



GOVERNMENT OF THE REPUBLIC OF MALAWI

MINISTRY OF HEALTH

SOUTHERN AFRICA TUBERCULOSIS AND HEALTH
SYSTEMS SUPPORT PROJECT

Infection Control and Waste Management Plan for Malawi

14 March, 2016



GOVERNMENT OF THE REPUBLIC OF MALAWI

MINISTRY OF HEALTH

SOUTHERN AFRICA TUBERCULOSIS AND HEALTH
SYSTEMS SUPPORT PROJECT

Infection Control and Waste Management Plan for Malawi

Contents

LIST OF TABLES.....	vi
LIST OF FIGURES.....	vi
ABBREVIATIONS	vii
EXECUTIVE SUMMARY	viii
1.0 PROJECT BACKGROUND AND DESCRIPTION	1
1.1 Project Background.....	1
1.1.1 Global level.....	1
1.1.2 Regional level	1
1.1.3 National level	2
1.2 Overview of the proposed project in Malawi	3
1.3 Project Goals and Objectives	5
1.4 Objectives of the Infection Control and Waste Management Plan.....	6
1.5 Constraints and limitations to the study.....	6
2. POLICY, LEGAL, ADMINISTRATIVE AND OPERATIONAL FRAMEWORK.....	7
2.1. Policy Framework.....	7
2.1.1. The Draft National Health Policy (2009)	7
2.1.2. The Health Sector Strategic Plan (2011-2016)	7
2.1.3. Infection Prevention and Control Policy (2006).....	8
2.1.4. Guidelines for infection prevention and control for TB including MDR-TB and XDR-TB	8
2.1.5. Draft National Sanitation Policy (2007)	8
2.1.6. The National Water Policy (2005)	8
2.1.7. Malawi Standards (MS) 615: 2005: Waste within healthcare facilities, handling and disposal (code of practice)	8
2.1.8. Malawi Growth and Development Strategy (2011-2016).....	9
2.2. Legal Framework.....	9
2.2.1. The Environment Management Act (1996)	9
2.2.2. Mines and Minerals Act Cap 61:01 (2010).....	9
2.2.3. Occupational Safety, Health and Welfare Act (1997)	9
2.2.4. Public Health Act Cap 34:01 (1948)	10
2.3. Administrative and operational framework	10
3. EXISTING PRACTICES ON INFECTION CONTROL AND HEALTH CARE WASTE MANAGEMENT	11
3.1 Methodology for Assessment	11

3.1.1	Stakeholder consultations	11
3.1.2	Field investigations	11
3.1.3	Literature review.....	11
3.2	Existing Infection Prevention and Control practices in Malawi	12
3.2.1	Prevention of nosocomial infections in the health facilities.....	12
3.2.2	TB data collection and management	12
3.3	Demographic profile of potential beneficiaries/households.....	13
3.4	Labour migration among miners and primary labour sending areas	13
3.5	Potential groups with experience in working in labour sending areas.....	14
3.6	Social issues.....	16
3.7	Existing environmental health control aspects within the mines.....	16
3.8	Existing infection control and medical waste management practices within the healthcare facilities (including laboratories).....	16
3.9	Ebola Virus Disease (EVD) Preparedness Plan	17
3.10	Current status of HCWM in Malawi	18
4.	POTENTIAL IMPACTS RELATED TO THE PROJECT ACTIVITIES	21
5.	BEST PRACTICES FOR INFECTION PREVENTION AND CONTROL	25
5.1	Understanding TB	25
5.1.1.	TB causes and stages.....	25
5.1.2.	TB and HIV.....	26
5.2	Infection Prevention and Control measures for TB	26
5.2.1.	Work practice and administrative control	26
5.2.2.	Environmental/Engineering Control	29
5.2.3.	Personal Respiratory Protection (Special masks)	29
5.2.4.	Facility based TB Infection Control Plan	29
5.3	TB Preventive requirements within the mines	33
5.4	Preventive measures for health-care workers.....	34
5.5	Standard precautions.....	34
5.6	Best practices for Ebola Virus Disease (EVD) infection control	35
5.6.1	Understanding Ebola threat.....	35
5.6.2	Standard Operating Procedures (SOPs)	35
6	BEST PRACTICES FOR HEALTH CARE WASTE MANAGEMENT	38
6.1	Health-care Waste	38
6.2	Health-Care Waste Management	39
6.2.1	Waste Segregation and on-site Storage.....	40
6.2.2	Collection and transportation of health-care waste.....	41
6.2.3	Treatment and Disposal of Health Care Wastes	41
6.3	Assessment of Laboratory Waste	42

6.3.1	Composition of Laboratory Waste	42
6.3.2	Quantities of Laboratory Waste	42
6.3.3	Determination of appropriate waste disposal technology	44
6.3.4	Handling, storage and collection	44
6.3.5	Waste treatment.....	45
6.3.6	On-site or off-site treatment	46
6.3.7	Other technical issues	50
6.3.8	Determination of disposal sites	50
6.4	Laboratory Waste Management and Monitoring.....	50
6.4.1	Management and Monitoring Plan.....	50
6.4.2	Committees for Plan Implementation	50
7	GAP ANALYSIS	58
7.1.	Gaps in environmental health control aspects within the mines	58
7.1.1.	Lack of Environmental Health Policy.....	58
7.1.2.	Inadequate preventive measures	58
7.1.3.	Use of unqualified staff.....	58
7.1.4.	Poor Record Keeping.....	58
7.1.5.	Inadequate health surveillance and monitoring.....	58
7.2.	Gaps in infection control and medical waste management in health-care facilities and laboratories.....	59
7.2.1.	Lack of awareness of policy framework.....	59
7.2.2.	Lack of a clear institutional framework	59
7.2.3.	Lack of awareness of the hazardous nature of wastes.....	59
7.2.4.	Inadequate and underqualified medical staff.....	59
7.2.5.	Shortage of equipment for handling TB cases	60
7.2.6.	Insufficient hazardous waste collection materials and disposal facilities	60
7.2.7.	Lack of or inadequate community engagement in HCWM.....	60
7.2.8.	Lack of Public Private Partnership.....	61
7.2.9.	Insufficient financial resource allocation towards ICWM.....	61
7.2.10.	Lack of planning, monitoring of HCW production and management.....	61
7.2.11.	Inadequate monitoring of the health of staff member	61
7.2.12.	Poor stakeholder coordination	61
8	TRAINING IN HEALTH-CARE WASTE MANAGEMENT	62
8.1.	Training programs	62
8.1.1	Areas of training.....	62
8.1.2	Management and Training for Institutions and Agencies.....	64
8.1.3	Follow-up and refresher courses	64
8.1.4	Training budget	64

9	GUIDELINES FOR PROJECT IMPLEMENTATION	66
9.1.	Guidelines for TB infection control	66
9.1.1.	Infection control in a community setting.....	66
9.1.2.	Transport of patients with known or suspected TB.....	67
9.1.3.	TB infection control in hospital	67
9.2.	Guidelines for HCWM	68
9.2.1.	Separation of HCW at source.....	68
9.2.2.	Storage	68
9.2.3.	Transport.....	69
9.2.4.	Treatment and disposal	69
9.2.5.	Protection of HCW handlers	69
9.2.6.	Emergency procedures	69
9.3.	Specific actions.....	70
9.4.	Implementation arrangement	71
9.4.1.	Institutional framework	71
9.4.2.	Implementation timeline and budget.....	73
10	CONCLUSION AND RECOMMENDATIONS.....	76
	LIST OF REFERENCES	78
	LIST OF APPENDICES	79

LIST OF TABLES

Table 1.1. TB Case notifications from 1994-2003 (Source, Nyirenda 2006 as adapted from MOH)	2
Table 1.2: Components of the TB in Mining Project in Malawi	4
Table 3.1. Projected 2015 population of potential beneficiaries based on 2008 NSO Census	13
Table 3.2. Stakeholders involved in activities associated with TB among mining communities	15
Table 3.3. TB statistics at DGM Livingstonia hospital (2011-2015).....	17
Table 4.1. Potential impacts and proposed mitigation measures	21
Table 5.1. Characteristics between latent TB infection and active TB (WHO, 2003)	26
Table 5.2. Steps for patient management to prevent TB transmission in HIV care settings (sources: WHO, 1999; WHO, 2009; WHO, 2012)	27
Table 5.3. Facility based TB Infection Control Plan.....	31
Table 5.4. Key DOTS program elements (as adapted from WHO, 2003)	33
Table 6.1. Waste categories, description and examples	38
Table 6.2. Waste segregation (Source: WHO, 2014)	41
Table 6.3. Laboratory waste estimation form	43
Table 6.4. Comparison of Health Care Waste Treatment Technologies (Kafatia, 2009)	47
Table 6.5. Laboratory Waste Management and Monitoring Plan	52
Table 8.1. Areas of training and target groups	65
Table 9.1. Specific actions for infection control and waste management.....	70
Table 9.2. Implementation timeline for the ICWMP	74
Table 9.3. Proposed implementation budget for ICWMP	75

LIST OF FIGURES

Figure 1.1. Tuberculosis MDG indicators for Malawi (Source: Malawi Health Sector Strategic Plan, 2011-2016).....	3
Figure 5.1. Factors affecting TB transmission (as adapted from WHO, 2003).....	25
Figure 5.2. Interventions to reduce TB incidence in the mining industry.....	34
Figure 5.3. Ebola outbreak: Preparedness, Alert, Control, and Evaluation	36
Figure 6.1. Typical waste composition in a Health Care Facilities (Source: WHO, 2014)	38
Figure 6.2. Summary for HCW stream (source: Secretariat for Basel Convention & WHO, National Health-Care Waste Management Plan: Guidance Manual. Can also be accessed at www.who.int website).....	40
Figure 7.1. Hygiene and medical waste management status at Jalawe health centre.....	60

ABBREVIATIONS

1. AIDS:	Acquired Immune Deficiency Syndrome
2. ACH:	Air Changes per Hour
3. ART:	Anti-Retroviral Treatment
4. CHAM:	Christian Health Association of Malawi
5. CHSU:	Community Health Sciences Unit
6. DHMT:	District Health Management Team
7. DHO:	District Health Officer
8. DOTS:	Directly Observed Therapy-Short course
9. EAD:	Environmental Affairs Department
10. EQA:	External Quality Assurance
11. HAART:	Highly Active Anti-Retroviral Therapy
12. HCF:	Health Care Facility
13. HCW:	Health Care Waste
14. HCWM:	Health Care Waste Management
15. HIV:	Human Immune Deficiency Virus
16. ICWMP:	Infection Control and Waste Management Plan
17. IC:	Infection Control
18. MDHS	Malawi Demographic Health Survey
19. MGDS:	Malawi Growth and Development Strategy
20. MDHS:	Malawi Demographic and Health Survey
21. MDR-TB:	Multi-Drug Resistant Tuberculosis
22. MOH:	Ministry of Health
23. NGO:	Non-Governmental Organization
24. NSO:	National Statistics Office
25. NSP:	National HIV and AIDS Strategic Plan
26. PAL:	Practical Approach to Lung Health
27. PVC:	Poly Vinyl Chloride
28. PLHA:	People Living with HIV /AIDS
29. PPE:	Personal Protective Equipment
30. PPP:	Public Private Partnership
31. SADC:	Southern Africa Development Community
32. STD:	Sexually Transmitted Diseases (synonymous with STI)
33. STI:	Sexually Transmitted Infections
34. TB:	Tuberculosis
35. TOR:	Terms of Reference
36. TWG:	Technical Working Group
37. USAID:	United States Agency for International Development
38. UVGI:	Ultra Violet Germicidal Irradiation
39. VCT:	Voluntary Counselling and Testing
40. WM:	Waste Management
41. WHO	World Health Organisation
42. XDR-TB:	Extremely Drug Resistant Tuberculosis

EXECUTIVE SUMMARY

Project background

The World Bank is supporting the Regional TB in mining Project (part of the Africa Regional Communicable Disease Control and Preparedness Program), which aims at controlling and or eliminating priority communicable diseases on the continent. Malawi is one of the four participating countries in the project. The overarching goal of the project is to: (i) increase utilization of key TB control and occupational lung diseases services in Malawi and (ii) strengthen the sub-region's capacity to address such conditions. This document constitutes an Infection Control and Waste Management Plan (ICWMP) with specific guidelines on infection control and health care waste management for Malawi. In addition to the institutional framework, implementation arrangements and budget, it also includes a laboratory waste management plan and Ebola Virus Disease preparedness plan.

Malawi context and objectives of the Infection Control and Waste Management Plan

Malawi, one of the sub-Saharan countries, continues to face high prevalence rates of preventable diseases such as HIV and TB¹. While considerable success has been made in the health sector (Health Sector Annual Report, 2010; NSP, 2011-2016), there are imminent public health concerns such as emergence of Multi Drug Resistant TB (MDR-TB), Extremely Drug Resistant TB (XDR-TB), and TB/HIV co-infection rates. According to recent WHO reports², Southern Africa has some of the highest TB/HIV co-infection rates in the world, ranging from 50% to 77% of the estimated burden. The mining sector is one of the sectors with potential risk factors such as: occupational and surrounding communities' exposure to silica dust; confined, poorly ventilated working environment; cramped living quarters; and high HIV prevalence. On the other hand, potential risk factors for health-care centres or hospitals (including laboratories) include: occupational exposure to TB and HIV (*ibid*).

Since the SADC declaration on Tuberculosis (TB) in the mining sector (2012), the Government of the Republic of Malawi has not moved significantly in its commitment to elimination of TB and improvement of environmental, health and safety practices and standards in the mining sector (National TB Programme, 2015, personal communication). It is against this background that the Government of Malawi, just like other SADC member states, has embarked on a Regional TB in Mining Project (five years project), which will involve three main components namely: 1) prevention, detection and treatment of TB; 2) disease surveillance; and 3) learning knowledge and innovation. The project further involves expansion and renovations of existing health facilities including laboratories.

Due to the possible impacts (which include increased infection risks and waste management challenges) of project activities, an Infection Control and Waste Management Plan is deemed necessary. Thus, this Infection Control and Waste Management Plan (ICWMP) is prepared to facilitate implementation of appropriate infection control and waste management practices across the three relevant sectors of Health, Mining and Labour, (which include work practice and administrative measures, environmental/engineering control, and use of appropriate personal respiratory protection, and improved waste collection, storage, treatment and disposal practices) to avoid infection and environmental pollution. Specifically, the objectives of this ICWMP were to 1) develop Standard Operating Procedures and Waste Management Plans for laboratories based on a quick situation assessment and 2) review and update existing documentation on health-care waste management plans under bank funded health projects. Other objectives of the assignment were to undertake gap analysis of existing situation (environmental health control aspects) within the mines and medical waste management aspects within health facilities.

¹ Malawi Growth and Development Strategy II (2011-2016).

² WHO Global Tuberculosis Control. (2013).

Methodology

Preparation of this ICWMP necessitated desk work (secondary data collection), stakeholder consultations, and field investigations. Desk work involved the review of national policies and legislative framework related to TB infection control and waste management, and review of existing documentation on health-care waste management plans and Ebola Risk Management plans. WHO literature on recommended TB infection control practices and health-care waste management practices were also reviewed. Field investigations were conducted in order to ascertain environmental health control aspects within selected coal mines of Mchenga and Kaziwiziwi and selected health facilities of Christian Health Association of Malawi (CHAM) and Ministry of Health (MOH). Stakeholder consultations involved Ministry of Health and the Department of Mines just to mention a few. The gap analysis of existing environmental health control aspects in the mines and medical waste management aspects was done by comparing literature on best TB infection control practices (as per WHO standards) with findings from field investigations and existing documentations on TB infection control, health-care waste management, and Ebola Virus Disease preparedness plan.

General findings

Through the assignment, it is found that the current situation of TB infection control measures and health-care waste management procedures in Malawi cannot guarantee safety among health-care workers, patients, and the general population. In the mines and health facilities visited, there were inadequate TB preventive measures (e.g. limited use of face masks) and health-care waste disposal was a problem due to understaffing (particularly for Mchenga coal mine clinic). From the quick assessment, it was also noted that there is inadequate health surveillance and monitoring of health of employees, both at the selected mines and in the health facilities.

Record keeping and information (TB data) sharing was also found to be a problem, especially between the mines and referral hospitals. When asked if there have been any TB cases, the respondents at the mines indicated 'no' hence no TB records from the mines. TB records were only found at referral hospitals such as David Gordon Memorial Livingstonia Hospital which had TB records of miners and their relatives.

More importantly, the Infection Control and Waste Management Plan has established best TB infection control measures (at both preventive and curative levels) and best health-care waste management procedures as per WHO standards. As part of the health-care waste management best practice, a laboratory waste management and monitoring plan has been drawn up as well.

Conclusions and recommendations

Based on information obtained from literature review and stakeholder consultations, best practices on TB infection control and health-care waste management have been developed as guidelines. Appropriate health-care waste management procedures from point of generation to point of disposal have been highlighted. The health-care waste training needs have been assessed and identified for relevant stakeholders and a training budget estimate has been drawn up.

Based on the quick situation assessment, and for successful implementation of the Infection Control and Waste Management Plan, there is generally the need for proper coordination among all stakeholders. The stakeholders here include but are not limited to health-care staff, patients and general public, relevant ministries and the mines. Adequate health surveillance and monitoring can help predict areas of health concerns and hence facilitate the development of adequate preventive and environmental management measures.

1.0 PROJECT BACKGROUND AND DESCRIPTION

1.1 Project Background

1.1.1 Global level

Tuberculosis (TB) remains one of the world's lethal contagious diseases. According to WHO (2014) global report, 6.1 million TB cases were reported to WHO and of these, 5.7 million were newly diagnosed and 0.4 million represented those who were already on treatment. While notification of TB cases has stabilised over the years, there appears TB cases that have not being diagnosed or if diagnosed, not reported to National TB Program (*ibid*). This represents one of the major global challenges encountered in tackling this preventable disease.

1.1.2 Regional level

At regional level, Southern Africa contributes significantly to the global burden of Tuberculosis (TB). Although a highly preventable and curable condition, TB still remains one of the world's deadliest communicable diseases. In 2013, an estimated 9 million people developed the disease and 1.5 million died—roughly 20% who were HIV positive. Of these 9 million, 25% were from the Africa region, which has one of the highest rates of cases and deaths per capita. Around 30% of the world's 22 high-burden TB countries are in Southern Africa and most countries in the sub-region are above the World Health Organization (WHO) threshold for a TB emergency (250 cases per 100,000). Of the 14 countries with highest TB incidence in the world (at least 400 cases per 100,000), eight are in Southern Africa and Swaziland has the highest TB incidence in the world. Swaziland aside, some progress on incidence rates is being seen in the sub region; yet this progress masks disparities between and across countries, particularly between the general population and those involved in mining.

TB is the most common opportunistic infection of people living with HIV/AIDS as well as the leading killer of HIV-infected patients. Southern Africa also has some of the highest TB/HIV co-infection rates in the world—50% to 77% and the trends in TB incidence closely mirror trends in HIV/AIDS. This dual epidemic is extremely tricky to manage and presents many challenges for the traditional approach of combating TB. Multidrug-resistant TB (MDR-TB) is becoming an increasing threat to the sub-region's health and development gains. Inadequate treatment of TB creates resistance to first-line drugs and leads to MDR-TB. Subsequently, inadequate treatment of MDR-TB leads to a highly lethal form of extremely drug resistant TB (XDR-TB).

Resistant forms of TB require the use of much more expensive drugs, which also have higher levels of toxicity and higher cases of fatality and treatment failure rates. Individuals who are treated inappropriately continue to transmit TB and the sub-region countries are ill equipped to identify and respond efficiently to such outbreaks. With the growth in regional migration, global travel and the emergence of lethal forms of the disease, TB poses a major regional and global public health threat. The cost-effectiveness of addressing drug-responsive TB is therefore unquestionable.

The sub-region also faces challenges of a disease burden linked to movement within and across borders. Migration often disrupts TB detection and care. Qualitative evidence from southern provinces of Mozambique shows that miners often have multiple treatment episodes, with inappropriate therapy and high default rates. This can lead to the acquisition of multidrug resistant TB. In Lesotho, most TB patients and 25% of drug-resistant TB patients have worked as miners in South Africa. Cross-border care and within country referral between mining areas and labour

sending areas is often inadequate or non-existent, contributing to significantly greater rates of extensive and multi-drug resistance in miners, ex-miners, their families, and communities.

1.1.3 National level

Malawi uses the World Health Organisation (WHO) Directly Observed Treatment Short course (DOTS) strategy for national TB control. DOTS is the acronym for the TB control strategy recommended by the World Health Organisation. Since the country began implementing the DOTS approach to TB management, TB case notification has gradually increased, particularly during the 1995-2003 period (NTP manual, 2012; NSP, 2011-2016). During the same period, there has been doubling in number of TB cases (Smear positive Pulmonary TB Relapse) that have relapsed after treatment (see table 1.1). However, from 2003 to 2014, TB cases decreased from 28,000 to 17,723 respectively (*ibid*). Major reasons that attributed to this include increased access to diagnostic services or microscopy centres, which reached 213 by the year 2011 and an increase in number of treatment centres from 44 in 2004 to 256 in the year 2014 (*ibid*).

Table 1.1. TB Case notifications from 1994-2003 (Source, Nyirenda 2006 as adapted from MOH)

Year	Total	SmPos(%) new PTB	SmNeg(%) new PTB	EPTB (%) new	SmPos(%) PTB Relapse	Other (%)
1994	19496	5988(31)	8958(46)	4046(21)	504(2)	-
1995	19155	6295(33)	7054(37)	5255(27)	551(3)	-
1996	20630	6703(32)	8070(39)	5328(26)	529(3)	-
1997	20676	7587(37)	7481(36)	5101(25)	507(2)	-
1998	22674	8765(39)	8311(37)	4993(22)	605(2)	-
1999	24396	8132(33)	10013(41)	5583(23)	668(3)	-
2000	24846	8267(33)	8799 (35)	5723(23)	758(3)	1299(6)
2001	27672	8309(30)	10763(39)	6145(22)	877(3)	1578(6)
2002	26532	7687(29)	10660(40)	5377(20)	872(3)	1936(8)
2003	28234	7716(27)	11246(40)	5829(21)	1050(4)	2393(8)

SmPos = sputum smear positive, SmNeg = sputum smear negative, PTB = pulmonary TB, other = all recurrent TB cases not included as smear positive relapse

During the period of 1990-2010 as is shown in figure 1.1, case detection rate of below WHO target of 70% was reported for all forms of TB. Recent evidence, however, suggest that Malawi has made improvements on TB detection exceeding the WHO target of 70%. For example, World Bank data show that TB detection rate for Malawi was last measured at 70% in 2013³. The following figure 1.1 shows the strides that the government has made towards achieving the Millennium Development Goals (MDG) indicators for TB during the 1990 to 2010 period.

