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**The Identification of Environmentally Sound
Technologies for Healthcare Waste Management in
Lesotho**

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ABSTRACT

Waste resulting from healthcare activities is hazardous due to its potential risk of infection to healthcare workers, waste workers and the public. Many tools and approaches have been applied in waste management in developed countries, but are not suitable for application in developing countries due to their complexity and extensive data and resource requirements. WasteOpt was therefore developed and applied as an appropriate decision-making tool in the developing country context. WasteOpt comprises of the Analytical Hierarchy Process (AHP), costing and Life cycle management (LCM).

The purpose of this study was to identify environmentally sound technologies (ESTs) that minimise the risk of infection by healthcare waste (HCW) in rural clinics. Rural clinics were selected because apart from financial constraints, they are challenged by the lack of procedure, infrastructure and technologies to develop reasonable waste management plans that can be implemented within a practicable time frame. WasteOpt was applied to aid in identifying ESTs in relation to the infection risks and costs of the technologies.

Experts in waste management in Lesotho were involved in a workshop for the ranking of technologies. The overall weighting values of the rankings were converted to risk factors for individual options and for alternatives (combination of options). Risk factors were classified as low, medium and high risk. The technologies within a single class were differentiated by analysing the cost of acquiring and running the technology to qualify as ESTs. The ESTs identified for Lesotho are Engineered containers, Refrigerated engineered facility, engineered wheeled transport, detailed procedures, multi chamber incinerator, engineered pit and landfill.

Ten (10) clinics in Lesotho were also assessed as case studies using the WHO RAT. The RAT was first modified to include questions on financial management at the clinics. The calculated risk factors were applied to the case studies to assess the risk under which healthcare workers operate in those clinics. The additive minimum risk for the overall life cycle of waste was 4.0 (excluding central treatment and disposal). The clinic workers were found to be at a risk of between 1.1×10^{-4} and 7.8×10^{-5} , which proves that rural clinics in Lesotho are still using inappropriate technologies.

In terms of financing for waste management, public clinics were found to have little decision-making powers over funds and had less accountability measures. CHAL clinics which are managed by churches in Lesotho had more control of funds and exhibit more accountability. All clinics had no targets for saving funds from waste management activities.

WasteOpt can be applied as a decision-making tool for HCW in Lesotho since it overcomes the barriers that inhibit environmentally sound management of HCW in developing countries.

In conclusion: WasteOpt can be applied as a decision-making tool for different types of waste by replacing HCW options with respective ones and designing a relevant questionnaire for qualitative data capture. WasteOpt can then be applied in a developing country to aid sustainable waste management decision-making. Informed decision-making helps resource poor managers to select cost-effective but low-risk options, which will be sustainable in the future.

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LIST OF ACRONYMS

AHP:	Analytical Hierarchy Process
CBA:	Cost-Benefit Analysis
CBO:	Community Based Organization
CEDAMA:	Committee for Environmental Data Management Authority
CHAL:	Christian Health Association of Lesotho
CHEMAC:	Chemical Management Committee
COWMAN:	Committee on Waste Management
EIA:	Environmental Impact Assessment
EST:	Environmentally Sound Technology
HCW:	HealthCare Waste
HCWM:	HealthCare Waste Management
ISWM:	Integrated Solid Waste Management
LCM:	Life Cycle Management
LEA:	Lesotho Environment Authority
MoHSW:	Ministry of Health and Social Welfare
MoLE:	Ministry of Labour and Employment
MoLG:	Ministry of Local Government
MoNR:	Ministry of Natural Resources
MoTEC:	Ministry of Tourism, Environment and Culture
NES:	National Environment Secretariat
NGO:	Non-Governmental Organisation
NPO:	Non Profit Organisation
PHC:	Primary Health Care
RAT:	Rapid Assessment Tool
SADC:	Southern African Development countries
WHO:	World Health Organization
WCED:	World Convention on Environment and Development
WM:	Waste Management

LIST OF TECHNICAL ABBREVIATIONS

CD:	Controlled dump
DP:	Detailed procedures
EC:	Engineered container
EC>EC:	Aggregating from engineered container to engineered container
EC>nEC:	Aggregating from engineered container to non-engineered container
EL:	Engineered location
EP:	Engineered pit
EnW:	Engineered non-wheeled transport
EWT:	Engineered wheeled transport
EWV:	Engineered wheeled vehicle
GT:	General transport
GV:	General vehicle
IT:	Inappropriate transport
IV:	Inappropriate vehicle
LF:	Landfill
MCI:	Multi-chamber incinerator
nREF:	Non-refrigerated engineered facility
nP:	No procedures
nRnEF:	Non-refrigerated non-engineered facility
OAB:	Open air burning
OD:	Open dump
REF:	Refrigerated engineered facility
SASSI-E:	South African small-scale incinerator-engineered
SASSI-M:	South African small-scale incinerator-minimum requirements
SCI:	Single chamber incinerator

DEFINITION OF KEYWORDS

Analytical Hierarchy Process: A multi-attribute decision support process based on organizational hierarchies and weighting of attributes/options.

Appropriate technology: A good match between technology utilized and the resources required for its optimal use. It ranges from low, medium to high technology (Khalil, 2000).

Best Practicable Environmental Option: An option that provides most benefits and least damage (long and short term) to the environment at an acceptable cost (Royal society of Chemistry, 1995).

Environmentally Sound Technology: A technology that protects the environment. It is less polluting, uses all resources in a more sustainable manner than the technology for which it is a substitute (Agenda 21, Chapter 34).

Healthcare waste: All waste generated within a healthcare establishment. Seventy five percent (75 %) of this waste is typically defined Healthcare General Waste, while the remainder is Healthcare Risk waste.

Primary Health Care facility: facilities at and from which a range of Primary Health Care services are provided, but no facilities exist to admit a patient to inpatient services. It is normally open only 8 hours a day. Certain staff may, however, be required to sleep at or near the clinic so that they are available on call in case of emergency.

Rural Area: an area with lower service quality than urban areas, whose population is poor and uneducated and agriculture being the principal land use (Lassey, 1977).

Sustainable waste management: integrated management of all types of wastes across all media and time in a way that is economically, environmentally and socially sustainable for present and future generations.

System: An entity of interacting elements that function individually or in unison to achieve the objectives of the entity as a whole (Chacko, 1989).

Systems analysis: A study of procedures for collection and evaluation of data of a system to determine ways of improving the functionality of the system (Checkland, 1989)

Systems approach: A way of thinking of total systems so as to constitute a planned and organised approach to problem solving (Wilson, 1974)

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