



Baseline Study for the Pacific Hazardous Waste Management Project - Healthcare Waste

The collection, collation and review of data on the management of healthcare waste and best-practice options for its disposal in participating Pacific Island Countries

RMI

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This document is issued in confidence to Secretariat of the Pacific Regional Environment Programme (SPREP) for the purposes of collection and collation of information on the regional management of healthcare waste and its disposal, as part of their broader strategy of improving hazardous waste management in Pacific Island countries, and specifically to assist in establishing sustainable healthcare waste management. This report presents the findings of this assessment. It should not be used for any other purpose.

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Executive Summary

Introduction

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the Pacific region's major intergovernmental organisation charged with protecting and managing the environment and natural resources. SPREP works with and on behalf of its 21 member countries and territories to promote cooperation in the Pacific islands region, providing assistance to protect and improve the Pacific environment and to ensure sustainable development for present and future generations.

SPREP is implementing the Pacific Hazardous Waste Management (PacWaste) Project, a four year, €7,850,000 (2013 – 2017) project funded by the European Union and administered through SPREP. The project will provide fundamental on-ground improvement in the way priority high risk wastes are managed in Pacific Island Countries to help build a healthy, economically and environmentally sustainable Pacific for future generations. The PacWaste project is funded by the European Union under its 10th European Development Fund (EDF 10). The project focuses on three priority hazardous waste streams including asbestos, E-waste and healthcare waste.

ENVIRON was engaged by SPREP to collect and collate information on the regional management of healthcare waste and its disposal, as part of their broader strategy of improving waste management in Pacific Island Countries, and specifically to assist in establishing sustainable healthcare waste management. This report presents the findings of the assessment conducted for the Republic of the Marshall Islands (RMI).

Current Healthcare Waste Management in the Republic of Marshall Islands (RMI)

The Ministry of Health operates two hospitals in the RMI, Majuro Hospital located in the capital of Majuro and the Ebeye Hospital located in Kwajalein Atoll. Basic healthcare services are provided at both hospitals and there are 49 dispensaries located on the outer atolls of RMI. The hospitals were audited on the following dates:

- Ebeye Hospital – 14 April 2014
- Majuro Hospital – 15 April 2014

A minimum standards framework has been developed to set a benchmark for the sustainable management of healthcare waste in the Pacific Island region. This framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

Using information obtained from the audits, the hospitals were assessed against this framework. Table ES1 highlights the key areas of concern in terms of health services delivery by the hospitals, as part of this assessment.

A full description and definitions of minimum standards applicable for healthcare waste management, as well as a comprehensive assessment against each of the criteria is presented in **Appendix C**.

Target areas have been rated as follows:

	Meets minimum standards assessment criteria
	Partially meets minimum standards assessment criteria.
	Does not meet minimum standards assessment criteria.

Scale	Category	Item	Minimum Standard Criterion	Ebeye	Majuro	RMI Overall
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)			
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types			
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types			
Healthcare Facility	Training	Planning and implementation	A structured waste management education program has been developed with a clear delivery structure			
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.			
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.			
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.			
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.			
Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.			
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.			
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.			

Key Issues

Both hospitals had a number of deficiencies with regard to the management of healthcare waste however; staff and hospital administration at both hospitals had identified these issues and are willing to rectify them as a matter of priority.

- None of the hospital had a waste management framework in place or a structured healthcare waste training program.
- Adequate signage and proper segregation needs improvement in both hospitals, with a lack of color coded bags and containers to aid correct segregation of waste streams.

Healthcare waste treatment issues specific to each hospital include the following:

Ebeye –

- Sharps are disposed of in a SteriMed™ 70 Healthcare Waste Processor the processor only has the capacity in macerate sharps waste therefore the remainder of the hospital's untreated healthcare waste (pharmaceuticals, pathological and anatomical) is disposed at the Ebeye Landfill. The landfill is unlined and accessed by scavengers and children.
- A MediBurn 30 incinerator has been donated and was in storage at the Ebeye Hospital at the time of the audit, it has not yet been commissioned.

Majuro –

- For the past ten years healthcare waste has been stockpiled in a storage room or stored in shipping containers at the rear of the hospital. The hospital has received several fines from the EPA and has made several attempts to rectify the problem. At the time of the audit there were approximately 10 shipping containers full of bags of healthcare waste at the rear of the hospital and another 10 located at a former treatment compound away from the hospital.
- In March 2014, under the directive of the RMI Environmental Protection Agency (EPA) contractors *Island Supplies International (ISI)* were engaged to assist with the disposal and treatment of healthcare waste. In March 2014, ISI sent 10 of their staff to the hospital to remove healthcare waste stored in bags in the storeroom at the rear of the hospital and transport it to ISI's compound for incineration in a MediBurn 30 Incinerator.
- ISI have the capacity to treat the stockpiled HCW however, according to a report from ISI to the RMI EPA, sighted during a consultation with the RMI EPA (16 April 2014), ISI have used 766 gallons (~ 2900 L) of diesel fuel for the incineration of the hospital's HCW, and have only been credited to 500 gallons (~1893 L) they were still owed \$ US 125,000 for fuel and services provided. Financial support is required to ensure the ongoing treatment of the stockpiled HCW in Majuro.

Analysis of Options for Sustainable Healthcare Waste Management in the RMI

Where non-treatment waste management aspects were observed to be performing below the Minimum Standards Framework, this framework is referenced for recommended actions.

For treatment of healthcare waste, various options used around the world were considered in the Pacific Islands context, via a two stage process:

- Stage 1: High-level costs and benefits (cost, lifespan, technical feasibility and how that relates to the Pacific Island regional context); and
- Stage 2: A RMI-specific feasibility assessment, using an analysis of 10 criteria (**Appendix D**)

Treatment options that rated best for the RMI were:

- **High Temperature Incineration** is the promoted disinfection practice where units are modern, maintained, have sufficient waste volumes and locked in supplier maintenance and training contracts.
- **Medium Temperature Incineration** is acceptable in the medium term to remedy current unacceptable practices at sites too small to justify costs of expensive equipment.
- **Autoclaving** is an acceptable disinfection practice where units with shredder are affordable and locked in supplier maintenance and training contracts are in place.
- **Low temperature burning** is a borderline practice which can only be acceptable in the short term, in low population density environments, to remedy current unacceptable practices.

Recommendations

Table ES2 provides a summary of the recommendations for the RMI.

Where a recommendation is **unique** to the circumstances of a particular hospital, because of issues identified that are **unique** to that hospital, the recommendation (and associated implementation action) is appended with the annotation ^{U2H}.

Table ES2: Recommendations for RMI		Ebeye Hospital	Majuro Hospital	RMI Overall
Applicable to				
Recommendation 1: Develop a Waste Management Framework				
Description	<ul style="list-style-type: none"> • A <i>Healthcare Waste Management Plan</i>, specific to each healthcare facility • Appoint an <i>officer responsible</i> for the development and implementation of the Healthcare Waste Management Plan (Ebeye Only) 			
Output	<ul style="list-style-type: none"> • An agreed <i>Healthcare Waste Management Plan</i>, specific to Ebeye and Majuro Hospitals outlining procedures and guidelines, waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures • Accountability for healthcare waste management through clearly defined roles and responsibilities 			
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Plan approved by Ministry of Health (all facilities) • Approved budget for implementation of Healthcare Waste Management Plan • The Plan should be regularly monitored, reviewed, revised and updated. 			

Table ES2: Recommendations for RMI		Applicable to	Ebeye Hospital	Majuro Hospital	RMI Overall
	<ul style="list-style-type: none"> Annual assessment of ‘Responsible Officer’s’ or Waste Management Committees’ performance against key healthcare waste management competencies. 				
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low, if existing systems (such as those for Fiji) are used as a starting points and document drafting assistance is provided Ongoing – Low 				
Recommendation 2: Procurement of Consumables (Segregation & Storage)					
Description	<ul style="list-style-type: none"> Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. Supply of small number of colour-coded wheelie bins (where required) per hospital to act as both in-ward/department storage and internal transport trolleys. Supply of signage to explain the colour-coded segregation system as well as posters to promote it. 				
Output	Adequate supply of consumables to bed down more rigorous segregation practices				
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Wastes are segregated at their place of production. Infection wastes, general wastes and used sharps are stored in separate colour coded containers and locations within medical areas. Zero Needle Stick Injuries. 				
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country				
Recommendation 3: Provide a Sustainable Training Program					
Description	<ul style="list-style-type: none"> Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies) This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists within Training should be coordinated with other countries’ needs in the region 				
Output	<ul style="list-style-type: none"> Improvement of personnel skills and competency in managing healthcare waste Promotion of the advantages of sustainable segregation and storage techniques for the different waste streams and an understanding of the health and safety risks resulting from the mismanagement risks of healthcare waste. 				
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Competency Assessments Refresher Training No/very little cross contamination between waste streams demonstrated by waste audits. 				
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low-medium per facility if regional synergies are utilised 				

Table ES2: Recommendations for RMI		Applicable to	Ebeye Hospital	Majuro Hospital	RMI Overall
	<ul style="list-style-type: none"> Ongoing – Low-medium per facility if regional synergies are utilised 				
Recommendation 4: Treatment Infrastructure Support ^{UZH}					
Description	<ul style="list-style-type: none"> Provide housing and commissioning support to set up the MediBurn 30 at the Ebeye Landfill. Provide financial support to ensure adequate and ongoing supply of fuel to reduce the volume (and associated risks) of stockpiled healthcare waste at Majuro. According to ENVIRON's calculations it will take 1.8 years to incinerate stockpiled HCW and its current incineration throughput or 0.9 years at the incinerators maximum capacity. Utilising secondary incinerators on Majuro (i.e incinerator located at the A/C Construction compound) may need to be considered to reduce the volumes more quickly. The integrity of the shipping containers should also be inspected frequently to check for corrosion and seepage of HCW. 				
Output	A disposal system that reduces the potential hazard posed by healthcare waste, while endeavoring to protect the environment.				
Monitoring & Evaluation Indicators	<p>Assessment of the following should be regularly undertaken for new and existing incinerators:</p> <ul style="list-style-type: none"> Operations and construction (e.g. pre-heating and not overloading the incinerator and incinerating at temperatures above 800°C only) Maintenance program – are maintenance issues dealt with promptly? Ensure burn times are sufficient to reduce waste ash volumes Significantly reduced volume of stockpiled HCW at Majuro Hospital 				
Costs (\$US)	<ul style="list-style-type: none"> Establishment –Low (Housing and commissioning costs only) (Ebeye) Ongoing – medium (fuel and maintenance) (Ebeye & Majuro) 				
Recommendation 5: Procurement of Consumables (PPE)					
Description	<ul style="list-style-type: none"> Supply appropriate PPE including overalls/protective clothing, gloves and eye protection for all waste handlers. Incinerator staff are provided with additional PPE such as face masks and noise protection. 				
Output	Adequate supply of PPE for protection of waste handlers				
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> PPE is provided to all staff and staff are aware on how to protect themselves from injuries and infectious wastes Zero Needle Stick Injuries. 				
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country				
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Plan approved by Department of Health (all facilities) Approved budget for implementation of Healthcare Waste Management Plan The Plan should be regularly monitored, reviewed, revised and updated. 				

Table ES2: Recommendations for RMI		Ebeye Hospital	Majuro Hospital	RMI Overall
	Applicable to			
	<ul style="list-style-type: none"> Annual assessment of ‘Responsible Officer’s’ or Waste Management Committees’ performance against key healthcare waste management competencies. 			
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low, if existing systems (such as those for Fiji) are used as a starting points and document drafting assistance is provided Ongoing – Low 			

Implementation actions are suggested for each recommendation, classified as short, medium and long-term priorities.

1 Introduction and Background

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the Pacific region's major intergovernmental organisation charged with protecting and managing the environment and natural resources. SPREP works with and on behalf of its 21 member countries and territories to promote cooperation in the Pacific islands region, providing assistance to protect and improve the Pacific environment and to ensure sustainable development for present and future generations.

