to be ongoing and is a line management function. However to support this role it was recommended that there be in-service training for supervisors and that supervision should be encouraged at lower levels so that staff could coach each other.

OH&S is believed not to have met the required expectations during the pilot period. There are probably many reasons for this. At the pilot sites the lack of trained staff for OH&S, poor communication and commitment were sited as reasons for this failure.

2.6 Component 3 - Segregation

An important aspect of the research was to determine the improvements made in segregation with the implementation of new equipment and the effectiveness of the training.

2.6.1 Waste Composition Studies

The baseline survey was conducted in August/September at Leratong hospital. This study was conducted prior to the intervention. A subsequent study was conducted in July/August 2003. The results of this second study and the comparisons between the two studies can be found in a detailed report² that was not yet available at the time of writing this report.

² Waste Composition Report Section 3