³ <http://www.tradingeconomics.com/malawi/tuberculosis-case-detection-rate-all-forms-wb-data.html>

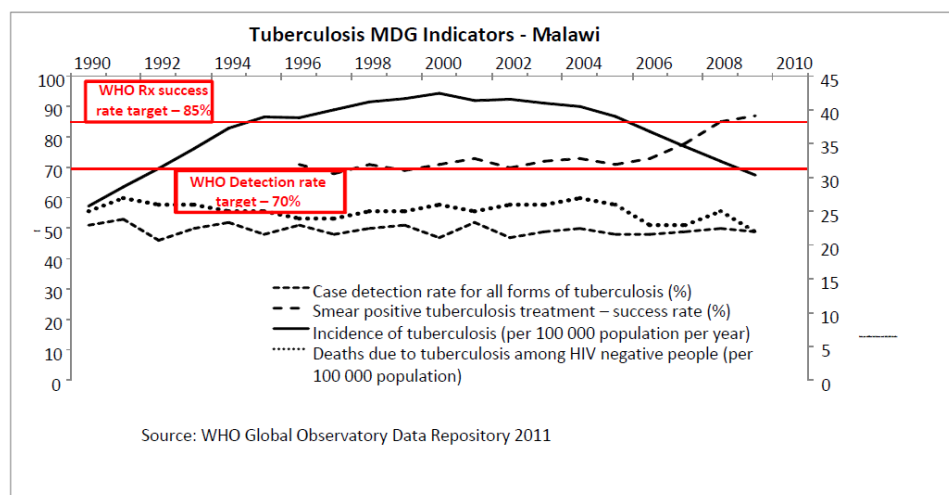


Figure 1.1. Tuberculosis MDG indicators for Malawi (Source: Malawi Health Sector Strategic Plan, 2011-2016)

According to The National TB Programme Data (2014), the TB/HIV co-infection rate is 50%. Some of the risk factors include lack of access to diagnosis and treatment, poor health status (e.g. HIV and malnutrition), environmental conditions (e.g. overcrowding), lifestyle (e.g. alcohol and drugs abuse) and poor hygiene.

Malawi's epidemiological profile is characterised by a high prevalence of communicable diseases such as Tuberculosis and HIV and AIDS (MDHS, 2010). As reported by NTP (2012) and NSP (2011-2016), the emergence of Multi-Drug Resistant (MDR) TB is one of the major challenges in the country's efforts to control TB.

Nyirenda (2006) observes that Malawi uses the most inexpensive way of managing and controlling TB, known as passive case finding, in a community. With passive case finding, only patients present at the hospital are diagnosed for TB. Using this approach in TB diagnosis presents challenges; with under-reporting of TB cases, particularly in rural areas where health centres or clinics are located far away from the villages. The Malawi Health Sector Strategic Plan (2011-2016) also notes that TB case detection is a problem in rural areas.

1.2 Overview of the proposed project in Malawi

The Southern Africa Regional TB in Mining Project in Malawi has the following three main components:

1. Prevention, detection and treatment of TB;
2. Regional capacity for disease surveillance, diagnostics and management of TB and occupational lung diseases; and
3. Learning, knowledge and innovation.

Full details regarding the project components and sub-components are presented in Table 1.2.

Table 1.2: Components of the TB and Health Systems Support Project in Malawi

Component 1	Prevention, Detection and Treatment of TB
1.1	Improved community TB interventions in the mining population
1.1.1	Forming grouping of former miners and others to improve knowledge and health seeking behaviour among the mining population
1.1.2	Coordination and collaboration among different stakeholders in communities to enhance efficiency and effectiveness
1.1.3	Developing and implementing a behavioural change strategy for the mining and other vulnerable population
1.1.5	Community sputum collection & transportation to microscopy sites: Karonga, Lilongwe, Mzimba, Blantyre, Rumphu, Nsanje, Balaka and Kasungu
1.2	TB and TB-HIV services delivery (facility based support)
1.2.1	Implement systematic TB screening and contact investigation in health facilities
1.2.2	Establish one-stop shop service centre
1.2.3	Improve patient adherence to treatment
1.2.4	Rolling out TB/HIV services in targeted districts cross-border areas
1.2.4	Strengthening patient referrals and follow-up
1.2.4	TB infection control in health care settings
1.3	Improve MDR TB service
1.3.1	Improve case detection
1.3.2	Improve patient management and support
1.3.3	Renovate MDR TB centres
1.4	Strengthen and improve occupational health
1.4.1	Equipment for mine health inspection
1.4.2	Equipment for pre- in- and post-service medical examinations for occupational health and safety
1.4.3	Strengthening IT systems for occupation health
Component 2	Regional Capacity for Disease Surveillance, Diagnostics and Management of TB and Occupational Lung Diseases
2.1	Human Resources for Health
2.1.1	Regional Field Epidemiology Training Program (Malawi component) and funding for advanced academic training/research in epidemiology
2.1.2	Laboratory Training (mycobacterial and disease surveillance experts pre-service and in-service)
2.1.3	MDR-TB Management Training (clinical and management staff)
2.1.4	Attend Post Graduate Training in Occupational Health Safety
2.1.5	Mine Health Inspectors Training/ in-service skills upgrading
2.1.6	In-service skills upgrading for management on TB and TB-HIV
2.2	Disease Surveillance
2.2.1	Conduct short courses for a multidisciplinary team on surveillance and outbreak investigation
2.2.2	Develop Guidelines, Standard Operating Procedures (SOPs) for relevant information sharing across Government of Malawi Ministries, other stakeholder and also Regional players.
2.2.3	Support staff to attend local, regional and international meetings for sharing surveillance information
2.3	Strengthening Diagnostic Capacity
2.3.1	Develop/ strengthen lab information systems & networking
2.3.2	Ensure Microscopy and Expert sites undergo quarterly External Quality Assurance (EQA)
2.3.3	Sample transportation
2.3.4	Expand lab network
2.3.5	Expand X-ray facilities

2.4	Strengthening Regulatory Capacity
Component 3	Learning, knowledge and Innovation
3.1	Program management
3.1.1	Review meeting
3.1.2	Coordination
3.1.3	Procurement
3.1.4	Capacity building
3.2	Experience sharing and learning
3.2.1	Regional Technical Working Group (TWG)
3.2.2	Exchange program (experience sharing)
3.2.3	Regional meeting
3.3	Support evidence-based policy analysis
3.3.1	Monitoring and evaluation
3.3.2	Operations Research
3.3.3	Baseline assessment mapping
3.3.4	Advocacy
3.4	Innovation and centre of excellence
3.4.1	TB screening among miners/ex-miners
3.4.2	Public Approach to Lung Health (PAL)

1.3 Project Goals and Objectives

The overarching goal of the project is to: (i) increase utilization of key TB control and occupational lung diseases services in Malawi and (ii) strengthen Malawi's capacity to address such conditions.

The specific objectives of the assignment were to:

- a. Review and update the existing Healthcare Waste Management Plans prepared under Bank funded health projects
- b. Develop Standard Operating Procedures and Waste Management Plans for Laboratories, based on a quick situation assessment.

Specific objectives a. and b. are prepared as a comprehensive Infection Control and Waste Management Plan (ICWMP). The ICWMP includes aspects of Ebola Virus Disease (EVD) Preparedness Plan (i.e. strong infection control interventions, particularly provision and use of Personal Protective Equipment (PPE).

Other objectives of the assignment were to:

- a. Undertake a gap analysis of existing environmental health control situation within the mines and the infection control and medical waste management aspects within healthcare facilities and laboratories;
- b. Undertake an analysis of the patterns of labour migration among miners and identify primary labour sending areas;
- c. Identify and develop a demographic profile of potential beneficiaries and their households;
- d. Identify any potential groups (e.g. community-based organization) with experience in working in labour sending areas; and
- e. Develop a stakeholder analysis of such groups, miners' organizations, and other voluntary organizations which undertake activities related to TB among mining communities

1.4 Objectives of the Infection Control and Waste Management Plan

The Infection Control and Waste Management Plan (ICWMP) has been developed to act as a guide in TB infection prevention and control. The overall objective is to detail steps that will ensure that Health Care Wastes generated by the project are handled in an appropriate and safe manner, consistent with international good practices. The ICWMP is to be used by relevant stakeholders including health care facilities, mining companies, the mining department, and Ministry of labour. The recommendations have been developed using the best available sources of information, including the WHO and national guidelines or policies.

This World Bank supported TB project aims at increasing utilisation of key TB control and occupational lung disease services in Malawi; and strengthening the country's capacity to address occupational health concerns. The project is targeting sputum collection and microscopy sites of Karonga, Rumphi, Mzimba, Kasungu, Lilongwe, Balaka, Blantyre, and Nsanje districts. Some of the proposed districts have mining activities and others are earmarked as potential Ebola Treatment Centres.

Implementation of the proposed project will result in increased laboratory waste generation (e.g. from sputum cups after service delivery), which will contribute to the strain on the already deficient laboratory waste management capacities. To mitigate this impact, one of the objectives of the Infection Control and Waste Management Plan is to facilitate implementation of appropriate laboratory waste management practices (which include collection, storage, treatment and disposal practices) to avoid the spreading of infection and environmental pollution.

In addition to this ICWMP, an Environmental and Social Management Framework (ESMF) has been prepared as a separate document to provide the process screening of sub-project activities to determine the level of environmental management work to be implemented.

1.5 Constraints and limitations to the study

One of the main objectives of the assignment was to review and update existing Health Care Waste Management Plans and Ebola Risk Management Plans under World Bank funded projects. There was, however, limited documentation on both documents. For instance, the Consultant mostly relied on ministerial statement on Ebola virus which was made by Minister of health (2014), in addition to the Ebola Virus Disease budget and timeline provided by Community Health Services Unit (CHSU), for reviewing the Ebola Risk Management Plan. While it was noted, through consultations with Ministry of Health, that a draft Health Care Waste Management Policy is under review, there were delays in getting hold of the final reviewed HCWM policy for the Consultant's review. However, the Consultant managed to get hold of the draft HCWM policy and through internet search, was able to find a Health Care Waste Management Plan for the Nutrition and HIV/AIDS Project (2012) which has been cited in this ICWMP. Another documentation, found through internet search and cited in this ICWMP, is the HCWM plan of action (2003-2008).

Lack of official data on mines also limited scope of this assignment particularly on primary labour sending areas and demographic profile of potential beneficiaries.

Due to time constraint, the situation analysis assessment focused on selected mines and health facilities and the study findings were not adequately discussed with people in the communities to garner indigenous knowledge on issues of occupation health in the target project districts. Hence, future investigations should focus on subjecting the study findings to a large random sample of key informants in the selected sites for validation.

2. POLICY, LEGAL, ADMINISTRATIVE AND OPERATIONAL FRAMEWORK

This chapter explores the linkages of relevant national policies and legal frameworks with the proposed regional TB in mining project.

2.1. Policy Framework

The important policies and declarations related to TB, Ebola management, mining, environmental protection, waste management, pollution control, and environmental health in Malawi include:

- a. Article 9 of The SADC protocol on Mining (1992) states that Malawi, as a SADC member state, shall agree to improve the practices and standards of occupational health and safety in the region's mining sector.
- b. Ministerial statement on Ebola Virus Disease outbreak in West Africa.

2.1.1. The Draft National Health Policy (2009)

It is the goal of this draft policy (work under progress) to improve the health status of all the people of Malawi by reducing the risk of ill health and occurrence of premature deaths. The policy encourages health interventions in the areas of:

- a. Developing sound and cost-effective interventions that ensure personal protection from communicable diseases and address their environmental determinants.
- b. Strengthening the capacity of the health care delivery system in the diagnosis and management of communicable and non-communicable diseases.
- c. Enhancing community participation in the prevention and control of communicable diseases.
- d. Devising measures to promote health-enhancing behaviours and life styles and curb those that negatively impact on health.
- e. Mitigating the burden of harmful effects of non-communicable diseases through primary, secondary and tertiary prevention.
- f. Strengthening institutional and community capacity to ensure safe motherhood and healthy child development.
- g. Developing a reliable surveillance system for preparedness and response to epidemics.

2.1.2. The Health Sector Strategic Plan (2011-2016)

The Health Sector Strategic Plan (HSSP) replaced the Sector Wide Approach (SWAp) Program of Work (PoW) for Malawi (2004-2010). The HSSP aims at contributing towards Malawi's attainment of the health and related Millennium Development Goals. The overall goal of the plan is to improve the health status of all the people of Malawi by reducing the risk of ill health and occurrence of premature deaths.

The specific objectives of the HSSP are to: increase coverage of the high quality Essential Health Package (EHP) services; reduce risk factors to health; improve equity and efficiency in the delivery of quality EHP services; strengthen the performance of the health system to support delivery of EHP services. The HSSP also reviewed the EHP for Malawi. The new EHP package includes: HIV&AIDS, Acute Respiratory Infections (ARI), Malaria, Diarrhoeal diseases, perinatal conditions, and communicable Diseases (CDs) including Tuberculosis. The interventions for each of these diseases are those that have been proven to be cost effective.

2.1.3. Infection Prevention and Control Policy (2006)

This policy was formulated to provide guidance to health facilities in development and implementation of infection prevention and control programs. The policy emphasises that implementation of infection prevention and control programs be done at various levels of health care delivery system within the public and private sectors. Under the Infection Prevention Control (IPC) section, the policy stipulates that all health care facilities (public and private) in Malawi shall have an active IPC program in place, aimed at promoting IPC practices and surveillance focusing on clients, patients, health care personnel and the environment.

2.1.4. Guidelines for infection prevention and control for TB including MDR-TB and XDR-TB.

It is the goal of these guidelines to help management and staff minimise the risk of TB transmission in health care facilities and other facilities where the risk of transmission of TB may be high due to high prevalence of both diagnosed and undiagnosed TB. This policy document was developed not only to assist health care workers, health care managers but also administrators and stakeholders in the public, private, and non-governmental health sector who are involved in providing care and treatment to persons with TB and or HIV and AIDS. The project stakeholders will, therefore, have to comply with the requirements of these guidelines for effective TB control and management in the proposed project sites.

2.1.5. Draft National Sanitation Policy (2007)

The policy, which is under review, stipulates the need to improve delivery of improved sanitation services in Malawi. Some of the strategies for accomplishing this objective include: (1) providing adequate wastewater disposal facilities at all wastewater generation points and (2) ensuring adequate provision of wastewater treatment and disposal facilities. The NSP outlines one the roles of MOH in ensuring proper management of health care waste. These issues, therefore, directly link to the waste management aspect of the proposed project.

2.1.6. The National Water Policy (2005)

One of the specific goals in the National Water Policy (NWP) is to ensure water of acceptable quality for all needs in Malawi. Thus, one of the overall objectives of the NWP is to ensure that all persons have convenient access to sufficient quantities of water of acceptable quality and the associated water-related public health and sanitation services at any time and within a convenient distance. The policy recognises that surface and ground water quality has been negatively affected by mining and poor sanitation practices. It therefore, emphasises on water pollution control in order to promote public health and hygiene and environmental sustainability. The proposed project will therefore have to comply with requirements of the NWP to ensure that the health of the communities is not compromised particularly for the immunosuppressed.

2.1.7. Malawi Standards (MS) 615: 2005: Waste within healthcare facilities, handling and disposal (code of practice)

This standard develops criteria for segregation, collection, movement, storage and on-site disposal of waste within healthcare units, biological research facilities, abattoirs and veterinary surgeries. These standards, therefore, have to be maintained throughout the project particularly on the health care waste management aspect of the project.

2.1.8. Malawi Growth and Development Strategy (2011-2016)

The country formulated the Malawi Growth and Development Strategy (MGDS, 2011–2016) phase II replacing the MGDS I as the Government’s overarching medium term strategy to attain the nation’s Vision 2020. The main objective of the MGDS II is to continue reducing poverty through sustainable economic growth and infrastructure development. The MGDS II has identified nine key priority areas and Public Health, Sanitation, and HIV and AIDS Management is one of the identified nine key priority areas. The proposed project will therefore have to comply and be aligned to the mentioned key priority area of the nation’s vision 2020.

2.2. Legal Framework

2.2.1. The Environment Management Act (1996)

This Act is the principal piece of legislation on the protection and management of the environment. Therefore, any written law inconsistent with the provisions of the Environment Management Act is invalid to the extent of the inconsistency. The Act provides the legal basis for protection and management of the environment and the conservation and sustainable utilization of natural resources.

Under Section 24, the Act specifies the types and sizes of activities that require an ESIA before implementation. It further outlines the ESIA process to be followed in Malawi; and requires that all project developers in both the public and private sectors comply with the process. Non-compliance with the ESIA requirements is an offence and attracts penalties.

The Act recognises that improper waste disposal can impact on various environmental and social resources and therefore regulates the management, transportation, treatment, recycling and safe disposal of waste; and to establish environmental quality standards for waste.

2.2.2. Mines and Minerals Act Cap 61:01 (2010)

Section 37 h of this Act stipulates that a mining licence be accompanied by a statement of any particular risks (whether to health or otherwise) associated with mining operations. Thus, mining companies have the obligation to ensure that mining operations take into consideration health risks of people involved. The Act clearly states that companies applying for a mining licence should give a statement of proposals for the prevention of pollution, treatment of wastes, safeguarding of natural resources, progressive reclamation and rehabilitation of land disturbed by mining and for minimization of the effects of mining on surface water and groundwater; and on adjoining or neighbouring lands.

Part V section 33 (underground operations) states that; all necessary measures shall be taken to ensure that all persons underground are in an atmosphere which does not contain gas or dust in quantities that are dangerous to health; and which in circulation, temperature and relative humidity creates conditions in which work can be performed without distress. The project will have to comply with the requirements of this policy to ensure that miners work in an environment that has reduced levels of dust for effective TB control.

2.2.3. Occupational Safety, Health and Welfare Act (1997)

Administered by the Ministry of Labour, this Act provides for the regulations of conditions of employment with regard to safety, health and welfare of employees; for the inspection of certain

plants and machinery; for the prevention and regulation of accidents occurring to persons employed or authorised to go into the workplace and for some related matters.

The Act, under section 13 (3), further specifies the duty of every employer to prepare and as often as may be appropriate, revise a written statement of his general policy with respect to the safety and health at workplace of his employees, and the organisation and arrangements for the time being in force for carrying out that policy, and to bring the statement and any revision of it to the notice of all his employees.

The Act also, in Section 34, requires medical examination for certain occupations such as mining operations. While TB is silent, schedule 2 of the Act lists industrial diseases which are compostable under the Act.

The World Bank supported project, therefore, will have to ensure that employment conditions of the miners are observed with regards to their safety, health, and welfare.

2.2.4. Public Health Act Cap 34:01 (1948)

This act is for the preservation of public health in Malawi. It calls for prevention of infectious diseases and provision of adequate sanitation and housing as well as sewerage and drainage. Under Section 59 of the Act, any person is prohibited from causing nuisance on any land and or premises owned or occupied by him. The Act under Part X also requires developers to provide adequate sanitary and health facilities to avoid harmful effects of waste on public health. Further, section 82 prohibits persons from disposing of certain matters into public waters. The project will, therefore, have to comply with the requirements of this Act by providing for appropriate and effective waste disposal facilities in accordance with the anticipated volumes of waste.

2.3. Administrative and operational framework

The Ministry of Health (MOH) is the government agency responsible for health care in Malawi. It is the Institution responsible for addressing health issues of TB and Ebola Virus Disease. Specifically, TB in Malawi is coordinated by the National Tuberculosis Control Programme (NTP) which was launched in 1964 following recommendations from the World Health Organisation. The Ministry of Health through the Preventive Directorate has an Environmental Health Unit that is responsible for primary health care, port health services (including issues of Ebola), water sanitation and hygiene, and health care waste management.

3. EXISTING PRACTICES ON INFECTION CONTROL AND HEALTH CARE WASTE MANAGEMENT

3.1 Methodology for Assessment

To assess the existing practices in Infection Control and Waste Management (ICWM) the Consultant carried out a number of activities which include the following:

3.1.1 Stakeholder consultations

The Consultant conducted stakeholder consultations to capture relevant primary technical and non-technical data regarding ICWM, as perceived by relevant key stakeholders. The initial consultations were with the Client (Ministry of Health) to identify key stakeholders and establish effective contacts for gathering data from selected health-care service providers. This facilitated entry into public and private health-care institutions to consult with key relevant personnel involved in treatment and management of TB and prevention of Ebola infections.

Consultations with the Head of the Mining Department also assisted in identifying the relevant mining companies for assessment of prevalence and management of TB and related infections, as well as practices for infection prevention and patient management. Appendix 1 shows full list of people consulted.

Other institutions consulted include the Ministry of Natural Resources, Energy and Mining; Ministry of Labour (Occupational Safety and Health); Ministry of Foreign Affairs (Department of Immigration) and Ministry of Health. Key Informants in these institutions were deemed to have some awareness of the regional TB in mining project or an understanding of the environmental and social issues associated with TB in mining (see Appendix 1 for stakeholders consulted).

3.1.2 Field investigations

The impetus behind field investigations was to ascertain the current situation of environmental health control aspects (including safety) within the selected Mchenga and Kaziwiziwi coal mines (Appendix 4 provides an overview of the mines sector in Malawi). The field investigations also focused on the infection control and waste management aspects with regard to TB management in the selected health-care clinics of Mchenga Coal Mine and David Gordon Memorial Hospital (Livingstonia Hospital) that serve communities surrounding Mchenga and Kaziwiziwi coal mines, Mzuzu and Kamuzu Central Hospitals. For Mzuzu and Kamuzu Central Hospitals, the Consultant wanted to obtain first-hand information on Ebola prevention measures in these proposed Ebola Treatment Centres. Appendices 5 and 6 give more details of the Malawi health delivery system and the health facilities visited.

3.1.3 Literature review

The Consultant conducted literature review of policy and legal documents related to waste management and infection control to understand the policy and legal context of the project. This assisted the Consultant to establish gaps in adherence to the existing policy and legal framework. The existing HCW and Ebola Risk Management Plans were also reviewed to benchmark the level of implementation. The Consultant also used information from the internet, the Client's documents and own library to establish Best Practice. Key documents; Health-care Waste Management Plans, Environmental Management Plans and Ebola Risk Management Plans; under the World Bank funded projects, as referred in the Terms of Reference for this assignment; were not available for review.

3.2 Existing Infection Prevention and Control practices in Malawi

3.2.1 Prevention of nosocomial infections in the health facilities

To reduce the potential risk of nosocomial infections in the health facilities of Malawi, the Ministry of Health identified Infection Prevention and Control (IPC) practices as a priority area for quality assurance interventions, to be implemented as part of the six year program of work (POW) beginning from 2002⁴. According to the IPC policy of 2006, the initiative is currently being implemented in 35 health facilities, including all central, district and some Christian Health Association of Malawi (CHAM) hospitals. Seven hospitals (these include Mtengowanthenga, Machinga, Chiradzulu, Salima, Thyolo and Queen Elizabeth Central Hospital) have been recognized as centres of excellence in infection prevention, thereby serving as role models.

According to the Infection Control Policy (2006), some of the measures that have been adopted to reduce spread of infections are:

- a. Traffic Control in the health facility i.e.
 - (i.) The number of visitors shall be no more than two per patient at any one time.
 - (ii.) Visiting hours, number and age of visitors allowed, shall be visibly displayed at each department/unit/ward.
 - (iii.) Visitors and health-care personnel shall not be allowed in restricted areas unless permission has been granted.
 - (iv.) Restricted areas shall be properly indicated with labels.
- b. Appropriate use of Personal Protective Equipment (PPE).
- c. Standard precautions⁵ shall apply to the following:
 - (i.) Hand hygiene and use of gloves
 - (ii.) Use of face masks, eye protective wear and face shields
 - (iii.) Use of gowns and aprons
 - (iv.) Placement of patients in isolated and non-isolated wards as may be appropriate
 - (v.) Care of individual patients' equipment
 - (vi.) Care of resuscitation equipment
 - (vii.) Handling and disposal of sharps
 - (viii.) Handling of laboratory specimens
 - (ix.) Handling of blood spills
 - (x.) Handling of linen
 - (xi.) Handling of medical waste

3.2.2 TB data collection and management

The National TB Programme (NTP) is responsible for collection of data related to TB in Malawi. This data is collected through registers, which are maintained at district level and kept by district TB officers. At community level, TB control activities are coordinated by Health Surveillance Assistants (HSAs) who work hand in hand with the community health workers and volunteers. These health workers and volunteers in turn provide important linkages with the nearest health facilities.