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1.1 Project Scope

This report covers the approach specified in the Request for Tender AP 6/5/6/2 'The collection, collation and review of data on the management of healthcare waste and best practice options for its disposal in selected Pacific Island communities' as it specifically relates to RMI and includes:

- Collection and collation of data on the current practice(s) used to dispose of hazardous healthcare waste in RMI. Data collected includes:
 - Basic background data on the operation of the hospital sites assessed (number of beds, population served, current and projected rates of hazardous healthcare waste generation);
 - Healthcare waste separation and infection control practices;
 - Adequacy of supply of hazardous healthcare waste collection equipment;
 - Hazardous healthcare waste storage;
 - Hazardous healthcare waste transportation;
 - Hazardous healthcare waste disposal practice and annual operating costs;
 - Frequency and adequacy of infection control training;
 - Frequency and adequacy of waste disposal training;
 - Adequacy of supply of personnel protective equipment.

- Consultation with national authorities to review and identify best-practice option(s) and preferences for national hazardous healthcare waste management by considering technical feasibility within the existing health infrastructure (including review of existing local institutional, policy and regulatory arrangements).
- Identification of local contractors who may have the expertise and capacity to potentially partner with regional or international expert's in future hazardous healthcare waste management including infection control training.

1.2 Report Structure

This report is structured as follows:

- an introduction to the project (**section 1**)
- discussion of current healthcare waste management in RMI, including the current regulatory framework and hospital details (**section 2**)
- a summary of existing waste management practices, waste streams and quantities, waste management and infection control framework, the waste management process that was reviewed, training and education programs and identified healthcare waste management issues (**section 3**)
- key healthcare waste management issues and any county-wide or regional themes that were identified (**section 4**)
- a summary of hospital and national authority consultation outcomes (**section 5**)
- an assessment of contractor roles and their capacity to sustainably manage and treat healthcare waste, including any training or education capacity (**section 6**)
- an analysis of the healthcare waste management and treatment options available, both regionally and specific to RMI, to address the key issues identified (**section 7**)
- recommendations and prioritization of actions necessary to enable sustainable hazardous healthcare waste management and disposal in RMI (**section 8**)

2 Healthcare Waste Management in RMI

2.1 National Regulatory Framework

The Republic of the Marshall Islands (RMI) is made up of 29 atolls (24 inhabited) and 5 isolated islands. The atolls and islands form two groups: the Ratak Chain and the Ralik Chain. In 2010, the estimated population was 68,000 with two-thirds of the population living on Majuro, the capital and Ebeye.

The Environmental Protection Act 1984, and associated Solid Waste Management Regulations approved in 1989, provides the legal and policy framework for the management of solid waste in the Marshall Islands. The EPA is responsible for setting and monitoring minimum standards for the design, construction, installation, operation and management of solid waste storage, collection and disposal facilities in the country. The Public Health, Safety and Welfare Act also empowers the Ministry of Health to ensure that SWM practices do not pose risks to public health.

A summary of relevant legislation is provided in Table 1.

Legislation	Type	Summary	References to Solid/HCW	Regulator/ Agency
National Environmental Protection Act 1984	Act	This Act makes provision for a framework for the national environment protection policy and environment protection measures and establishes the National Environmental Protection Authority. The 66 sections are divided into 8 Parts.	-	Office of Environmental Planning and Policy Coordination (OEPPC)
RMIEPA Solid Waste Disposal Regulations 1989	Regs	The purpose of these regulations is to establish minimum standards governing the design, construction, installation, operation, and maintenance of solid waste storage, collection and disposal system.	Outlines Standards for Hazardous Waste Disposal. Defines 'Infectious Waste' as the equipment, instruments, utensils and fomites of a disposable nature from the rooms of patients who are suspected to have a communicable disease and must therefore, be isolated as required by public health agencies.	

2.2 Hospitals Assessed

The Ministry of Health operates healthcare facilities in RMI there is also a US military operated private hospital on Kwajalein Atoll and dispensaries located across the outer islands.

This section summarises the hospitals that were assessed in RMI, key contact personnel and key hospital administrative statistics.

2.2.1 Kwajalein Atoll Health Services (Ebeye Hospital)

The Kwajalein Atoll Health Service or Ebeye Hospital is a 45 bed hospital servicing a population of approximately 11,000 people. It provides services is emergency operations, outpatient, inpatient, polio-injection, hepatitis B, general surgery, internal medicine, cardiology, obstetrics and orthopedics, pharmacy, X-ray, an intensive care unit and a private room for inpatients.

2.2.2 Majuro Hospital

The Majuro hospital in an 80 bed hospital and provides healthcare serves for a population of approximately 30,000 providing emergency care, district nursing, outpatients, and pathology. There are also 53 outer island dispensaries and the Laura Health Centre

Detailed operational statistics for each of these hospitals are described in Table 2 below.

Table 2: Hospital Details – RMI		
Hospital/Region	Kwajalein Atoll Health Services, Ebeye, Kwajalein Atoll	Majuro Hospital, Majuro
Contact Name	Abon Jeadrik	Malia Heine
Position	Hospital Administrator	Hospital Administrator
Pop Served	11,000 +	30,000 +
No. of Beds	45	80
Annual Average Occupancy Rate (%)	50%	9%
OBD's	8,212	2,745
No. Operations	508	-
No. of Births	286	878
Emergency Patients Attended	2492	7827
Out-Patients Attended	29277	16950
No. of staff	80	112
No. of staff per function		
Nursing/ Medical	~40/10	96/16
Infection Control	1	1
Dedicated Waste Management – Internal Management	1	1
Dedicated Waste Management –	1	0 (Externally contracted)

Treatment Operation		
Administration	-	2
Other	-	-

Notes: OBDs = Occupied Bed Days (previous 12 months)

“ - ” = data could not be provided by the hospital

3 Existing Waste Management Practices

This section describes waste management practices observed during hospital audits carried out at each of the hospitals introduced in Section 2. Information regarding the waste management process occurring, from ward-level waste generation through to ultimate treatment and disposal is described for each of the four hospitals in Table 3.

Audit observations are elaborated upon further for each hospital individually in sections 3.1 and 3.2 for the remaining issue headings:

- Wastestreams, Treatment Constraints and Costs
- Waste Management and Infection Control Framework and
- Training.

A comprehensive list of all data collected from the site audits of each hospital is located in **Appendix B**.

Hospital Name	Ebeye Hospital		Majuro Hospital					
Generation & Segregation	Dedicated Containers/ Bags	Y - Limited	Y - Limited	Y - Limited				
	Colour Coding	Y - Limited	Y - Limited	Y - Limited				
	Sharps segregated & secure	Y - Limited	Y - Limited	Y - Limited				
	Signage Present	Y - Limited	Y - Limited	Y - Limited				
Internal Handling	Degree of manual handling of bags	High	High	High				
	Internal Transport Mode	Trolley	Trolley	Trolley				
	Spill Kit Present	N	N	N				
Storage	Dedicated & Appropriate Area	Y	N	N				
	Loading/unloading acceptable	Y	Y	Y				
	Spill Kits Present	N	N	N				
	Monitoring & record keeping occurs	N	N	N				
Treatment	Treatment per Waste Stream	Tech. Type	Volumes (kg/wk)	Tech. Type	Volumes (kg/wk)	Stockpile Volume (m3)		
	Healthcare Waste	✓	Landfill (w/o treat) ¹	~100	✓	Landfill (w/o treat)	~300	1,520 [#] 76,000 kg
	Sharps	✓	SteriMed	~70	✓	Incinerate (external)	~120	
	Pharmaceutical	✓	Landfill (w/o treat) ¹	NM	✓	Landfill (w/o treat)	NM	
	Cytotoxic	×	NA	NA	×	NA	NA	NA
	General	✓	Landfill (w/o treat) ¹	NM	✓	Landfill (w/o treat)	~240	NA
	If incinerator present	SteriMed 70 (Shredder & Disinfector)		MediBurn 30 (owned and operated by an external contractor)				
	Make, Model, Year commissioned	SteriMed - System 70		MediBurn 30 used is currently owned and operated by ISI Island Supplies International Commissioned November 2013				
	Operating Temp (°C)	NA		1000				
	No. chambers	NA		2				
	Condition	Good		Good				
	Comments	The SteriMed 70 does not have the capacity to macerate all clinical waste therefore the remaining untreated HCW goes to landfill.		According to hospital administrations for the past 10 + years waste has been stockpiled in a storage room at the rear of the hospital or stored in shipping containers. The hospital has received several fines from the EPA for the improper handling of healthcare waste. A contractor was previously engaged (2012) and the hospital purchased an incinerator for the contractor however they proved to be unreliable often not incinerating their HCW waste and ultimately sent four shipping containers back to the hospital. In march 2014				

Hospital Name	Ebeye Hospital		Majuro Hospital	
			<i>Island Supplies International (ISI)</i> was engaged and are now in the process of removing and treating healthcare waste at their compound using a MediBurn 30.	
Operational statistics	Per week	Per year	Per week	Per year
Waste Throughput (kg)	70	3,920	-	-
Operating Hours (hr)	20 minute cycle time		**	
Fuel	-		Diesel	
Fuel use (kg/litres)	-		NA	
Fuel use per kg waste burnt	-		According to ISI they used 766 gallons (2899.63 L) in the month of March and burnt 11,114 bags (~66,684 kg) of HCW	
Technology siting and operation issues	-		Located at ISI's compound - Technology siting is good.	
Offsite transport assessment	Fair		Good	

Notes:** According to ISI at the time of the audit 15 April 2014 the MediBurn 30 has been operating 12 hours a day since March 2014 to treat of backlog of healthcare waste stored at the hospital.

Based on a 40ft container volume of 76 m³ (source: <http://prospectorslogistics.com.au/main/freighttable2.asp>)

3.1 Ebeye Hospital, Ebeye

3.1.1 Wastestreams, Treatment Constraints and Costs

Ebeye Hospital generates general waste and healthcare wastes (including, infectious waste, sharps and pharmaceutical wastes) in the approximate quantities described in Table 3. They do not generate cytotoxic waste. The hospital operates a SteriMed™ 70 healthcare waste processor which simultaneously shreds and disinfects healthcare waste. This treatment system has insufficient capacity to treat all healthcare waste therefore only sharps are processed through this system. The remainder of the untreated HCW is disposed of at the Ebeye Landfill.

The hospital has a MediBurn 30 (donated 2013) which is in storage at the hospital and has not yet been commissioned. According to Hospital Administration the intention is to set up the incinerator at the Ebeye landfill within brick housing infrastructure to prevent corrosion. The remainder of the HCW will be treated in this incinerator once it has been commissioned.

No costs information was obtained; since waste disposal costs are internally borne by the hospital it is not directly measured.

3.1.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Ebeye Hospital:

- Ebeye has a draft waste management policy (was not sighted at the time of audit) that has not yet been enacted or reviewed by the hospital's management committee.
- There is no formalised waste management procedure.

- Waste Management is administered through the Infection Control Program that is being managed by the nursing department.
- There is no formal waste auditing or inspections.

3.1.3 Training

According to hospital personnel in July 2013 a 'Navy Team' and the World Health Organisation (WHO) visited the hospital and discussed waste management issues in indicated training. Details of the curricular or attendance records were not available/ sighted during the audit. Ebeye Hospital does not have a formal training program in place that covers infection control, waste segregation, incinerator (or other treatment infrastructure) operation or any other topic related to healthcare waste management.

3.2 Majuro Hospital

3.2.1 Wastestreams, Treatment Constraints and Costs

Majuro Hospital generates general waste and healthcare wastes (including, infectious waste, sharps and pharmaceutical wastes) in the approximate quantities described in Table 3.

According to hospital administration, for approximately 10 years healthcare waste has been stockpiled either in a storage room or in shipping containers at the rear of the hospital. An external contractor from the building and construction industry was engaged in 2012, to remove and incinerate the hospital's healthcare waste however this arrangement proved to be unsuccessful and the contract was terminated. A drive-by inspection at the time of the audit indicated that approximately 10 shipping containers full of healthcare waste are still being stored at the compound.

In March 2014, *Island Supplies International (ISI)* were engaged under the directive of the RMI Environmental Protection Agency (EPA) and are now in the process of removing, and incinerating healthcare waste at the hospital. ISI staff have removed all the healthcare waste from the hospital's rear storage room (approximately 11,114 bags and 7,750 boxes of HCW) and are now in the process of removing and treating the healthcare waste stored in shipping containers at the rear of the hospital. At the time of the audit ISI staff were sorting through all bags of HCW and are manually segregating general waste from potentially infectious waste.

All healthcare waste is being incinerated in a MediBurn 30 incinerator at ISI's compound. The incinerator was procured by ISI in October 2013.

