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GOVERNMENT OF THE REPUBLIC OF ZAMBIA

MINISTRY OF HEALTH

SOUTHERN AFRICA TUBERCULOSIS AND HEALTH SYSTEMS
SUPPORT PROJECT

**Draft Infection Control and Waste
Management Plan for Zambia**

14th MARCH, 2016



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Draft Infection Control and Waste Management Plan for Zambia

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ABBREVIATIONS

1. AIDS: Acquired Immune Deficiency Syndrome
2. ACH: Air Changes per Hour
3. ART: Anti-Retroviral Treatment
4. ASLM: African Society for Laboratory Medicine
5. CHAZ: Christian Health Association of Zambia
6. CDC: Centre for Disease Control
7. DHMT: District Health Management Team
8. DHS: Director of Health Services
9. DHO: District Health Officer
10. DMS: District Medical Store
11. DOTS: Directly Observed Therapy-Short course
12. HAART: Highly Active Anti-Retroviral Therapy
13. HCF: Health Care Facility
14. HCW: Health Care Waste
15. HCWM: Health Care Waste Management
16. HIV: Human Immune Deficiency Virus
17. ICWMP: Infection Control and Waste Management Plan
18. IC: Infection Control
19. MDR-TB: Multi-Drug Resistant Tuberculosis
20. MOH: Ministry of Health
21. NGO: Non-Governmental Organization
22. OPD: Out-Patient Department
23. PCI: Products of Incomplete Combustion
24. PVC: Poly Vinyl Chloride
25. PLHA: People Living with HIV /AIDS
26. PPE: Personal Protective Equipment
27. PPP: Public Private Partnership
28. PTCT: Prevention of Parent to Child Transmission
29. SADC: Southern Africa Development Community
30. STD: Sexually Transmitted Diseases (synonymous with STI)
31. STI: Sexually Transmitted Infections
32. TB: Tuberculosis
33. TOR: Terms of Reference
34. USAID: Unites States Agency for International Development
35. VCT: Voluntary Counselling and Testing
36. WM: Waste Management
37. WHO: World Health Organisation
38. XDR-TB: Extremely Drug Resistant Tuberculosis
39. ZEMA: Zambia Environmental Management Agency
40. ZK: Zambian Kwacha

EXECUTIVE SUMMARY

This Infection Control and Waste Management Plan (ICHCWMP) for Zambia, includes the management of Laboratory Waste. The Infection Control and Waste Management Plan is a subcomponent of the National Health Care Waste Management Plan

Project background

The World Bank is supporting the Regional Tuberculosis (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. Zambia is one of the four participating countries (which include Malawi, Lesotho and Mozambique) in the project. The overarching goal of the project is to: (i) increase utilization of key TB control and occupational lung diseases services in Zambia and (ii) strengthen the sub-region's capacity to address such conditions.

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

Zambia, 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 (NHSP, 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 high 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 exposure to silica dust and silicosis; 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 with a focus on high risk areas such as 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 Zambia 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 Control Programme). It is against this background that the Government of Zambia, just like other SADC member states, has embarked on a Regional TB in Mining sector through a five year project; which will involve three main components namely: 1) Innovative prevention, detection and treatment of TB; 2) Capacity for disease surveillance, and Diagnostics and Management of TB and Occupational Lung Disease; and 3) learning knowledge and innovation, and Project Management. The project further involves expansion and renovations of existing health facilities including laboratories.

Due to the potential impacts (which include increased infection risks and health care waste management challenges) of project activities, an Infection Control and Waste Management Plan was deemed necessary. Thus, this Infection Control and Waste Management Plan (ICWMP) is prepared to facilitate implementation of appropriate infection control and waste management practices, (which include appropriate use of personal protective equipment and waste collection, storage, treatment and disposal practices) to avoid infection and environmental pollution. Specifically, the objectives of this ICWMP are 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 the World Bank funded health projects. Other objectives of the assignment are to undertake gap analysis of existing situation (environmental health control aspects) within the mines and medical waste management aspects

¹ Zambia National Tuberculosis Prevalence Survey (2013-2014).

² WHO Global Tuberculosis Control. (2013).

within health facilities. The key challenges and solutions or actions developed in the infection control and waste management plan are to be integrated in the National Health Care Waste Management Plan supported by the World Bank. In this way, the former is an addendum to the latter.

Methodology

Preparation of this ICWMP necessitated desk work (secondary data collection), physical assessments/inspections and observations in the field and preliminary stakeholder consultations composed of diverse backgrounds and involved women. 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 such as the national plan on medical waste which was disclosed in November 2015 but comments not yet integrated. WHO literature on recommended TB infection control practices and health-care waste management practices were also reviewed to act as yardstick.

General findings

From the assignment, it is found that the current situation of TB infection control measures and health-care waste management procedures in Zambia cannot emphatically guarantee safety among health-care workers, patients, and the general population. Literature review on important documents such as the National TB and Leprosy programme TB manual (2010) and the assessments of Health-care Waste Management activities signal gaps in infection control and waste management practices or handling in all sampled health facilities visited.

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, by building on existing documentation on health-care waste management practices. 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, best practices on TB infection control and health-care waste management have been developed as minimum 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.

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, private companies or Non – Governmental Organisations and relevant ministries and the mines.

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 or 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 MDR-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 system 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

Tuberculosis is one of the major public health concerns in Zambia. The TB notification rate has increased from 105/100000 in 1985 to 545/100000 in 2006³. This increase in TB notification rate is mainly attributed to the HIV/AIDS epidemic. Since 1984, with the beginning of HIV pandemic, Zambia has experienced a four-fold increase in TB notification rates⁴. Other factors exacerbating the TB burden in Zambia include high poverty levels, limited TB control strategies in congregate settings, and challenges with diagnosing TB in paediatric patients (*ibid*). Stuckler *et al.*, (2011) observe that TB is also persistent in countries with low HIV prevalence suggesting that other factors such as late diagnosis, incomplete treatment, migration, and low socio-economic status contribute to TB transmission. Notwithstanding, poor and unregulated housing apartments underscores all infection control practices that may be practiced.

The TB disease burden, however, varies among provinces. The province with highest notification rate is Lusaka, followed by Copperbelt and Southern provinces (see figure 1.1.). Regions along the railway line experience higher notification rates than areas off the railway line (MOH TB programme report, 2011). The distribution of TB is similar to that of HIV prevalence rates in the nation. As reported by MOH TB programme (2011), 50-70% of TB patients are co-infected with HIV. Progress has, however been made in tackling TB in the nation. The recent strides include: increased coverage of the World Health Organisation (WHO) Directly Observed Treatment Short course (DOTS)⁵ strategy; increasing treatment success rate of all forms of TB from 81.5% in 2003 to 88%; and strengthening of collaborative TB/HIV services.

While the country has made significant progress in the fight against TB, challenges are imminent especially in light of the emergence of Multi-Drug Resistant TB (MDR), inadequate programmatic management of this drug resistant TB and inappropriate infrastructure sometimes poorly sited, high TB/HIV co-infection rates and expanding regional migration. As can be seen from figure 1.1, the number of confirmed TB cases is greatest in the Copperbelt and least in the eastern provinces. This data, which has been collected from the TB prevalence survey, indicates that TB notification rates and other TB outcomes are now plateauing. This situation may repeat itself in North Western Province as well due to mining and influx of people.

³ Guidelines for the programmatic management of Drug Resistant TB. Also available at http://www.who.int/hiv/pub/guidelines/zambia_tb2.pdf

⁴ National Tuberculosis Prevalence Survey (2013-2014). Technical report by Ministry of Health. Zambia.