⁴ Malawi Infection Prevention and Control Policy (2006).

⁵ WHO (2007) define standard precautions as the basic level of infection control practices which are to be used, as a minimum, in the care of all patients regardless of suspected or confirmed infection status. (source: http://www.who.int/csr/resources/publications/EPR_AM2_E7.pdf)

3.3 Demographic profile of potential beneficiaries/households

Based on the National Statistical Office (NSO) population census of 2008 when total population was 13 million with a growth rate of 2.8%, Malawi has a current projected population of 16 million. Since the Regional TB in Mining Project is targeting the districts of Karonga, Rumphi, Mzimba, Kasungu, Lilongwe, Balaka, Blantyre, and Nsanje; table 3.1 shows an overview of the demographic profile (projected population) of potential beneficiaries in these districts.

Table 3.1. Projected 2015 population of potential beneficiaries based on 2008 NSO Census

District	Population					
	Total-2008	Total-2015 ⁶	Male-2008	Male-2015	Female-2008	Female-2015
Karonga	272,789	326,256	131,882	157,731	140,907	168,525
Rumphi	169,112	202,258	83,051	99,329	86,061	102,929
Mzimba	853,305	1,020,553	413,491	494,535	439,814	526,018
Kasungu	616,085	736,838	306,768	366,895	309,317	369,943
Lilongwe	1,897,167	2,269,012	938,985	1,123,026	958,182	1,145,986
Balaka	316,748	378,831	151,637	181,358	165,111	197,473
Blantyre	999,491	1,195,391	502,201	600,632	497,290	594,759
Nsanje	238,089	284,754	115,371	137,984	122,718	146,771

While gender only is reflected in table 3.1, age is also an important demographic variable. As indicated in the Malawi Demographic and Health Survey (2010), the younger age groups (under 25 years old) make up 67% of the household population in both rural and urban areas. Only 4 percent of the population is aged 65 or older while 29% of the population is aged between 25 and 65 years. The age distribution shows that Malawian population is young, an indication that the country has high fertility rate. The 2008 population census revealed an average household size of 4.6 people from 4.0 in 1987.

3.4 Labour migration among miners and primary labour sending areas

Through consultations with Ministry of Labour and Department of Mines, The Consultant learnt that the mines consist of both skilled and unskilled labour and that each and every district is a labour sending area. In order to identify primary labour sending areas, the Consultant was advised to visit selected mines and obtain a pattern of labour migration among miners. The Consultant, therefore, visited Mchenga and Kaziwiziwi coal mines in Rumphi district.

Labour at the Mchenga coal mine is divided into two: 1) Skilled and 2) Unskilled labour. Most of the miners (unskilled labour) at Mchenga coal mine migrate from surrounding communities of Chiefs Chiguliro, Njukula (Jalawe), and Kachulu (Phoka Side) areas; while the skilled labour comes from various districts in the country. It was indicated by the Human Resource Officer that 65% of unskilled labour force comes from these surrounding communities while 35% of employees migrate from other regions of Malawi. The Mine Labour force currently comprises of 241 employees (with a male: female ratio of 13:1) working in mining production, surveying, engineering, coal processing, security, safety, health & environment, finance & administration.

⁶ The projected population has been calculated based on the assumption of 2.8% annual growth rate

3.5 Potential groups with experience in working in labour sending areas.

Through the field investigations, the Consultant noted that there is a registered Community Based Organisation (CBO) called Mchenga Coal Mine which was established in 2006, with funding from National Aids Commission (NAC).

The idea behind the establishment of the CBO was to sensitise people in the community on HIV/AIDS. After noticing an increase in number of orphans, Mchenga Coal Mine and the community thought of establishing this CBO, which is organised into four groups of: i) Youth Group; ii) Community Home Based Care (CHBC); iii) Orphan and Vulnerable Care (OVC); and iv) People Living with HIV/AIDS (PLHA). The Youth Group targets its sensitisation work on the youth in the project area, while the CHBC looks after the chronically ill patients and the elderly. The OVC looks after the disadvantaged children such as poor children and the orphan whereas the PLHA group is involved in counselling of patients on ARV treatment and proper medication as well as offering minimal TB counselling. On minimal TB counselling, the CBO stated that they lack training on how to manage TB cases and would love to be trained on TB counselling and management.

Through funding from NAC, the CBO is involved in orphan care activities, producing pamphlets on HIV and AIDS; and performing drama in an effort to raise awareness and sensitize the surrounding communities on HIV on AIDS issue. From the interviews at Kaziwiziwi coal mine, the Consultant noted that there is no CBO working in the labour sending areas. Table 3.2 shows a number of stakeholders, as noted by the Consultant, involved in activities associated with TB.

Table 3.2. Stakeholders involved in activities associated with TB among mining communities

Stakeholder	Characteristics	Main interest	Impact on situation	Interests, fears, expectations	Role in relation to project	Potential impact	Recommendations	Priority
Mchenga CBO	Community based	HIV/AIDS sensitisation	Project implementation	Expectation: To be financially supported to increase TB awareness	Supportive role	Critical	To be involved in the project from planning to implementation	High
Community volunteers	Community based volunteer	Sputum collection and monitoring TB treatment	Project implementation	Expectation: To be financially supports as source of income	Supportive role	Critical	To be involved from project planning phase to project implementation	High
HSAs	Government sponsored	Coordinate TB activities at communal level	Project implementation	Interest: Following up on TB patients	Supportive role	Critical	To be involved from project planning phase to project implementation	High
Local leaders	The most respected leads local community	Keep the local community alive	Local decision maker	Don't know	Facilitator and mediator between local people and project	Highly critical	Rapport establishment	High
Traditional healers	Practitioners of traditional medicine	HIV/AIDS and TB therapy	Project implementation	Don't know	Supportive role	Critical	To be involved from project planning phase to project implementation	medium

HSAs = Health Surveillance Assistants, CBO = Community Based Organisation. **N/B:** For stakeholders having a 'don't know' entry, they need to be consulted in future investigations preferably prior to commencement of the project

3.6 Social issues

In the mines visited, the Consultant observed that the major issue that determines utilisation of health services is the difficult topography and location of the villages. Most of the villages or settlements, where miners are coming from, are isolated and located far away from the major community health centre (David Gordon Memorial Livingstonia hospital) and Rumphi district hospital. While the communities have Health Surveillance Assistants (HSAs) or Community volunteers for training communities on sputum collection, the major challenge is on transportation of sputum to the health centre under the difficult terrain conditions. Most often, the community volunteers carry the sputum specimens on foot or bicycle. This sometimes results in leakage of sputum specimen which is a major health risk.

One other key issue noted is difficulty in transfer of TB patients under traditional healer therapy to hospitals. Thus, traditional healers take time to release their patients to hospitals and this poses challenges in TB management. Owing to this is higher reliance on traditional healers and local solutions by the surrounding communities.

3.7 Existing environmental health control aspects within the mines

Mchenga and Kaziwiziwi Coal Mines

The Consultant observed that both Mchenga and Kaziwiziwi coal mines use natural ventilation methods (see appendix 2 for example); while the respondents stated that dust is controlled through watering and that silicosis is prevalent in mines that follow blasting methods of extraction, the Consultant did not observe any watering activities and did not have the time to ascertain dust conditions under the mines, let alone the technical capacity to quantify dust conditions conducive for silicosis development. Perhaps in the near future, this could be an urgent area for research. Unlike Kaziwiziwi coal mine, the Consultant observed safety signs around Mchenga mining area (see appendix 3).

3.8 Existing infection control and medical waste management practices within the healthcare facilities (including laboratories)

Mchenga Coal Mine

From the interviews with the Human Resource Officer and Medical Officer for Mchenga Coal Mine, it was learnt that the coal mine clinic only offers general Out-Patient Department (OPD) services (i.e. offers drugs and treat common ailments such as malaria). Serious cases (specific cases) are referred to a nearby clinic, Jawale Health Centre (public health centre) or Rumphi District Hospital, for people of the surrounding villages. The following were the outcomes of the interview at Mchenga Coal Mine:

- i. The respondent(s) were not aware of the Infection Prevention Control guidelines (2008) for TB including MDR-TB and XDR-TB;
- ii. There are no policies to contain respiratory infections but on general infection prevention, the clinic uses locally trained people to offer clinical services following general infection prevention measures;
- iii. TB is not common in the project area or community;
- iv. The health of workers is not monitored. Workers only go through medical check-ups once (i.e. on employment) and these are not voluntary;
- v. There is no follow-up on the health of ex-employees or ex-miners but the mine has personal data (including physical address) of their former employees;
- vi. There is no laboratory to conduct tests;
- vii. There are no workers' camps or hostels. All miners come from their homes to work;
- viii. There is an influx of people in the project area and people migrate from other districts.

- ix. **Health-Care Waste Management-** disposal of Health Care Waste at Mchenga Clinic is through burning. While other HCWs are completely burnt, sharps or needles remain unburnt.

David Gordon Memorial (DGM) Livingstonia Hospital

The interviews at DGM Livingstonia hospital yielded the following data:

- i. The facility has an Infection Prevention and Control Plan which they use to train new staff members on infection prevention control measures;
- ii. The facility has a laboratory and conducts TB diagnosis where Voluntary Counselling and Testing (VCT) services are offered on daily basis;
- iii. The hospital handles 1-2 TB patients on average per month and 26 TB patients on average per year. Table 3.3 below shows TB statistics for the past 5 years recorded by the hospital;

Table 3.3. TB statistics at DGM Livingstonia hospital (2011-2015)

Year	Number of patients reported	Number of deaths reported	Number of HIV/TB co-infection
2015	27	5	10
2014	20	4	4
2013	23	2	7
2012	26	6	7
2011	35	10	21

- iv. TB suspects are given first management or priority and their sputum is collected and sent to laboratory in 2 days' time
- v. The facility has a waste management plan
- vi. All the Health Care Wastes are put in sharp collecting safety boxes before disposal in the incinerator-no complaints on waste handling
- vii. Complaints on occupational health are there as the incinerator produces bad smoke-plans to re-site it exist
- viii. TB sputum collection and transportation to laboratory

	Collection in the health centres	Transportation to microscopy sites
Materials used	Sputum collection boxes	HSAs use motorcycle
Procedures	On spot	-
Personnel used	Health Surveillance Assistants (HSAs)	Healthy riders & HSAs
Protective equipment and clothing	Use gloves and masks	-

3.9 Ebola Virus Disease (EVD) Preparedness Plan

Since the Ebola Virus Disease Outbreak in West Africa in 2014, the Ministry of Health in Malawi (with technical guidance from WHO) started implementing a range of activities in preparedness of the Ebola Outbreak. The aims of the activities were to prevent Ebola from being transmitted to Malawi and to prepare the country to handle any Ebola case, should it be diagnosed. Specific activities included:

- a. Development of Information Education and Communication (IEC) materials on Ebola and placement of IEC materials at strategic places such as airports, schools, colleges, and health facilities.

- b. Radio phone-in programmes where listeners ask questions on Ebola.
- c. Strengthening screening procedures at Chileka and Kamuzu international airports, particularly for passengers from Ebola affected countries.
 - According to a Ministerial statement on Ebola in parliament in 2014, renovations for the isolation room (quarantine room) at **Chileka International Airport** are underway. Beds, beddings and a fridge have been supplied. Orientation of Airport staff was done but they are still waiting for more Personal Protection Equipment (PPE) to be prepositioned at the airport. The PPEs are being procured through the Central Medical Stores.
 - According to the same source, renovation of the quarantine rooms at **Kamuzu International Airport** is almost complete and beds and linen have been supplied. More PPE is being procured through Central Medical Stores. Airport Staff have been oriented on Ebola.
- d. Development of Standard Operating Procedures (SOPs) including:
 - Surveillance at port of entry;
 - Case definition for Ebola Virus Disease;
 - Case management and treatment of cases;
 - SOP for collection, packaging and transportation of laboratory specimen;
 - SOP on handling and transportation of Ebola suspect/confirmed dead bodies;
 - Infection Prevention and Control measures; and
 - Training of Health Workers in Central Hospitals and District Health Offices. The training material is ready for orientations (Training Social workers in EVD psychosocial support).
- e. Sensitisation meetings (on Ebola) with central hospitals, zonal and district health offices where it was agreed that:
 - Three Central Hospitals in (Mzuzu, Lilongwe and Blantyre have been designated as treatment centres for Ebola. But these centres should be in isolated buildings, away from the other patients at the hospital.
 - Since Ebola can also come to Malawi by land, 6 border districts are designated as Ebola management centres. These are the border districts especially those with ports of entry at: Mwanza, Dedza, Mchinji, Songwe, Kapororo (Karonga), Chitipa and Muloza (Mulanje)
- f. Setting up Ebola Rapid Response Teams for Lilongwe, Blantyre, Mzuzu and in all border districts.
- g. Training of laboratory personnel on international certification in sample packaging and transportation.
- h. Procurement of PPE⁷

3.10 Current status of HCWM in Malawi

It is acknowledged in the HCWM Strategic Plan of Action (2003-2008)⁸ that there is no policy document or formal management procedures for health-care wastes in Malawi. Some of the important policies of sound management of health-care related waste include:

- a. assignment of legal responsibility for safe management of waste disposal to the waste producers; and

⁷ Information on EVD preparedness plan for Malawi has been extracted from the Ministerial statement on health made in 2014.

⁸ Health Care Waste Management Plan of Action. (July 2003-June 2008). Malawi Government. Ministry of Health and Population. Lilongwe.

- b. high level of awareness on proper waste disposal among all health workers and general public and limited level of awareness of proper waste disposal among health workers and general public.

To this effect, the Ministry of Health (MOH) is, currently, in the process of finalising the draft Health-Care Waste Management Policy that was developed between November 2002 and January 2003. Development and finalisation of this policy has been stimulated by the need for improving health-care waste management in Malawi. Two assessments (2002 and 2007)⁹ on Health-Care Waste Management in health facilities (encompassing public, private, CHAM, and training institutions) identified key problems existing in the health-care system of Malawi. These include:

- i. deficient institutional and legal framework;
- ii. mediocre behaviour and practices of health-care workers and waste handlers;
- iii. insufficient financial resource allocation towards HCWM;
- iv. inexistence of private agencies that deal with health-care waste collection and treatment;
- v. lack of clarity given to HCWM in the National Health Policy; and
- vi. Non-performing organizational structure and equipment within the health care system.

Similarly, other documents such as the Health-Care Waste Management Plan (2012) on HIV and AIDS project indicate many gaps in implementation of sound Health-Care Waste Management (HCWM) practices in the country. For example, the latter document noted that the majority of Health Facilities (HFs) were found to have no storage areas for HCW and 92% of health facilities were observed to dispose HCWs on-site.

Based on the assessment of HCWM and injection safety, the HCWM strategic action plan (2003-2008) emphasised areas of focus or action during the five year period from 2003 to 2008 and these included:

- a. **Institutional and legal framework.** The assessment observed that there is no national strategy in HCWM as there was no policy document or any formal management procedure for health-care wastes. The legal framework was characterised by lack of internal regulations in the health facilities for HCWM. It was therefore recommended, in the assessment, that an institutional and legal package be developed;
- b. **Capacity building and training.** Unlike the paramedical staff, the assessment noted that auxiliary staff, waste collectors, health workers (supply staff), and waste handlers are not aware of the hazardous constituents of health-care waste and therefore, are involved in inappropriate collection, storage and disposal of HCW. This lack of awareness, especially to these type of staffs (that are at the receiving end of HCWM stream) is often a major source of accidents causing wounds and infection. The inappropriate HCWM also often results in mixing of hazardous wastes and non-hazardous wastes, further exacerbating environmental degradation. It was hence recommended, in the assessment, that HCWM should be included in pre-service training curricula in all health training institutions and also in service-training;
- c. **Information Education and Communication (IEC) and advocacy on community involvement in HCWM.** The assessment noted that the public's knowledge of dangers or risks associated with handling of health care waste is very weak especially for:
 - scavengers looking for useful objects;
 - children playing on the landfill or looking for toys;

⁹ Information from draft HCWMP policy developed by Ministry of Health

- population using recycled objects
- population performing or receiving home based health care; and
- people living near the landfills.

It was, hence, suggested that awareness campaigns targeted to the public may facilitate reduction in HCW associated risks.

- d. **Public Private Partnership.** One of the major constraints noted in the assessment was that there is no private company or specialised companies involved in solid waste collection in Malawi. This provides a limitation in management of HCW as the management skills and financial resources of the private sector are not tapped. It was therefore recommended that any HCWM action plan should support private initiatives and develop a partnership between public and private sectors with civil society;
- e. **Improvement of HCW collection, treatment and disposal.** Major constraints noted during the assessment of the health facilities were: i) lack of planning or internal management procedures; ii) absence of viable data about HCW production and characteristics; iii) no monitoring system or staff member designated to monitor HCW management; iv) insufficiency of secure collection materials and protective equipment; v) mixing of HCW waste with household and office waste; and inefficient waste treatment and disposal. It was therefore recommended that appropriate HCW facilities (with accompanying equipment) be put in place to safely handle, treat and dispose waste in an environmentally friendly manner.

4. POTENTIAL IMPACTS RELATED TO THE PROJECT ACTIVITIES

In this project, most of the potential impacts will come during handling of sputum from point of collection to laboratory analysis. Table 4.1 has identified potential impacts likely to come as a result of the project activities. The costs for mitigating the impacts are included in the laboratory waste management and monitoring plan (table 6.5) and the training costs in the training budget (table 8.1).

Table 4.1. Potential impacts and proposed mitigation measures

Environmental components	Impacts	Mitigation measure
Soil	Soil contamination from detergents and laboratory chemicals	<ol style="list-style-type: none"> 1. Use appropriate waste drainage systems leading to septic tanks or public sewerage facilities; as provided by contractor 2. Conduct mobile health clinics and x-rays at health centres with appropriate drainage and waste disposal facilities
	Contamination from sputum resulting from careless spitting	<ol style="list-style-type: none"> 1. Conduct civic education and public health meetings
	Contamination from sputum and wastes during transportation and disposal	<ol style="list-style-type: none"> 1. Transport sputum and waste in properly sealed and approved containers 2. Dispose liquid waste in proper drainage system 3. Provide controlled air incinerators for treatment and disposal of sputum and wastes 4. Collect and transport ash from incineration in sealed and approved bags with a biohazard label 5. Dispose incinerator ash in approved landfill sites
Surface and ground water quality	<p>Water pollution from detergents and chemicals used in the laboratory</p> <p>Infectious wastewater and contaminated blood</p>	<ol style="list-style-type: none"> 1. Use appropriate waste drainage systems leading to septic tank or public sewerage facilities as provided by contractor
Air Quality	Air pollution from smoke from incinerators	<ol style="list-style-type: none"> 1. Position the incinerators on a leeward side or in such that the direction of wind is away from habited areas 2. Sort the waste to ensure only organic and combustible waste goes into incinerators 3. Train staff on how to operate the incinerators 4. Regularly maintain the incinerators to ensure they are working properly 5. The laboratory staff should be oriented to the ICWMP, especially segregation at source and

Environmental components	Impacts	Mitigation measure
		colour coded waste management
Health and Safety	Spread of TB from infected persons	<ol style="list-style-type: none"> 1. Develop Laboratory Standard Operating Procedures (SOPs) and good practice and emergency manuals 2. Provide adequate ventilation in laboratories and treatment areas 3. Provide appropriate protective equipment for handling TB specimen and ensure they are used 4. Use appropriate and safe procedures for handling specimen and laboratory waste 5. Store specimen and culture in appropriate containers and places 6. Treat laboratory waste by incineration or other approved methods 7. Ensure that staff are trained in SOPs and good practices 8. Conduct staff and public awareness campaigns quarterly; 9. Conduct civic health education in the communities.
	Risk of exposure to infectious specimen during collection and transportation of sputum from collection points to laboratories	<ol style="list-style-type: none"> 1. Provide protective gear to staff and ensure they are used to handle sputum and infectious wastes 2. Package sputum in right containers that can be sealed tight and cannot break 3. Transport sputum containers in appropriate boxes 4. Ensure that staff know and use the recommendations in the ICWMP
	Accidents and risks of fire in the laboratory	<ol style="list-style-type: none"> 1. Provide fire-fighting equipment 2. Raise awareness on staff about accidents and fire risks
	Radiation from X-rays	<ol style="list-style-type: none"> 1. Make sure the X-ray Lab and Mobile machines are properly shielded 2. Regularly check for x-ray leakage <p>Provide medical treatment where staff are exposed to high levels of radiation</p>
	Spread of Ebola from infected person to uninfected person	<ol style="list-style-type: none"> 1. Sensitize the communities to regularly wash hands after visiting patients in hospital, as well as after taking care of patients at home

Environmental components	Impacts	Mitigation measure
		<p>2. Encourage communities to rush to the hospitals with suspected cases</p> <p>3. Provide adequate and appropriate protective clothes to health workers</p> <p>4. Health workers must attend to one suspected case or confirmed case and change clothes or disinfect before attending to another person</p> <p>5. Train staff on appropriate trained on wearing of protective gear and handling of patients</p> <p>6. Use chlorine to clean the facilities and linen;</p> <p>7. Do not allow guardians inside the Ebola quarantine/treatment centres</p> <p>8. Staff must be oriented to and follow the ICWMP;</p> <p>9. Conduct civic health education for the communities</p> <p>10. Observe safe burial practices (i.e. no keeping of remains in the homes, contact with dead person, no washing of the remains, wearing protective clothes during burial)</p> <p>11. Burials of dead patients must be conducted by trained health workers</p>
	Exposure to infectious wastes	<p>1. Segregate wastes at the point of generation to enable appropriate and safe handling</p> <p>2. Waste should not be stored more than 24 hours before being destroyed</p> <p>3. Waste bins with puncture resistant containers inside (or thick plastic bags) must be placed inside the facilities and close to the patient</p> <p>4. Use trolleys or wheel barrows to transport wastes (do not use hands)</p> <p>5. Ensure there is total incineration of wastes</p> <p>6. Install advanced incinerators which can reach high temperatures for long periods</p> <p>7. Sharps and metallic wastes must be incinerated</p> <p>8. All infectious waste must be appropriately disinfected before disposal</p> <p>9. Follow the proposed waste management measures in the ICWMP</p>
Social	Discrimination of	1. Sensitize communities on Ebola and

Environmental components	Impacts	Mitigation measure
	suspected or confirmed cases and persons declared Ebola free	preventive measures
	Difficult terrain is a barrier to access health services	Reach local people through innovative means e.g. strengthening work relationships under PPP
	Higher reliance on traditional healers	Increase awareness through IEC
Soil	Land degradation and soil contamination	<ol style="list-style-type: none"> 1. Follow the given specification for digging pit and burying wastes 2. Rehabilitate the land after burying of wastes 3. The site for burying wastes must be properly marked or fenced 4. Ensure that there is complete incineration of the wastes

5. BEST PRACTICES FOR INFECTION PREVENTION AND CONTROL

5.1 Understanding TB

5.1.1. TB causes and stages

The bacillus or pathogen is normally spread when people with TB infection in their lungs cough and spread germs into the air. Figure 5.1 depicts how TB is normally spread.