A critical analysis of ISI's waste treatment capacity available versus actual volumes of stockpiled is shown in Table 4. This demonstrates that it will take approximately 1.8 years to incinerate the existing stockpiled HCW at the current incinerated waste throughput or 0.9 years at the incinerators full capacity.

Table 4: Waste Treatment Capacity Analysis – Majuro Hospital Incinerator		
Waste Treatment Parameter	Volume	
Incinerator Design Capacity (kg per batch)	30	
No. batches run per day	4	
	Per week*	Per Year
Available Incinerator Capacity (kg)	1400*	78,400*
Actual Incinerated Waste Throughput (kg)	720**	40,320**
Spare Capacity (kg)	680	38,080
Stockpiled Volume (kg)	76,000***	
Reducing Existing Volumes		Years
Time needed to incinerate stockpiled HCW at <u>current</u> incinerated waste throughput (years)	-	1.8
Time needed to incinerate stockpiled HCW at <u>available incinerator capacity</u> throughput (years)	-	0.9

*Assumes a theoretical capacity of 200kg/day

**Based on a 6 day week and 4 batches/day

*** Assume conversion factor for healthcare waste of 50kg:1 m³

Theoretical spare capacity does not take into account other factors such as increased downtime maintenance that could be required under higher loads.

3.2.2 Waste Management and Infection Control Framework

The following summarises the waste management and infection control framework at Majuro Hospital:

- There is no waste management policy, plan or formalised waste management procedure. There is no dedicated person who oversees waste management and disposal.
- There is no documented infection control policy.
- There is no formal waste auditing or inspections, however there has recently been a waste management committee formed.
- A Waste Management Officer (Mr. Sherwood Tibon) was appointed in April 2014.

3.2.3 Training

Majuro Hospital does not have a formal training program in place that covers infection control, waste segregation, incinerator (or other treatment infrastructure) operation or any other topic related to healthcare waste management.

There were no records of historical training sessions having taken place. Anecdotally, waste management training is communicated informally upon new staff employment at a hospital.

There were no barriers evident in discussions with onsite personnel regarding training being provided by an external organisation.

4 Key Healthcare Waste Management Issues in RMI

This section takes the collected information from Section 3 and summarises and critically assesses it, for each hospital surveyed, in the context of a Minimum Standards Framework.

A key issues summary is also provided.

4.1 Minimum Standards Framework

A minimum standards framework has been developed to set a benchmark for the sustainable management of healthcare waste in the Pacific Island region. This framework is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context.

A full description and definitions of minimum standards applicable for healthcare waste management, as well as a comprehensive assessment against each of the criteria is presented in **Appendix C**. Target areas have been rated as follows:

Table 5: Assessment criteria rating system	
	Meets minimum standards assessment criteria
	Partially meets minimum standards assessment criteria.
	Does not meet minimum standards assessment criteria.

Table 6 highlights the key areas of concern, both per hospital, and in terms of health services delivery across RMI hospitals, as part of this assessment.

The sub-sections below discuss these key areas of concern further.

Table 6: Healthcare Waste – Key Issues for RMI

Scale	Category	Item	Minimum Standard Criterion	Ebeye	Majuro	RMI Overall
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)			
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types			
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types			
Healthcare Facility	Storage	Interim storage in healthcare facility	Storage areas at ward/department level should be secure and located away from public areas. Storage areas should be sufficient in size to allow waste to be segregated and so as to avoid waste of different classifications being stored together.			
Healthcare Facility	Storage	Storage before treatment	Meets the standards stated in Appendix E, Recommendation 2, <i>Correct Storage</i> .			
Healthcare Facility	Training	Planning and implementation	A structured waste management education program has been developed with a clear delivery structure			
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.			
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.			
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.			
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.			
Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.			
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.			
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.			

4.1.1 Ebeye – Key Issues

The most significant healthcare waste management issues observed at Ebeye Hospital were:

- There is some signage, and average segregation at the Ebeye Hospital. Dedicated red containers were used in some instances. **(Photo 1)**. Sharps segregation is good, with dedicated red sharps containers used throughout the hospital **(Photo 2)**.
- There is no documented waste management planning system in place.
- There is no structured training or waste segregation auditing program in place.
- No PPE such as gloves, protective clothing, eye protection or covered footwear was observed for waste management staff and spill control kits were not observed anywhere throughout the facility.
- Sharps are disposed of in a SteriMed 70 Healthcare Waste Processor **(Photo 4)** the system only has the capacity in macerate sharps therefore the remainder of the healthcare waste (pharmaceuticals, pathological and anatomical) is currently being disposed of untreated at the landfill. The landfill is unlined and accessed by scavengers and children **(Photo 5)**
- A MediBurn 30 has been donated and was in storage at the Ebeye Hospital at the time of the audit, it has not yet been set up but according the Wesley Lemari of the Ministry of Public Works, the intention is to set it up at the Ebeye Landfill. The incinerator will be enclosed in a brick structure to protect it from corrosion.

4.1.2 Majuro Hospital – Key Issues

The most significant healthcare waste management issues observed at Majuro Hospital were:

- According to the Hospital Administrator (Malia Heine) for the past ten years healthcare waste has been stockpiled in a storage room or stored in shipping containers at the rear of the hospital. The hospital has received several fines from the EPA and has made several attempts to rectify the problem. At the time of the audit there were approximately 10 shipping containers full of bags of healthcare waste at the rear of the hospital **(Photo 8)**
- According to Ms. Heine, a local contractor was engaged by the hospital approximately two years ago and the hospital purchased an incinerator for the contractor to dispose of their healthcare waste. Anecdotally, they proved to be unreliable, often failing to incinerate the hospital's healthcare waste. Their contract was therefore terminated and four shipping containers were sent back to the hospital. During the time of the audit, this contractor's compound was inspected and there is still remaining healthcare waste stored at this site in shipping containers. Over time the base of the shipping containers the HCW is stored in at this compound has corroded and HCW is seeping out the base **(Photo 12)**.
- In March 2014, under the directive of the RMI Environmental Protection Agency (EPA) contractors *Island Supplies International (ISI)* were engaged to assist with the disposal of healthcare waste. In March 2014, ISI sent 10 staff to the hospital to segregate

healthcare waste from general waste stored in bags in the storeroom at the rear of the hospital and transport the healthcare waste to ISI compound for incineration. The storage was emptied however there are still approximately 10 shipping containers at the rear of the hospital full of bags of healthcare waste.

- According to Lowell Alik General Manager of the RMI EPA, ISI have incinerated 11,114 bags and 7,750 boxes of healthcare waste during the month of March. At the time of the audit, ISI staff were working at the hospital segregating bags of stockpiled waste into general and healthcare waste for incineration at ISI's compound. During the month of March the incinerator was operated for twelve hours a day to reduce volumes of stockpiled waste **(Photo 9,10,11,13 & 14)**.
- According to a report from ISI to the RMI EPA, sighted during a consultation with the RMI EPA (16 April 2014), ISI have used 766 gallons (~ 2900 L) of diesel fuel for the incineration of the hospital's HCW, however they have only been credited to 500 gallons (~1893 L) and were still owed \$ US 125,000 for fuel and services provided.
- There is very limited signage, and poor segregation used throughout the hospital **(Photo 6 & 7)**. Sharps segregation was good, with dedicated red sharps containers used throughout the hospital.
- There is no documented waste management planning system in place.
- There is no structured training or waste segregation auditing program in place.
- PPE worn by ISI staff at the time of the audit such as gloves, protective clothing, eye protection or covered footwear was generally good. Anecdotally PPE is not worn for waste management by hospital staff and spill control kits were not observed anywhere throughout the facility.

5 Consultation

Apart from hospital staff across both hospitals, discussions were held with Mr. Lowell Alik, General Manager of the RMI EPA, Chief Mook, Hazardous Waste Department Manager of the RMI EPA, Mr. Wesley Lemari Assistant Director of the Ministry of Public Works and staff from Islands Supplies International (ISI) Construction Company.

Mr. Jorelik Tibon, General Manager Majuro Atoll Waste Company - Ministry of Public Works was the PacWaste Focal Point for the project; he was supportive of the project and the need for sustainable healthcare management for RMI. Ms. Tibon was extremely helpful in arranging all meetings at both hospitals, as well as the collection of operational statistics and information from each.

6 Contractor Roles and Capacity

At the time of the audit Island Supplied International (ISI) were currently under contract to dispose of the healthcare waste at the hospital. They have the staff, the transportation and treatment capacity (MediBurn 30, purchased in October 2013) to safely dispose of Majuro Hospital's healthcare waste. ISI do not provide any HCW management or training services.

Training has been provided at the Ebeye Hospital by the US Navy and the World Health Organisation (WHO) however it was not possible to speak to trainers from these organisations at the time of the audit.

7 Analysis of Options for Sustainable Healthcare Waste Management in RMI

Section 4 identifies key issues that need to be addressed in improving healthcare waste management in RMI. This section evaluates the potential options that could be employed to respond to these key issues.

Table 7 categorizes these key issues (A – E) against potential options that could be adopted to tackle them, as a collated list of high-level responses.

Key Issue Category	Key Issue	Options to address the issue
A. Waste Management Framework	There is no documented waste management planning system in place at either Ebeye or Majuro Hospitals.	Establish a waste management framework including: <ul style="list-style-type: none"> Waste Management Plan Responsible officer for implementation of waste management plan Waste management committee, appropriate to the scale of each facility.
B. Signage, Segregation & Containers	Segregation and containment practices are generally below minimum standard in that: <ul style="list-style-type: none"> There is virtually no signage present (Majuro) There is room for improvement in segregation practices in all hospitals. 	Improve segregation practices by: <ul style="list-style-type: none"> Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. Supply of small number of colour-coded wheellie bins (where required) per hospital to act as both in-ward/department storage and internal transport trolleys. Supply of signage to explain the colour-coded segregation system as well as posters to promote it.
C. Training & Audit	There is no structured training program in place at both Ebeye and Majuro.	Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies). This could be facilitated/ delivered by: <ol style="list-style-type: none"> SPREP staff, or International technical training providers (or a combination of both), <ul style="list-style-type: none"> as no competent healthcare waste management training capability exists in RMI
D. Treatment	The SteriMed is working efficiently at Ebeye however, it has insufficient capacity to deal with all Ebeye's HCW. The backlog of HCW at Majuro needs to be disposed of as a matter of priority to reduce volume and infection risk.	Ebeye: The donated MediBurn needs to be set up as a matter of priority to eliminate the infection risk to scavengers at the landfill. Majuro: ISI have the labour and resources to dispose of the backlog of HCW, however could benefit from financial support for fuel costs. A long-term contract needs to be established to with ISI to ensure the safe and sustainable treatment of HCW into the future.

<p>E. Occupational Health and Safety</p>	<p>Waste handlers regularly do not use appropriate PPE including overalls /protective clothing, gloves and eye protection.</p> <p>Spill control kits were not observed anywhere.</p>	<p>Procurement of Consumables (PPE):</p> <ul style="list-style-type: none"> • Supply spill kits and appropriate PPE including overalls/protective clothing, gloves and eye protection for all waste handlers. • Incinerator staff are provided with additional PPE such as face masks and noise protection.
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7.1 Options for (Non-Treatment) Waste Management Aspects

Those options that do not relate directly to the waste treatment process tend to have limited alternatives that can address their respective key issue, given they typically relate to the fundamentals of hazardous waste management. These are:

- The waste management (and infection control) framework, including policies, plans, procedures, responsibility for implementation and audit of the functioning of the framework (A in Table 7)
- The waste management process, from generation to transport up to the treatment location (B in Table 7)
- Training systems for sustainable healthcare waste management (C in Table 7)
- OHS related protection for waste handlers (E in Table 7)

These areas have not been subjected to an options analysis, because the minimum standards framework has clear requirements with limited variation options.

7.2 Options for Treatment of Healthcare Waste

Healthcare waste treatment (key issue category D) has a range of alternative approaches, as summarized in Table 7. These have strengths and weaknesses that need to be considered in the context of criteria such as performance and cost of the technology itself, the waste types and volumes it is required to process, the environment it would be operating in and a range of factors specific to the Pacific Islands region and in some cases an individual country’s circumstances.