⁵ DOTS is the acronym for the TB control strategy recommended by the World Health Organisation

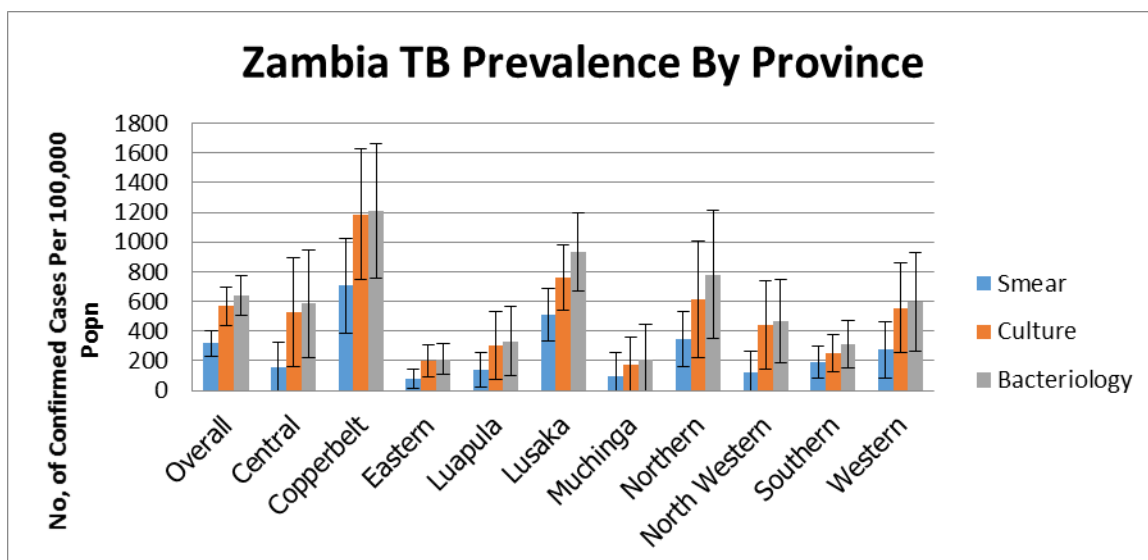


Figure 1.1. TB prevalence survey results by province
 Source: Mission Estimates Using National TB Prevalence Survey 2014 Results

Despite the challenges, Zambia has an opportunity to forcefully tackle the burden of TB, focusing on the exceptionally high rates in the mining industry, mainly in the Copper Belt Province. Zambia’s expanding mining sector is commonly referred to as the “new Copper Belt” and includes new mining operations in the North-Western Province, which suffers a high HIV burden and contains major transport corridors.

1.2 Overview of the proposed project in Zambia

Just like the other three (3) participating countries, the Southern Africa Regional TB in Mining Project in Zambia has the following three main components:

1. Innovative interventions supporting prevention, detection and treatment of TB;
2. Regional capacity strengthening for enhanced disease surveillance, diagnostics and management of TB and occupational lung diseases; and
3. Learning, knowledge and innovation at national and regional levels.

However, Zambia has adapted the three main components to suit its context through careful consultations with stakeholders. The following are the key components identified⁶:

Component 1: Prevention, Detection and Treatment of TB

1.1 Based on the 2014-2016 Revised National TB Strategic Plan, the project will support interventions to **strengthen case detection and treatment success rates** in different geographic areas and population groups. Interventions will include:

- a. Peer education and referral of potential TB suspects by ex-TB patients, ex-miners, NGOs and volunteers using community-based interventions (door-to-door; outreach mobile vans) and public/private initiatives to improve case finding.
- b. Social mobilization for TB/HIV to improve awareness and promote behaviour change.
- c. Establishment/reinforcement of community sputum collection points and transportation to microscopy sites using innovative strategies.

⁶ Information obtained from **preparatory mission report (2015)** for the Southern Africa Tuberculosis (TB) and Health Systems Project as part of a three-country mission to Malawi, Zambia and Lesotho.

- d. Improved access to a harmonized package of high quality TB services in health-care facilities, promoting service delivery integration (e.g. screening for TB in maternal and child health services; screening for NCDs given co-morbidities-TB/diabetes; screening of miners).

1.2 In light of the co-epidemic of HIV and TB, interventions that **strengthen TB/HIV integration** through close collaboration between the National TB Control Program and the National HIV/AIDS/STI/TB Control Program are critical in improving TB control outcomes. Priority interventions will include:

- Improve diagnosis of TB in HIV-infected persons and immediate treatment for TB.
 - Increase HIV testing to 100% of all patients diagnosed with TB and initiate anti-retroviral treatment for all those diagnosed
 - Strengthen TB/HIV infection prevention and control measures in health-care and community settings⁷
- Develop, target and roll-out quality improvement interventions to ensure that Zambia achieves best practices in offering high quality clinical TB and TB-HIV services.
- Strengthen cross-border TB/HIV services, including community based health services, with a focus on miners, ex-miners and refugees.
- Strengthen patient referrals within and across borders to minimize cases lost to follow up within the country and the region.

1.3 **MDR-TB management** priority areas include:

- Support the establishment of second line drug sensitivity testing in one of the three reference laboratories.
- Strengthen supply chain management for adequate procurement of second line drugs.
- Strengthen effective infection control measures within participating health facilities (e.g. train staff to monitor and evaluate their own infection control activities and successes).

1.4 Given Zambia's vibrant mining industry and large occupational health gaps, the regional project will: **enhance the policy and regulatory framework** to address occupational health services; and **support the development/introduction of a standardized package of occupational health services to:**

- Roll out core occupational health services including pre-service, in-service and post-employment screening of miners. Support the Occupational Health and Safety Institute (OHSI) to carry out medical examinations for occupational diseases associated with silica dust-pneumoconiosis and pulmonary TB for job seekers in the mines, existing mine workers and retirees;
- Strengthen disease surveillance systems in mining districts;
- Support the DMS to conduct periodic, unannounced safety audits of mines⁸ on a quarterly basis (this is currently being done annually);

⁷ National HIV/AIDS Strategic Framework 2014-2016

⁸ Mine safety audits are aimed at certifying if mining operations are safe, that protective gear is available and that miners are not exposed to hazardous working environments

- Support Mine Health Inspectorates with the equipment to execute regulatory functions; and strengthen the accountability of mine inspection services to enhance the polluter pay principle;
- Strengthen OHSI human and material resources to audit mining companies to determine their compliance with the mandatory health screening program for employees including small mining companies;;
- Support OHSI to roll out outreach services to track exposure to occupational diseases in the informal mining sector;
- Support environmental monitoring and assessment for silica dust in the nearby mining communities; and
- Support OHSI to roll-out outreach services to track exposure to occupational diseases in the informal mining sector

Component 2: Regional Capacity for Disease Surveillance, Diagnostics and Management of TB and Occupational Lung Diseases

The second component focuses on the critical systems that need to be strengthened for prevention, detection and treatment of TB and associated diseases. The support to these critical areas of health systems would be selective and not exhaustive, as described below.

2.1 **Human resources for health** support will include providing high quality, regionally recognized training to strengthen clinical skills in both the public and private sectors, including in management of MDR-TB and HIV related TB; diagnostics and laboratories (auditors, assessors, mentors, trainers); disease surveillance; and occupational health (inspectors); as well as basic training for Surveillance Officers, community volunteers and civil society groups. Within the Zambian context, human resources for health strengthening can include:

- Pre- and in-service training, mentorships, country exchanges and support for the Field Epidemiology and Training Program (FELTP) in partnership with the CDC. The project could partner with the National Public Health Institute to establish a regional flagship training program in field epidemiology.
- Training additional physicians for MDR-TB treatment; additional nurses who should be responsible for DOTS, including cohort monitoring within each health facility; additional outreach workers to find patients lost-to-follow-up; and existing and new laboratory staff (technicians and management professionals) to ensure treatment adherence.
- In mine health regulation, support for use of modern technology for mine health regulatory inspection in line with international best practices and training of mine health inspectors, possibly through a regionally coordinated training to achieve economies of scale and promote regional learning.

2.2 To improve **diagnostic capacity**, the project may roll out more accurate, newer technologies (e.g. GeneXpert and Line Probe (Hain test) for rapid diagnosis of HIV related TB and MDR-TB at targeted facilities; pilot digital imaging to determine feasibility for use in remote settings; support a selected number of district hospital laboratories to participate in the SLIPTA/SLMTA programs to expand the number of Zambia facilities progressing towards international accreditation; and upgrade the National TB Reference Laboratories through improvements in

physical infrastructure and specialized equipment, to bolster its role in strengthening and mentoring lower-level facilities in the national laboratory network. These activities would be supported in collaboration with key partners active in these areas (e.g., ASLM, the CDC and the WHO). Given the overall level of financing, the number of facilities to be supported will depend on the state of these facilities (i.e. level of investments required). As the goal is to make these facilities premiere structures within the national laboratory network and ensure a good geographic distribution, it will be sensible to build on the investments made by the CDC and the MOH in the 17 labs and also support OHSI's laboratory to enroll in the SLMTA process. Targeting labs in areas that meet the project's geographic focus will be critical in achieving complementary capacity on the supply-side of health services to support demand-side (i.e. community demand generation) activities supported under component 1.