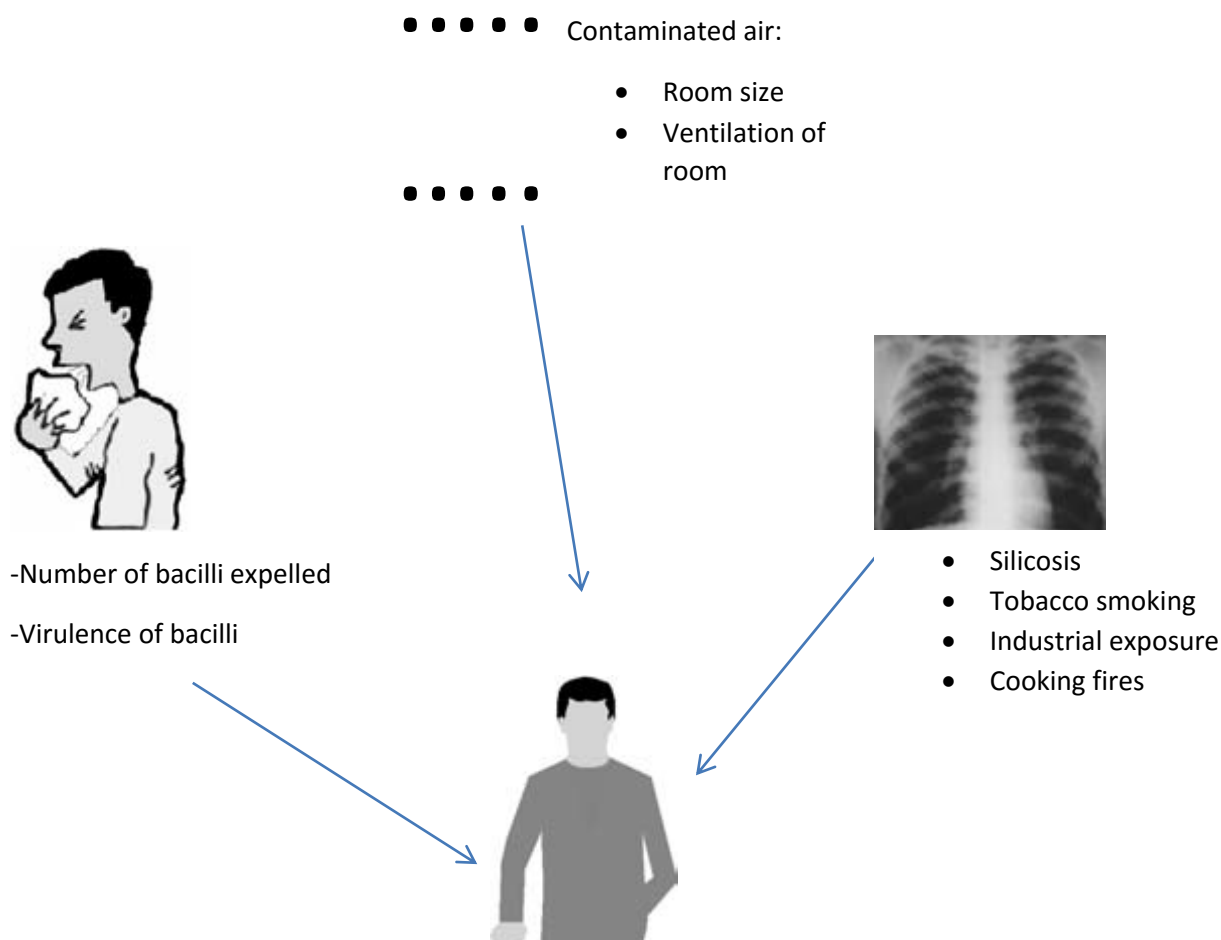


Figure 5.1. Factors affecting TB transmission (as adapted from WHO, 2003)

TB transmission is in fact more intense in crowded, poorly ventilated spaces where there is little air flow and ambient sunlight¹⁰. In such settings, there is increased likelihood of inhalation of infectious *Mycobacterium tuberculosis*.

For best TB infection prevention and control, it is important to understand what TB is and how it spreads. TB is an infectious disease caused by *Mycobacterium tuberculosis*¹¹. There are various phases of TB infection that are worthwhile to note for an effective TB infection prevention and control programme. Exposure to *M. tuberculosis* from an infectious case can lead to infection that is

¹⁰ Malawi National Tuberculosis Programme Manual. (2012). 7th edition. Can also be accessed at www.who.int/./malawi_tb or www.medcol.mw/globalhealth/uploads

¹¹ WHO (2003). Guidelines for workplace TB control activities: The contribution of workplace TB control activities to TB control in the community.

either asymptomatic or symptomatic. Asymptomatic phase of infection is when there are no symptoms of TB, while the symptomatic phase is when there are symptoms of TB infection (see table 5.1 for more differences or characteristics).

Table 5.1. Characteristics between latent TB infection and active TB (WHO, 2003)

Latent TB infection	Active TB
Few disease causing organisms (bacilli) in body	Many disease causing organisms (bacilli) in body
No symptoms	Symptoms exist e.g. weight loss, cough
Chest X ray normal	Chest X ray generally abnormal
Tuberculin test generally negative	Tuberculin test generally positive
Sputum smears and cultures negative	Sputum smears and cultures positive
Not infectious	Infectious before effective treatment

The stage at which there are no symptoms of infection is termed latent infection while the stage at which there are symptoms of infection is termed active TB. Proper diagnosis of active TB or the definition of TB cases by health workers is important for the following¹²:

- Proper patient registration and case notification;
- Selecting appropriate standard treatment regimens
- Standardizing the process of data collection for TB control;
- Evaluating the proportion of cases according to site, bacteriology and treatment history;
- Cohort analysis of treatment outcomes;

5.1.2. TB and HIV

It is known that presence of HIV infection increases the risk of development of active TB from latent stage. Without HIV infection, 90% of the cases will never become ill with TB and 10% will develop active TB (WHO, 2009). Thus, the higher the HIV prevalence in a population, the greater the risk of TB incidence. The probability of developing active TB is actually highest during the first two years after infection and then the chance of developing active TB decreases with time. Active TB phase may occur either due to reactivation of latent infection or re-infection with *M.tuberculosis* or a combination of both.

5.2 Infection Prevention and Control measures for TB

Infection Control refers to specific measures and work practices that reduce the likelihood of transmitting pathogens (in this case *M.tuberculosis*) from one individual to the other. It is paramount that infection control measures are included in all work place programme activities. According to WHO, the three main recommended methods for effective TB control in congregate settings (e.g. mines, health facilities or households) include: 1) Work practice and administrative control; 2) Environmental or engineering control; and 3) Personal respiratory protection¹³. These measures should be implemented together as they complement one another (WHO, 2009).

5.2.1. Work practice and administrative control

These are practices that alter the way the work is done including timing of work, policies and work practices such as standards and operating procedures¹⁴. The *work practice and administrative*

¹² WHO (2009). Treatment of tuberculosis: guidelines – 4th ed. WHO/HTM/TB/2009.420

¹³ WHO (2006). Guidelines for the programmatic management of drug-resistant tuberculosis.

¹⁴ Guidelines for infection prevention and control for TB including MDR-TB and XDR-TB. (2008). Can be accessed at <http://www.who.int/hiv/pub/guidelines/malawi.pdf>

control measures are known to be the most effective, least expensive, and are of highest priority in resource constrained situations⁷. These measures have the greatest impact on preventing TB transmission within facilities caring for People Living with HIV/AIDS (PLHA)¹⁵. The WHO recognises the following components to good work practice and administrative control measures:

- a. Infection Control Plan;
- b. Administrative support for procedures in the plan (including quality assurance);
- c. Training staff;
- d. Education of patients and increasing community awareness; and
- e. Coordination and communication with the TB program.

5.2.1.1 Infection Control Plan

It is recommended by the WHO for each facility to have a written TB infection control plan that outlines procedures for prompt recognition, separation, provision of services, investigation for TB and referral of patients with suspected or confirmed TB disease. The plan should designate a staff member to be the Infection Control Officer who is responsible for ensuring that infection control procedures are implemented. The following table 5.1, for example, shows the necessary steps for patient management to prevent TB transmission in HIV care settings or congregate settings.

Table 5.2. Steps for patient management to prevent TB transmission in HIV care settings (sources: WHO, 1999; WHO, 2009; WHO, 2012)

Step	Action	Description
1	Screen	Early recognition of patients with suspected or confirmed TB disease is the first step in the protocol. This can be achieved by assigning a staff member to screen patients for prolonged duration of cough immediately after their arrival at the facility. Patients with cough lasting more than 2 weeks or those under TB investigation or treatment should not be allowed to wait in line with other patients to enter, register or get a card. Instead, such patients should be managed as outlined in steps 2, 3, 4, and 5.
2	Educate	Instructing the above mentioned persons in cough hygiene. This includes instructing them to cover their noses and mouths when coughing or sneezing. Where possible, provide them with face masks or tissues to assist them in covering their mouths.
3	Separate	Patients identified as TB suspects or cases, through the screening method in step 1, must be separated from other patients and requested to wait in a separate well-ventilated area and should be provided with surgical masks or tissues to cover their mouths while waiting.
4	Provide HIV services	It is recommended to triage symptomatic patients to the front of the line for the services they are seeking (e.g. VCT) to quickly provide care and reduce the amount of time that others are exposed to them. In an integrated service delivery setting, if possible, the patient should receive VCT services they are accessing before TB investigation.
5	Investigate for TB or refer	TB diagnostic tests should be done on-site, or if not available onsite, the facility should have an established link with a TB diagnostic centre to which symptomatic patients can be referred. Also, each facility should have a linkage with a TB treatment centre to which those who are diagnosed with TB can be referred.

The length of time patients spend in the hospital is also an important issue under administrative control. When patients stay for prolonged periods in the hospital, as is the case when patients come

¹⁵ Addendum to WHO Guidelines for the Prevention of Tuberculosis in Health Care Facilities in Resource-Limited Settings, 1999.

from faraway places, there is an increased risk of nosocomial transmission among patients and health-care workers. This increased risk is, however, decreased when hospital stays are reduced and community based ambulatory treatment is established. It is also important for ambulatory patients to be advised to avoid contact with the general public and susceptible people (e.g. people with HIV and young children).

5.2.1.2 Administrative support

It is recommended that each facility should have an Infection Control Officer. Large facilities may, in addition to the infection control officer, also have an infection control committee. The Officer is responsible for managing the infection control committee and developing a written infection control plan, monitoring its implementation, and providing effective training for health care workers and other staff.

In case of mines, the following should be safeguarded at administrative level:

- a. Adequate and regular service of mine vehicles and plant (for dust and noxious fumes);
- b. Enforcement of pre—and-post and regular medical check-ups of workers for TB and other occupational diseases;
- c. Adequate monitoring of the mine work environment and information dissemination;
- d. Making sure that occupational safety and health committees are set up;
- e. Enforcement and making sure that all workers adhere to appropriate use of PPE;
- f. Provision of adequate PPE (e.g. helmet, face masks); and
- g. Isolation or redeployment of patients to other sections.

5.2.1.3 Training of staff

For effective infection control, all staff working in the facility should understand the importance of infection control policies and their role in implementing them. Health care workers, staff members, and lay workers ought to receive job category specific instruction. Training of all staff should be conducted before initial assignment and continuing education should be provided to all employees and volunteers on an annual basis. Content of training should include:

- a. Basic concepts of *M.tuberculosis* transmission and pathogenesis (difference between latent infection and disease, see section 5.1 for more details);
- b. Risk of TB transmission to health care workers and staff;
- c. Symptoms and signs of TB;
- d. Impact of HIV infection on increasing risk of developing TB disease and importance of TB as the major cause of death for PLHA;
- e. Importance of the Infection Control Plan and the responsibility that each staff member has to implement and maintain infection control practices;
- f. Specific infection control measures and work practices that reduce the likelihood of transmitting TB; and
- g. Measures staff can take to protect themselves from TB

5.2.1.4 Education of patients and community awareness

For settings providing care to HIV infected persons, educating communities and patients to recognise symptoms of TB and to seek health care and further investigations should be a routine. Patients and community members should understand how to protect themselves and others from exposure to TB by simple cough hygiene measures.

5.2.1.5 Coordination between TB and HIV/AIDS care programs

The coordination between TB and HIV/AIDS is one of the initiatives of STOP TB department of WHO to prevent TB in persons infected with HIV. Most countries have established TB/HIV coordinating bodies with a goal of having similar committees at every level of health care service. It is

recommended that facilities, without an integrated system of TB and HIV, develop an agreement with the local TB program which establishes: 1) a referral mechanism for patients suspected of having TB disease to be investigated in the TB diagnostic centre and started on treatment, if indicated; and 2) a monitoring mechanism which provides feedback to the referring facility to evaluate the linkage with TB diagnostic services and the appropriateness of referrals as indicated by the proportion of suspects actually confirmed as having TB disease.

5.2.2. Environmental/Engineering Control

These are known as second line defence mechanisms. *Environmental control* measures assume that unsuspected and untreated TB patients will enter hospitals despite all efforts to identify them. These measures attempt to reduce the concentration of infectious droplet nuclei in the air¹⁶. Such measures include maximisation of natural and or mechanical ventilation (controlling direction of airflow)¹⁷, Ultraviolet Germicidal Irradiation (UVGI) and high efficiency particulate air filtration. It is recommended by WHO (2009) that, buildings in congregate settings comply with national regulations for ventilation. For example, the current WHO ventilation standard for an airborne precaution room is at least 12 ACH. This is equivalent to 80 l/s/patient for a room of 24 m³. Environmental control measures are also important for high risk settings such as sputum induction rooms and bronchoscopy rooms. Laboratories that process MDR-TB specimens, therefore, require strict environmental controls.

Similarly, in case of mines, there has to be provision for adequate environmental and engineering controls through:

- a. Provision of adequate air flow to confined underground operations;
- b. Evacuation of operators before and after blasts; and
- c. Dust suppression on crushing, milling, plant, haulage roads and other confined workplaces.

5.2.3. Personal Respiratory Protection (Special masks)

This refers to special masks that prevent TB transmission which are known as ‘particulate respirators’ and are specially designed to protect the wearer from tiny (1-5µm) airborne infectious droplets (WHO, 2009). This is the third line of defence against nosocomial TB transmission. It is of particular importance because both administrative and environmental controls cannot provide complete TB protection. An N95 mask for example, which can be worn by health-care providers and visitors, protects from inhaling respiratory pathogens that are transmitted through the airborne route. Medical masks generally reduce the spread of microorganisms from the wearer to others, by capturing large wet particles. Patients and presumptive TB cases who are coughing are supposed to wear the surgical masks to prevent TB transmission.

The use of special masks should, similarly, be enforced in the mines as already indicated in section 5.2.1.2. The subsequent section provides more information on what is required in a TB infection plan at facility level.

5.2.4. Facility based TB Infection Control Plan

It is very important, prior to coming up with a facility TB infection control plan, to evaluate clinical focus (e.g. TB or HIV services), the number of beds, the number of employees, location, disease prevalence in the community, volume of patients and the risks of exposure to employees and

¹⁶ Francis J. Curry National Tuberculosis Centre. (2007). Can also be accessed at <https://www.ndhealth.gov/Disease/TB/Documents/Infection%20Control.pdf>

¹⁷ TUBERCULOSIS INFECTION CONTROL IN THE ERA OF EXPANDING HIV CARE AND TREATMENT: Addendum to WHO Guidelines for the Prevention of Tuberculosis in Health Care Facilities in Resource-Limited Settings

patients¹⁸. Table 5.3 shows a facility based TB Infection Control Plan which includes the monitoring aspect. The costs presented in the plan are estimations for one TB facility per year and are deemed to be part of the implementation budget, presented in table 9.3.

Among other activities, the facility based TB infection control plan should include the following (*ibid*):

- a. Assessment of TB disease among health care workers;
- b. Assessment of TB and HIV prevalence in the patient population;
- c. Assessment of health care workers training needs;
- d. Training staff on TB, TB control, and the TB infection control plan;
- e. Educating staff periodically on signs and symptoms of TB disease, specific risks for TB for HIV-infected persons, and need for diagnostic investigation for those with signs or symptoms of TB;
- f. Patient flow and placing TB suspects and patients with TB in a separate waiting area or ensuring that they receive services faster;
- g. Using and maintaining environmental and respiratory control measures such as ensuring adequate ventilation and respirators, if applicable;

Appendix 7 provides an example of a facility based TB infection control plan. Health facilities triggered by this project could follow this template or maintain the same facility TB infection control plan templates in place.

¹⁸ http://www.stoptb.org/wg/tb_hiv/assets/documents/tbicimplementationframework1288971813.pdf

Table 5.3. Facility based TB Infection Control Plan

Issue	Responsible authority for implementation	Estimated management cost (budget) in USD	Responsible authority for monitoring	Recommended frequency or times of monitoring	Monitoring indicators
Improve knowledge and skills of health workers in implementing TB infection control					
Print and disseminate training materials	Hospital Director/Manager	230	NTP/MOH/Infection prevention and control committee	Annually	Training materials printed and disseminated
Conduct Training of Trainers (TOT)	Hospital Director/Manager	1870	NTP/MOH/infection prevention and control committee	Quarterly	Number of trainings
Improve health infrastructure and equipment for TB infection control					
Conduct health facilities assessment on TB-IC	Hospital Director/Manager	Part of the job	OSH department/NTP/infection prevention and control committee	Quarterly	-Infection Control Plan in place -
Conduct TB IC facility equipment assessment as an integral part of the Infection Prevention and Control (IPC) assessment (baseline)	Hospital Director/Manager	Part of the job	OSH department/MOH/infection prevention and control committee	Quarterly	Final assessment report
Facilitate the designs renovations, construction and maintenance of the facility buildings	Contractor	To be costed by the Contractor	MOH/NTP/Infection Prevention and Control committee	-Once on making estimates and requisitions -During construction	Purchase requisitions, delivery notes and receipts, contract specifications
Installation of UVGI	Contractor	To be costed by the Contractor	MOH/NTP/Infection Prevention and Control Committee	-During design and construction	Number of UVGI used
Procurement of particulate respirators/surgical masks	Respective Hospital Directors/Managers	2965	NTP/Infection Prevention and Control committee	Once on making estimates, requisitions, and once after purchase	Particulate respirators available
Create awareness in TB-IC among miners and the surrounding communities					
Develop IEC materials on TB IC	Respective Hospital	150	NTP/Infection prevention and	Once on making	IEC materials

	Directors/Managers		Control Committee	estimates, requisitions, and once after purchase	developed
Distribute IEC materials on TB IC to the facility and surrounding communities	Respective Hospital Directors/Managers	115	NTP/Infection Prevention and Control Committee	Once on making requisitions for materials	IEC materials distributed
Educate health care staff on signs and symptoms of TB disease, specific risks for TB for HIV-infected persons	Respective Hospital Directors/Managers	Part of the job	MOH/NTP/Infection Prevention and Control Committee	periodically	Knowledge gained
Develop M&E checklist for TB	Respective Hospital Directors/Managers	50	NTP/Infection Prevention and Control Committee	Quarterly	Checklists developed
Screening of health care workers/miners for TB (provision of total health care package)	Respective Hospital Directors/Managers	10,050	NTP/Infection Prevention and Control Committee	Continuously	-Surveillance for TB among health workers established -Package of prevention interventions for HIV-positive health workers established

5.3 TB Preventive requirements within the mines

TB prevention can be tackled at two points in the cycle of infection and disease¹⁹. The first intervention is that of preventing the passage of the pathogen from someone who is infectious to someone who is not. The strategy here is to find and treat infectious cases. The second intervention is that of preventing people infected with the bacillus (at latent infection stage) from developing active TB. Unlike the first intervention, the impetus here is to maintain good health and in the mining context, to control silicosis and HIV.

For control of TB in the work place (e.g. mining industry), WHO recommends the DOTS²⁰ (Directly Observed Therapy, Short-course) strategy which consists of five elements as shown in table 5.4 below:

Table 5.4. Key DOTS program elements (as adapted from WHO, 2003)

DOTS components	Method	Why it is important in the work place
Political commitment	Government/Senior management accords priority for TB	Only strong commitment can truly ensure that sufficient resources are mobilized and sustained over time
Good quality diagnosis	This relies primarily on sputum smear microscopy of patients presenting to health facilities	a. Early detection of infectious cases is essential to prevent further spread of TB b. Inability to diagnose promptly and accurately can result in prolonged illness, treatment failure, and/or development of multidrug-resistant TB (MDR-TB)
Good quality drugs	A process is established to guarantee uninterrupted supply of approved anti-TB drugs	Inability to guarantee drug quality can result in treatment interruption and/or development of MDR-TB
Short-course chemotherapy given under direct supervision	A health worker or another trained person (usually not a family member) watches the patient swallow anti-TB drugs	Inability to monitor drug intake during the intensive treatment phase can result in irregular medication, treatment failure and/or development of MDR-TB
Systematic monitoring and accountability	a. Treatment progress and outcome is monitored by microscopy for infectious cases b. Cohort analysis is used for evaluation of programme performance	Monitoring and evaluation is essential for programme quality control and sustained improvement

It is known that effective implementation of DOTS strategy saves lives through decreased TB transmission, reduced risk of emergence of drug-resistant TB, and reduced risk for individual TB patients of treatment failure, TB relapse, and death²¹. Figure 5.2 shows some other interventions, in

¹⁹ International Council on Mining and Minerals (ICMM) final report (2008). Good practice guidance on HIV/AIDS, Tuberculosis and Malaria.

²⁰ DOTS is an internationally standardized recommended program for TB treatment and management.

²¹ WHO (2003). Guidelines for workplace TB control activities: The contribution of workplace TB control activities to TB control in the community

addition to the DOTS strategy, which are crucial and have potential to reducing TB incidence in the mining place.

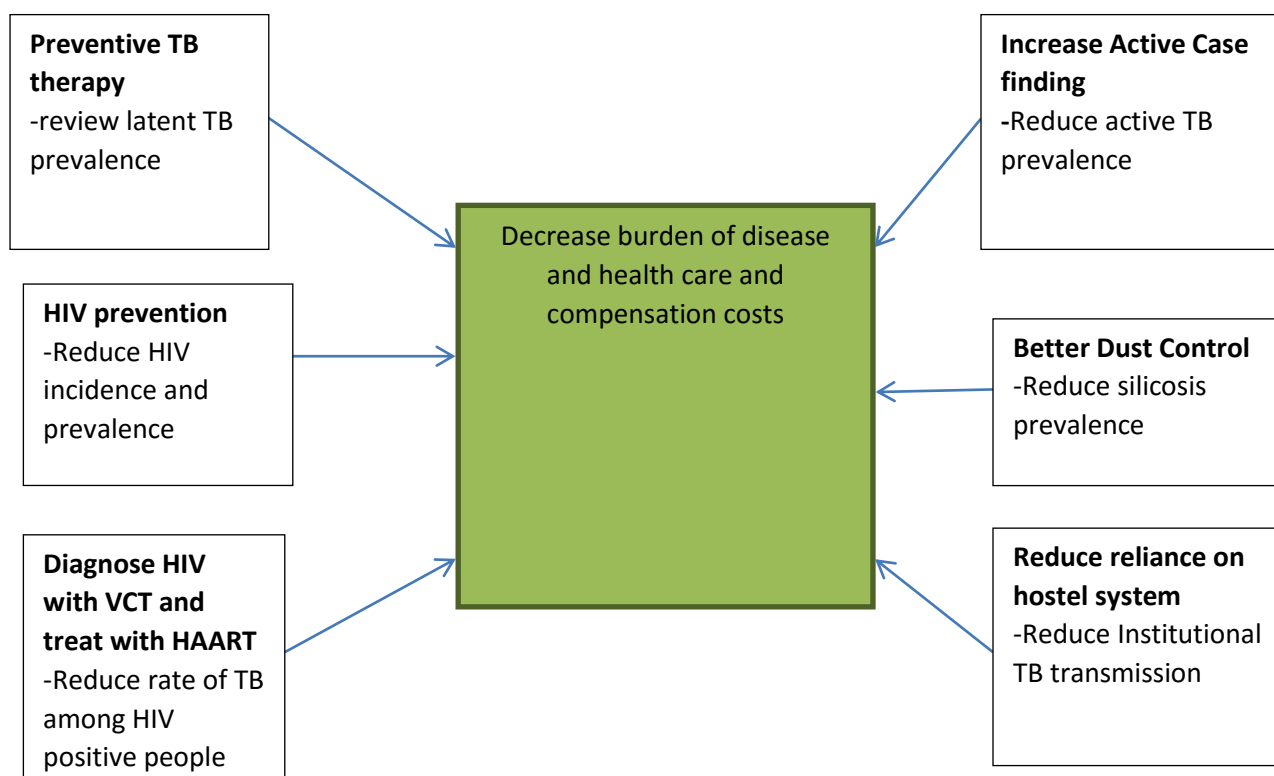


Figure 5.2. Interventions to reduce TB incidence in the mining industry

5.4 Preventive measures for health-care workers

Health-care workers in areas where there are patients with TB (e.g. chest clinics, HIV wards, bronchoscopy units, radiology units, and TB laboratories) are at a great risk of being exposed to TB²² infection. Similar to the preventative measures associated with TB in mining, the WHO guidelines for infection control¹¹ recommend the following infection control measures for Multi-Drug Resistant TB (MDR-TB):

- a. Rapid detection;
- b. Immediate implementation of infection control precautions for all suspect or proven cases;
- c. Diagnosis and treatment of TB;
- d. Transport of patient – patient should wear a surgical mask; and
- e. Appropriate infection control precautions, including standard precautions plus additional precautions (airborne precautions).