Treatment solutions may involve a single technology, more than one technology for sub-categories of healthcare waste or combination of the technologies listed in Table 7. These alternatives have been assessed using a two stage process:

Stage 1: High-level costs and benefits

- Cost (capital, operating, maintenance)*
- Lifespan
- Technical feasibility (advantages and disadvantages) and how that relates to the Pacific Island regional context

* Costs are estimated at a high level for relative comparison purposes. Detailed quotations, particularly for equipment purchase and associated operating and maintenance costs will be required as part of any future procurement process to be managed by SPREP.

Stage 2: Local feasibility assessment (per country)

- comparative cost to implement
- comparative effectiveness across all HCWs
- health and safety considerations
- sustainability
- institutional and policy fit
- cultural fit
- barriers to implementation
- environmental impact
- durability and
- ease of operator use.

The stage 1 treatment technology options assessment is generic to the Pacific region so is included in the *Whole of Project – Summary Report*, Appendix E. This analysis highlights the following technologies as worthy of consideration for RMI's Stage 2 assessment:

1. Incineration (high temperature: >1,000°C ¹)
2. Incineration (medium temperature: 800 – 1,000°C ⁴)
3. Low temperature burning (single chamber incinerator/ pit/ drum/ brick enclosure/ land: <400°C ⁴)
4. Autoclave
5. Encapsulation (of sharps only, in combination with a form of disinfection).

7.2.1 Waste Treatment Systems Relevant for RMI

The Stage 2 local feasibility assessment (for RMI) took these first 4² technologies and assessed them against the ten dot point criteria listed in 7.2. These criteria are explored qualitatively in **Appendix D**. Table 8 takes these qualitative descriptions and assigns a quantitative score from 1 – 5, to prioritise local applicability of technology options to the Marshallese context, on a relative basis as follows:

1. Very low
2. Low
3. Moderate
4. High
5. Very High.

The treatment technologies suitable for the Marshallese context are ranked in order of preference in Table 8:

¹ As defined in *Management of Solid Health-Care Waste at Primary Health-Care Centres - A Decision-Making Guide*, WHO (2005)

² Encapsulation is assessed separately as its potential applicability is only for sharps that have already been treated to remove the infection risk, whereas all other technologies have a wider application and are fundamentally standalone options.

Table 8: QUANTITATIVE Treatment Technology Options Assessment - Local Feasibility (RMI)

Stage 1-Approved Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility								Total Score out of 50	Rank
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment protected	Durability	Ease of operation		
Incineration at high temperature (>1000°C)	1	5	4	4	4	4	3	3	3	3	34	1
Autoclave with shredder	2	4	4	2	4	5	4	3	2	2	32	2
Incineration at med. temperature (800 - 1000°C)	4	4	3	3	2	4	4	2	2	4	32	2
Low temperature burning (<400°C)	5	3	1	2	1	2	3	1	5	5	28	3

Notes:

- Scored on a scale of 1-5, where 1= very low; 2 = low; 3= moderate; 4 = high and 5 = very high
- Criteria given equal weighting
- Possible maximum score: 50

In support of Table 8's ranking:

- **High Temperature Incineration** is the promoted disinfection practice where units are modern, maintained, have sufficient waste volumes and locked in supplier maintenance and training contracts.
- **Autoclaving** is an acceptable disinfection practice where units with shredder are affordable and locked in supplier maintenance and training contracts are in place; currently successfully used in Ebeye.
- **Medium Temperature Incineration** is acceptable in the medium term to remedy current unacceptable practices at sites too small to justify costs of expensive equipment.
- **Low temperature burning** is a borderline practice which can only be acceptable in the short term, in low population density environments, to remedy current unacceptable practices.

Based on the qualitative assessment in **Appendix D**, **encapsulation** ranks as an effective way to deal with the residual risk from already disinfected sharps: i.e., the risk of needle stick injury by healthcare workers or the community (waste disposal area) due to the fact that sharps are disinfected but not physically destroyed by the low-medium temperature of open burning (or non-destruction of autoclaving). Encapsulation is never recommended as an isolated form of treatment, as it does not disinfect or otherwise treat the hazard of the waste.

A substantial amount of data exists on the emissions generated from incinerators, but conversely, little studies have been conducted on all aspects of alternate technologies performance. While the literature is inconclusive on the requirements needed to effectively manage the blood and body fluid contaminated and infectious components of the waste streams, there does seem to be consensus that hazardous components such as

pharmaceuticals and cytotoxic wastes do need to be treated prior to final disposal to ensure there is no risks to the environment or health of humans and other species. No publication from a government environmental or health agency, or any article reviewed advocated any other preferred form of treatment for pharmaceuticals and cytotoxic wastes than incineration. In most instances the preference for anatomical waste was also incineration.

Since RMI does not currently generate cytotoxic wastes, limitations regarding these wastes are not particularly relevant for healthcare waste treatment choices in RMI.

7.2.1 Treatment Investment Options for individual RMI Hospitals

Wastes should be treated and disposed of accordingly to ensure the infectious hazard is destroyed. Both hospitals in RMI require some investment in their treatment infrastructure to ensure the long-term viability of treatment solutions, as described by their respective treatment weaknesses in sections 4.1.1 – 4.1.2.

Table 9 determines ‘intervention’ options that are suggested to improve treatment of healthcare waste in each of the hospitals visited. Shading in green indicates where investment is proposed, while orange shading shows where a technology consideration is also relevant.

Table 9: Technology Options Applicable for Each Hospital in RMI	
Remaining Technology Options	Technology Applicability
Ebeye Hospital	
Disinfection & Encapsulation (only sharps assessed)	Not applicable to Ebeye, as sterilised and macerated sharps are treated in a SteriMed 70. Shredded waste is transported to the Ebeye Landfill.
Incineration at high temperature (>1000°C)	<p>The existing SteriMed 70 has insufficient capacity to treat all healthcare waste generated at Ebeye Hospital. A new incinerator has already been purchased therefore ENVIRON recommends to:</p> <ul style="list-style-type: none"> • <i>Set-up the new incinerator</i> – the MediBurn 30 model has a manufacturer’s claimed throughput of 200 kg/day of healthcare waste. At Ebeye an estimated rate of 170 kg healthcare waste per week, this unit is theoretically large enough. Engineering and technical support are needed to commission the new incinerator and the associated housing infrastructure at the Ebeye Landfill. • The SteriMed can still be used in tandem with the MediBurn; however the MediBurn can also be used for the disposal of sharps waste in the SteriMed fails.
Incineration at med. temperature (800 - 1000°C)	<ul style="list-style-type: none"> • Not applicable to Ebeye as the MediBurn has already been purchased.
Autoclave with shredder	<ul style="list-style-type: none"> • Not applicable to Ebeye as the MediBurn has already been purchased and the SteriMed is operating efficiently.
Low temp. burning (<400°C)	<ul style="list-style-type: none"> • Not applicable to Ebeye as the MediBurn has already been purchased.

Majuro Hospital	
Disinfection & Encapsulation (only sharps assessed)	Not applicable when incinerator is operating.
Incineration at high temperature (>1000°C)	A MediBurn is currently being used to treat HCW however financial support is required to ensure the long term supply of fuel for ongoing operation.
Incineration at med. temperature (800 - 1000°C)	The existing incinerator should be supplied with a replacement transformer urgently and repaired to provide the hospital with a functional treatment option.
Autoclave with shredder	Not applicable to Majuro as the MediBurn has already been purchased and operated by a contractor
Low temperature burning (<400°C)	Not applicable to Majuro as the MediBurn has already been purchased and operated by a contractor

Timing considerations for these options, in the context of other (non-treatment) options, is provided in the Section 8 (Recommendations).

8 Recommendations

The following section outlines recommendations and a proposed implementation plan for each recommendation to achieve sustainable management of healthcare waste in RMI. Further details and guidance on each recommendation are provided in **Appendix E**.

Table 10 provides a summary of the recommendations for RMI. A colour coding system is used to describe the degree of applicability of each recommendation to each hospital as follows:

	Fully Applicable
	Partially applicable
	Not applicable

In terms of relative priorities of the five recommendations, they are all high, based on the deficiencies addressed against the minimum standards framework. They are also highly inter-related, for example: segregation practices cannot be sustainably improved without the requirements and responsibility of the waste management framework; which in turn cannot be turned into active policies and procedures without the understanding and reinforcement that comes from training. Effective treatment and use of PPE cannot be sustained without the reinforcement of training, effective segregation and the procedures and monitoring spelled out in the waste management framework.

However, the staggered timing of actions required to implement the recommendations, as outlined for each hospital in section 8.1, and their different short, medium and long term approaches give an indication of priority of the recommendation actions themselves.

*Where a recommendation is **unique** to the circumstances of a particular hospital, because of issues identified that are **unique** to that hospital, the recommendation (and associated implementation action) is appended with the annotation ^{U2H}.*

Table 10: Recommendations for RMI		Ebeye Hospital	Majuro Hospital	RMI Overall
Applicable to				
Recommendation 1: Develop a Waste Management Framework				
Description	<ul style="list-style-type: none"> • A <i>Healthcare Waste Management Plan</i>, specific to each healthcare facility • Appoint an <i>officer responsible</i> for the development and implementation of the Healthcare Waste Management Plan • A <i>waste management committee</i>, appropriate to the scale of each facility. 			
Output	<ul style="list-style-type: none"> • An agreed <i>Healthcare Waste Management Plan</i>, specific to each healthcare facility outlining procedures and guidelines, waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures • Accountability for healthcare waste management through clearly defined roles and responsibilities 			
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Plan approved by Ministry of Health (all facilities) • Approved budget for implementation of Healthcare Waste Management Plan • The Plan should be regularly monitored, reviewed, revised and updated. • Annual assessment of 'Responsible Officer's' or Waste Management Committees' performance against key healthcare waste management competencies. 			
Costs (\$US)	<ul style="list-style-type: none"> • Establishment – Low, if existing systems (such as those for Fiji) are used as a starting points and document drafting assistance is provided • Ongoing – Low 			
Recommendation 2: Procurement of Consumables (Segregation & Storage)				
Description	<ul style="list-style-type: none"> • Supply of colour-coded waste bins and plastic liners in quantities sufficient to serve all wards/departments for a period of time sufficient to allow bedding down of the segregation process. • Supply of small number of colour-coded wheelie bins (where required) per hospital to act as both in-ward/department storage and internal transport trolleys. • Supply of signage to explain the colour-coded segregation system as well as posters to promote it. 			
Output	Adequate supply of consumables to bed down more rigorous segregation practices			
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> • Wastes are segregated at their place of production. • Infection wastes, general wastes and used sharps are stored in separate colour coded containers and locations within medical areas. • Zero Needle Stick Injuries. 			