- 2.3 The project will achieve **disease surveillance improvements** through supporting mechanisms and processes for sharing information on public health threats, within the sub-region, in order to contain disease outbreaks more quickly and minimize risk of high case fatality rates. Particular attention will be given to cross-border areas with higher risks of disease transmission. This would include: strengthening laboratory based surveillance systems, establishing cross border committees, conducting joint investigations and carrying out joint table-top simulations. Given the project's focus on TB control, special effort would be given to strengthening surveillance of TB in special geographic, hot spot areas and among priority vulnerable groups.
- 2.4 The project will **enhance regulatory capacity** to assist the public sector to track and monitor environmental conditions in the mining sector (i.e. levels of silica dust); develop and adapt internationally recognized best practice guidelines and standards; and enforce mine health regulations—including through penalizing non-compliant firms. Given the non-enforcement of existing regulations by the Mines Safety Department, the project will support performance-based or disbursement linked approaches and introduce added incentives for regular and comprehensive mine inspections.
- 2.5 Support the revision of current legislation framework to ensure that the laws and regulations are standardized as per international guidelines/best practices.

Component 3: Learning, Knowledge and Innovation

The third component includes support for regional learning and knowledge sharing, focusing on innovative aspects to be supported under the project in each country. Zambia's National TB Program and the DMS expressed strong interest in embedding a strong learning and evaluation agenda into the regional project design. Key questions of policy level interest include cost effectiveness of various TB prevention and treatment interventions and technical effectiveness of specific innovations. The types of activities to be supported are described below. The list is indicative and not exhaustive.

- 3.1 **Learning and knowledge sharing** will include: (i) participating in South-South learning exchanges between policymakers and practitioners from the four countries and beyond, focusing on topics of interest such as: improved case detection; strengthened MDR-TB management; and mining sector regulation; (ii) producing case studies on innovations underway in the country (e.g.

community level interventions; transport specimen innovations; task shifting); and (iii) conduct joint annual reviews that involve participants from all four countries to take stock of lessons and experiences.

3.2. The project will fund rapid **baseline assessments** for a better understanding of the size and scale of the TB problem among miners and mining communities, to better define the context and proposed interventions. One of the key surveys proposed is for MDR-TB, to obtain knowledge that is up to date (the most recent surveillance data is eight years old).

3.3. The project will support **rigorous operational research** of proposed interventions under component 1, to learn what works and under what circumstances; how much it costs; and how it can be sustained in Zambia's resource constrained context. The operational research will include a combination of quantitative and qualitative methods, looking at key variables of interest (i.e. case detection rates, treatment success rates) as well as views, perceptions and attitudes of providers and patient health seeking behavior. Broad areas of learning through operations research of greatest interest to Zambia include: (i) why there is high TB prevalence among high income earners in rural areas; (ii) the process and qualitative dimensions of re-hiring those who have been successfully treated for TB; (iii) cost-related questions (e.g. differential costs of TB treatment and investment in prevention by mining firms); (iv) research on patients lost to follow up during the course of TB treatment; (v) postmortem studies; and (vi) comparative analysis of treatment outcomes for MDR-TB patients on ambulatory and in-patient approaches.

3.4 A "**Centers for Excellence in TB Control**" approach will be innovated within the context of this project to facilitate knowledge generation, provide capacity building support to participating countries and lead the demonstration of excellence in the management of TB and occupational lung diseases. Each country will decide on a technical area within TB control to lead and propose an innovation. A lead institution with demonstrated technical expertise within each country will be selected to serve as a center of excellence. With the Bank's support, each innovation will be piloted, evaluated and documented for the benefit of other participating countries and the SADC region. Examples of innovations include: (i) establishing an in-patient MDR-TB patient management center; (ii) performance-based incentives for community based health workers in strengthening TB case finding; and (iii) introduction of modern electronic health record systems to strengthen occupational health and safety which can be extrapolated for other occupational diseases as a sustainable measure..

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 Zambia and (ii) strengthen the sub-region'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), which includes infection control interventions, particularly provision and use of Personal Protective Equipment (PPE) and segregation materials.

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 stakeholders including mining companies, health-care personnel as well as laboratory services providers. 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 Zambia; and strengthening the country's capacity to address occupational health concerns. The project is targeting sputum collection and microscopy sites at national, provincial, district and community levels.

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 for screening of sub-project activities to determine the level of environmental management work to be implemented to support efforts in TB prevention and control.

2. POLICY, LEGAL, ADMINISTRATIVE AND OPERATIONAL FRAMEWORK FOR HEALTH-CARE WASTE MANAGEMENT IN ZAMBIA

2.1. Policy Framework

The important policies and declarations related to TB management, mining, environmental protection, waste management, pollution control, and environmental health in Zambia include the following

2.1.1. The SADC protocol on Mining (1992)

Article 9 of The SADC protocol on Mining (1992) states that Zambia, as a SADC member state, shall agree to improve the practices and standards of occupational health and safety in the region's mining sector.

2.1.2. National Health Policy (2012)

It is the vision of this policy to have a Zambian population of healthy and productive people. The overarching objective of the National Health Policy is to reduce the burden of disease, maternal and infant mortality and increase life expectancy through provision of a continuum of quality and effective health-care services as close to the family as possible in a competent, clean and caring manner.

One of the specific objectives of this policy is to achieve increased coverage of occupational health and safety services in all sectors, in order to contribute to the reduction of occupational health and safety hazards at places of work. To achieve this, the Government of Zambia, through this and policies emphasises the need for strengthening prevention and protection from communicable diseases (e.g. TB) at work place. Furthermore, the policy recognises Tuberculosis as one of the major public health problems, particularly in high risk groups (e.g. prisoners). The objective, therefore, is to halt and reduce the spread of TB by increasing access to quality TB interventions for prevention, treatment, and care.

2.1.3. National Health Strategic Plan (2011-2016)

The National Health Strategic Plan (NHSP) though planned to be reviewed in the near future, seeks to provide the strategic framework for ensuring the efficient and effective organisation, coordination and management of the health sector in Zambia during the next five 5 years from 2011. It builds on the achievements made in the NHSP (2006-2010). The mission of NHSP is to provide equitable access to cost effective and quality health services as close to the family as possible. The overall goal of the NHSP is to improve the health status of people in Zambia in order to contribute to the socio-economic development.

2.1.4. National Health Care Waste Management Plan (2015-2019)

The National Health-Care Waste Management Plan (2015 -2019) was developed as a guide to all institutions producing health-care waste, in planning and implementation of interventions that will reduce mismanagement of hazardous waste in Zambia. During the operation phase of the Southern Africa Regional TB in Mining project, health-care waste is will be generated in the TB wards, laboratories and sputum collection centres. Environmental degradation, contamination or pollution

is likely to result from waste handling, storage, transportation and final disposal activities. The ICWMP must therefore adopt appropriate measures for enhancing waste reduction, recycling, proper waste transportation and adequate final disposal of health-care waste as prescribed in the National Health-Care Waste Management Plan.

2.1.5. National HIV and AIDS/STI/TB Policy (2005)

This policy was adopted in 2005 to provide the requisite framework for informing and guiding various stakeholders in the quest to contribute to the fight against HIV and AIDS, STI, TB and other opportunistic infections. The policy presents measures to be followed to prevent and control the spread of HIV/STI/TB, promote care for those who are infected and affected, and reduce the personal, social and economic impact of the epidemic. Some of the measures which are of importance to the Southern Region TB in Mining, Zambia Project include the following:

- Multi-sectoralism: all sectors of society must be actively involved in the design, implementation, review, monitoring and evaluation of the national response to HIV and AIDS and TB.
- Increased Advocacy, Social Mobilization and Communication: the project must strive to achieve highest levels of social mobilization against and commitment to the fight against HIV and AIDS/TB.
- Involvement of Traditional Leadership and Structures: the use of traditional values and strengths must be promoted as part of the foundation for the fight against HIV and AIDS as well as TB.

All challenges associated with HIV/AIDS and TB at workplace must be resolved, for example, through development of relevant work place policies and encouraging and supporting work place based HIV/AIDS/STI and TB.