5.5 Standard precautions

Standard precautions are the basic level of infection control practices which are to be used, as a minimum, in the care of all patients regardless of suspected or confirmed infection status²³. The following are the standard preventative measures for health-care workers (including patients and visitors at the health facility):

- a. Hand washing and anti-sepsis (hand hygiene);

²² WHO. (2004). Practical Guidelines for Infection Control in Health Care Facilities

²³ WHO. (2007). Can also be accessed at http://www.who.int/csr/resources/publications/EPR_AM2_E7.pdf

- b. Appropriate use of Personal Protective Equipment (PPE) when handling blood, body substances, excretions, and secretions;
- c. Appropriate handling of patient care equipment and soiled linen;
- d. Prevention of needle stick/sharp injuries;
- e. Environmental cleaning and spills management; and
- f. Appropriate handling of waste.

It is essential that standard precautions are applied at all times for the following reasons:

- I. People may be exposed to risk of infection from others who carry infectious agents;
- II. People may be infectious before signs or symptoms of disease are recognised or detected, or before laboratory;
- III. Tests are confirmed in time to contribute to care;
- IV. People may be at risk of infectious agents present in the surrounding environment including surfaces or from equipment; and
- V. There may be an increased risk of transmission associated with specific procedures and practices.

5.6 Best practices for Ebola Virus Disease (EVD) infection control

5.6.1 Understanding Ebola threat

Ebola Virus Disease is severe and often fatal disease with no known specific treatment or vaccine²⁴. There are five known different species of Ebola virus namely: Bundibugyo; Cote d'Ivoire; Reston; Sudan; and Zaire²⁵. The Ebola virus of Bundibugyo, Sudan and Zaire species have been associated with epidemics of Viral Haemorrhagic Fever (VHF) characterised by high inter-human **transmission** and causing death of 25-90% of infected persons. The **source** of the virus is thought to be fruit bats which feed on fruits in the tropical forest and enter into direct or indirect contact with other animals and pass on the infection. Humans are known to be infected through handling of infected wild animals. **Possible routes of infection** include but not limited to: i) close contact with the blood, secretions, organs or other bodily fluids of infected or dead animals; ii) consumption of infected bush-meat; and iii) touching objects that have come in contact with the virus. The **incubation period**²⁶ is 2-21 days. The disease is often characterised by the sudden onset of fever, intense weakness, muscle pain, headache, and sore throat. This is followed by vomiting, diarrhoea, rash, impaired kidney and liver function, and in some cases, both internal and external bleeding.

5.6.2 Standard Operating Procedures (SOPs)

The Standard Operating Procedures (SOPs) developed by WHO (2014)²⁷ describe the prevention and control measures to be put in place during the Ebola pre-epidemic (before outbreak), outbreak, and post-epidemic eras. Figure 5.3 briefly shows the recommended activities to be done during these eras.

²⁴ Center for Disease Control and Prevention

²⁵ WHO. (2014). Standard operating procedures for controlling Ebola and Marburg virus epidemics. Provisional recommendations from WHO. Can be accessed at <http://ebolaalert.org/wp-content/themes/ebolaalert/assets/PDFS/WHOSOPPreference.pdf>

²⁶ Incubation Period is the time interval from the infection with the virus to onset of symptoms

²⁷ WHO. (2014). Standard operating procedures for controlling Ebola and Marburg virus epidemics. Provisional recommendations from WHO. Can be accessed at <http://ebolaalert.org/wp-content/themes/ebolaalert/assets/PDFS/WHOSOPPreference.pdf>

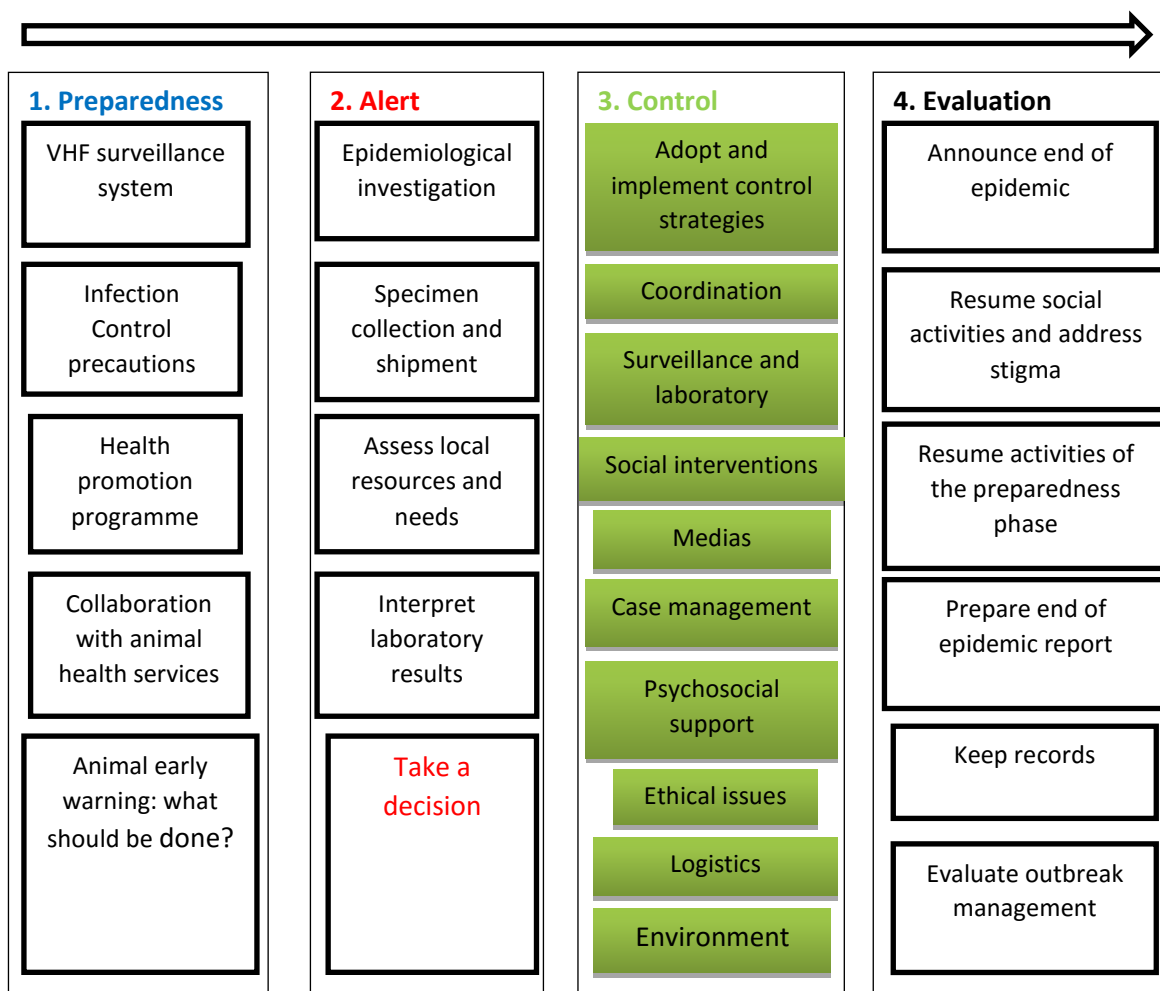


Figure 5.3. Ebola outbreak: Preparedness, Alert, Control, and Evaluation

5.6.2.1 Pre-epidemic period

During this period, when there are no EVD cases or preparatory phase as is shown in figure 4.3, it is vital to for the public health services to put in place a system for monitoring cases of Ebola. What is important to note is that Ebola outbreaks in animals precede the case of humans. Collaboration, therefore, with the system that monitors mortality of wildlife in national parks is paramount to quickly alert public health officials. During this period, basic infection control measures (standard precautions) should be intensified in all health facilities. It is also important to take advantage of this period to inform the public about Ebola and high risk behaviours; and protection measures that each person can take to prevent infection. Financial resources permitting, health authorities may put in place social mobilisation campaigns to promote and encourage practices that prevent Ebola infection.

5.6.2.2 Suspicious Ebola case/Alert phase

If there is grapevine communication and rumours are everywhere about an Ebola case, a multidisciplinary team (comprising of Epidemiologist, Clinician, Laboratory Specialist, Logistics Coordinator and other necessary experts) should be sent to the area-fully equipped with necessary protection gear to investigate, assess the risk of the epidemic, collect samples and send them to the reference national laboratory, and take the initial control measures while waiting for laboratory results.

5.6.2.3 Outbreak epidemic period

Once Ebola case is confirmed, the following need to be done:

- a. Establish coordination of the epidemic prevention and control activities, and resource mobilisation;
- b. Have in place a monitoring system for active search of Ebola cases and monitoring of all contact subjects for 21 days after their last exposure, and the isolation of the contact subjects if they fall ill;
- c. Promote a health promotion and communication programme with the intention of informing the public and promoting practices that reduce community transmission;
- d. Provide treatment and care for Ebola patients in the affected zone during which, the following rules have to be adopted:
 - i. Respecting the dignity and right of patients and their families;
 - ii. Installation of an isolation ward and adoption of protected care rules;
 - iii. Organisation of safe transportation of patients from their homes to the ward; and
 - iv. Protected burials to be done in respect of funeral ceremonies
- e. Intensify basic infection control measures in medical community within or outside the affected zone; and
- f. Provide efficient logistics for establishing, as soon as possible, all the necessary inputs, and as early as possible, ensure possible movements of experts, patients and samples under safety conditions.

5.6.2.4 Post-epidemic period

Once the EVD outbreak has ended, the monitoring activities of the pre-epidemic period should be reviewed. The District supervising team should conduct an assessment of the management of the Ebola outbreak; prepare an end of Ebola outbreak report, file documents on the international outbreak which could be used as reference documents for the health district, country and international community during future EVD episodes. The District supervising team should also take advantage of this epidemic end, to express solidarity and empathy to the affected populations.

During this phase, it is also very important to provide psychosocial care to cured patients, orphans, affected communities, and all health staff who participated in management of cases to ensure their social re-insertion.

6 BEST PRACTICES FOR HEALTH CARE WASTE MANAGEMENT

6.1 Health-care Waste

Health Care Waste (HCW) includes all the waste generated within health-care facilities, research centres and laboratories for medical procedures; and includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radio-active materials (WHO, 2014)²⁸. This waste carries greater potential for causing infection and injury than any other form of waste due to its contamination state (*Ibid*) and this necessitates its proper handling and management²⁹ (WHO, 2004). Between 75% and 90% of the waste produced by health care providers is equivalent to domestic waste which is usually called ‘non-hazardous’ or general health care waste (figure 6.1).

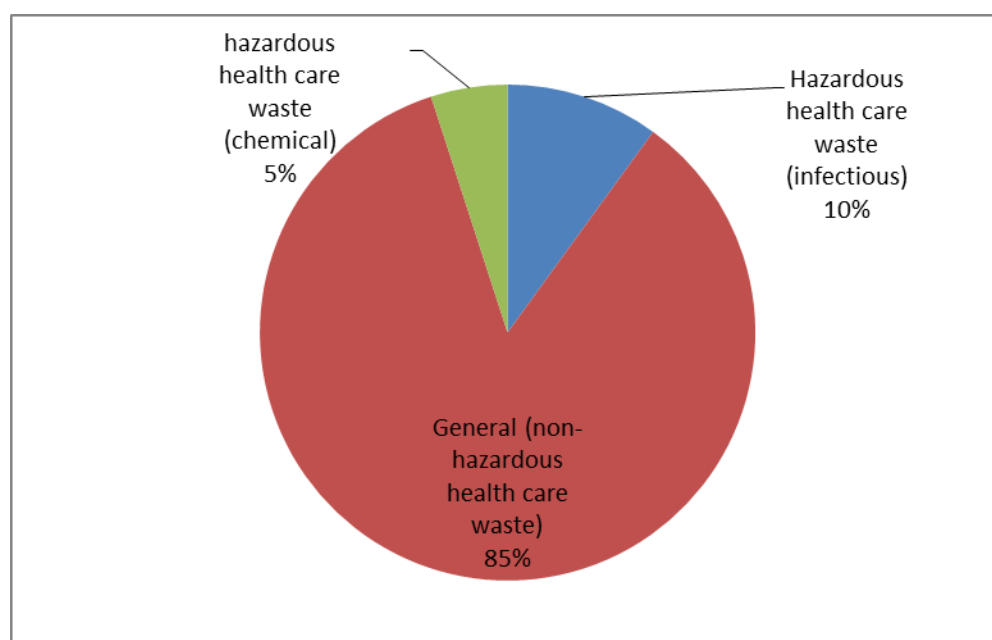


Figure 6.1. Typical waste composition in a Health Care Facilities (Source: WHO, 2014)

There are generally two major classifications of waste: hazardous and non-hazardous waste⁶. Hazardous waste includes cytotoxic drugs and clinical waste (e.g. sharps and non-sharps) while non-hazardous waste includes biodegradable waste (e.g. kitchen waste or generally domestic waste) and inorganic waste (i.e. waste that is recyclable and can be sold at the market). Table 6.1 shows more categories of waste (hazardous and non-hazardous) according to WHO (2014) classifications.

Table 6.1. Waste categories, description and examples

Waste category	Descriptions and examples
Hazardous HCW	
1. Sharps waste	Used or unused sharps (e.g. hypodermic, intravenous or other needles; auto-disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass)
2. Infectious waste	Waste suspected to contain pathogens and that poses a risk of

²⁸ WHO. (2014). Safe management of wastes from health-care activities.

²⁹ WHO. (2004). Practical Guidelines for Infection Control in Health Care Facilities.

	disease transmission (e.g. waste contaminated with blood and other body fluids; laboratory cultures and microbiological stocks; waste including excreta and other materials that have been in contact with patients infected with highly infectious diseases in isolation wards).
3. Pathological waste	Human tissues, organs or fluids; body parts; foetuses; unused blood products
4. Pharmaceutical waste	Pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals
5. Cytotoxic waste	Cytotoxic waste containing substances with genotoxic properties (e.g. waste containing cytostatic drugs – often used in cancer therapy; genotoxic chemicals)
6. Chemical waste	Waste containing chemical substances (e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents; waste with high content of heavy metals, e.g. batteries; broken thermometers and blood-pressure gauges)
7. Radio-active waste	Waste containing radioactive substances (e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources)

Non-hazardous or general HCW Waste that does not pose any particular biological, chemical, radioactive or physical hazard.

6.2 Health-Care Waste Management

The proposed project will generate health care waste through a number of clinical activities including sputum testing or TB detection. These activities will demand use of sputum cups and slides among medical equipment which have to be safely disposed to prevent infection. Management of Health-Care Waste (HCW) is thus a public health, workplace, safety, and environmental concern. Improper management of HCW may result into health and environmental hazards including: 1) Infectious hazards such as AIDS and respiratory cases; 2) Toxic hazards which include effects of radioactive substances; 3) Genotoxic hazards which include effects of cytotoxic drugs; and 4) Injury hazards from needle pricks and sharp objects³⁰. Developing and monitoring a sound health-care waste management system is therefore an obligation that must be done in coordination with an Infection Control team (WHO, 2004). Health-care Waste Management for the proposed project must therefore, best be done in accordance with recommended standards and procedures such as those of the WHO (2004).

In Malawi, as is stated in the draft HCWM policy (2008), HCWM starts at collection and storage stage where HCW is generated. The processes involved in HCW collection and storage include: Waste collection; Segregation; waste storage; and recycling. Waste collection is the process of generating and gathering HCW into appropriate waste receptacles (containers or bags) while segregation involves the systematic separation of HCW into categories in order to reduce risks, treatment cost, and ensuring proper treatment of each HCW category. As indicated by the WHO (2014) and the HCWM training manual (2008), HCW segregation should be standardised throughout the country using colour codes (see table 6.2 for recommended measures). On the other hand, waste storage

³⁰ Malawi Ministry of Health (2008). Health Care Waste Management Training Manual for Qualified Health Workers. Department of Environmental Health.

encompasses the secure keeping of HCW into appropriate waste receptacles/containers prior to final treatment or disposal whereas recycling involves recovering the basic material in a product (e.g. cartons or bottles from pharmacy) for reuse as a new or different product. Chapter 9 of this ICWMP details out the guidelines to be followed when handling HCW to be generated from this project.

According to WHO (2004, 2014), though, steps in health-care waste management include: waste generation; segregation/ separation; collection; transportation, treatment and disposal. Figure 6.2 presents an overview of the minimal procedures that should be followed to effectively manage HCW from point of generation to point of disposal.

step	location	healthcare waste stream	key points
0		<i>waste minimization</i>	<i>purchasing policy; stock management; recycling of certain types of waste...</i>
1	in medical unit	generation	
2		segregation at source	<i>one of the most important steps to reduce risks and amount of hazardous waste</i>
3		collection + on-site transport	<i>protective equipment; sealed containers; specific easy to wash trolleys</i>
4	in health facility	on-site storage	<i>lockable easy to clean storage room; limited storage time of 24-48 hours</i>
5		on-site treatment / disposal	<i>adequate storage room; limited time of max 48 hours</i>
6	outside of health facility	off-site transport	<i>appropriate vehicle and consignment note; HCF is informed about final destination</i>
7		off-site treatment / disposal	<i>appropriate vehicle and consignment note to ensure...</i>

Figure 6.2. Summary for HCW stream (**source:** Secretariat for Basel Convention & WHO, National Health-Care Waste Management Plan: Guidance Manual. Can also be accessed at www.who.int website)

6.2.1 Waste Segregation and on-site Storage

Waste segregation is one of the important ways of managing Health-care Waste. It is basically the process of separating the different waste streams, based on the hazardous properties of the waste, the type of treatment and disposal methods that are applied. A recommended way of segregating HCW into categories is by sorting and storing the waste into colour-coded, well packed and labelled containers (see table 6.2).

Segregation must always be done at source. Given the fact that only about 10-25% of the HCW is hazardous, treatment and disposal costs could be greatly reduced if thorough segregation was performed. Segregating hazardous from non-hazardous waste also significantly reduces risks of infecting workers handling HCW. Generally, the part of the HCW that is hazardous and requires special treatment could be reduced to some 2-5% if the hazardous part was immediately separated from the other waste.

Table 6.2. Waste segregation (Source: WHO, 2014)

Type of waste	Colour of container and markings	Type of container
Highly infectious waste	Yellow. marked 'Highly Infectious' with biohazard symbol	Strong, leak-proof plastic bag or container capable of being autoclaved
Other infectious waste, pathological and anatomical waste	Yellow with biohazard symbol	Leak-proof plastic bag or container
Sharps	Yellow marked 'sharps' with biohazard symbol	Puncture-proof container
Chemical and pharmaceutical waste	Brown labelled with appropriate hazard symbol	Plastic bag or rigid container
Radioactive waste	Labelled with radiation symbol	Lead box
General Health Care Waste	Black	Plastic Bag

6.2.2 Collection and transportation of health-care waste

To avoid waste accumulation, collection must be on a regular basis. The waste must be transported to a central storage area within the HCF before being treated or removed. Collection must follow specific routes through the HCF, to reduce the passage of loaded carts through wards and other clean areas. The carts should:

- Be easy to load and unload;
- Have no sharp edges that could damage waste bags or containers; and
- Be easy to clean.

Great care should be taken when handling HCW as most serious risks are associated with injuries from sharps. When handling HCW, sanitary staff and cleaners should always wear protective clothing including (as a minimum) overalls or industrial aprons, boots and heavy duty gloves.

In the large health-care facilities, HCW is temporarily stored before being treated or disposed of on-site, or transported to a disposal facility off-site. Non-risk HCW should always be stored in a separate location from the infectious/ hazardous HCW in order to avoid cross-contamination.

6.2.3 Treatment and Disposal of Health Care Wastes

In large health-care facilities and laboratories, disposal of HCW can be a serious problem and is normally the case in many countries, in the absence of adequate financial means and specific budget lines. In addition, lack of specific and affordable transportation services in municipalities and towns as well as the low monitoring capacities of the municipal authorities drastically reduces the waste treatment and disposal options. Due to lack of protocols, disparities between institutions in the way HCW is disposed of are common and this is also applicable for many laboratories.

In small health facilities and laboratories, it is common practice to dispose of clinical waste and sharps into pits without segregation; and burn them periodically. This is mainly due to absence of

adequate infrastructures and equipment as well as supporting municipal systems for waste management.

6.3 Assessment of Laboratory Waste

Implementation of the proposed Southern Africa Regional TB in Mining Project will result in increased generation of health-care waste in the laboratories. Such wastes which include used sputum cups and slides will have to be monitored. To mitigate this impact, the wastes likely to be generated have been assessed and a Laboratory Waste Management Plan has been developed in Section 6.4. The assessment has considered the quantities and composition of laboratory wastes, handling, collection, storage and treatment as well as disposal.

6.3.1 Composition of Laboratory Waste

Laboratory waste, just like medical waste (as described in section 6.1.); generally comprises of **non-risk health-care waste, infectious waste and highly infectious waste** consisting of all viable biological and pathological agents, including those artificially cultured in the laboratory. Cultures and stocks, dishes and devices used to transfer, inoculate and mix cultures of infectious agents belong to this category of waste. As a precaution, all waste from laboratories should be considered as hazardous waste due to the nature of activities, type of waste and high risk of contamination likely to occur.

Laboratory waste may also consist of anatomical and pathological waste, depending on the functions of the laboratory.

The majority of the waste generated in HCFs in general and laboratories in particular consists of Non-risk Health-care Waste, which is similar to normal household or municipal waste and can be managed by the municipal waste services.

6.3.2 Quantities of Laboratory Waste

Assessment of laboratory waste is important because it helps to organise the flow of waste, stage by stage, all the way to the treatment or disposal place. As it may be appreciated, the amount of waste generated by a laboratory can only be established through an assessment process conducted specifically for that particular laboratory. This is because the amount of waste generated during any particular period or at any particular time depends on several factors including but not limited to:

- a. Size of laboratory and scale of activities;
- b. Type of laboratory materials and chemicals purchased (e.g. whether reusable, recyclable or disposable;
- c. Quantities of laboratory materials and chemicals used (e.g. depending on reagent formulations, larger quantities of low concentration chemicals may be used for a chemical analysis, leading to generation of more waste); and
- d. Type of packaging (whether packaging is reusable or recyclable etc.)