Table 10: Recommendations for RMI		Ebeye Hospital	Majuro Hospital	RMI Overall
Applicable to				
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country			
Recommendation 3: Provide a Sustainable Training Program				
Description	<ul style="list-style-type: none"> Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies) This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists within Training should be coordinated with other countries’ needs in the region 			
Output	<ul style="list-style-type: none"> Improvement of personnel skills and competency in managing healthcare waste Promotion of the advantages of sustainable segregation and storage techniques for the different waste streams and an understanding of the health and safety risks resulting from the mismanagement risks of healthcare waste. 			
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Competency Assessments Refresher Training No/very little cross contamination between waste streams demonstrated by waste audits. 			
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low-medium per facility if regional synergies are utilised Ongoing – Low-medium per facility if regional synergies are utilised 			
Recommendation 4: Treatment Infrastructure Support U2H				
Description	<ul style="list-style-type: none"> Provide housing and commissioning support for the MediBurn 30 at the Ebeye Landfill. Provide financial support to ensure adequate and ongoing supply of fuel to reduce the volume (and associated risks) of stockpiled healthcare waste at Majuro. According to ENVIRON’s calculations it will take 1.8 years to incinerate stockpiled HCW and its current incineration throughput or 0.9 years at the incinerators maximum capacity. Utilising secondary incinerators on Majuro (i.e incinerator located at the A/C Construction compound) may need to be considered to reduce the volumes more quickly. The integrity of the shipping containers should also be inspected frequently to check for corrosion and seepage of HCW. 			
Output	A disposal system that reduces the potential hazard posed by healthcare waste, while endeavoring to protect the environment.			
Monitoring & Evaluation Indicators	Assessment of the following should be regularly undertaken for new and existing incinerators: <ul style="list-style-type: none"> Operations and construction (e.g. pre-heating and not overloading the incinerator and incinerating at temperatures above 800°C only) 			

Table 10: Recommendations for RMI		Ebeye Hospital	Majuro Hospital	RMI Overall
	Applicable to			
	<ul style="list-style-type: none"> Maintenance program – are maintenance issues dealt with promptly? Ensure burn times are sufficient to reduce waste ash volumes Reducing the backlog of stockpiled HCW at Majuro Hospital 			
Costs (\$US)	<ul style="list-style-type: none"> Establishment –Low (Housing and commissioning costs only) (Ebeye) Ongoing – medium (fuel and maintenance) (Ebeye & Majuro) 			
Recommendation 5: Procurement of Consumables (PPE)				
Description	<ul style="list-style-type: none"> Supply appropriate PPE including overalls/protective clothing, gloves and eye protection for all waste handlers. Incinerator staff are provided with additional PPE such as face masks and noise protection. 			
Output	Adequate supply of PPE for protection of waste handlers			
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> PPE is provided to all staff and staff are aware on how to protect themselves from injuries and infectious wastes Zero Needle Stick Injuries. 			
Costs (\$US)	Establishment – Low; Ongoing - Low, sustainably funded by country			
Monitoring & Evaluation Indicators	<ul style="list-style-type: none"> Plan approved by Department of Health (all facilities) Approved budget for implementation of Healthcare Waste Management Plan The Plan should be regularly monitored, reviewed, revised and updated. Annual assessment of ‘Responsible Officer’s’ or Waste Management Committees’ performance against key healthcare waste management competencies. 			
Costs (\$US)	<ul style="list-style-type: none"> Establishment – Low, if existing systems (such as those for Fiji) are used as a starting points and document drafting assistance is provided Ongoing – Low 			

U2H - Unique to hospital

8.1 Implementation Priorities

8.1.1 Recommendation 1: Develop a Waste Management Framework

1. Develop a **Healthcare Waste Management Plan** specific to each hospital, including technical guidelines and procedures relating to waste management and if not already present, infection control.
2. Appoint an **officer responsible** for the development and implementation of the Healthcare Waste Management Plan
3. Establish a **waste management committee**, appropriate to the scale of the facility.

A **Healthcare Waste Management Plan**, specific to each healthcare facility outlining waste definitions and characterisation, segregation techniques, containment specifications and storage practices, collection and transport, treatment and disposal and emergency procedures should be developed as an overarching document to guide healthcare waste management processes and procedures at each healthcare facility.

A responsible officer or **waste management officer** would be responsible for the day-to-day operations and monitoring of the waste management system and is usually established as a separate post in larger hospitals (however, one appointee could be responsible for the waste management performance for a number of hospitals with a stated time fraction allocated to each hospital). It is important that the waste management officer be adequately resourced to enable them to undertake their role as well as supported by hospital management to ensure that all staff recognise the importance of adopting waste management practices that are in accord with all requirements.

8.1.1.1 Short Term (0-6 months)

- Identify existing documents and systems that may have been used in the past
- Responsible officer or healthcare waste management committee set up as part of infection control.
- Definitions of responsibilities and key accountabilities of responsible officers and Waste Management Committee developed for inclusion in Waste Management Plan.

8.1.1.2 Medium Term (6 months-1 year)

- Formulate a Draft Waste Management Plan drawing on the results of this 'Baseline Assessment' (i.e. present situation, quantities of waste generated, possibilities for waste minimization, identification of treatment options, identification and evaluation of waste-treatment and disposal options, identification and evaluation of record keeping and documentation and estimations of costs relating to waste management)
- The draft discussion document would be prepared in consultation with hospital staff, and officials from the relevant government agencies.

8.1.1.3 Long Term (1year-3 years)

- Finalise the Waste Management Framework
- Continually improve the mandatory standards of healthcare waste management

- Implement a program to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.

8.1.2 Recommendation 2: Procurement of Consumables (Segregation & Storage)

Waste should be collected in accordance with the schedules specified in the Waste Management Plan (Recommendation One). The correct segregation of healthcare waste is the responsibility of the person who produces each waste item, whatever their position in the organisation. The healthcare facility is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adhere to the correct procedures. Labeling of waste containers is used to identify the source, record their type and quantities of waste produced in each area, and allow problems with waste segregation to be traced back to a medical area.

8.1.2.1 Short Term (0-6 months)

- Procurement of in-hospital healthcare waste management consumables including:
 - Colour coded bins and bin liners (partially Majuro)
 - Classification and segregation signage as well as instructional posters to promote good healthcare waste management practices (all hospitals)
- Procurement plan developed to ensure the sustainable supply of healthcare waste management resources.

8.1.2.2 Medium Term (6 months-1 year)

As per short term above.

8.1.2.3 Long Term (1-3 years)

Consumables to be supplied from in-country health agency budgets.

8.1.3 Recommendation 3: Provide a Sustainable Training Program

Development and delivery of a structured healthcare waste training program to all hospital personnel as well as personnel from other stakeholders (e.g., government health and environment agencies).

This could be facilitated/ delivered by SPREP staff, or outside trainers, or a combination of both, as no competent healthcare waste management training capability exists in RMI

Training should be coordinated with other countries' needs in the region.

All staff and contractors should attend a waste management training session. This is to be conducted during all induction programs in the first instance. For those staff and contractors currently employed on-site, they will be required to attend a dedicated training session so that they are fully aware of their roles and responsibilities in respect to waste management.

Records shall be maintained of all staff and contractors attendance at a training session to ensure that all personnel attend.

8.1.3.1 Short Term (0-6 months)

- Identify potential trainers and build training skills
- Develop a budget for long term training delivery
- Identification and prioritization of employees that need to be trained
- Defining the specific learning objectives for each target audience
- Develop a detailed curriculum specifying the training plan for each session.

8.1.3.2 Medium Term (6 months-1 year)

- Explore incentives for training (e.g. training in collaboration with a health professional society or university that can award certificates or professional credentials)

8.1.3.3 Long Term (1 year-3 years)

- Continually improve the mandatory standards of healthcare waste management
- A continuing audit program be implemented to identify incorrect waste management practices and results of such audits communicated to staff in all wards/departments. Results from these audits and corrective actions to be reported to the facility waste management committee

8.1.4 Recommendation 4: Improved Treatment Infrastructure ^{U2H}

Wastes should be treated and disposed of accordingly to ensure the infectious hazard is destroyed:

Ebeye Hospital – Assist with commissioning and housing costs for the already purchased MediBurn incinerator, planned for set-up at Ebeye Landfill (high priority)

Majuro - Provide financial support to ensure adequate diesel supply to reduce volume of backlog of healthcare waste.

^{U2H} – Unique to hospital

8.1.4.1 Ebeye State Hospital

(a) Short Term (0-6 months)

The MediBurn 30 should be set-up as a matter of immediate priority. It is recommended to:

- Provide financial assistance and technical support to commission the MediBurn 30 at the landfill, ensure that appropriate housing is also constructed for the incinerator to prevent public access and corrosion

(b) Medium Term (6 months-1 year)

- Dispose of ash at Ebeye Landfill.

(c) Long Term (1-3 years)

- Ongoing incineration system maintenance support

- Recording of waste treatment quantities and operating conditions (e.g. burn temperatures per batch)
- Maintain training of operators as required

8.1.4.2 Majuro Hospital

(a) Short Term (0-6 months)

- Provide financial support to ISI International for the purchase of fuel to operate the incinerator (high priority)

(b) Medium Term (6 months-1 year)

- Develop an ongoing contract with ISI to ensure the long-term sustainable treatment of HCW.

(c) Long Term (1-3 years)

- Provide ongoing incineration system maintenance support to ISI
- ISI to commence recording of waste treatment quantities and operating conditions (e.g. burn temperatures per batch)
- Maintain training of operators as required
- Investigate feasibility and compatibility of alternate cost effective fuel options for incinerator i.e. solar photovoltaic options, ethanol based fuels.

8.1.5 Recommendation 5: Procurement of Consumables (PPE)

All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection.

8.1.5.1 Short Term (0-6 months)

- Procurement of in-hospital healthcare waste management PPE including overalls/protective clothing, gloves and eye protection
- Incinerator staff are provided with additional PPE such as face masks and noise protection
- Procurement plan developed to ensure the sustainable supply of healthcare waste management resources.

8.1.5.2 Medium Term (6 months-1 year)

- A system is set up to monitor correct use of PPE.

8.1.5.3 Long Term (1-3 years)

Nil.

Appendix A

Photo Log



Photo 1: Example of healthcare waste disposal at Ebeye Hospital. (taken 14/04/2014 by Natalie Stella ref:DSC0933)

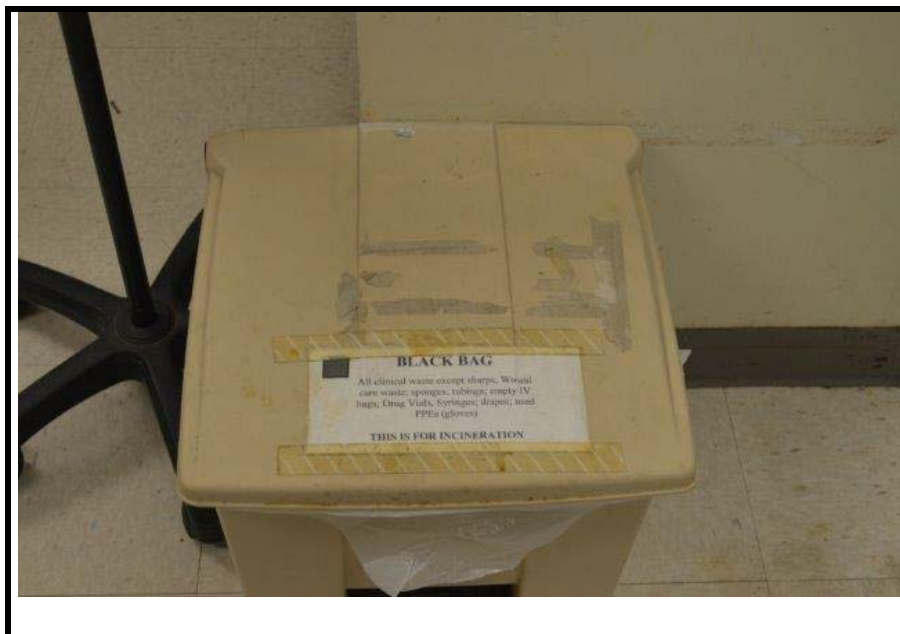


Photo 2: Example of healthcare waste disposal at Ebeye Hospital, sign indicating general waste only (taken 14/04/2014 by Natalie Stella ref:DSC0998)



Photo 3: Vehicle used to transport general and HCW to Ebeye Landfill (taken 14/04/2014 by Natalie Stella ref:DSC0887)



Photo 4: SteriMed used for the maceration of sharps at Ebeye Hospital (taken 14/04/2014 by Natalie Stella ref:DSC0899)



Photo 5: A child scavenging at Ebeye Landfill where healthcare waste is disposed of (taken 14/04/2014 by Natalie Stella ref:DSC0975)



Photo 6: Example of HCW disposal at Majuro Hospital (taken 15/04/2014 by Natalie Stella ref:DSC00135)



Photo 7: Example of HCW disposal at Majuro Hospital, no signage, high level of cross-contamination observed throughout the hospital (taken 15/04/2014 by Natalie Stella ref:DSC0139)