2.1.6. Zambia Infection Prevention Guidelines (2010)

These are standard guidelines, which are technically sound and feasible, for infection prevention practices applicable at all levels of the health care system, in the current environment of health care services in Zambia. The guidelines comprise, among other infection control practices, Tuberculosis infection control measures in health care settings whose objective is to prevent the spread of *M. tuberculosis* to vulnerable patients, health personnel, the community and those living in congregate settings. In addition, the guidelines specify proper health care waste management, to ensure a safe and clean environment to protect waste handlers, health care providers, patients and the community from accidental injury and communicable diseases. The guidelines are not enough in circulation and are earmarked to be revised. The proposed Southern Africa TB and Health Systems Support Project will, therefore, have to comply with these guidelines.

2.2. Legal Framework

2.2.1. The Environmental Management Act (2011)

The Environmental Management Act (EMA) was enacted in 2011 to repeal the Environmental Protection and Pollution Control Act (EPPCA), 1990. The Act provides for integrated environmental management, protection and conservation of the environment and sustainable management and use of natural resources. It promotes prevention and control of pollution and environmental degradation; and public participation in environmental decision making and access to environmental information. Part 1, Section 4, (1) of the Act gives every person living in Zambia the right to a clean,

safe and healthy environment, including the right of access to the various elements of the environment for health (Part 1, Section 4, (2)). Thus the Southern Africa Regional TB in Mining Project must be designed in a way that the activities do not threaten individuals, cause harm to human health or the environment.

Part 2, Section 1, (Sub-section 1) of the Act gives the Zambia Environmental Management Agency (ZEMA) the mandate to ensure the sustainable management of natural resources and protection of the environment and the prevention and control of pollution. In line with the mandate, one of the core functions of ZEMA is to draw and enforce regulations related to water, air, land and noise pollution, pesticides and toxic substances, waste management and natural resources management. In addition, ZEMA manages the Environmental Impact Assessments process provided for in the Act as one of the measures for Integrated Environmental Management: *“A person shall not undertake any project that may have an effect on the environment without the written approval of the Agency, except in accordance with any conditions imposed in that approval (Part III, Section 24 (1))”*. The approval follows preparation of an **Environmental and Social Impact Assessment (ESIA)** and ZEMA determining that the effects of the proposed project will not cause adverse effects or that the mitigation measure are adequate to satisfactorily mitigate the effects. Thus the MOH will be required to carry out an ESIA and prepare a project brief or an environmental impact statement depending on the nature of the activities at the site. The ESIA will ensure that the potential impacts of a project on the natural environment and local communities, whether positive and negative, are assessed at the planning and decision making stage, thus enabling appropriate measures to be put in place to prevent, limit or manage any potentially negative impacts of a project whilst enhancing the positive impacts, in accordance with the principles of sustainable development.

2.2.2. Mines and Minerals Act (2015)

This Act has provisions for safety, health and environmental protection in mining operations. The mining or mineral processing licence is issued or renewed with conditions for protection of environment and human health (Part VI, Section 80 and 81). The said sections aim to conserve and protect air, water, soil, flora, fauna, fish and fisheries; and scenic attractions as well as protect human health, in consultation with the minister responsible for health. Therefore, the TB in mining project must protect human health and safety in the mines. The Act provides for environmental and social impact assessments, inspections by the relevant authority, penalties and compensations where mining activities have endangered the environment, human health and livelihoods.

2.2.3. The Occupational Health and Safety Act (2010)

This Act provides for the protection against risks to health or safety arising from, or in connection with, the activities of persons at work. Therefore it is important that the activities for the Southern Africa Regional TB in Mining project must protect the miners as well as the ex-miners. Part IV, Section 16 (1 and 2) outlines the duties of the employer which are generally: providing a safe working environment; making sure that the employees are healthy and fit to work in the provided work environment; providing protective clothing or equipment; making sure there are health, safety, emergency and first aid measures; and providing information on safety and health. On the other hand the employees have the responsibility for their personal health and safety (Part IV, Section 17 (1)). For success of the Southern Africa Regional TB in Mining project, employers and employees must comply with the provisions of the Act, which also requires the establishment of health and safety committees and enforcement of the occupational health and safety measures.

2.2.4. Public Health Act (1930)

This Act is for the preservation of public health in Zambia. It provides for the prevention and suppression of diseases and generally to regulate all matters connected with public health in the country. The Act recognises TB as a notifiable infectious disease requiring giving notice to the nearest Medical Officer of Health when a person is recognised as suffering from the disease (Part III, Section 9 and 10). As such notification of the diseases should be one of the topics for sensitization and awareness during implementation of the project. The Act also has provisions for medical attention, detention, isolation and medical surveillance of infected persons. Sanitation and housing is regulated in Part IX of the Act through prohibition of nuisance, giving powers to the local authority to maintain cleanliness and prevent nuisances. MOH must encourage control or prevention of nuisance in the mines and at the sites for construction activities including creation of awareness on built environment tenets such as housing..

2.2.5. Workers' Compensation Act No. 10 of 1999

The Act applies to any injury that is caused or disease contracted by a worker due to the negligence, breach of statutory duty or other wrongful act or omission by the employer; or of any person for whose act or default the employer is responsible, nothing in this Act shall limit or in any way affect any civil liability of the employer independently of this Act. Part IX of this Act states that a person shall not be eligible for periodical examination unless at the date of the last examination, the applicant was found to be free from Tuberculosis. The proposed project will therefore have to be wary of such legislations for effective implementation.

2.3. Administrative and operational framework

The Ministry is headed by the Minister of Health who handles policy issues, while operational issues are handled by the Permanent Secretary (PS). Ministry of Health (MOH) holds the central responsibility for medical and preventive health care services in Zambia. It has a wide network of public health institutions categorized as Health Posts (rural and peri urban), Health Centres (rural and urban), first level referral hospitals, second level referral hospitals and third level referral hospitals and tertiary hospitals. In addition, MOH regulates the activities of Private Hospitals through the health professions council and works with the Churches Health Association of Zambia (CHAZ) which runs a network of Christian Hospitals.

The health system has a decentralised structure having offices at Central, Provincial, District and Health Centre Level (table 2.1). At central level, the project falls under the Directorate of Disease Surveillance Control and Research which has a special unit created to respond to Tuberculosis. The unit, which is headed by a National TB control Manager (see table 2.2), will lead in the implementation of the Southern Africa TB and health systems support project within the country.

Table 2.1 Structure, roles and responsibilities of the decentralised Health System

Level	Unit Structure	Roles and responsibilities	Key Officers
Ministry Level	Ministry of Health (HQ)	Policy, Regulation and High level Supervision, mentorship, performance assessment, dissemination, Training, and Technical	Minister and Permanent Secretary Director of - <ul style="list-style-type: none">• Technical and Support services• Disease Surveillance

Level	Unit Structure	Roles and responsibilities	Key Officers
		oversight	Control and Research <ul style="list-style-type: none"> • Clinical Care and Diagnostic Services • Human Resources and Administration • Policy and Planning
Province	Provincial Health Office <ul style="list-style-type: none"> • Public Health Unit • Clinical Care Unit 	<ul style="list-style-type: none"> • Provides a link between the central and district level 	<ul style="list-style-type: none"> • Provincial Health Director • Provincial Medical Officer
District (hospital) Level	<ul style="list-style-type: none"> • District Health Management teams • Hospital Management teams 	<ul style="list-style-type: none"> • Technical Support to the provision of health services • Support to hospital management • Strategic orientation and decision making 	<ul style="list-style-type: none"> • District Director of Health • District Medical Health Officer
Health Centre (Community) level)	<ul style="list-style-type: none"> • Health Centre Committees • Neighbourhood Health Committees 	<ul style="list-style-type: none"> • Community Participation to the management of health centres • Community participation in health 	<ul style="list-style-type: none"> • Health Centre in-charge

TB and other opportunistic diseases are operationalized through the NHSP (2011-2016) and National TB Control Program Strategic Plan (2014-2016). Table 2.2 provides the structure and function of the National TB Control Programme.