Therefore, it is important that an assessment process is drawn up and used to determine the amount of waste generated and to be managed by each laboratory in Malawi; and the following are steps of a typical waste assessment process:

- 1) Identify volume and nature of products purchased and used by each department and area of the laboratory, for laboratory use;
- 2) Identify and map out all the sources or origins of waste from the laboratory services;
- 3) Identify, characterize and quantify waste streams from each department and area of the laboratory;

- 4) Identify volume and nature of reusable and disposable materials from each department and area of the laboratory;
- 5) Design a "system" and "flow pattern" of waste to facilitate waste separation at source, collection, transportation and on-site storage for separated waste. Consider and analyse options including waste minimization, recycling and reuse;
- 6) Identify and evaluate options for collection, internal transportation and disposal methods as well as sites; and
- 7) Establish regular measuring, weighing and recording patterns and locations; including personnel to perform the tasks.

Laboratory waste can be measured in pre-calibrated or pre-weighed containers (bags, rubbish bins etc.) and based on the number of containers filled with laboratory waste during a defined period of time; the total quantity of waste can be estimated.

Where waste is measured in volume, mass to volume ratio can be applied to estimate the total weight of the laboratory waste generated. However, preference should be given to weighing the waste directly as this would give a more accurate estimation of quantity. The figures obtained for waste collected over a period of several days can then be divided by the total number of days to estimate the average quantity of laboratory waste generated per day for that particular laboratory.

The amount of liquid waste can be measured directly using line meters installed on wastewater pipes or can be measured through weighing in pre-calibrated collection buckets. Where volume measurements are used, the density or specific weight (kg/litre) of the liquid waste may be used to obtain the total weight for the waste.

To determine the quantity of waste produced by a laboratory over a period of time, measurements for all the waste streams are to be regularly and properly recorded, using the record sheet provided as Table 6.3. The table can be used to estimate quantities of laboratory waste generated daily, weekly or monthly (depending on the waste generation rates). Care should always be taken to avoid overfills of temporary storage containers and it is important to note that infectious wastes are not to be temporarily stored for long periods to avoid chances of contamination and infection.

Table 6.3. Laboratory waste estimation form

RECORD OF LABORATORY WASTE GENERATION FOR 2015						
Batch No.....						
Opening Date						
Opening Time						
	Waste generated (kg)	Waste treated onsite (kg)	Waste treated off-site (kg)	Waste Discharged to sewer (kg or litre)	Radioactive waste (kg)	Total Waste (kg)
Risk Waste						
General Infectious Waste						
Sharps						
Pathological Waste						
Pharmaceutical / Chemical						
Liquid Waste						

Other (please specify)						
Total Risk Waste						
Non Risk General Waste						
General / non-infectious						
Liquid Waste						
Foodstuffs used as pigswill						
Cardboard						
Paper						
Plastic recovery						
Metal recovery						
Glass recovery						
Other (Please specify)						
Total Non-Risk General Waste						
Total HCW						
Batch Closing date.....						
Completed by Date Time						

6.3.3 Determination of appropriate waste disposal technology

To determine the appropriate waste disposal technology, it is necessary to estimate the quantities and compositions of waste generated per year and classify it as:

- General waste which can be disposed of or treated like municipal waste
- Medical waste (sharps and hazardous waste) which poses a variety of potential health risks thereby needing special attention.

Only after then would the different appropriate technologies be selected, purchased and applied at the different levels or stages of HCWM (e.g. figure 6.2).

6.3.4 Handling, storage and collection

Handling and storage of special health-care waste consists of primary packaging at the source and secondary packaging for transportation. For primary packaging, all special health-care waste should be placed in leak-proof and disposable bags or containers. In addition, containers for sharps must be puncture proof. Glass containers are generally unsuitable and PVC containers are not preferred for environmental protection reasons.

A colour code of either yellow or red should be chosen for all special HCW. For pathological waste, a contrasting and non-transparent colour should be used. For secondary transport packaging, leak-proof solid containers mounted on wheels should be used for easy transport. Colour-coding should follow the primary packaging code. World Health Organization recommended colour-coding, to indicate the level of risk is as follows;

- a. General Health Care waste should be put in black bags;
- b. Potentially infectious or hazardous HCW should be put in yellow bags; and
- c. Sharps should be placed in rigid containers which are yellow or with yellow stickers.

To be consistent, all bag holders (preferably to be the same as 'pedal bins') and transporting trolleys should be black for general waste and yellow for hazardous waste. Separate trolleys should be used for general waste and potentially infectious waste.

In-house storage may consist of two levels:

- a. A well ventilated room at or near the ward, where collectors will take the waste; and
- b. A centrally located air-conditioned storage room, where temperatures can be kept low, until the waste is picked up for treatment.

Personnel handling HCW must be protected with appropriate personal protective clothing (mop caps, heavy duty gloves, acid resistant coverall and plastic aprons, safety goggles and safety shoes).

6.3.5 Waste treatment

It may be safer for some wastes to be treated or pre-treated on site. Laboratories are uniquely capable of treating some wastes to eliminate hazards or reduce the amount of waste for disposal, thereby cutting costs. However, the technologies are rather sophisticated and capital intensive; requiring elaborate maintenance capacity. The HCWM training manual for Malawi (2008) recommends the following treatment systems:

i. Autoclaving, which involves the heating of waste material with steam in an enclosed container at high pressure. At the appropriate time (> 60 min), temperature (>121°C), and pressure (100kPa) effective inactivation of all vegetative micro-organisms and most bacterial spores can be achieved. Preparation of waste for autoclaving requires separation to remove unsuitable material and shredding to increase the surface area of waste.

Small autoclaves are common for sterilization of medical equipment but a waste management autoclave can be a relatively complex and expensive system, requiring careful design, appropriate segregation of materials, and a high level of operation and maintenance support. The output from an autoclave is non-hazardous material that can normally be land-filled with municipal waste. The wastewater stream needs appropriate care and treatment. Large autoclaves may require a boiler with stack emissions that will be subject to environmental control;

ii. Chemical disinfection, which is routinely used in healthcare practices to kill micro-organisms on medical equipment. Chemicals (mostly strong oxidants like chlorine compounds, ammonium salts, aldehydes, and phenolic compounds) are commonly used in many health facilities. This treatment is most suitable for liquid wastes such as blood, urine stools or hospital sewage. Highly hazardous solid wastes like microbiological cultures or sharps are also chemically disinfected. Chemical disinfection requires strong chemical management infrastructure and sufficient capacity for treatment of hazardous wastewater streams; and

iii. Incineration, which when done properly is a highly advanced technology that can adequately treat all types of special healthcare waste. The key parameters of controlled incineration are combustion at a sufficiently high temperature (between 1,000°C and 1,200°C in the combustion chamber) for long enough time in a combustion chamber with sufficient turbulence and oxygen for complete combustion to be achieved; and problematic gases to be minimized.

In Malawi, the low cost medical waste incinerator called De Montfort is recommended for all hospitals and health centres. The waste is manually loaded and de-ashed on a daily basis. A shovel is used to remove the ashes (after cooling down) and disposed of appropriately in an ash pit. All wastes delivered to the incinerator should be burnt within 24 hours. The HCWM training manual for Malawi (2008) provides details on how a De Montfort incinerator ought to be used i.e.:

- i. Initially put some cartons in the empty incinerator;
- ii. Light and wait for 2-5 minutes before filling with paraffin;
- iii. When it is hot enough, add the waste gradually since all wastes do not burn at the same time;
- iv. To check if recommended combustion temperature has been achieved, look at the smoke. If the smoke is black or white (instead of not visible) then the temperature is not high enough. Either add some more paraffin or wait a longer time before filling the incinerator; and
- v. When you have burnt all the waste, add a small quantity of paraffin so that you can be sure the waste is totally burnt.

There is, however, need for a standardised high temperature incinerator like the St. Gabriel ('Namitondo') - no smoke with complete combustion. This is environmentally friendly.

It has to be noted, though, that Incinerators require: skilled operators or technicians who can control the system manually; extensive flue gas emission controls; and frequently imported spares and supplies. Properly controlled incineration is relatively expensive. Incineration of wastes generates residues, including air emissions and ash. Environmental controls on incinerators in developed countries have been tightened in recent years, principally because of concerns over air emissions such as dioxins and furans as well as heavy metals.

6.3.6 On-site or off-site treatment

Hazardous / infectious HCW can be treated *on-site* (i.e. in the HCF itself) or *off-site* (i.e. in another HCF or in a dedicated treatment plant). On-site treatment is often the only possibility in rural HCFs but on-site treatment can also be carried out for HCW generated in large HCFs (Kafatia, 2009). On-site treatment systems are particularly appropriate in areas where hospitals are situated far from each other and the road system is poor. Advantages of providing each HCF with an on-site treatment facility include convenience and minimization of risks to public health and the environment by confinement of hazardous / infectious HCW to the health-care premises. However, extra technical staff may be required to operate and maintain the systems and it may be difficult for the relevant authorities to monitor the performance of many small facilities. This may result in poor compliance with operating standards, depending on the type of systems, and increased environmental pollution.

The HCW generated in a HCF can also be treated off-site, when centralized facilities exist, in urban areas for instance. Greater cost-effectiveness may be achieved for larger units, through economies of scale, unless the running costs for waste collection and transportation remain too expensive. Although off-site treatment increases dependency of the HCF on an external actor and requires a reliable transportation system, it provides the following advantages:

- a. Hospitals will not have to devote time and personnel to manage their own installations;
- b. Efficient operation can be more easily ensured in one centralized facility than in several plants where skilled workers may not be readily available;
- c. Future modifications or expansions (relating to flue-gas cleaning systems of incinerators, for example) are likely to be less expensive;
- d. Where privatization of facilities is seen as a desirable option, this can be achieved more easily on a regional basis than for numerous small units;

- e. Air pollution may be more easily kept to a minimum at a centralized plant, if specific flue-gas cleaning procedures and incineration temperatures are respected.

Land deposition or Land-filling is considered as a “bottom of the list” option for disposal of untreated HCW, and is only recommended when the economic situation of the country does not permit access to environmentally safer technologies, such as an incinerator or the other previously described options. However caution is to be taken because in most cases what people call landfills are not real landfills but dump-pits where waste is just dumped without covering it with soil. In all cases, waste dumping without land fill is not recommended regardless of category/ classification of the waste (Kafatia, 2009).

In summary, table 6.4 compares the various technologies available for treatment of HCW in general and laboratory waste in particular.

Table 6.4. Comparison of Health Care Waste Treatment Technologies (Kafatia, 2009)

	LANDFILLING	INCINERATION	STERILIZATION (AUTOCLAVE AND MICROWAVE)	CHEMICAL DISINFECTION
Capital cost	Least cost	High investment cost for good, efficient and high capacity incinerators Moderately low capital cost (about \$1000 for a Mark II and \$2000 for a Mark III De Montfort)	Generally expensive (capital intensive) For high volumes of waste, the technology is expensive and needs good infrastructure	Requires investment for strong and safe chemical management infrastructure Requires additional investment for treatment of wastewater streams
Operating cost	Least cost	High operating cost (especially fuel cost) for large capacity and sophisticated units Moderately low (less than 5 USD/ton) for De Montfort Must be replaced or repaired every 3 to 5 years when continuously operated.	Main energy source is electricity Requires spare specialized parts Requires combustion of fuel, for steam generation	Requires reliable stock of chemicals
Ease of operation	Very easy	Small units are relatively simple to operate and maintain and can use biomass	Elaborate preparation process to separate and	Solid and highly hazardous HCW (microbiological cultures or sharps)

	LANDFILLING	INCINERATION	STERILIZATION (AUTOCLAVE AND MICROWAVE)	CHEMICAL DISINFECTION
		<p>to initiate combustion);</p> <p>Regular Operation and Maintenance must be well planned for sustainability</p> <p>Combustion at a sufficiently high temperatures (between 1,000°C and 1,200°C in the combustion chamber) for a long enough time</p> <p>Sufficient turbulence and oxygen required for complete combustion to be achieved and for minimization of flue gas pollutants</p>	<p>remove undesirable material from waste</p> <p>Waste is pulverized, and compressed prior to disinfection</p>	<p>must undergo a relatively complex and expensive preparatory process of segregation, shredding, and milling prior to application of the chemical reagents.</p>
local availability of spare parts	N/A	<p>Flue gas emission controls and imported spares and supplies required.</p> <p>Need for importation of some spare parts may lead to high cost and downtime</p>	Spare parts not readily available	Spare parts not readily available
local availability of operational skills	Skills available	<p>Complex technology for low income countries where skills are lacking</p> <p>High level of operator training and skills required</p>	Sophisticated knowledge and skills required and not readily available locally.	Special training and skills required
demonstrated reliability, durability	Most landfills end up being mere dump pits considered as a lowest option	For properly operated, and maintained units, complete destruction of highly infectious waste can easily be	Used in laboratories mostly on small scale	Most suitable for treating liquid wastes such as blood, urine stools or hospital sewage.

	LANDFILLING	INCINERATION	STERILIZATION (AUTOCLAVE AND MICROWAVE)	CHEMICAL DISINFECTION
	for disposal of untreated HCW	guaranteed		
environmental impacts	<p>Not recommended regardless of category/ classification of the waste.</p> <p>Only recommended when the economic situation of the country does not permit access to environmentally safer technologies</p> <p>Open to scavengers and animals, pests and rodents</p> <p>High potential for surface water pollution and groundwater contamination hence needing special attention e.g. by providing groundwater quality monitoring wells.</p> <p>Waste must be disinfected before burial</p>	<p>Generates residues, including air emissions and ash.</p> <p>Environmental controls on incinerators in developed countries have been tightened in recent years, principally because of concerns over air emissions from pollutants such as dioxins and furans as well as heavy metals</p> <p>Requires disposal of bottom ash/slag and fly ash in a sanitary landfill</p> <p>Requires good site security to keep away animals (such as birds, rodents, insects and other vermin)</p> <p>Air emissions from the incinerator (PM, SO₂, CO₂)</p>	<p>minimal generation of wastewater and with the appropriate conditioning it can be recycled into the system</p> <p>Low gas emissions</p> <p>Waste must finally be taken to landfill site</p>	<p>Requires special treatment of hazardous wastewater streams.</p> <p>Waste must finally be taken to landfill site</p>

6.3.7 Other technical issues

Transportation of special healthcare waste also needs to be given special attention. Unless waste is transported in the most environmentally friendly manner, waste disposal becomes a transfer of problems from one place to another (WHO, 2014).

Special vehicle with closed containers should, as a minimum, transport special health-care waste. Recommended design criteria for special healthcare waste transportation vehicles are provided in the WHO handbook. These should be used to set up standards and guidelines for licensing and monitoring.

Operation and maintenance of equipment and facilities is essential for proper waste management. Good operation and maintenance requires trained and motivated staff, an adequate supply of consumables and spares, and a sufficient ongoing budget. Assessment of these matters is fundamental to choice of waste treatment technology (*ibid*).

6.3.8 Determination of disposal sites

Proper selection of disposal sites is a prerequisite for efficient and effective disposal of waste. Sites for all the treatment technology options and for ultimate disposal of waste must have the following conditions satisfied (Kafatia, 2009):

- a. Minimum distance to watercourses, bores, and dug wells must be met, as recommended by the Water or Local Authority;
- b. High water table areas, flood plains or water logged areas must be avoided;
- c. Soil characteristics (permeability and texture) must not permit percolation of leachate;
- d. It must be located far away from human settlements, and public services, (including roads, airports etc.);
- e. Wind direction must not deliver odours to residential areas;
- f. The site must be easily accessible by delivery vehicles and landfill maintenance plant; and
- g. It must be protected from encroachers and scavengers.

6.4 Laboratory Waste Management and Monitoring

6.4.1 Management and Monitoring Plan

A Laboratory Waste Management and Monitoring Plan is prepared to facilitate the implementation of appropriate laboratory waste management practices (which include collection, storage, treatment and disposal practices) to avoid infection and environmental pollution. Monitoring will be a very essential part for the plan to succeed. It will help Ministry of Health to track the path of implementation of laboratory waste management activities and to ensure they are being carried out as planned. It is therefore a requirement that monitoring is done at all levels. An Environmental and Social Management Framework for the Southern Africa Regional TB in Mining Project has been prepared separately to address environmental issues associated with the construction/refurbishment and operation of the laboratories.

6.4.2 Committees for Plan Implementation

The Draft Health Care Waste Management Policy for Malawi recommends setting up HCWM committees at all levels which must also lead in the monitoring of the Laboratory Waste Management Plan. The recommended committees are as follows:

- National HCWM Multi-sectoral Co-ordinating Committee - to be responsible for evaluating the Management plan, Mobilising financial resources for HCWM and approving appropriate HCWM technologies;
- District HCWM Committee – to be responsible for developing laboratory waste management plans, preparing annual budgets, Supervising HCWM practices in the district including CHAM and the private health facilities and establishing database for monitoring and evaluation.
- Health centres HCWM Committee – to be responsible for supervising HCWM practices in the district including CHAM and the private health facilities at health centre level.

In the hospitals each laboratory should form a sub-committee to be in charge of direct implementation of the plan. The sub-committee should report to and be monitored by the District HCWM Committee. The District HCWM Committee should be headed by the Chief Preventive Health Officer from Environmental Health Unit of the Ministry of Health.

Activities to be implemented for the Laboratory Waste Management Plan will be based on the Waste Management issues highlighted in Section 6.2 and 6.3 from which key issues to be monitored are drawn up and listed in the first column of Table 6.5. The other columns of the table indicate the responsible authority for implementing the issues, cost for implementation, the responsible authority for monitoring and the frequency of monitoring and monitoring costs. The estimated costs given in table 6.5 are for one facility and are meant to be indicative average costs. Each facility will therefore have to prepare specific budgets. The costs are deemed to be part of the Monitoring and evaluation for TB project activities, presented in table 9.3

Table 6.5. Laboratory Waste Management and Monitoring Plan

Issue	Responsible Authority for Implementation	Estimated Management Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
WASTE PRODUCTION						
Develop specifications and standards for waste management equipment and supplies.	Respective Laboratory Managers	2,000	MOH & NTP	Continuously during specifications and standards development	Draft and final Standards and Specification	N/A
Following guidelines of this ICWMP, Infection Control Teams should develop facility specific infection control and waste management plans for the selected hospitals (Ebola Treatment Centres)	Respective Laboratory Managers	1,000	MOH & NTP	Continuously during development of plans	Draft and final Plans	N/A
Construct two chambers high temperature incinerators for the proposed district Laboratories (hospitals)	Contractor	2,500	MOH	During design and during construction	Approved designs and contract schedules	200
Purchase initial supplies for waste management for use in health facilities (regional labs)	Respective Laboratory Managers	4,000	MOH	a. Once on making estimates and requisitions. b. Once after purchase	c. Purchase requisitions, delivery notes and receipts d. Supplies stock	N/A
Purchase Occupational Health and Safety /Personal Protective Equipment. (PPEs)	Respective Laboratory Managers	5,000	MOH, Ministry of Labour & department responsible for environment	-Once on making estimates and requisitions. -Once after purchase	a. Laboratory safety manual b. Number of signs displayed in appropriate places	N/A

Issue	Responsible Authority for Implementation	Estimated Management Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
Procure and install water storage tanks	Contractor	To be costed by the contractor	MOH	-Once on making estimates and requisitions. -Once after purchase -During construction	-Purchase requisitions, delivery notes and receipts Contract and specifications	200
Develop and implement public (including local people) social mobilization/ awareness	DHO /NTP	2000	MOH	Continuously during preparation of plans and during implementation	Number of people accepting and participating in the project	500
Ensure set-up of laboratory is conducive for easy and safe working	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of accidents and near misses related to laboratory set- up	N/A
Availability of appropriate laboratory chemicals / materials to avoid or minimize waste	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of items purchased according to recommended list	N/A
	Laboratory Manager	N/A	DHO	Quarterly	ditto	
Minimize movement of people in the work area	Laboratory Supervisor	N/A	Laboratory Manager	All the time	Number of times unauthorised persons found in laboratory	N/A
WASTE MOVEMENT						
Ensure internal safe movement of covered carts/bins for waste	Laboratory Manager	N/A	MOH	Quarterly	Number of carts as recommended	N/A
Ensure availability of staff	Laboratory	N/A	Laboratory Manager	Monthly	Number of positions	N/A

Issue	Responsible Authority for Implementation	Estimated Management Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
specifically designated for waste movement	Supervisor				filled on the establishment	
Ensure availability and use of appropriate tools, protective wear and safety equipment	Laboratory Manager	Cost included under purchase Occupational Health and Safety (PPEs)	DHO or ministry or department responsible for environment	Quarterly	Number of people having and using PPE	400
Tightly close and secure waste bins to avoid waste spills during transportation	Laboratory Supervisor	N/A	Laboratory Manager	Daily	Number of spills per day	N/A
Provide covered trucks for movement of waste to distant disposal site where necessary	MoH and Local District Council	30,000 USD for a truck	District Environmental Health Officer	Every six months	Number of working trucks available as recommended	200
Follow defined routes of waste (loaded carts) movement	Laboratory Supervisor	N/A	Laboratory Manager	Daily	Number of carts using the designated route	N/A
Ensure availability of washing and disinfecting material for staff	Laboratory Supervisor	N/A	Laboratory Manager	Daily	Quantity of disinfectant available in recommended places	N/A
TREATMENT AND DISPOSAL						
Ensure availability and use of appropriate tools and PPE for personnel at disposal sites	Laboratory Manager	N/A	MOH	Quarterly	Number of people having and using PPE	200
Ensure appropriate method of treatment is used for each type of waste	Laboratory Manager	N/A	DHO or Ministry or department responsible for	Monthly	Number of complaints against poor waste treatment and	N/A

Issue	Responsible Authority for Implementation	Estimated Management Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
			environment		disposal	
Cover disposal pits when half full to prevent access by people, animals and birds.	Laboratory Supervisor	N/A	Laboratory Manager	As appropriate, just before pits are covered	Number of pits covered as recommended	N/A
	Laboratory Manager		DHO or Ministry or department responsible for environment	Monthly	Number of pits covered as recommended	N/A
DISPOSAL SITE LOCATION						
All year round accessibility to disposal site.	DEHO	N/A	Ministry or department responsible for environment	Biannually	Number of cases of failure to access site	N/A
Location of disposal site to be: <ul style="list-style-type: none"> Far from habited areas On a leeward side Far from reach of animals Low water table sites 	DEHO	N/A	Ministry or department responsible for environment	As necessary during disposal facility sighting	Number of complaints from neighbouring residents Ground water quality	N/A
GENERAL COMPLIANCE						
Use colour coded waste bins in appropriate positions	Laboratory Manager	N/A	MOH	Quarterly	Number of bins in recommended places	100
Segregation and storage of waste into marked bins	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of waste streams used	N/A
Place disposable and re-usable materials separately	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of cases of misplacement of re-	N/A

Issue	Responsible Authority for Implementation	Estimated Management Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
					usable	
Disinfect re-usable materials such as slide holders, forceps etc.	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of disinfections done per month	N/A
Follow steps and times for waste movement, storage and internal transportation	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Frequency of waste movement	N/A
Keep infectious (e.g. TB lab specimens and wastes) away from human contact	Laboratory Supervisor	N/A	Laboratory Manager	Weekly	Number of reported infection cases Inspection report	N/A
Sterilize or disinfect waste before it leaves the laboratory	Laboratory Supervisor	N/A	Laboratory Manager	Weekly	Disinfections statistics Inspection report	N/A
Discard contaminated materials and sputum containers in 5% phenol disinfectant or as recommended.	Laboratory Supervisor	N/A	Laboratory Manager	Weekly	Number of disinfections done per day Inspection report	N/A
Disinfect TB work surface areas with appropriate chemicals and methods.	Laboratory Supervisor	N/A	Laboratory Manager	Daily	Number of disinfections done per day	N/A
Use of appropriate technology	MOH	N/A	Ministry or department responsible for environment	Quarterly	Number of complaints on poor waste management	N/A
General health and safety of workers, employees and public	MOH	N/A	Ministry or department responsible for	Quarterly	Number of complaints against health and safety	N/A

Issue	Responsible Authority for Implementation	Estimated Management Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
			environment			
Nuisance (air pollution, dust, smell and aesthetics)	MOH	N/A	Ministry or department responsible for environment	Quarterly	Number of complaints against nuisance	N/A
Water pollution	MOH	N/A	a. Ministry responsible for Water Resources b. Ministry or department responsible for environment	Quarterly	Water quality	N/A

7 GAP ANALYSIS

7.1. Gaps in environmental health control aspects within the mines

7.1.1. Lack of Environmental Health Policy

From the literature review, field investigations and public consultations; it was established that in most of the mines there are no documented Environmental Health Policies (either a general health policy or a specific policy to TB infection prevention and control), strategies or action plans. As a result there are no defined environmental health management measures and targets to be achieved. It is proposed, therefore, that the Department of Mines, in collaboration with other relevant stakeholders (Ministry of Labour and Ministry of Health), must enforce their legal provisions to ensure that all mining institutions develop and observe environmental health policies. In addition, all new mine developers must prepare environmental health policies and infection prevention and control management plans before mining licenses are issued by the Department of Mines.