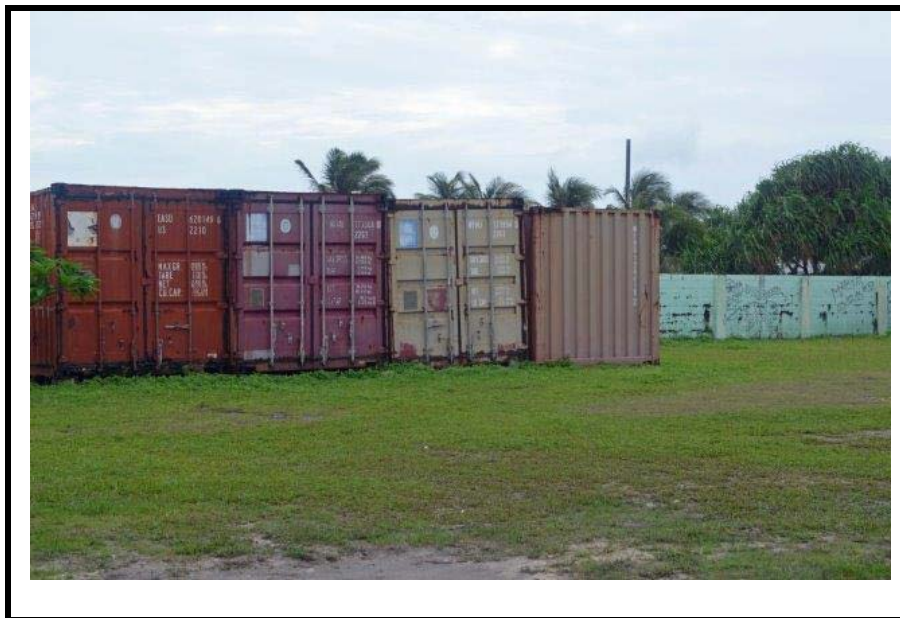


Photo 8: Shipping containers of HCW stored at the rear of Majuro Hospital (taken 15/04/2014 by Natalie Stella ref:DSC0063)



Photo 9: ISI contractors segregating general and HCW (taken 15/04/2014 by Natalie Stella ref:DSC0068)



Photo 10: ISI contractors segregating general and HCW (taken 15/04/2014 by Natalie Stella ref:DSC0101)



Photo 11: Sharps observed on the ground at the sorting area at the rear of the hospital (taken 15/04/2014 by Natalie Stella ref: DSC0345)



Photo 12: Former contractor's compound. HCW still stored here and seeping out of the bottom of a shipping container (taken 15/04/2014 by Natalie Stella ref:DSC0413)



Photo 13: HCW at ISI's compound before incineration (taken 15/04/2014 by Natalie Stella ref:DSC0412)



Photo 14: MediBurn used at ISI's compound (taken 15/04/2014 by Natalie Stella ref:DSC0455)

Appendix B

Collected Data from Hospital Audits in RMI

Table B1: Collected Data from Hospital Audits in RMI							
HOSPITAL DETAILS	Region		Ebeye		Majuro		
	Facility Name & Contact Information	Hospital Name		Kwajalein Atoll Health Services, Ebeye, Kwajalein Atoll		Majuro Hospital	
		Contact Name & Position		Abon Jeadrik	Hospital Administrator	Malia Heine	Hospital Administrator
		Email		abonj-418@hotmail.com	-	malia.heine@gmail.com	-
		Phone		692 329 8030	8514	692-625-3399	2396
	Key Services Data	Summary of Services Provided		KAHS provided services in emergency operations, outpatient, inpatient, polio-injection, Hepatitis B, MMR, Meningitis, Influenza, TB, STD/HIV, DTAP, Dentistry, general surgery, internal medicine, cardiology, Obstetrics and Orthopedics provided by a Lab, an emergency room, an operation room, pharmacy, X-ray, an Intensive care unit and a Private room for inpatient.		Majuro Hospital provides for all RMI citizens, we also have 53 outer island dispensaries as well as our Laura Health Centre located at the other end of Majuro. They also service patients from Ebeye Hospital. emergency care, district nursing, outpatients, and pathology	
		Pop Served		11,000 +		26,000	
		No. of Beds		45		80	
		OBD's ¹		50		9.4	
		No. Operations		508		-	
No. of Births ²		286		878			
Emergency Patients Attended ²		2492		7827			
Out-Patients Attended ²		29277		16950			
No of Staff		80		112			
WASTE MANAGEMENT PROCESS	Waste Streams Managed						
	Estimates		Volumes (kg/wk.)		Cost ext. (\$US)		
	Healthcare Waste		100		300		
	Sharps		70		120		
	Pharmaceutical						
	Cytotoxic		NA		NA		
General		not provided		240			

	Recycling	-			
	TOTAL	170	\$ -	840	\$ -
Generation & Segregation	Dedicated Containers/ Bags	Y - Limited		Y - Limited	
	Colour Coding	Y - Limited		Y - Limited	
	Sharps segregated & secure	Y - Limited		Y - Limited	
	Signage Present	Y - Limited		Y - Limited	
Internal Handling	Degree of manual handling of bags	High		High	
	Internal Transport Mode	Trolley		Trolley	
	Spill Kit Present	N		N	
Storage	Dedicated & Appropriate Area	Y		N	
	Loading/unloading acceptable	Y		Y	
	Spill Kits Present	N		N	
	Monitoring & record keeping occurs	N		N	
Treatment	Treatment per Waste Stream	Tech. Type	Int/Ext	Tech. Type	Int/Ext
	Healthcare Waste	Landfill (without treatment)	Internal	Incinerate (external)	External
	Sharps	Chemical/Maceration	Internal	Incinerate (external)	External
	Pharmaceutical	Landfill (without treatment)	Internal	Incinerate (external)	External
	Cytotoxic	NA	NA	NA	NA
	General	Landfill (without treatment)	Internal	Landfill (without treatment)	Internal
	SteriMed	SteriMed - Medical Waste Processor			
	Make, Model, Year commissioned	SteriMed - System 70			
	Cycle Time	20 minutes			
	Water Consumption	35 liters (9.2 gallons) per cycle for treatment liters (18.5 gallons) per cycle for auto-cleaning (105 liters total per cycle)			

	Comments	The SteriMed does not have the capacity to macerate all clinical waste therefore the majority of the landfill waste goes to landfill		
	If incinerator present	Mediburn incinerator has been purchased but not commissioned		MediBurn used is currently owned and operated by <i>ISI Island Supplies International</i>
	Make, Model, Year commissioned	MediBurn 30 - Not commissioned yet		MediBurn 30 – October 2013
	Operating Temp (°C)	In excess of 1000 degrees C		In excess of 1000 degrees C
	No. chambers	2		2
	Condition	New		New
	Comments	New incinerator will be located at the landfill. Investigating options of a private contractor from Majuro to manage it so all they will be responsible for will be the transportation of waste to the landfill.		For the past 10 + years waste has been stockpiled in a storage room at the rear of the hospital or placed in shipping containers. The hospital has received several fines from the EPA for the improper handling of health care waste A contractor was previously engaged and the hospital purchased an incinerator for the contractor however they proved to be unreliable often not incinerating their waste and ultimately sent four shipping containers back to the hospital. In March 2014 <i>Island Supplies International (ISI)</i> was engaged and are now in the process of segregating general and healthcare waste onsite and incinerating the HCW at their compound using a MediBurn 30.
		Per week	Per year	Per week Per year
	SteriMed 70 Waste Throughput (kg)	70	3920	According to ISI they incinerated 11,114 bags and 7,750 boxes of HCW in March 2014 the incinerator has been operating on average for 12 hours per day
	SteriMed 70 Operating Hours (hr)	20 minute cycle time (6 times a week)		2
	Fuel	Mains Electricity		diesel
	Fuel use (kg/liters)	NA		

WASTE MANAGEMENT FRAMEWORK		Fuel use per kg waste burnt	NA		According to ISI they used 766 gallons (2899.63 l) in the month of March and burnt 11,114 bags (~66,684 kg)of HCW **		
		Technology siting and operation issues	NA		Located at ISI's compound - Technology siting is good.		
		Offsite transport assessment	Fair		Fair		
	Waste Management Documents	Waste Management Policy	Y but has not been implemented or reviewed by committee				N
		Waste Management Plan	N				N
		Waste Management Procedure	N				N
		Waste Management Committee	N				N
	Infection Control	Infection Control Policy	N				N
		Infection Control Procedures	N				N
	Auditing and Record Keeping	Audit Program	N				N
		What is audited	Segregation	NA		Segregation	NA
			Compliance P&P	NA		Compliance P&P	NA
			Int. transport	NA		Int. transport	NA
			Storage	NA		Storage	NA
			Treatment/ disposal	NA		Treatment/ disposal	NA
		Frequency	NA				NA
	Training	Training Program	N				N
		Curricula	Infection Control	NA		Infection Control	NA
			Waste Mgt	NA		Waste Mgt	NA
			PPE	NA		PPE	NA
			Treat. Tech operation	NA		Treat. Tech operation	NA
Duration / frequency of training		NA				NA	
Records of who has been trained		NA				NA	
Monitoring or refresher courses		NA				NA	

PROJECTED ISSUES	Forecasting	10 year projections for waste management			There is a planned renovation of the hospital for the next 2 - 3 years. The renovation will either be a rebuild or a new facility. Increasing population pressure	
		Barriers to change	Space limitations Compliance issues		Staff shortages. Anecdotally each department is deficient by approximately 2 people. Space limitations Compliance issues	
		Other issues				
LOCAL CONTRACTORS		Potential in-country contractors	Who	Key Capability	Who	Key Capability
					Island Supplies International	Removal
						Treatment
						Transport

¹ Occupied Bed Days (previous 12 months) annual average occupancy rate (as %)

² Previous 12 months

Appendix C
Minimum Standards Assessment

Table C1: HEALTHCARE WASTE - MINIMUM STANDARDS FRAMEWORK & ASSESSMENT FOR RMI						
Scale	Category	Item	Minimum Standard Criterion	EBEYE	MAJURO	RMI - overall
National Authority	National Legislation	Definitions	A clear definition of hazardous healthcare wastes and its various categories has been developed and used by generators.			
National Authority	National Legislation	Annual Compliance Reporting	Hospitals required to annually report on waste generation and management			
	National Legislation	Technical Guidelines	Practical and directly applicable technical guidelines			
National Authority	Regulations	Annual Compliance Reporting				
National Authority	Policy	National healthcare waste management plan	A national strategy for management of healthcare waste has been published and is up to date (i.e., within 5 years) and hospitals required to adhere to its requirements			
Healthcare Facility	Policy	Infection Control	Infection control policy incorporates principles of waste management within it			
Healthcare Facility	Policy	Waste Management Plan	Has been developed by the hospital and is based on a review of healthcare waste management and is current (within 5 years)			
Healthcare Facility	Responsible Person		An officer has been appointed to assume responsibility for waste management within the hospital, and has been allocated sufficient time and resources - this person could have waste management as part of other duties			
Healthcare Facility	Signage		Signs are located in all wards/department areas where waste bins are located indicating the correct container for the various waste types			
Healthcare Facility	Segregation		Waste are correctly segregated in all wards/departments with use of containers that are colour coded for the different waste types			
Healthcare Facility	Containers		All areas have dedicated waste containers are suitable for the types of waste generated. All waste containers are colour coded and have correct wording on them. Sharps are deposited into containers that reduce potential for needle-stick injury			
Healthcare Facility	Storage	Interim storage in healthcare facility	Storage areas at ward/department level should be secure and located away from public areas. Storage areas should be sufficient in size to allow waste to be segregated and so as to avoid waste of different classifications being stored together.			
		Storage before treatment	Meets the standards stated in Appendix E, Recommendation 2, <i>Correct Storage</i> .			
Healthcare Facility	Internal Handling	Transport Trolley	A dedicated trolley is used for waste transport. The trolley is designed so that any spills are contained.			
	Internal Handling	Routing	Healthcare waste is not transported where clean linen and/or food are transported			
Healthcare Facility	Training	Planning and implementation	A structured waste management education program has been developed with a clear delivery structure			
Healthcare Facility	Training	Curricula	A structured waste management training program has been developed that targets the different roles within the hospitals.			
Healthcare Facility	Training	Follow-up & refresher courses	All staff receives waste management education during induction. All staff receive refresher training annually. Waste management training is delivered following an adverse incident to the relevant staff/ward/department.			
Healthcare Facility	Training	Training responsibility	A hospital officer has responsibility for ensuring all training occurs as required and that records are maintained of all training and attendance.			