Table 2.2. Structure and function of the National TB control programme

LEVEL	FUNCTIONS
CENTRAL UNIT Director of Public Health and Research NTB Programme Manager TB/Leprosy Officers	<ul style="list-style-type: none"> • Planning, co-ordinating, monitoring and evaluating standardised Tuberculosis control measures. • Training and supervision of personnel involved in Tuberculosis work. • Budgeting and procuring supplies e.g. drugs and laboratory equipment. • Resource mobilization. • Coordinating TB/HIV activities through a National TB/HIV Coordinating Committee. • Set and support operational research agenda • Supporting Reference laboratories.
PROVINCIAL LEVEL Provincial Medical Officer Communicable Diseases Control Specialist	<ul style="list-style-type: none"> • Co-ordinating Tuberculosis Control activities in the province by working closely with the Central Unit staff. • Supervising and training of District TB/Leprosy Control Officers and other peripheral health workers. • Compiling and analysing TB data for the province in consultation with the Central Unit.

LEVEL	FUNCTIONS
TB Focal Point Person	<ul style="list-style-type: none"> • Ordering, distributing and monitoring supplies e.g. drugs and laboratory supplies. • Coordinating TB/HIV activities through a Provincial TB/HIV Coordinating Committee
DISTRICT LEVEL District Director of Health District Planners/Auxiliary staff TB Focal Point Person	<ul style="list-style-type: none"> • Implementing the NTLP activities in the district through health facility staff. • Supervising health workers in case finding and chemotherapy of Tuberculosis. • Keeping up to date records on TB, and compiling quarterly TB reports. • Liaising with other stakeholders in the district • Coordinating TB/HIV activities through a District TB/HIV Coordinating Committee. • Ordering, distributing and monitoring supplies e.g. drugs and laboratory supplies.
HEALTH FACILITY LEVEL Health Facility in Charge Out Patient Department in Charge TB Focal Point Person	<ul style="list-style-type: none"> • Refer Tuberculosis suspects or their sputum specimens/smears to diagnostic (microscopy) centres for investigations. • Carrying out treatment services including direct observation of therapy. • Tracing irregular and defaulting patients. • Keeping up to date TB register and compiling required TB reports for submission to the district heal office. • Carrying out Health Promotion activities to patients, communities and other health providers.

More details on the health service delivery system in Zambia are provided in appendix 2.

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

3.1 Methodology for the 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

Consultations were also held with officials from the various government ministries including the Ministry of Labour and the Ministry of Mines; staff of the medical facilities at various levels in Lusaka, Kabwe, Ndola, Kitwe and Solwezi; members of the public, including the Association of ex-miners; individual ex-miners in their own capacity and a group of taxi drivers; members of other institutions such as the Occupational Safety and Health Institute and the Zambian Environmental Management Agency; staff of the mine clinics and members of staff of the various laboratories including the Chest Disease Laboratory and management representatives of major health facilities namely Kabwe General Hospital, Ndola Central Hospital, Kitwe Central Hospital, Wusakile Mine Hospital (Private), Solwezi General Hospital and Mary BEGG Hospital (private). Discussions were centred on the project activities; TB case management, infection prevention and control and waste generation and management including mandates of respective institutions challenges and constraints of discharging duties to curb TB.

Ministry of Gender, Ministry of Community Development, Chamber of mines and Coal Mines in Southern Province and Workers Compensation Fund were not visited due to limited time and could further be explored later to form an addendum

3.1.2. Field investigations

Field investigations were conducted to ascertain the current situation of environmental health control aspects (including safety) within the selected mines to facilitate a paradigm shift to prevention and reduction of TB burden. The field investigations also focused on the infection control and waste management aspects, with regard to TB case management in selected Health Care Facilities of Kabwe, Ndola and Kitwe central hospitals, and Wusakile mine hospital, among others operating within the national framework of health care waste management system.

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 Health Systems Support Project. This assisted the Consultant to establish gaps in adherence to the existing policy and legal framework. The existing HCWM plans (2004-2006; 2010 – 2014; and 2015-2019) 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 and insights in to institutional gaps in addressing due diligence risks of health care waste..

3.2 Demographic profile of potential beneficiaries/households

3.2.1 Population of Zambia

Based on the 2010 Census of Population and Housing when total population of Zambia was 13,092,666 with a growth rate of 2.8% per annum, Zambia has a current projected population of

14,925,639. According to the 2010 Census, Zambia's total population is broken down into 49.3 percent (6,454,647) males and 50.7 percent (6,638,019) females. Zambia's total population is distributed as 60.5 percent (7,923,289) in rural areas and 39.5 percent (5,169,377) in urban areas. The percentage of the urban population increased from 34.7 percent in 2000 to 39.5 percent in 2010, consolidating Zambia's position as one of the highly urbanized countries in Sub Saharan Africa. At Provincial level, Lusaka Province has the largest percent share of the population at 16.7 percent (2,191,225) of the total population. Copperbelt Province is second with 15.1 percent (1,972,317), while Eastern Province is third with 12.2 percent (1,592,661) of the total population. Muchinga Province has the least percent share of the total population at 5.4 percent (711,657).

3.2.2 Labour migration among miners and primary labour sending areas

As stated in the 2010 census of population and housing, Zambian population has a long history of mobility associated with economic development. The impetus on migration and growth of towns during the late 1920s came from large scale exploitation of mineral ores such as copper, lead and zinc. Towns like Ndola, Kabwe and Kitwe gained population as a result of migrant labour to the mines. Missionary activities were responsible for growth of towns like Chipata and Mbala. By 1931 most towns in the mining areas and others that developed later had a large resident of immigrant European communities and African population (Kay 1969, CSO; 1995). The 2010 census population and housing, however, does not specify the patterns of labour migration among miners and the primary labour sending areas. The Zambia Demography and Health Survey (2013) observes that women have low status in society.

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

Table 3.1 shows a number of stakeholders likely to be involved in activities associated with Southern Africa Regional TB in Mining Project.

Table 3.1. Stakeholders likely to be 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
CBO	Community based	Sensitisation on TB and HIV and AIDS	Project implementation	Expectation: To be financially supported to increase TB and HIV and AIDS awareness	Supportive role	Critical	To be involved in the project from planning to implementation	High
HIV support groups	Community based	HIV/TB sensitisation	Project implementation	Expectation: To be financially supported to increase TB and HIV and AIDS awareness	Supportive role	Critical	To be involved in the project from planning to implementation	High
Community volunteers	Individuals preferably from the community members	Sputum collection and monitoring TB treatment	Project implementation	Expectation: To be financially supported on wages and subsistence	Supportive role	Critical	To be involved from project planning phase to project implementation	High
Community health workers	Government sponsored	TB prevention activities at community level	Project implementation	Interest: Following up on TB patients and generating records	Supportive role	Critical	To be involved from project planning phase to project implementation	High
Local leaders	The most respected leads in the local community	Keep the local community alive and involved	Local decision making	Financial of material rewards	Facilitator and mediator between local people and project	Highly critical	Rapport establishment	High
Traditional healers	Practitioners of traditional medicine	HIV and AIDS and TB therapy	Project implementation	To earn income from their services	Supportive role	Critical	To be involved from project planning phase to project implementation	medium

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

3.4 Health Care Services Delivery in Zambia

Health services delivery in Zambia is through the five main categories of: Health Posts (HPs) and Health Centres (HCs) at community level, Level 1 hospitals at district level, Level 2 general hospitals and Level 3 tertiary hospitals at national level (MoH, 2011).

Health Centres: Include Urban Health Centres (UHC), which are intended to serve a catchment population of 30,000 to 50,000 people, and Rural Health Centres (RHC) servicing a catchment area of 29 km radius or with a population of 10,000.

First Level or Referral Hospitals: Are found in most districts and are intended to serve a population of between 80,000 and 200,000 with medical, surgical, obstetric and diagnostic services; including all clinical services to support referrals from lower levels.

Second Level Hospitals: Are general hospitals at provincial level, serving a catchment area of 200,000 to 800,000 people; providing internal medicine, general surgery, paediatrics, obstetrics and gynaecology, dental, psychiatry and intensive care services. These are also referral centres for the first level institutions, which also provide technical back-up and training functions.

Third Level Hospitals: Are central and specialist hospitals serving populations of above 800,000. They have sub-specializations in internal medicine, surgery, paediatrics, obstetrics, gynaecology, intensive care, psychiatry, training and research. They are referral centres for second level hospitals.

The distribution of the health facilities, according to the level is given in table 3.2.