7.1.2. Inadequate preventive measures

It was established that environmental health measures implemented at the mines focus on a few selected diseases (mainly Malaria) and leaves out many other diseases including Tuberculosis. At Kaziwiziwi and Mchenga coal mines, a Typhoid outbreak forced the companies to start implementing measures for avoiding the disease. Due to the absence of policy and plans for environmental health management, Environmental or Human Resources Officers do not adequately enforce environmental, health and safety requirements. Wearing of helmets (which, if not done, would have immediate and visible consequences) is more readily enforced as compared to wearing of mouth masks, basic hygiene, dust control and ensuring adequate ventilation (whose undesired consequences would show after some time; and would not always be related to occupational practices).

7.1.3. Use of unqualified staff

It was observed that the posts for Environmental Health Officer/Safety Officers at the mines are filled by unqualified staff. Generally the mining companies promote long serving mining staff, and in other cases posts staff certified as unfit to work in the mines (because of injuries or health concerns) to work in positions requiring skilled labour. While the practice itself is not bad, the staffs deliver low quality services and their focus is narrow. In this regard, mining companies must be required to hire qualified and able staff or must regularly send staff for training.

7.1.4. Poor Record Keeping

Environmental health aspects at the mines are affected negatively by poor record keeping, review and a lack of health monitoring for the employees as well as their households. The mining companies keep records of sick leave for the employees. However the records do not have the reports from the hospitals and as such it is difficult to track common diseases and to design environmental health measure for avoiding or reducing the diseases. In relation to TB and MDR-TB, the mining companies visited could not provide records for case detection and treatment.

7.1.5. Inadequate health surveillance and monitoring

There is inadequate monitoring of health of the workers and environmental conditions by the mining companies. Staffs are not compelled to undergo regular check-ups and the miners are sent to hospitals only when they report sick by themselves. There is no air quality measuring and monitoring in the mines to facilitate quick detection of diseases that can spread through air contamination. The

mining companies do not survey the environmental health conditions in the mining communities. They rely on the poorly funded MOH. There is also no follow-up on the health of ex-employees or ex-miners.

7.2. Gaps in infection control and medical waste management in health-care facilities and laboratories

7.2.1. Lack of awareness of policy framework

From the study, it is established that only few people (top level management) in the facilities visited are aware of the Infection Prevention Control policy, let alone the TB infection guidelines. For example, the nurse in charge of the TB ward at Mzuzu Central Hospital indicated that she was aware of the TB policies but pointed out that most of the staff are not aware hence suggested need of training or raising awareness. Similarly, medical practitioners at Mchenga Coal Mine Clinic indicated that they were not aware and do not have TB policies (or health policies in general) in the work place.

7.2.2. Lack of a clear institutional framework

There is lack of awareness of the Infection Prevention and Control Policy; and the TB infection guidelines. In most of the Referral Hospitals, health-care waste management is left to sub-contractors who are mainly interested in the cleaning of the rooms, collection and disposal of wastes. There is a need to ensure that infection control measures are observed and wastes are managed and disposed of properly. These are the duties of the environmental health officers, matrons, nursing officers in charge for wards, doctors and nurses and hence it is important to orient them on these specific roles.

In the rural hospitals and mining companies' clinics, there are no sub-contractors; infection control and waste management is left to medical staff and support staff. Here also, the institutional arrangement and responsibilities must be clarified.

7.2.3. Lack of awareness of the hazardous nature of wastes

It was established that unlike health-care workers, waste handlers (mostly those employed by a sub-contractor) are not aware of the hazardous nature of health-care waste. As a result they are involved in inappropriate collection, storage, and HCW disposal which is often a major source of accidents resulting in injury and infection. The inappropriate HCWM also often results in mixing of hazardous wastes and non-hazardous wastes, further exacerbating environmental health risks. Incomplete incineration was evident at the waste incinerators and burning sites. It is hence recommended that HCWM sensitization should be included in selection of waste handlers.

7.2.4. Inadequate and underqualified medical staff

It has been established that the hospitals do not have adequate staff. This is a very serious challenge in the rural health centres and clinics at the mines and it creates problems of overloading staff who get too tired to care about waste management and infection control. At Jalawe Health Rural Centre in Rumphi there is only one health worker, which leaves other activities including hygiene and waste management unattended to as can be seen in figure 7.1.



Figure 7.1. Hygiene and medical waste management status at Jalawe health centre

It was also observed that the mining companies in rural areas fail to retain qualified staff. This contributes to inadequate implementation of the health care-waste management and infection control. Hence, MOH and mining companies must provide incentives to attract qualified health workers to rural areas.

7.2.5. Shortage of equipment for handling TB cases

It has been established that the clinics at the mines, the rural health centres around the mines, district hospitals and referral hospitals do not have adequate equipment for handling TB cases. Mzuzu Central Hospital was noted to have inadequate PPE such as mouth mask at the TB wards and as a result, health-care workers are forced to wear them repeatedly; against proper infection control measures. There is need to ensure a steady and sufficient supply of medical supplies, PPE and health-care waste management tools and equipment such as hazardous waste plastic bags. It was also established that there is inadequate space and proper facilities for handling patients with MDR-TB and hence such patients are treated at home, which may compromise infection control.

7.2.6. Insufficient hazardous waste collection materials and disposal facilities

It was noted that there is no provision of hazardous waste plastic bags or containers and that ordinary plastic bags are used. There are also no proper waste storage facilities. Furthermore in most of the health facilities there is no proper incinerators for disposing hazardous wastes and that batch burners are used which is a danger to the environment. The MOH must ensure there are secure waste collection materials and waste storage facilities. While installation of proper disposal facilities is expensive and may take time, the MOH must consider pre-treatment of hazardous wastes. Furthermore, waste handlers must ensure hazardous wastes are completely burnt and that there are no scavengers or animals near the wastes.

7.2.7. Lack of or inadequate community engagement in HCWM

It was noted that the public's knowledge of the dangers or risks associated with health-care waste is very weak especially by: i) scavengers looking for reusable objects; ii) children playing on the landfill or looking for toys; iii); iv) people performing or receiving home-based health care; and v) people living near the landfills. Hence, awareness campaigns targeted at the communities will facilitate reduction in HCW associated risks and illnesses.

7.2.8. Lack of Public Private Partnership

One of the major constraints noted in the assessment was that there are no formal public-private partnerships in health-care services delivery and health-care waste management. This limits the provision of services as the management skills and financial resources of the private sector remain untapped. It is therefore recommended that any ICWM action plan should support private initiatives and develop a partnership between public and private sector.

7.2.9. Insufficient financial resource allocation towards ICWM

Health-Care Waste and Infection is not allocated enough financial resources in the hospitals as compared to drugs and medical equipment. The lack of funds adversely affects proper health-care waste management activities. Hospital directors must be sensitized on the importance of a functioning waste management system for effective infections control and prevention.

7.2.10. Lack of planning, monitoring of HCW production and management

In the hospitals visited there was no record keeping of the quantities of waste generated per day or month, the type of wastes and the disposal methods. In addition, HCW generation is not monitored and there is no planning ahead on how to manage wastes in the event that volumes of waste increase. The health facilities must start collecting data about HCW production and characteristics as it will ensure effective implementation of the ICWMP.

7.2.11. Inadequate monitoring of the health of staff member

Health-care workers in TB wards and laboratories are required to undergo medical check-ups regularly. However it was observed that this is not enforced and that medical check-ups are sometimes not administered. Hospitals must set time a table for medical check-ups for this type of staff and the check-ups must be compulsory.

7.2.12. Poor stakeholder coordination

There is a poor coordination among stakeholders in the development of the ICWMP and Ebola Virus Disease preparedness plans. For example it has been established that there is no collaboration with the department responsible for animal services or the department of wildlife in fighting Ebola during the pre-epidemic period. There is, therefore, need for collaboration between the Ministry of Health and these departments to monitor mortality of wildlife as this is a good indicator of Ebola incidence. This collaboration should not only target department of wildlife but also markets providing meat whose source is unknown. Generally coordination must be encouraged and adequately supported among stakeholders to be involved in the implementation of the ICWMP.

8 TRAINING IN HEALTH-CARE WASTE MANAGEMENT

8.1. Training programs

A policy for the management of health-care waste cannot be effective unless it is applied carefully, consistently, and universally. Training both health-care and non-health-care workers in implementing the policy is thus critical if a waste management programme is to be successful.

An important point for a well-functioning waste management system is information, training and instruction of the employees, especially those with specific tasks within the waste management unit. Hence, all doctors, nurses, assistant nurses, laboratory staff and the relevant general workers should be trained and informed about the correct HCW management practices.

For laboratory staff, training programmes in laboratory waste management would be similar to that for the general HCW programme. The programme will be targeted at:

- a. Imparting knowledge on health-care risks in all the waste streams,
- b. Developing skills to conduct certain tasks such as sealing a sharps container when 3/4 full and skills related to use of safety equipment and protective clothing;
- c. Developing positive attitude to caring for the environment and protecting the health and safety in the workplace; and
- d. Decontamination of generated wastes.

Change of knowledge, skills and attitudes would contribute to the type of behaviour necessary to sustain the healthcare waste management system or the laboratory waste management plan leading into staff being conscientious about HCWM. Interviewing and observing health workers, laboratory staff and support staff working in laboratories, will facilitate identification of the knowledge, attitudes and skills gaps, which will be the basis for developing a targeted training programme.

8.1.1 Areas of training

Laboratory/ Medical Staff

Healthcare facility staff requires more technical and detailed training with regards to the different categories of HCW and the way of coping with each of them from "cradle" (generation) to "grave" (final disposal). The overall aim of training is both to create a competent workforce and develop awareness of the health, safety and environmental issues relating to HCW, and how these can affect employees in their daily work. In this respect, highlighting the roles and responsibilities of each category of staff is an important element of success.

To facilitate better communication between all categories of health workers, it is recommended that an important part of the training be multidisciplinary. Most health workers need the same basic sets of skills, information and attitudes towards good waste management. Laboratory staff, nurses, general assistants and doctors as well as other medical staff can all be trained together in their wards and departments. If training is conducted on the job, it should help reinforce good practice and team work.

The general areas of training on HCWM or Laboratory Waste Management Plan for laboratory or medical staff will therefore be as follows:

Legal and regulatory framework will provide staff with knowledge of existing national and international laws and protocols related to Infection Control and Health-care Waste Management;

Definition of health care waste categories will ensure that laboratory staff has a common understanding or interpretation of the various categories of laboratory waste;

Sources of health care waste will give staff an appreciation of how the waste is generated and where minimization can be effected;

Health, safety & environmental impacts on life, safety and natural resources will help staff appreciate the consequences of absence of a proper health-care/ laboratory waste management plan;

Organisation of HCWM will facilitate development of appropriate skills to plan for and organise the various steps of structured management of a laboratory waste;

Procedures (Code of Practice) for HCWM will create awareness of the rules of conduct in implementing an effective laboratory waste management plan;

Discussing specific topics of **waste minimization recycle or reuse; waste separation, storage; treatment; transportation and disposal** will impart knowledge and skills as well as justification for a well laid out and structured laboratory waste management plan.

Finally discussion on the need for and steps to **auditing and monitoring of the Infection Prevention and Control; and Laboratory Waste Management Plan**, as part of the overall environmental management system will emphasize the need for checks and balances and introduce the tools to ensure effective implementation of the laboratory waste management plan

It is also important to ensure that waste management operators (e.g. transporters, treatment plant and landfill operators etc.) get similar and appropriate training and support.

Policy makers

Lobbying decision makers and securing government commitment and financial support for safe HCWM can only be achieved if decision makers are convinced of the importance of the subject. Raising awareness amongst them is therefore a critical step to be taken and should be essentially conducted using arguments pertaining to public health and environmental risks that arise when HCW is not managed in a safe and appropriate manner. Awareness for the high level management of Ministry of Public Health and Sanitation is important for them to appreciate the need to comply with national and international regulations. It is also important for these people to understand the benefits of proper laboratory waste management for the well-being of staff as well as the general public. Policy makers must be made to realise that the mistakes made today in damage to the environment and public health is a future cost that cannot be avoided. This cost will appear in form of high medical costs for chronic ailments and high costs for restoration of natural resources and the environment.

General Public

Public education (including indigenous peoples in Malawi on hazards linked to healthcare waste and imparting knowledge, awareness and changing attitudes of the general public will foster their support in HCWM. The community needs (and has a right) to be informed to prevent exposure, be it voluntary in the case of scavengers, or accidental as a consequence of unsafe disposal methods. The general public should be made aware of the impacts of HCW on their lives and that of their children. Immediate and long term dangers of coming into contact with infectious waste through careless acts of scavenging should be pointed out to them through appropriate public messages. The public should be made aware of their right to clean and safe environment and they should be encouraged to play a role in monitoring of HCWM. In this regard, they should be made aware of their obligations to report any mismanagement of HCW and any incidences of scavenging.

Different methods can be used for public education on risks, waste segregation, or waste disposal practices:

- In HCFs by displaying posters at strategic points such as waste bin locations, giving instructions on waste segregation. Posters should be explicit, using diagrams and illustrations to convey the message to as broad an audience as possible, including illiterate people.
- Outside HCFs, simple messages can be conveyed through schools, radio or television programmes, raising awareness about the risks involved in scavenging discarded syringes and hypodermic needles, etc.

For maximum effectiveness, all information should be displayed or communicated in an attractive manner that will hold people's attention. Language used for communication should be one which can be understood by the message recipient community. Communities and cross boarder groups where satellite laboratories will be located are to be sensitised with respect to laboratory services to be delivered, times for them to access the services and how the services will be delivered. Communities will need to know how soon and when they are likely to get feedback on tests and what will be the expected follow up activities. Appropriate signs and posters will have to be displayed in strategic positions to inform the public about the laboratory services and activities and where these will be accessed.

Consultation and participation of Indigenous Peoples should be effectively done to ensure that it adequately deals with their needs, priorities, and preferences. Local Peoples should be provided with relevant project information in language(s) and in a manner suitable to them. Separate focus group discussions should be carried out to assess the subprogram impacts and benefits of these groups and to sensitize them accordingly. As appropriate, NGOs can be used and appropriate documents should be made available to the affected Indigenous Peoples

8.1.2 Management and Training for Institutions and Agencies

Success in implementation of this Laboratory Waste Management Plan, which is part of the overall ICWMP, will depend on key stakeholders' understanding of the importance of such a plan. Key stakeholders will come from various government institutions including government ministries or departments responsible for environmental management, health care waste management, Local Government as well as the private sector. It is important therefore that implementing agencies or those in one way or another affected by HCWM are clear of what is expected of them. Raising awareness and imparting skills to these key stakeholders will be very important for the success of this ICWM Plan. Two levels of training are proposed for this group of people; one for the top level administration (to have a policy makers' awareness raising) and another for the technocrats (to have training similar to that proposed for the Laboratory/medical staff). This has been reflected in the training budget in Table 3.4.

8.1.3 Follow-up and refresher courses

Periodic repetition of courses will provide refreshment training as well as orientation for new employees and for existing employees with new responsibilities; it will also update knowledge in line with policy changes. Follow-up training is also instructive for trainers, indicating how much information has been retained by course participants and the likely need for future refresher courses.

8.1.4 Training budget

Training sessions as proposed above should be implemented under coordination of the Ministry of Health (MOH). Experts and speakers in various topics can be invited to present on special topics. An estimated cost, for reference only, of training the various groups is given in Table 8.1.

Table 8.1. Areas of training and target groups

Target Group	Areas of Training	Duration	Cost ³¹ (US\$)
Laboratory/ Environmental health Officers/ Medical Staff Technocrats from various ministries and from private sector institutions including district administration	a. Legal and Regulatory framework b. Definition of health care waste categories c. Sources of health care waste d. Health, safety & environmental impacts e. Organisation of HCWM f. Procedures (Code of Practice) for HCWM g. storage; storage; treatment; transportation and Disposal h. auditing and monitoring of the Laboratory Waste Management Plan	2 No. 3 – Days training for two groups of 30 at US\$20, 000 per group	40,000
Awareness for policy makers and senior staff (Top level staff from MOH) Awareness for policy makers (from other ministries including the private sector)	a. Legal and Regulatory framework b. Definition of health care waste categories c. Risks (Health, social and economic impacts) of Poor HCWM d. Benefits (short and long term) of good HCWM e. National and International regulations on HCWM	2 No 1 - Day trainings for two groups of 30 people per group at US\$10,000 each	20,000
General Public	a. Explanation/ demonstration of HCW b. Immediate and long term impacts of HCW on lives of all (including children) c. People's rights and obligations to clean and health environment d. Dangers of scavenging e. Public role in monitoring HCWM	2 Days for mass awareness education and demonstrations	30,000 ³²
Local Peoples Sensitisation	a. Explanation/ demonstration of HCW b. Immediate and long term impacts of HCW on lives of all (including children) c. People's rights and obligations to clean and health environment d. Dangers of scavenging e. Public role in monitoring HCWM	3 Days	30,000
TOTAL			90,000.00

³¹ Includes training material and trainer's fees³² Includes Information Education and Communication materials as well as facilitator's fees

9 GUIDELINES FOR PROJECT IMPLEMENTATION

The regional TB in mining project will be implemented through the Malawi health system including the preventive health services directorate and NTP. This Infection Control and Waste Management Plan will be implemented in the districts in which the project will be operating.

Drawing on the findings of the existing situation in the visited mines and health facilities, as well as reviews of national TB control manual (2012), draft HCWMP policy and HCWM plan of action for Malawi, the goal of the ICWMP shall be achieved through strengthening the policy and legal framework related to infection control and HCWM, ensuring that all project Health Care Facilities (HCFs) and mining department have adequate equipment and measures for TB infection control and sound HCWM, and ensuring that project HCFs have adequate planning and receive adequate training.

This section, therefore, contains specific guidelines for successful implementation of this infection control and waste management. While the main audience for the document is the project implementation team, the first part of this section details out the specific minimum standards which have to be followed by all HCFs (including laboratories) triggered by this project.

9.1. Guidelines for TB infection control

Following good practices on TB infection control (chapter 5 of this document) and national TB control manual (2012) for Malawi; this section describes the minimum and basic TB infection control procedures to be followed. Since the proposed project will be targeting communities in the mining areas (e.g. community sputum collection and transportation), the following minimum guidelines focus on the community, transportation, hospital set up, and emergency situation.

9.1.1. Infection control in a community setting

9.1.1.1. Sputum collection:

Before sputum collection, patients or suspects should be informed about the diagnostic process and reason for sputum collection. Thereafter, two sputum specimens should be collected using the spot-morning approach i.e. one specimen the time the patients presents himself/herself at the clinic and another specimen to be collected next morning. Below are more guidelines:

- a. Patients or suspects should clean their mouths if they have been eating;
- b. Health workers (i.e. community volunteers or HSAs) should demonstrate how to cough and how to open and close the sputum container;
- c. To collect quality sputum, health workers should demonstrate how to cough deeply. Tell the patient or suspect that the best sputum specimens come from the lungs after coughing.
- d. Instruct the patient to inhale deeply 2-3 times and to breathe out hard each time.
- e. Instruct the patient to place the container close to the mouth;
- f. Sputum collection to be done in open air or ventilated room away from other people;
- g. Volume of sputum should be between 3 millilitres and 5 millilitres;
- h. Avoid contaminating the outside of sputum container with sputum. If outside is contaminated, discard the container and repeat the collection with a new container; (NB: Instructions to be carefully followed in case of limited number of containers)
- i. Clearly label the sputum container with the patient's or suspect's name and date of collection. The container itself should be labelled and NOT the lid;
- j. Upon coughing, instruct the patient or suspect to screw the lid tightly; and
- k. Laboratory request form should be filled out accurately and completely.

9.1.1.2. *After sputum collection:*

- a. Double check to ensure the sputum container is properly labelled;
- b. Ensure that the sputum container is firmly closed;
- c. Wash your hands with soap and clean water;
- d. The two sputum specimens to be sent to microscopy site within 24 hours;
- e. Store sputum specimens for culture preferably in a refrigerator or cool, safe and dark place; and
- f. Sputum specimens for culture should be sent to the laboratory within 4 days.

9.1.1.3. *Transportation of sputum specimens:*

- a. Every health worker should be responsible for sending sputum specimens to the laboratory as soon as possible to ensure examination is done within 4 days of collection;
- b. Any convenient means of transport, preferably in small cooler boxes;
- c. The sputum specimens should be carefully packed, ideally in a transport box;
- d. Ensure that every specimen goes to the laboratory with a laboratory request form; and
- e. Cold chain should be maintained throughout the transportation process particularly when sending samples for culture.

9.1.2. **Transport of patients with known or suspected TB**

- a. Patients who are smear positive or whose sputum smears have not yet been examined should wear a mask during transport.
- b. When travelling by road, ensure that masks are on and windows down to promote maximum ventilation.

9.1.3. **TB infection control in hospital**

9.1.3.1. *Managerial level:*

- a. Ensure that each facility has an infection control committee (headed by Infection Control Coordinator) that is responsible for developing a written infection control plan, monitoring its implementation, and providing effective training for health workers and other staff;
- b. Every health worker should be trained in TB infection control;
- c. HIV-positive health workers should not work in high risk areas such as TB wards, TB suspect/patient waiting areas, and cough triage areas; and
- d. Encourage all health workers to undergo HIV testing and counselling.

9.1.3.2. *Administrative control measures:*

- d. Recognise TB suspects at an early stage and accelerate the diagnostic process (see section 8.1.1);
- e. Separate TB suspects and patients from other patients in congregate settings;
- f. Sputum collection to be done in designated areas;
- g. Triage TB suspects to access diagnostic services quickly;
- h. Encourage cough etiquette to TB suspects and patients; and
- i. If possible, provide face masks (N95) to all hospitalised TB suspects;
- j. If possible also, visitors and staff entering the isolation rooms should wear particulate masks; and
- k. Children (other than the patient's own children or those living within the same household) and immunosuppressed friends should be discouraged from visiting the patient until infectious TB has been excluded or treated.