Table C1: HEALTHCARE WASTE - MINIMUM STANDARDS FRAMEWORK & ASSESSMENT FOR RMI						
Scale	Category	Item	Minimum Standard Criterion	EBEYE	MAJURO	RMI - overall
Healthcare Facility	Waste Audits		A program has been implemented to ensure waste audits are conducted of all waste materials/systems in all wards/departments on an annual basis and reports are provided to the waste management committee. Effective systems are in place to ensure that any non-conformances (with the hospital waste management strategy) are remedied.			
Healthcare Facility	Transport - External		A dedicated vehicle is used to transport untreated healthcare waste. This load carrying area of the vehicle is enclosed and constructed so that any spilt material is contained within this area. A spill kit is provided.			
Healthcare Facility	Treatment	Suitability of treatment for healthcare waste	The method for treating healthcare waste is in accord with required standards - this includes operating parameters and location of the treatment unit.			
Healthcare Facility	Economics	Cost Effectiveness	A process has been developed that cost all aspects of waste management and these costs are reported annually to the waste management committee.			
Healthcare Facility	Occupational Health and Safety	PPE	All waste handlers are provided with and use appropriate PPE including overalls/protective clothing, gloves and eye protection. Incinerator staff are provided with additional PPE such as face masks and noise protection. A system is in place to monitor correct use of PPE.			
Healthcare Facility	Occupational Health and Safety	Staff risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to staff in accessing the waste and/or having needle-stick injuries.			
Healthcare Facility	Occupational Health and Safety	Patient/Visitor risk	Waste containers, locations, storage and management procedures for healthcare waste incorporate identified risks to patients and visitors in accessing the waste and/or having needle-stick injuries.			
Healthcare Facility	Healthcare waste management emergencies	Spill Prevention and Control	Spill kits are provided or all types of healthcare waste in all wards/departments, storage areas and on trolleys and vehicles. Staff are trained on the use of spill kits. All incidents of spills of healthcare waste are investigated and where appropriate remedial actions implemented.			
Healthcare Facility	Future Planning	Planning for change	Hospitals have developed a process to benchmark waste generation so as to (amongst other requirements), plan of future hospital development in terms of services and numbers of patients.			
Local Council	Waste Treatment Facility	Landfill	Healthcare waste is disposed of at a dedicated location and covered immediately on arrival. Scavengers cannot access untreated healthcare waste.			

* The minimum standard is drawn from the *Industry code of practice for the management of biohazardous waste (including clinical and related) wastes*, Waste Management Association of Australia (2014), Draft 7th edition, taking into account the Pacific Island hospital and environmental context

Appendix D

Qualitative Local Feasibility Assessment – Treatment Technology

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (RMI)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
Incineration at high temperature (>1000°C)	\$211,460 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Most effective – can treat all waste types and achieves complete sterilization, complete combustion and destroys waste	Some issues for operators (requires training & PPE); some potential issues for community (potential for smoke, some controlled emissions)	Equipment lifespan ~ 10 years plus; sustainability dependant on maintaining operator skills plus proper operation and maintenance	No legal barriers to incineration; loses a point for potential for smoke nuisance and the potential for minor contribution to combustion derived POPs – RMI is a party to Stockholm	Incinerators are/ have been previously used in hospitals and throughout Majuro	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support	Emissions of air pollutants and leaching from ash disposal to receiving environment are potential impacts. High temp operation minimises pollution & proper landfilling of ash restricts leaching.	Equipment lifespan ~ 10 years plus but will only last if maintained. High temperature equipment is prone to require a moderate level of maintenance	Requires skilled operators but modern equipment combined with training simplify operation
Incineration at med. temperature (800 - 1000°C)	\$69,820 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Can treat all waste types, achieves complete sterilization, incomplete combustion, may not destroy needles	Some issues for operators (requires training & PPE); potential issues for community (smoke, emissions not fully controlled)	Equipment lifespan ~ 5 years; sustainability dependant on maintaining operator skills plus proper operation and maintenance	No legal barriers to incineration; potential for smoke nuisance is med - high and the potential for contribution to combustion	Incinerators are/ have been previously used in hospitals and throughout Majuro.	Equipment breakdown and lack of local skills to maintain equipment – real barrier but can be managed through skills training & supplier support. Simpler	Emissions of air pollutants/ smoke and leaching from ash disposal to receiving environment are potential impacts. Med. temperature	Equipment lifespan typically less ~ 5 years but will only last if maintained. Equipment is prone to require a moderate level of maintenance	Requires less skilled operators than high temperature equipment - training simplifies operation

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (RMI)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
					derived POPs & other pollutants is high – RMI is a party to Stockholm		infrastructure.	operation increases risks of air pollution, but not likely to be an issue in isolated small communities.		
Low temperature burning (<400°C)	\$6,485 USD over 10 years (ref Whole of Project – Summary Report, Appendix E)	Not applicable for all waste types, relatively high disinfection efficiency, incomplete combustion, will not destroy needles	Some issues for operators (requires training & PPE); issues for community (smoke, emissions not controlled at all)	No equipment; sustainability dependant government & community acceptance which would be expected to decline with time	Potential for smoke nuisance is very high and the potential for contribution to combustion derived POPs & broader range of other pollutants is very high – RMI is a party to Stockholm	Burning of rubbish is historically accepted & widely practised in RMI but for healthcare waste Incinerators are/ have been previously used.	No equipment operation reliability barrier; burning rubbish common practice in RMI but burning HCW likely to raise community concern	Emissions of air pollutants/ smoke and leaching from ash disposal to receiving environment are potential impacts. Low temperature operation provides no controls on air pollution. Risk of fire impact.	Simple, zero technology so there is nothing that can break down	Simple, zero technology so there is nothing that can break down and no specific training is required other than health and safety.
Autoclave with shredder	\$158,000 USD over 10 years (ref Whole of	Cannot treat all waste types, achieves	Some issues for operators (requires	Equipment lifespan ~ 10 years;	No legal barriers; no potential for	A SteriMed 70 is being utilised at	Equipment breakdown and lack of local skills	No emissions of air pollutants/ smoke; some	Equipment will only last if maintained.	Requires skilled operators to

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (RMI)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
Project – Summary Report, Appendix E)	complete sterilization when correctly operated, no combustion required, shredder destroys needles	training & PPE); small potential for odours and wastewater discharge (community).	sustainability dependant on maintaining operator skills, longevity of equipment use given technology complexity and strains autoclave waste volumes place on landfill facilities which are basic in the Marshalls.	smoke nuisance; some potential for odour nuisance; no air pollution (no combustion-POPs) and some potential for waste water management issues. Additional landfill load a concern due to lack of lining.	Ebeye Hospital so they are familiar with the technology and there were no cultural barriers when it was implemented	to maintain equipment –I barrier can be managed through skills training & supplier support. Increased complexity of equipment (compared to incineration) but unit in Ebeye demonstrates that this barrier is manageable.	potential for odour impacts; still requires landfill disposal so some potential for leaching on burial; the RMI EPA have approved wastewater discharge from the SteriMed and there have not been any discharge issues so far. However landfills are of basic quality and autoclaving produces higher waste volumes post treatment.	Adding shredder to autoclave technology increases mechanical parts that can go wrong. May require moderate level of maintenance	achieve best level of disinfection.	
Encapsulation (only post-	Virtually zero additional cost	Not applicable to non-sharps	Encapsulation has handling	No equipment; sustainability	No legal barriers; no	No particular cultural fit	New practice proposed – may	Encapsulation itself poses no	Highly durable due to its	Simple procedure

Table D1: <u>QUALITATIVE</u> Treatment Technology Options Assessment - Local Feasibility (RMI)										
Remaining Technology Options	Comparatively low cost to implement	Comparative effectiveness across all HCWs	Local Feasibility							
			Health & safety to workers & community	Sustainability of solution	Institutional and policy fit	Cultural fit	Implementation barriers can be overcome?	Receiving environment not impacted	Durability	Ease of operation
disinfection sharps (assessed)	to disinfection system costs	waste. In the context of pre-sterilised sharps only: no combustion required and completely removes downstream needle injury risk	issues for operators (requires training & PPE) and no community issues	dependant burial space available. No engineered landfill is in RMI so increases waste volume that requires burial.	smoke nuisance; no odour nuisance; no air pollution and some potential for leachate to groundwater, although limited inherent hazard	concerns	face some inertia barrier. Lack of new 'shiny' machinery may imply the change is not that important.	smoke nuisance; no odour nuisance; no air pollution and some potential for leachate to groundwater, although limited inherent hazard.	simplicity.	once operator understands and manages the risk of sharps handling and knows how to mix cement correctly.

Legend: Descriptions equate to the following scores:

	1. very low agreement with feasibility criteria
	2. low agreement with feasibility criteria
	3. moderate agreement with feasibility criteria
	4. high agreement with feasibility criteria
	5. very high agreement with feasibility criteria

Appendix E

Recommendation Guidelines

Recommendation 1: Develop a Waste Management Framework**Healthcare Waste Management Plan**

Hospital waste management plans should incorporate strategic objectives of the national medical waste management strategy as well as the following information:

- Location and organisation of collection and storage facilities
- Overview of the purpose of, and design specifications:
 - Drawing showing the type of waste container to be used in the wards and departments (eg., sizes, colours and wording)
 - Drawing illustrating the type of trolley or wheeled container to be used for bag collection
 - Minimum specifications of sharps containers
- Required Material and human resources
- Responsibilities:
 - Including definitions of responsibilities, duties and codes of practice for each of the different categories of personnel of the hospital who, through their daily work, will generate waste and be involved in the segregation, storage and handling of the waste.
 - Definitions of responsibilities of hospital attendants and ancillary staff in collecting and handling wastes, for each ward and department.
- Procedures and practices
- Training
 - Description of the training courses and programs to be set up and the personnel who should participate in each.
- Implementation Strategy

It is important that it also is compatible with any National Waste Management Strategies to ensure consistency of approaches such as with external transport and disposal of treated residues.

Appointment of a Responsible Officer

A responsible officer or waste management officer would be responsible for the day-to-day operations and monitoring of the waste-management system and is usually established as a separate post in larger hospitals (however, one appointee could be responsible for the waste management performance for a number of hospitals with a stated time fraction allocated to each hospital).

It is important that the waste management officer be adequately resourced to enable them to undertake their role as well as supported by Hospital management to ensure that all staff recognise the importance of adopting waste management practices that are in accord with all requirements.

Appointment of a Waste Management Committee

A waste management committee should also be established to provide guidance and support to the waste management officer and assist in implementation of developed actions. In larger hospitals, a separate waste management committee should be formed. For smaller hospitals, such a committee could be either part of the responsibility of another related committee (eg., infection control or quality assurance), or a sub-committee reporting back to this related committee.

This Committee should not necessarily undertake all activities themselves, but by the nature of the members and the professions/departments represented will ensure that there is a balanced approach to the investigations and analysis to ensure that patient and staff safety will not be compromised.

In addition, the Committee approach will enable advocates for such factors as environmental and economic performance to be heard in a balanced manner.

Waste Management Committee Members should serve for a minimum period of 2 years, with the option of reappointment.

The Waste Management Committee will work with hospital staff, stakeholders and the wider community to develop a culture of environmentally responsible waste management through information sharing and education.

Its members will ensure that waste management issues are considered on committees that deal with product evaluation, infection control and occupational health and safety, and in user groups such as Unit/Department Managers.

The Waste Management Committee should:

- Develop a waste management policy that meets current environmental legislation “due diligence” requirements. This policy is to include strategic directions for correct waste minimisation and management.
- Ensure that the hospital is meeting due-diligence requirements as specified by the Waste Management Team.
- Develop and implement a system to document waste and recyclable quantities on a spreadsheet to evaluate these quantities and therefore the waste minimisation programs that have been implemented, ensuring the results are circulated to all Unit managers/department managers on a regular basis.
- Review and submit subsequent reporting to Unit managers/department managers of the results of all implemented programs and trials.
- Work on implementing the most appropriate waste minimisation/management recommendations as agreed with hospital management and the Waste Management Team.

- Target in order the waste items that are contributing the most significant quantities of waste being generated and in particular waste segregation methods.
- Agree on the Waste Reduction targets for the hospital and outline the key objectives of the committee
- Review current work and waste management practices and develop waste management/minimisation initiatives.
- Conduct mini audits to review progress.
- Visually inspect waste and recycling containers to ascertain if staff are depositing appropriate items into them.

Recommendation 2: Procurement of Consumables (Segregation & Storage)

The correct segregation of healthcare waste is the responsibility of the person who produces each waste item, regardless of their position in the organisation. The healthcare facility is responsible for making sure there is a suitable segregation, transport and storage system, and that all staff adheres to the correct procedures.

Ideally, the same system of segregation should be in force throughout a country, and many countries have national legislation that prescribes the waste segregation categories to be used and a system of colour coding for waste containers. Colour coding makes it easier for medical staff and hospital workers to put waste items into the correct container, and to maintain segregation of the wastes during transport, storage, treatment and disposal. Colour coding also provides visual identification of the potential risk posed by the waste in that container.