Table 3.2. Health Services Delivery System in Zambia

Description by level	Central	Copperbelt	Eastern	Luapula	Lusaka	Northern	North-Western	Southern	Western	Zambia
Level 3 hospitals	0	3	0	0	3	0	0	0	0	6
Level 2 hospitals	2	9	2	1	0	2	2	2	1	21
Level 1 hospitals	6	8	8	5	15	6	10	14	12	84
Urban health centre	32	137	8	1	182	14	18	34	10	436
Rural health centre	113	53	156	125	47	145	120	174	127	1060
Health post	35	25	53	10	32	49	17	30	24	275
Total	188	235	227	142	279	216	167	254	174	1882

Source: MOH, NHSP 2011

- Health posts: Intended to cater for population of 500 households (3,500 people) in rural areas and 1,000 households (7,000 people) in the urban areas.

3.5 HCW in Zambia

According to the Health Care Waste Management Plan 2015 -2019, health facilities have the potential of generating upto 30 tonnes of infectious health care waste per day (MoH, 2013). Table 3.3 gives the estimated health care waste generated in health care facilities

Table 3.3. Estimated health care waste generated in health care facilities

Facility type		Health Facilities and Ownership			Number of Beds and Cots			Waste Generation / Day	
		GRZ	Private	Mission	Beds	Cots	Total	Rate in kg/bed/day	Amount in kg/ day
CBHWs *		-	-	-	-	-	-	-	-
Health Posts		161	8	2	198	11	209	0.1	20.9
Health Centres	Rural	913	53	6	1814	300	2,114	0.1	211.4
	Urban	252	22	77	9224	559	9,783	0.1	978.3
1 st Level hospital		39	4	29	6016	859	6,875	1	6,875
2 nd level hospital		13	5	3	4204	827	5,031	2	10,062
3 rd level hospital		5	0	0	2532	417	2,949	4	11,796
								Total	29,943.6

- **Note:*** Neighbourhood Health Committees (NHCs), although not in the health delivery system, facilitate linkages between communities and the health system. This is achieved through community based volunteers (CBV) such as Community Health Assistants, Community Health Workers (CHW) and Safe Motherhood Action Groups (SMAGs) who generate a minimal amount of wastes.

3.6 Existing environmental health control aspects within the mines

According to the report of the Auditor General (2014), mining companies fail to comply with the environmental rules, laws, regulations and environmental licensing conditions set by the Zambian government. While the comprehensive national policy has protocols on protection and control of the environment, the Ministry responsible for environment and the Zambia Environmental Management Agency (ZEMA) have not carried out any assessments as to whether the national policy is being implemented by the mining companies or not (*ibid*). This gap is critical to be addressed.

3.7 Existing and previous infection prevention and control; and medical waste management practices within the healthcare facilities.

As a result of concern on spread of TB in clinical and congregate settings, the Government of Republic of Zambia is implementing and strengthening existing infection control activities⁹. The National TB and Leprosy Programme TB manual (2010) provides two main ways of reducing TB transmission namely: *work practice and administrative control measures* and *environmental control measures*. Further to this, the Zambia Infection Prevention Control Guidelines (2010) provide specific measures for TB prevention and control. These measures have been further explained in the implementation guidelines of this ICWMP.

According to the MoH assessment done in Lusaka, Copperbelt, Northern, Muchinga and Southern Provinces in 2013, Health Care Waste Management is generally unsatisfactory at all levels of health care delivery. The assessment revealed that many Health Care Facilities do not entirely ensure safe, sustainable and environmentally acceptable methods for segregation, storage, collection, pre-treatment and transportation; and final disposal for both within and outside their premises. The health care waste management facilities are either inadequate, non-existent or the technology used is not appropriate. Many large hospitals have incinerators for disposing of HCW while rural-based facilities use pits or burning chambers for disposal. Many of these incinerators do not meet environmentally acceptable standards and legal requirements for air emissions or waste disposal.

⁹ National Health Sector Strategic Plan (2011-2016).

Therefore, untreated HCW has been seen at disposal sites for general waste where scavenging is practiced without taking necessary measures to control or abate (CBoH, 2003).

The previous HCWM assessments by several institutions (e.g. World Bank, WHO, and Auditor General’s report and Ministry of Health) show that the current HCWM practices in Zambia are not up to national and international standards and severely lacks financial resources for consistent monitoring and dealing with technological issues. The HCWMP (2004-2006) assessment, for instance, observed that the current infectious wastes such as contaminated gloves, syringes and other health care wastes (HCWs) are just thrown into shallow open pits where other HCWs are burnt and others are not. The situation has often resulted into scavenging by street kids and unemployed youths. The assessment also noted that there is an increase of private clinics or hospitals and private waste management entrepreneurs which has resulted in situations where HCW ends up at domestic waste dumping sites. This has often resulted into mixing of domestic and hazardous waste. While disposal facilities are available, the 2004-2006 HCWM assessment also revealed that the majority of health facilities do not segregate waste, 25% of the local community scavenge HCW within health facilities, and most of the facilities do not have functional Infection Control Committees in place (see table 3.2).

Table 3.4. Handling of Health-care Waste (source: HCWMP for Zambia, 2004-2006)

Category	Percentage	
	Yes	No
Segregation of waste by type	37	63
Re-use of HCW	31	69
Disposal facilities(e.g. incinerator, open pit)	75	25
Scavenging HCW	25	75
Functional Infection Control Committee	50	50
Health Care Wastes awareness programmes	44	56

While the 2004-2006 assessment found that 31% of health facilities re-use disposables/HCWs, it was generally observed that disposal of sharps in most public health facilities is not satisfactory. Furthermore, most disposal sites are located far away from points of HCW generation and during HCW transportation, spills and fly-offs sometimes occur. Mazick (2001) notes that 74% of dumping sites are unsecured as they are accessible to the general public and therefore create high levels of infection risks. Capacity by Municipal or Local Councils is lacking both technologically and financial resources, including documenting standardised best practices.

3.8 Summary of observations from the Field Investigations and Public Consultations

The Consultant conducted field investigations and public consultations from 3 to 13 March 2015 and the following sections present the summary of the findings on infection prevention and control; and medical waste management practices within the healthcare facilities, including laboratories.

3.8.1 Kabwe general hospital

Infection control measures

At Kabwe General Hospital, the following infection control measures were observed:

- During the visit, seven MDR TB cases were currently on treatment (4 at Kabwe, 1 at Mumbwa and 2 at Kapiri. Case management takes two years or more;
- The building currently used as the TB ward has poor natural ventilation due to wrong orientation with respect to natural air flow
- Hand hygiene is practiced but there is lack of some facilities, especially hardware.
- Supplies for Infection Prevention and Control are usually adequate;
- Personal Protective Equipment (PPE) is not adequate and sometimes staff must buy their own. Normally, gloves and coats are readily available. Nurses are provided uniforms once in a while. A 95 MDR masks are sometimes not available. PPE is sometimes taken home by staff for cleaning.
- No central approach for cleaning PPE's is available for coats at the hospital
- Rating on compliance with Infection prevention and control ranges between 20 to 80 percent.

Training on TB infection prevention and control is done internally. The hospital has an 83% cure rate and 87% treatment success. In 2004, 100 persons were trained in infection prevention and control. Training challenges include:

- No case management and infection prevention and control trainings are conducted due to inadequate funding;
- Training (mentorship) is usually on the job for 3 days but is sporadic. There is no organised way of screening and inducting newly recruited staff;

Waste management

Waste segregation is done by storing clinical waste into yellow bin liners and general waste into black bin liners. However, the segregation efficiency could be improved by ensuring adequate supply of bin liners at all times and continually sensitising the waste collectors (daily employees or general workers) on both short and long term dangerous effects of clinical waste. Sensitization could include presentation of case studies and video clips of patients that have contracted illnesses from improper handling of waste.

Challenges in waste management include: mixing of waste, periodically running out of incinerator fuel due to shortage of funds, defective incinerators and lack of absence of maintenance schedules, running out of appropriate PPE's including heavy duty gloves and inherent attitude of negligence to use PPE by waste handlers. Hence quarterly sensitization meetings would assist to remove this inherent attitude and barriers to infection prevention and control.

The Hospital had a waste treatment system (sedimentation tank and a trickling filter). However, this broke down and has since been abandoned. The hospital therefore, currently uses 4 septic tanks which are usually choked as they cannot bear the load of usage. There is a possibility to connect to the public sewerage system and discussions with the Local Authority are under way to effect this connection.

3.8.2 Ndola General Hospital

Ndola General Hospital is a third level hospital which deals with complicated referral cases from the catchment of North Western Province and Luapula. It has a bed capacity of 800. The hospital is a focal point for TB and MDR and currently it has a chest clinic that attends to patients one day in a week; and an MDR TB makeshift ward with 9 admitted patients. The TB ward has 3 dedicated nurses under the supervision of Dr, Tshiboko.