9.1.3.3. *Environmental/engineering control measures:*

- a. Ensure that all health care working environments (i.e. TB wards, consultation rooms, laboratory etc.) are well ventilated. Doors and windows should be opened to ensure maximum ventilation;
- b. Ensure that ceiling fans, air conditioners, and exhaust fans are in good working condition; and
- c. For Ultraviolet Germicidal Irradiation (UVGI), ensure that the lamps are cleaned and monitored on a weekly basis. Lamps should be left switched on for 24 hours daily and UV bulbs should be replaced every 6 months.

9.2. Guidelines for HCWM

While the draft National Health Care Waste Management Policy is finally being reviewed, the following are specific minimum procedures and guidelines to be followed by staff involved in HCWM for this project³³.

9.2.1. Separation of HCW at source

The following are the minimum guidelines to be followed:

- a. Project staff handling HCW (in particular used sputum cups and slides) shall do colour coding of the containers or receptacles according to category of HCW for storing HCW;
- b. Sharps which are infectious waste must be stored into impermeable containers or receptacles labelled yellow and marked 'sharps';
- c. General wastes or non-hazardous waste shall be stored into containers labelled black; and
- d. Staff must record and report quantity of waste (used sputum cups or slides) generated according to HCW category.

9.2.2. Storage

The following are the minimum guidelines to be followed:

- a. Staff shall use impermeable bags and hard standing containers;
- b. The containers should have a tight fitting lead;
- c. Containers must have handles and be easy to clean;
- d. Staff shall ensure use of easy to clean surfaces for storage and placement of containers containing HCW;
- e. Management and staff should ensure availability of water supply for convenient cleanliness and hygiene of storage surfaces;
- f. Storage areas, containers or bags should not be readily accessible to non-staff or animals;
- g. Containers and bags containing HCWs must be stored in good lighting and ventilation rooms
- h. Rooms and areas containing HCWs must be kept proofed against rodents, insects and birds;
- i. Staff must ensure that maximum storage time of infectious wastes is 48 hours in cool dry season and 24 hours in hot dry season;
- j. Categories of HCW must be kept separate during storage. This may be on the same site but the area divided into separate bays, labelled with appropriate colour coding and provision of a physical barrier separating them ;

³³ The guidelines are based on the HCWM training manual for qualified health workers developed by MOH-Malawi and also the HCWM plan for HIV/AIDS nutrition project (2012).

- k. All storage sites should be enclosed to ensure that they are not accessible to the public and livestock and in areas not at risk of flooding;
- l. Storage facilities should be covered and at least at a distance of 10 metres from kitchens, canteens, wards, and any central air systems; and
- m. Storage sites should be placed on concrete platforms and near a source of water for ease of cleaning.

9.2.3. Transport

Here, the following guidelines should be followed;

- a. Management and staff on the project must establish and adhere to routine program for HCW collection;
- b. HCWs must, ideally, be collected and transported on a daily basis to the treatment and disposal sites;
- c. Prior to transportation, staff responsible must ensure that sealing of waste bags and containers has been in accordance with labelled colours of the containers and bags;
- d. On collection and transportation of filled bags and containers, staff must ensure replacing them with empty bags and containers; and
- e. Special covered trolleys should be used in transporting HCWs.

9.2.4. Treatment and disposal

During stage, the following minimum guidelines should be followed:

- a. Sharps and infectious waste ought to be incinerated followed by disposal of ashes within lined pits or burial;
- b. Chemical wastes must be incinerated at high temperature or must be disposed into sealed pits;
- c. General wastes which include packaging materials, plastics, and plastic bins must be buried with or without burning although burning is preferred for waste volume reduction;
- d. All storage and treatment sites should be kept clean and in good order; and
- e. Hazardous HCW must not be sent to municipal waste disposal sites.

9.2.5. Protection of HCW handlers

Generally, all staff involved in handling HCW in this project should follow the standard precautions outlined by WHO. However, the following minimum guidelines are to be followed:

- a. All HCW handlers including disposal workers must be issued and should wear PPE including gloves, mask goggles, aprons, gum boots, and head wear;
- b. Uniforms should be regularly cleaned and replaced as necessary; and
- c. HCW handlers must undergo periodic in-service training in HCW handling. They must also undergo adequate supervision by their Managers.

9.2.6. Emergency procedures

In the event of an emergency, the following minimum guidelines are to be followed:

- a. Any spillage of HCW must be immediately and completely cleaned up;
- b. If infectious waste is involved, the affected area must be disinfected;

- c. Any injuries or puncture injuries or cuts from potentially infected sharps should be immediately reported. The area of the injury must be cleaned and dressed as appropriate. The subject should then be monitored for infections; and
- d. All health workers and HCW handlers should be offered hepatitis vaccinations.

9.3. Specific actions

Table 9.1 shows specific actions to be taken, by who and when for the entire project period of five years.

Table 9.1. Specific actions for infection control and waste management

Main activity	Sub-activity	Responsibilities
Promote proper sputum handling from communities to laboratories	1. Provide guidelines for proper sputum handling to project beneficiaries	National TB control programme
Preparation for procurement of Occupational Health equipment, PPE and other materials for standard precautions	1. Purchase of PPE including N95 masks or standard face masks, soap for hand washing, and supplies for HCW	Ministry of Health to encourage private entities
Improve HCW collection/segregation, storage, transportation, treatment and disposal	1. Undertake needs assessment of HCW generated. 2. Properly place HCW in appropriate receptacles according to their classification 3. Provide recommendations for improved HCW storage areas 4. Specifically for Health Centres in remote areas, discuss with relevant stakeholders on appropriate HCWM (e.g. disposal sites etc.)	Heads of Institutions/Hospital Directors
Capacity building	1. Conduct a training needs assessment (all relevant stakeholders including health workers and potential project beneficiaries) and then develop a training plan 2. Develop training modules in English and appropriate local languages 3. Replicate on a regular basis (quarterly) training activities,	Ministry of Health (Preventive Health Directorate including National TB control programme) Training Institutions (e.g. Malawi College of Health Sciences)

	through designated trained staff, using the train the trainer approach	
Monitoring and Evaluation	1. Establish a monitoring system and HCWM database 2. All Health Facilities shall maintain records/data associated with HCW generation, collection, transportation, treatment and disposal-These records shall be subject to inspection by prescribed authority	Ministry of Health and EAD
Public Private Partnerships (PPP)	1. Provide a conducive environment for private companies to be involved in HCW management (e.g. solid waste collection) 2. Private partner contracts to include clauses on environmental compliance during waste collection and disposal	Ministry of Health
Information Education Communication (IEC)	1. IEC activities to be given through mass media and other means necessary (e.g. social networks) 2. Awareness campaigns to target the public and health providers about appropriate infection control and HCW management methods	Ministry of Health-Communication department

9.4. Implementation arrangement

9.4.1. Institutional framework

For effective implementation of this plan, an institutional framework involving relevant stakeholders at central level, district level, and health facility levels will be required.

9.4.1.1. Central level

The Ministry of Health (MOH)

The Ministry of Health is the agency responsible for supervising Health Facilities, which are the main producers of HCW. The Directorate of Preventive Health Services is responsible for sanitation issues, hygiene, and environmental health. The Department of Environmental Health has agents specialised in environmental health and have a Desk Officer tasked specifically for HCWM. It is the department accountable for developing HCWM policies and overseeing their implementation. It will therefore be the department that will take the lead in coordinating the implementation of this ICWMP. Since the drafting of the HCWM policy, a HCWM Steering Committee has held several meetings and recently (2015) organised a review workshop of the draft HCWM policy. The Committee comprises of the Directorates of Preventive Health Service, Clinical Services and Nursing within MOH, the Medical

Council, the Nurses Council, Development Partners such as USAID, and Non-Governmental Organisations (NGOs).

Reporting to the Director of Preventive Health Services are; Deputy Directors of Preventive Health Services responsible for Malaria, Public Health Laboratory, Extended Programme of Immunizations (EPI), Tuberculosis Control (TB) and Deputy Director of Preventive Health Services responsible for Health Education Services.

As of training activities, there is no single department specifically tasked with staff training in MOH. The training activities are carried out by various departments. For instance, The Health Education Unit of MOH is tasked with disseminating information and increasing levels of public awareness about health issues such as TB and Ebola.

According to the draft HCWM policy, The Ministry of Health shall establish a Health Care Waste Management Office within the Directorate of Preventive Health Services to co-ordinate HCWM at national, district and health facility levels. The Directorate of Preventive Health Services will have to facilitate the formation of National HCWM Inter-agency Co-ordinating Committee (ICC)³⁴ with representation from stakeholders involved in HCW activities. There shall be a committee at district level to coordinate HCWM activities. The secretariat can be in Environmental Health section. District Health Management Team (DHMT) shall be the overall responsible body which shall oversee District HCW management.

Similar structures shall operate at community hospital level. Health Centre Management Team (HCMT) will be the overall responsible body which shall oversee health centre HCW management. The secretariat will have to be in Environmental Health section and should coordinate HCWM at health centre level.

Regular Monitoring and mid-term evaluation are the key activities, which should be carried out by the responsible teams (i.e. HCMT, DHMT).

Department of Environmental Affairs

They will be responsible for supervising HCWM activities in the respective health facilities and local landfills. They will particularly supervise project activities so that they are done in accordance with Environmental and Social Impact Assessment guidelines for Malawi.

9.4.1.2. District level

City/District Assemblies

The mandate of city and district assemblies is to manage non-hazardous waste or domestic waste. However, in reality, local landfills or public containers often receive HCW either from domestic care givers or health facilities. The district assemblies should therefore give their opinion about HCWM plan/ICWMP activities proposed for HCFs in their jurisdiction. Coordination and implementation of the ICWM plan of action will be exercised by the District Health Care Waste Management Committee comprising of the following: Environmental Health Officer; Environmental Inspector; District Assembly Representative; Infection Prevention and Control Coordinator; Stores Supervisor;

³⁴ The ICC is the highest level in HCWM. It will be responsible for reviewing reports from all institutions and submit the reports to the Secretary for Health.

Matron; Procurement Officer; Member of Facility Advisory Committee; Human Resource Officer; and at least two members of the subordinate class (hospital attendants who handle HCW).

9.4.1.3. Health facility level

It will be the responsibility of each and every Manager, at health facility, for ensuring sound HCWM. The Manager is to ensure that guidelines (minimum standards) set forth in this ICWMP are followed and respected. The Manager will elect teams for HCW segregation, collection, transportation, treatment and disposal. There will also be a Health Care Waste Management Committee.

9.4.2. Implementation timeline and budget

Table 9.2 provides the implementation timeline for this ICWMP for the entire project period; and the estimated budget for implementing the ICWMP is provided in table 9.3. The budget line for monitoring and evaluation for TB project activities includes the monitoring costs for Laboratory Waste Management and Monitoring, summarised in table 6.5.

Table 9.2. Implementation timeline for the ICWMP

Serial No.	Activity	Year 1				Year 2				Year 3				Year 4				Year 5			
		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
1.	Formalizing role of the secretariat i.e. Environmental Health Unit and NTP, responsibilities and scope of Secretariat in carrying ICWM activities in the project.																				
2.	Identification of inter-sectoral Coordination measures and implementation and monitoring Frameworks (i.e. HCMT and DHMT)																				
3.	Finalization of Roadmap for implementation																				
4.	Developing training manuals, capacity building plans and sensitization/ awareness manuals (including for TB & Ebola as well as infection control and HCWM)																				
5.	Training and capacity building in infection control and HCWM at national, district and health centre levels-including potential project beneficiaries																				
6.	Needs assessment of HCW in health facilities triggered by the project																				
7.	Develop facility specific ICWMP for the project health facilities, following guidelines of this ICWMP																				
8.	Prepare specifications and procurement plans for purchase of PPE and other waste management materials and equipment																				
9.	Construct incinerators and purchase initial supplies for waste management																				
10.	Periodic review of the ICWMP																				
11.	Enforce and monitor compliance to the reviewed ICWMP																				
12.	Midterm evaluation of ICWMP																				
13.	Final evaluation of ICWMP and report																				

Table 9.3. Proposed implementation budget for ICWMP

No	Activity or item	Cost in USD
1.	Capacity building and sensitization	90,000
2.	Purchase of PPE for Ebola	45,000
3.	Purchase of PPE for TB, occupation health and safety equipment & HCW supplies	140,000
4.	Infection control measures for TB in health facilities	365, 200
5.	Infection control measures for Ebola	338,000
6.	HCWM implementation	46,500
7.	Monitoring and reporting	105,470
8.	Independent final evaluation and report write-up	30, 000
Total		1,160,170

10 CONCLUSION AND RECOMMENDATIONS

The assignment has established the need for the Government of Malawi to move significantly in its efforts of eliminating TB/MDR-TB/XDR-TB and improving environmental, health and safety practices in both the mining and health sectors. It has been found in this study that the current situation of TB infection control measures in Malawi cannot guarantee safety among health-care workers, patients, and general population. The assessment has also shown that the current health care waste management procedures present high risk of infection hence need for improvement in management of health-care waste. The gap analysis on Ebola Virus Disease has shown that other stakeholders such as department of wildlife were not included in the EVD preparedness plan.

In the mines visited and from the consultations held, the Consultant observed that there is very limited appropriate use of Personal Protective Equipment (i.e. face masks), limited record keeping and sharing of TB infection information between the mines and the nearby hospitals. To move forward, there is need of law enforcement or continuous monitoring by relevant authorities such as Ministry of Labour to ensure that mines adequately adhere to national safety procedures. There is also need of proper coordination between CHAM or MOH hospitals and all mines as regards to active case finding and follow up on TB patients.

While it was indicated that dust is controlled through natural ventilation and watering, the Consultant did not observe any watering and did not have the technical capacity to ascertain dust conditions in the underground mines and determine if Air Changes per Hour (ACH) falls within the recommended WHO category. Future investigations should focus on ascertaining whether dust conditions prevalent in the mines are conducive for silicosis development or not.

Further to this, the mines administration and social welfare department did not indicate any awareness of relevant national policies regarding TB infection control such as the TB infection control guidelines by National TB control programme. Similarly, in the health facilities visited, top level management were the ones mostly aware of such relevant TB policies. Whether such policies are adhered to or not remains unclear. It is however crucial that all stakeholders, including all health-care personnel, are made aware of the relevant policies and know the importance of adhering to them.

As of the Ebola Virus Disease Preparedness Plan, the gap analysis has revealed that there is urgent need for proper coordination between Ministry of health and department of wildlife or animal services department. This is very crucial as sudden and unknown cause of death of animals or wildlife has been known to be related to Ebola Virus Disease in West African countries.

It has also been shown, through the gap analysis, that lack of policy and legal framework hinders proper health care waste management. The urgent approval of the draft health care waste management policy, which is under review, would be crucial in ensuring proper health care waste management procedures in all settings (particularly laboratories).

Implementation of this Infection Control and Waste Management Plan is, thus, a positive step towards ensuring effective TB control and improvement of health-care waste management from service delivery and treatment centres. For effective TB infection control, proper health care waste management and Ebola Virus Disease control, there is generally need of proper coordination among all stakeholders. The stakeholders here include and are not limited to key sectors in the Ministry of

Health, Department of Mines, and Ministry of Labour. Thus, health-care staff, patients, general public, relevant ministries need to hold hands to ensuring effective TB control in the mining sector. In particular, Health Care staff, patients, and general population need to maintain the highest standards of performance on safety measures and to adhere to standard procedures. It is therefore recommended that:

- a. Personnel (those working in the mines or health facilities) are properly trained and provided with appropriate safety and emergency Personal Protective Equipment;
- b. Laboratory facilities are well planned and adhere to safety regulations;
- c. All health care wastes are properly handled and disposed of according to the available guidelines;
- d. Laboratory personnel are accountable to safety and comply with standards and best practices;
- e. Good communication is practiced and that any environmental health or safety concern is referred to the relevant authority; and
- f. Laboratory monitoring and evaluation tools are reviewed and developed and comply with the available guidelines.
- g. The DOTS strategy of TB control is effectively implemented and all stakeholders are adequately involved.

LIST OF REFERENCES

1. Centre for Disease Control (2008). Guidelines for the control of Tuberculosis in the northern territory. Can also be accessed at <http://www.nt.gov.au/health/publications>
2. Francis J. Curry National Tuberculosis Centre. (2007). **Tuberculosis Infection Control: A Practical Manual for Preventing TB**. 184 pages. Can be accessed at <https://www.ndhealth.gov/Disease/TB/Documents/Infection%20Control.pdf>
3. Kafatia, K. (2009). **Regional health systems strengthening and TB support project: laboratory waste management plan for Kenya**. Ministry of Public Health and Sanitation. Kenya.
4. MGDS II. (2011-2016). **Second medium term national development strategy**. Ministry of economic planning and development. Lilongwe
5. Malawi Infection Prevention Policy. (2006). Ministry of Health. Lilongwe
6. Malawi Health Sector Strategic Plan. (2011-2016). Ministry of Health. Lilongwe
7. Malawi National HIV and AIDS Strategic Plan. (2011-2016). National Aids Commission (NAC). Lilongwe
8. Ministry of Health (2008). **Health Care Waste Management Training Manual for Qualified Health Workers**. Department of Environmental Health. Lilongwe 3. 34 pages.
9. NSO. (2008). **2008 Population and Housing Census**. National Statistical Office of Malawi
10. The National TB Programme (2012).
11. WHO. (2014). **Safe management of wastes from health-care activities**. Chartier, Y., Emmanuel, J., Pieper, U., Prüss, A., Rushbrook, P., Stringer, R., Townend, W., Wilburn, S. and Zghondi, R. (eds). 2nd edition.
12. WHO. (2009). **WHO policy on TB infection control in health-care facilities, congregate settings and households**.

LIST OF APPENDICES

Appendix 1. List of people consulted

	NAME	DESIGNATION	ADDRESS	PHONE NUMBER
1	Mr H. Kafanikhale	Principal Environmental Health Officer responsible for Water, sanitation & hygiene	Ministry of Health, P. O Box 30377, Capital city, Lilongwe 3	+265888851089
2	Mrs F. Dimba	Principal Environmental Health Officer responsible for Food safety & hygiene and port health services	Ministry of Health, P. O Box 30377, Capital city, Lilongwe 3	+265888891574
3	Mr P. Phiri	Principal Environmental Health Officer responsible for primary health care	Ministry of Health, P. O Box 30377, Capital city, Lilongwe 3	+265999203449
4	Mr P. Chilungama	Deputy Director of Mines	Mines Department, P.O Box 251, Lilongwe	+265888862882/ +265999390130
5	Mr W. Simwaka	Human Resource Officer	Mchenga Coal Mine	+265881539554
6	Mr Tembo	Senior Mine Overseer	Mchenga Coal Mine	+265999192315
7	Mr Ndovi	Safety Supervisor	Mchenga Coal Mine	+265995150971
8	Mr Nyirongo	Medical Officer	Mchenga Coal Mine	
9	Mr Jailosi	Nurse in Charge	Jarawe Health Centre	+265881664947
10	Mr C.Y Silumbu	TB Officer	David Gordon Memorial Livingstonia Hospital	+265884300156
11	Mr Y. Soko	Senior Preventive Health Officer	David Gordon Memorial Livingstonia Hospital	

Appendix 2. Underground mine at Mchenga coal mine (pictures taken during site visit on 10th December, 2015)



Appendix 3. Safety signs around Mchenga coal mine



Appendix 4. Overview of the mines sector in Malawi

The current mining activities in the country are focused on production of the following main minerals:

1. Uranium oxide (U₃O₈) was first mined by Paladin Africa Limited at the Kayerekera Uranium Mine in April 2009. 10.46 million Tonnes of ore containing 11,337 tonnes of oxide is estimated for seven years extraction. The yellowcake produced at Kayelekera is exported for upgrading into fuel for nuclear power plants.
2. Coal - Bituminous and sub-bituminous coal is found in Karoo sediments. 60,000 tonnes per year is sold to domestic users and a small amount is shipped to Tanzania. Mchenga Coal Mine has been operating since the 1980s and accounts for about three-quarters of the national production, exploiting 1.4 million tonnes reserve.
3. Limestone - Shayona Cement Co. (under expansion) is the main producer, supplying own needs from deposits at Kasungu.
4. Gemstones - About 12,000 kg of gemstones were produced in 2008. Aquamarine, amethyst, gem tourmaline, smoky and rose quartz, sunstone, heliodor, rhodolite and almandine garnets are among the stones mined fairly regularly. Recent focus is on blue agate, aquamarine and rhodolite. The mechanized ruby/sapphire operations of the Nyala Mines at Chimwadzulu Hill contrast with the sporadic pick and shovel operations. Nyala Mines, with an expected throughput of 1,000 tons per day, re-opened in 2008 but production has not

commenced. Miners groups, especially of women, have been formed with encouragement from the DoM and a Gemstone Association exists.

5. Construction Minerals - Over twenty operators supply quarry stone for construction. Artisanal miners supply aggregate stones and most of the mining activities are not regulated. Ornamental stones and granitic dimension stones are also quarried, but the quantities are insignificant. Kaolinitic clays are produced annually and small scale mining of sand and other clay takes place.
6. Artisanal and Small Scale Mining - A study of ASM in 2001 estimated that 40,000 Malawians are mining gemstones, aggregate, limestone, river /dambo sands, ceramic clays and salt. Equipment is limited to picks, shovels, hoes and hammers. ASM operations result in land degradation, open pits, water pools, heaps of topsoil and waste rock. They also lead to soil erosion along river banks. Limestone extraction areas tend to be heavily de-forested. As reported by The Mines and Mineral Policy (2010), this sub-sector experiences poor occupational health and safety.

Appendix 5. Overview of the Malawi health delivery system

The health care services are provided at three levels of care: i) **Primary level** - provided by community health workers, health posts, dispensaries and health centres ii) **Secondary level** - provided by district hospitals and Christian Health Association of Malawi (CHAM) hospitals of equivalent capacity and iii) Tertiary level– provided by central hospitals. There are **four central hospitals**, two in the southern region, one in the central region and one in the northern region. There is one mental hospital and **twenty three district hospitals**.

The referral hierarchy of the health system involves community health workers, health centres/dispensaries/health posts referring their cases to district hospitals. District hospitals in turn refer their cases to a central hospital within the same region unless the service sought is not available there. Central hospitals tend to deliver all levels of care i.e. primary, secondary and tertiary because of lack of a functional gate keeping system.

Appendix 6. Details of health facilities visited

Facility name	Zone	Region	Type	CHAM/MOH
DGM Livingstonia hospital	North	Rumphi	Community rural hospital	CHAM
Mzuzu Central Hospital	North	Mzuzu	Central hospital	MOH
Jawale Health Centre	North	Rumphi	Health Centre	MOH
Kamuzu Central Hospital	Central West	Lilongwe	Central hospital	MOH

DGM = David Gordon Memorial, CHAM = Christian Health Association of Malawi, MOH = Ministry of Health

Appendix 7. Template of facility based TB infection control plan

Name of Health Facility/Clinic:	Administrator of the Health Facility:
Plan adopted or modified by (date):	
This facility based TB IC plan includes: 1. The IPC committee 2. An overview of the health facility's IPC strategy 3. IPC in specific places of the health facility	Circle where applicable 1. IPC in patient wards 2. IPC in laboratories 3. IPC in x-ray rooms 4. IPC in waiting areas/consultation rooms

Infection Prevention and Control Committee

Name of Committee Member	Position/Designation	Responsibility

Task management

Main task	Person responsible	Time line/frequency	Budget