Labeling of waste containers is used to identify the source, record they type and quantities of waste produces in each area, and allow problems with waste segregation to be traced back to a medical area.

Waste containers specification and siting

Containers should have well-fitting lids, either removable by hand or preferably operated by a foot pedal. Both the containers and the bags should be of the correct colour for the waste they are intended to receive and labeled clearly.

All containers should be able to adequately contain the wastes deposited into it – to prevent the possibility of spills.

Sharps should be collected in puncture proof and impermeable containers that are difficult to open after closure.

The appropriate waste receptacle (bags, bins, sharps containers) should be available to staff in each medical and other waste-producing area in a healthcare facility. This permits staff to segregate and dispose of waste at the point of generation, and reduces the need for staff to carry waste through a medical area. Posters showing the type of waste that should be disposed of in each container should be displayed on the walls to guide staff and reinforce good habits.

Segregation success can be improved by making sure that the containers are large enough for the quantities of waste generated at the location during the period between collections, as well as a collection frequency that ensures no container is overfilled.

Setting and Maintaining Segregation Standards

Segregation requirements and methods should be clearly set out in the waste-management policy of a healthcare facility. It is important that the waste-management policy is supported and enforced by senior staff and managers. Managers and medical supervisors should know the relevant legislation and understand how to implement waste audits.

The 'Responsible Person' or Waste Management Committee should be responsible for seeing that segregation rules are enforced and waste audits are carried out to quantify the amount of waste produced.

Correct Signage

Signage indicating correct waste segregation practices is a valuable tool to provide ongoing guidance to staff. The success of the waste/recycling system will depend on having a clearly identified container for each type of material. This is achieved by the use of colour coded containers, symbols and wording. In addition, signage must be placed so that those wanting to dispose of materials can clearly and readily identify which container to deposit such materials into.

Once designed, signs should be located on walls above all waste containers as well as on the container itself.

Correct Storage

The storage area should be signposted with the bio-hazard symbol and other labeling appropriate to the types of waste stored in the area (eg healthcare) and includes the following:

- The base should be an impervious surface (eg. concrete) surrounded by a bund appropriate to contain any spill.
- All loading/ unloading takes place within the bunded area in such a manner to ensure any spills are appropriately managed.
- The base and walls of bunded areas are free of gaps or cracks.
- No liquid waste, wash down waters or stormwater contaminated with biohazardous wastes are disposed of via the stormwater drainage system; and
- The bunded area drains to a sump or sewer to collect spills and wash waters. Cut-off drains, which drain to a sump, should be used instead of bunds if approved by the relevant authority.
- Loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- Containers in which biohazardous waste are stored secured when loading/unloading is not taking place.

- Spill Kits for biohazardous waste located in the storage areas.

Storage for larger generators may involve a dedicated room that is constructed specifically for waste management, or could be via the use of appropriately sized mobile garbage bins (eg., 240 or 660 litre).

Conditions related to security of healthcare waste include the following:

- (a) The operator shall ensure that loading/ unloading of waste is carried out in accordance with designated safe procedures, and relevant records are completed and maintained.
- (b) Containers in which healthcare waste are stored shall be secured when loading/unloading is not taking place.

Spill Kits for healthcare and cytotoxic waste shall be located in the storage areas.

Recommendation 3: Provide a Sustainable Training Program

All waste management strategies (particularly resource management programs), rely on all staff to participate and co-operate in order to ensure that objectives are met. Staff therefore should receive appropriate training/education to understand the inherent hazard and risks posed of healthcare waste, and the importance of its management from generation to final treatment and disposal.

The Waste Management Committee (apart from ensuring staff education programs are developed and implemented), should also address other methodologies in order to ensure that staff receive information on waste reduction programs (eg., signage, information sheets and flow charts).

One of the initial steps for developing a structured training program is to gain management support from hospital administration. The development of a training program can be facilitated by establishing core competencies related to healthcare waste management.

In the development of a training program, the following should be considered:

- Conduct of a training needs analysis
- Identification and prioritisation of employees that need to be trained.
- Defining the specific learning objectives for each target audience.
- Develop a detailed curriculum specifying the training plan for each session.
- Incorporate pre-evaluation and post evaluation of learners, evaluation of trainers, follow-up activities, and documentation into the training program.
- Develop training content or adapt available training materials, tailor training content to specific target audiences.
- Identify potential trainers and build training skills
- Develop a budget and secure funding

- Explore incentives for training (e.g. training in collaboration with a health professional society or university that can award certificates or professional credentials)

The following is an outline of a Staff Waste Management Education Program that could be developed:

- Introduction to the session
- Importance of good waste/environment management/ infection control
- Waste management hierarchy
- Waste minimisation principles
- Brief overview of legislation pertaining to waste management
- Hospital policies on environment/waste management/ infection control/ needle stick injuries
- Overview of waste types
- Issues relating to waste reduction
- Management responsibilities
- Identification of, and hazards associated with the different types of wastes generated
Importance of effective waste segregation
- Infection control and sharps management
- Waste, handling, packaging and disposal routes for the different types of wastes generated
- Questions

All staff and contractors should attend a waste management training session. This should be conducted during all induction programs in the first instance.

For those staff and contractors currently employed on-site, they should attend a dedicated training session so that they are fully aware of their roles and responsibilities in respect to waste management. Records should be maintained of all staff and contractors attendance at a training session to ensure that all personnel attend.

At a national and regional level, training programs could be in the form of train the trainer. The training of trainers approach allows rapid capacity building and widespread training outreach.

Training of Waste Disposal Treatment Operators

Incinerator/ healthcare waste treatment system operators should receive training in the following:

- Overview of healthcare waste management including risks and management approaches
- General functioning of the incinerator, including basic maintenance and repair training.

- Health, safety and environmental implications of treatment operations
- PPE, its correct use and removal and cleaning (if appropriate)
- Technical procedures for operation of the plant.
- Recognition of abnormal or unusual conditions
- Emergency response, in case of equipment failures.
- Maintenance of the facility and record keeping
- Surveillance of the quality of ash and emissions.
- Disposal of residues

Recommendation 4: Improved Treatment Infrastructure

The healthcare waste stream is diverse in that it contains a variety of chemical substances, organic materials, plastics, metals and materials that are potentially contaminated with pathogenic substances. The primary aim of treating this waste stream is to ensure that there is no potential negative impact to human health or the environment as a consequence of the components of this waste not being treated adequately.

This means that the treatment process should render the waste material so that there are no pathogens likely to cause harm as well as be conducted in a manner that reduces any environmental consequences.

There are a number of treatment processes for healthcare waste. However, not all of these are able to treat all types of healthcare wastes. Materials such as pharmaceuticals, cytotoxic and anatomical wastes can only currently be treated by incineration. Therefore, when selecting a process to treat healthcare wastes, the generator must be aware of the capabilities and limitations of each of the various treatment processes and ensure that only those wastes that can be thus treated are actually sent to such a facility, and the remainder sent to an incineration facility. This is part of any facilities due diligence process.

There are a number of means of treating healthcare waste that are in commercial use around the globe. The question arises as to what type of technology is best suited to meet the various waste categories/quantities generated, environmental requirements and that treatment is done safely and in a cost-effective manner. Treatment of healthcare wastes should achieve a change in the wastes biological or chemical hazard so as to reduce or eliminate its potential to cause disease or other adverse consequences, by meeting acceptable biological standards and to ensure that there is minimal adverse environmental impact in respect to water, soil, air and noise.

Management of wastes should be based on the **precautionary principle** in that a lack of data should not mean that options be undertaken when there is still a perceivable risk of damage (to human health or the environment). The literature and other sources of information have clearly demonstrated a need for maintaining incineration as the most preferred option for at least the treatment of pharmaceutical and cytotoxic wastes – if not other components such as microbiological specimens and body parts. Only one technology has been demonstrated to be able to effectively treat all categories of healthcare waste.

This technology is incineration (at high temperature, with sufficient residence time and appropriate air pollution control equipment).

A substantial amount of data exists on the emission generated from incinerators, but conversely, little studies have been conducted on all aspects of alternate technologies performance. While the literature is inconclusive on the requirements needed to effectively manage the blood and body fluid contaminated and infectious components of the waste streams, there does seem to be consensus that these hazardous components such as pharmaceuticals and cytotoxic wastes do need to be treated prior to final disposal to ensure there is no risks to the environment or health of humans and other species.

It is also very clear that there is little work been undertaken on the consequences of landfilling untreated healthcare waste, and in particular pharmaceuticals and cytotoxic wastes. The literature does relate to impacts resulting from untreated pharmaceuticals being discharged into the environment from hospital sewers and wastewater treatment plants and does indicate that there are potential negative environmental and health consequences. The implications of these studies could legitimately be applied to discharge of waters such as leachate or surface water runoff from landfills should these wastes be deposited untreated. According to the World Health Organization^{3, 4}, incineration is the preferred method for treating pharmaceutical and cytotoxic wastes. This is further supported by the United Nations^{5, 6} in that they have also recommended incineration as the preferred method for treatment prior to disposal of pharmaceuticals and cytotoxic wastes. These recommendations are generally standard throughout the world in relation to these two specific waste types^{7, 8}.

There are other studies that have been conducted on what is referred to as “alternate treatment technologies”, and these have demonstrated that all of these technologies cannot effectively treat pharmaceutical and cytotoxic waste, with many also unable to treat anatomical waste.. Some jurisdictions do allow alternative means of treating anatomical waste prior to disposal to landfill, but these are by far in the minority and mostly related to ethical or religious rationales.

In Australia as an example where there is allowed a variety of treatment technologies for the range of clinical and related wastes, without exception, jurisdictions do not allow treatment

³ World Health Organization Regional Office for Europe, EURO Reports and Studies 97, Management of Wastes from Hospitals and other Health Care Establishments, 1983.

⁴ World Health Organization, Safe management of Wastes from healthcare Facilities, Geneva, 1999.

⁵ United Nations Environment Programme – Technical Working Group on the Basel Convention, Draft Technical Guidelines on Biomedical and Health Care Wastes, 1999.

⁶ Environment Australia, Basel Convention – Draft Technical Guidelines on Hazardous Waste: Clinical and Related Waste (Y1), March 1998.

⁷ Health care Without Harm, Non-Incineration Treatment Technologies, August 2001.

⁸ London Waste Regulation Authority, Guidelines for the Segregation, Handling, Transport and Disposal of Clinical Waste, 2nd Edition, 1994.

other than incineration for anatomical waste, pharmaceuticals and cytotoxic wastes^{9, 10, 11, 12, 13, 14}. This is also quite evident in a review of Australian State/Territory environmental agency licence conditions for approved clinical and related waste treatment technologies. In countries that do allow landfilling of clinical and related wastes, often these two specific waste categories are specifically excluded from this option¹⁵.

In summary, no publication from a government environmental or health agency, or any article reviewed advocated any other preferred form of treatment for pharmaceuticals and cytotoxic wastes than incineration. In most instances the preference for anatomical waste was also incineration.

Recommendation 5: Procurement of Consumables (PPE)

Personnel Protective Equipment

The use of Personal Protective Equipment (PPE) should be a condition of employment for employees with waste management responsibilities. PPE is one aspect of a multifaceted program, designed to protect employees from injuries and unnecessary exposure to hazardous substances.

Other aspects of this program are:

- employee training
- engineering controls to reduce or eliminate known hazards
- administrative controls

The following is a list of the personal protective equipment that should as a minimum to be supplied for all waste handlers:

- Gloves
- Masks
- Safety glasses/eye shields
- Overalls/aprons
- Safety boots

⁹ National Health & Medical Research Council, National Guidelines for Waste Management in the Health Industry, Commonwealth of Australia, 1999.

¹⁰ EPA Victoria, Draft Guidelines for the Management of Clinical and Related Waste, July 2003.

¹¹ NSW Department of Health, Waste Management Guidelines for Health care Facilities, August 1998.

¹² Queensland Government, Environmental Protection (Waste Management) Regulation, 2000.

¹³ Australian/New Zealand Standard 3816:1998, Management of Clinical and Related Wastes.

¹⁴ Australian and New Zealand Clinical Waste Management Industry Group, Industry Code of Practice for the Management of Clinical and Related Wastes, 3rd edition July 2000.

¹⁵ Provincial Government of Gauteng (South Africa), Draft Health Care Waste Regulations, 11 September 2003.