Both the diagnostic laboratory and TB ward lack adequate space. Hence there are plans to construct new buildings within the hospital premises on a piece of land that is currently used by psychiatric patients. Drawings for the proposed TB ward and laboratory have been prepared and submitted to the Ministry for consideration. The developments are under the hospital modernisation that the Ministry is undertaking..

The hospital conducts annual assessment of adherence to the infection control policy and procedures and has a rating of between 85 to 90% on following infection prevention and control guidelines. It was observed that:

- They conduct general screening of newly employed staff but this is not specifically for TB, although those that have been noted to have chest problems would be examined in detail for TB;
- Hand hygiene is practiced and staff is periodically sensitised. Members of staff were last year trained in cough etiquette although in practice, the procedures are, not strictly followed; and
- PPE (dust coats and nurses' uniforms) are provided by the hospital.

Waste management including disposal

The hospital uses the Health Care Waste Management plan of 2016-2018 as a guide for health care waste management. It generates approximately 300 kilogrammes of clinical waste and 4.8 tonnes of domestic waste per day. The waste is segregated into clinical/ infectious waste (placed in yellow or red bin liners) and general waste (placed in black bin liners). Laboratory waste is autoclaved before incineration and is, together with the other types of waste, carried in the bin liners and trolleys by the four waste handlers, at least once a day, to a general collection point.

Four waste handlers are responsible for collection of the waste, twice a day, from points of generation to the intermediate storage area; from where the clinical waste is taken away for incineration within the hospital premises and the general waste is taken to the City Council's landfill by a private sub-contractor. The waste handlers are provided with the required PPE, which includes gumboots, work-suits and gloves. They need aprons and masks in addition to the PPE that they are given. They have no bathing facilities except for a tap for hand washing near the incinerator. They also do not have a toilet and instead, they use the hospital toilets.

The incinerator can attain temperatures of up to 1000⁰C. 630 litres of diesel are used to burn the waste per week. However, only 1 drum of diesel is available per week and this exerts pressure on the waste handlers. Ashes from the incinerator are heaped just near the incinerator. The hospital has subcontracted, to a private contractor, removal of domestic waste to the Council's waste disposal area. Charges are ZK500 per skip load and 18 to 20 skips are removed per month. MOH is implementing two projects under the GEF and EIB funding to introduce non-incinerator technology options for disposal of waste and support water and sanitation in health facilities and medical waste disposal respectively. This will help to address the public outcry on the smoke and smells from the incinerator exhausts from the chimney. The smell affects the patients at the clinic, taxi drivers who have a rank nearby, owners and guests of New Lodge and the general public. Ndola General Hospital is connected to the City Council's sewerage system.

Problems and challenges include the following:

- a. Health-care personnel are generally considered unsafe, as they are not adequately protected from environmental health risks; and inadequate ventilation conditions in the TB ward and laboratory working areas;

- b. Periodic unavailability of N95 masks and aprons due to logistical and financial problems;
- c. Some of the PPE (laboratory boots, dustcoats and aprons) is taken by the employees to their homes for cleaning, although the preference is that the cleaning should be done at the hospital.
- d. Insufficient supplies of hand rub chemicals, although the hand rub is manufactured in house;
- e. There are no washing facilities for the waste handlers;
- f. The hospital periodically runs out of bin liners, colour coded waste bins and bin trolleys;
- g. The waste storage bay (especially the floor) needs rehabilitating to improve drainage;
- h. The incinerator chimney is very short and as a result, stinking smoke pollutes the surrounding areas, causing discomfort to patients and the general public. Complaints are continuously received about this from the public;
- i. There is no security gate at the TB ward. Hence patients and other people can easily move in and out of the isolation premises and this exposes people to infection.
- j. Due to lack of resources, the TB patients eat only two times a day and they eat the same type of meal (beans) nearly every day. This is inappropriate for patients that are on strong drugs.

3.8.3 Wusakile mine hospital

Wusakile is a private mine hospital with a bed capacity of 230. The hospital has very elaborate Infection Control and Waste Management Policy documents (e.g. Infection Control Manual 2010 and Mopani Copper Mine Infection Control Manual), although these are not specific for TB case management.

For TB case management, both the TB suspects/ patients and the rest of the patients are housed in the same (general) ward; with the TB patients at one end of the ward. On average, the facility receives 2 or 3 patients per month from either the community or the work group, under the AIDS Relief project.

The mine hospital trains its staff in Infection Prevention and Control. Recently, there were presentations made to the members of staff on MDR TB. The Occupational Health and Safety function, which has superintendents and nursing/ clinical officers, is headed by a doctor (Dr. Boniface Zulu)

Wusakile mine hospital offers medical services under the following arrangements:

- Miners and dependents (biological child and spouse) are given free medical services;
- Registered patients (RPs) under contractors pay for the services; and
- Non Registered patients pay approximately ZK500 for consultation

Where Wusakile Mine Hospital has engaged a contractor for specified work, the contractor's employee's medical services are paid for by the contractor. This raises scepticism on the contractor's commitment and obligations to safeguard the employees' interests and it was learnt from consultations that mine employees under contractors usually have less favourable conditions of service than those directly employed by the mine owners.

There are no waste management problems and the incinerator is in very good condition.

Challenges at the hospital include:

- a. Lack of communication on policies or change of policies from the government;

- b. The private sector does not attend meetings held by government staff; and
- c. Diagnosis in the hospital is limited to microscopy as there are no gene experts.

3.8.4 Kitwe Central Hospital

Kitwe Central Hospital has Infection Control Guidelines, which are displayed in the wards. Screening of patients is done at the chest clinic where 50 patients are screened Daily? Every HIV patient is screened for TB in their Chest Clinic and more screening is done in their Buchi Area Clinic. At the time of visit Kitwe Central Hospital had 15 adult patients, 8 of which were male and 7 were female. MDR TB patients are referred to Ndola Hospital.

The District Medical Office (DMO) has a TB/HIV/Leprosy Coordinator (Sharon Musakanga). The office registers all TB cases and assigns code numbers in the District Register. There are eight private hospital facilities that register their TB cases with the DMO. There was training in January on the new guidelines

The hospital staff is trained in Infection Prevention and Control and they normally have a good supply of Infection Control materials. They are guided by the three “Is” which stand for Intensifying Case Findings, Isolation and Isonise. The Occupational Health and Safety Institute certifies workers who have been cured from TB to indicate whether they can work in the mines or not. After being cured, the patient may:

- Be discharged honourably;
- Be redeployed to another area not requiring highly intensive work;
- Continue working; or
- May be dismissed.

Challenges include:

- Inadequate gene expert machines; approximately 10 additional are needed to be able to service the 28 TB treatment sites including 4 private sites. Currently these sites have only 4 gene expert machines;
- There is periodic shortage of sputum sampling containers;
- Only 7 laboratories out of 20 in the district perform sputum tests;
- Currently, very small cubicles are used for TB management. One room and a store room with large windows are needed for adequate ventilation. TB management for the private sector is difficult, especially with consultants that do not follow any rules;
- The miners sometimes lie that they are not diagnosed with TB, when in fact they are; in order to save their job;
- There is need to engage mine operators to facilitate health and safety protection of the workers; and
- There is need to harmonise the legislation. The Workers’ Compensation Act does not allow ex-TB patients to be re-employed after they have been certified ok by the OSHI.

Challenges include that:

- The TB structures are not ideal. Hence the corridors at the OPD 1 are congested
- The hospital was constructed in 1931 for a bed capacity of 8,000. However, currently, the hospital is very much stressed with patients numbers ranging from 8000 to 20,000
- The hospital functions as a level 1 and 2, since there is no District Hospital;

- Side wards are not adequate. However, there are plans to relocate the TB services to another site and also to modernise the whole hospital

3.8.5 Solwezi General Hospital

Challenges:

- Too much mix of medical and domestic waste
- Waste decontamination is a problem due to lack of facilities
- Shortage of bin liners
- Currently there are operational problems with the micro burner, which is currently being repaired. The hospital needs two incinerator chimney is too low and as such, the emissions are a nuisance to the workers and staff
- The incinerator
- The hospital needs a utility vehicle
- There is need for education and sensitisation of staff in infection prevention and control as well as waste management

4 POTENTIAL IMPACTS RELATED TO THE PROJECT ACTIVITIES

Based on the project components, most of the potential negative impacts will be felt during the operation phase of the project (e.g. handling of sputum from point of collection, laboratory analysis, health-care waste collection and disposal). Table 4.1 has identified potential environmental and social impacts likely to be generated 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 7.1).

Table 4.1. Potential negative impacts and proposed mitigation measures

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

Environmental/ Social components	Impacts	Mitigation measure
Health and Safety	Spread of TB from infected persons and waste	<ul style="list-style-type: none"> a. Provide adequate ventilation in laboratories and treatment areas b. Provide appropriate protective equipment for handling TB specimen and ensure they are used c. Use appropriate and safe procedures for handling specimen and laboratory waste d. Store specimen and culture in appropriate containers and places e. Treat laboratory waste by incineration or other approved methods f. Ensure that staff know and use the recommendations in this ICWMP g. Conduct staff and public awareness campaigns quarterly; and h. Conduct civic health education in the communities.
	Risk of exposure to infectious specimen during collection and transportation of sputum	<ul style="list-style-type: none"> a. Provide PPE to staff and ensure the PPE is used to handle sputum and infectious wastes b. Package sputum in appropriate containers that can be sealed tight and cannot break, or leak c. Transport sputum containers in appropriate boxes d. Ensure that staff know and use the recommendations in the ICWMP
	Accidents and risks of fire in the laboratory	<ul style="list-style-type: none"> a. Provide fire-fighting equipment b. Raise awareness on staff about accidents and fire risks
	Radiation from X-rays	<ul style="list-style-type: none"> a. Make sure the X-ray Laboratory and mobile machines are properly shielded b. Regularly check for X-ray leakage c. Provide medical treatment where staff are exposed to high levels of radiation

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.

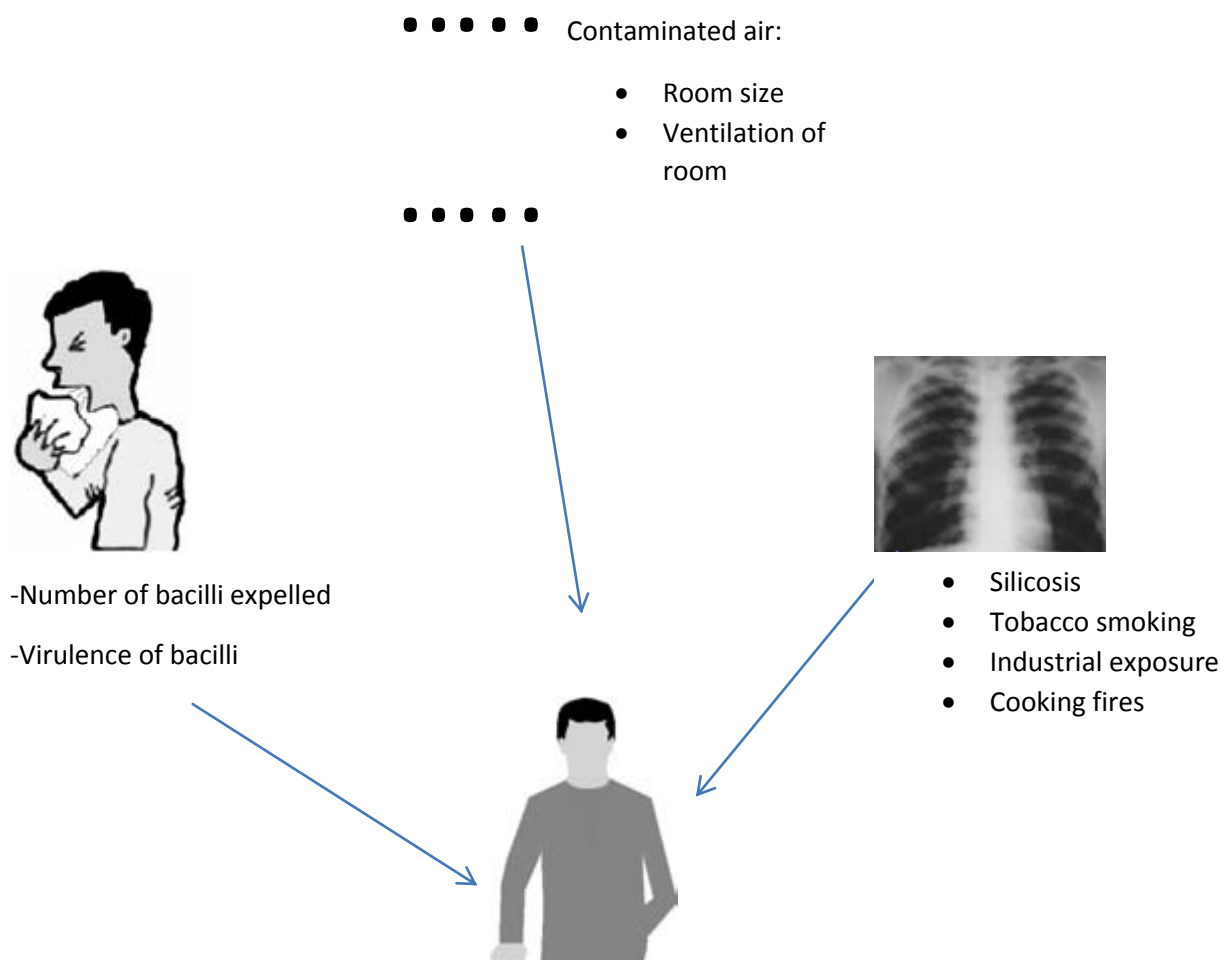


Figure 5.1. Factors affecting TB transmission (as adapted from WHO, 2003)

TB transmission is in fact more intense in crowded, poorly ventilated spaces where there is little air flow and ambient sunlight. 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*¹⁰. There are various phases of TB infection that are worthwhile to note for an effective TB infection prevention and

¹⁰ WHO (2003). Guidelines for workplace TB control activities: The contribution of workplace TB control activities to TB control in the community.

control programme. Exposure to *M.tuberculosis* from an infectious case can lead to infection that is 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 5.2 for more differences).

Table 5.1. Differences 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 following¹¹:

- a. Proper patient registration and case notification;
- b. Selecting appropriate standard treatment regimens
- c. Standardizing the process of data collection for TB control;
- d. Evaluating the proportion of cases according to site, bacteriology and treatment history;
- e. 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. 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 protection¹². These measures should be implemented together as they complement one another (WHO, 2009).

¹¹ WHO (2009). Treatment of tuberculosis: guidelines – 4th ed. WHO/HTM/TB/2009.420

¹² WHO (2006). Guidelines for the programmatic management of drug-resistant tuberculosis.

5.2.1 Work Practice and administrative Control

The *work practice and administrative 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)¹³. 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

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

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	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

¹³ Addendum to WHO Guidelines for the Prevention of Tuberculosis in Health Care Facilities in Resource-Limited Settings, 1999.

	refer	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.
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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 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.

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 5.2 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 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 air. Such measures include maximisation of natural and or mechanical ventilation (controlling direction of airflow)¹⁴, 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.

5.2.3 Personal Respiratory Protection (Special masks)

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. Masks that prevent TB transmission are known as ‘particulate respirators’ and are specially designed to protect the wearer from tiny (1-5µm) airborne infectious droplets. 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. A patient, when being transferred to another department, also has to wear such type of masks to prevent TB transmission.

5.3 TB Preventive requirements within the mines

TB prevention can be tackled at two points in the cycle of infection and disease¹⁵. 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 (treatment and management) of TB in the work place (e.g. mining industry), WHO recommends the DOTS¹⁶ (Directly Observed Therapy, Short-course) strategy which consists of five elements as shown in table 5.3 below:

¹⁴ 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

¹⁵ International Council on Mining and Minerals (ICMM) final report (2008). Good practice guidance on HIV/AIDS, Tuberculosis and Malaria.

¹⁶ DOTS is an internationally standardized recommended program for TB treatment and management.

Table 5.3. 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 death¹⁷. Figure 5.2 shows some other interventions, in addition to the DOTS strategy, which are crucial and have potential to reducing TB incidence in the mining place.

¹⁷ WHO (2003). Guidelines for workplace TB control activities: The contribution of workplace TB control activities to TB control in the community

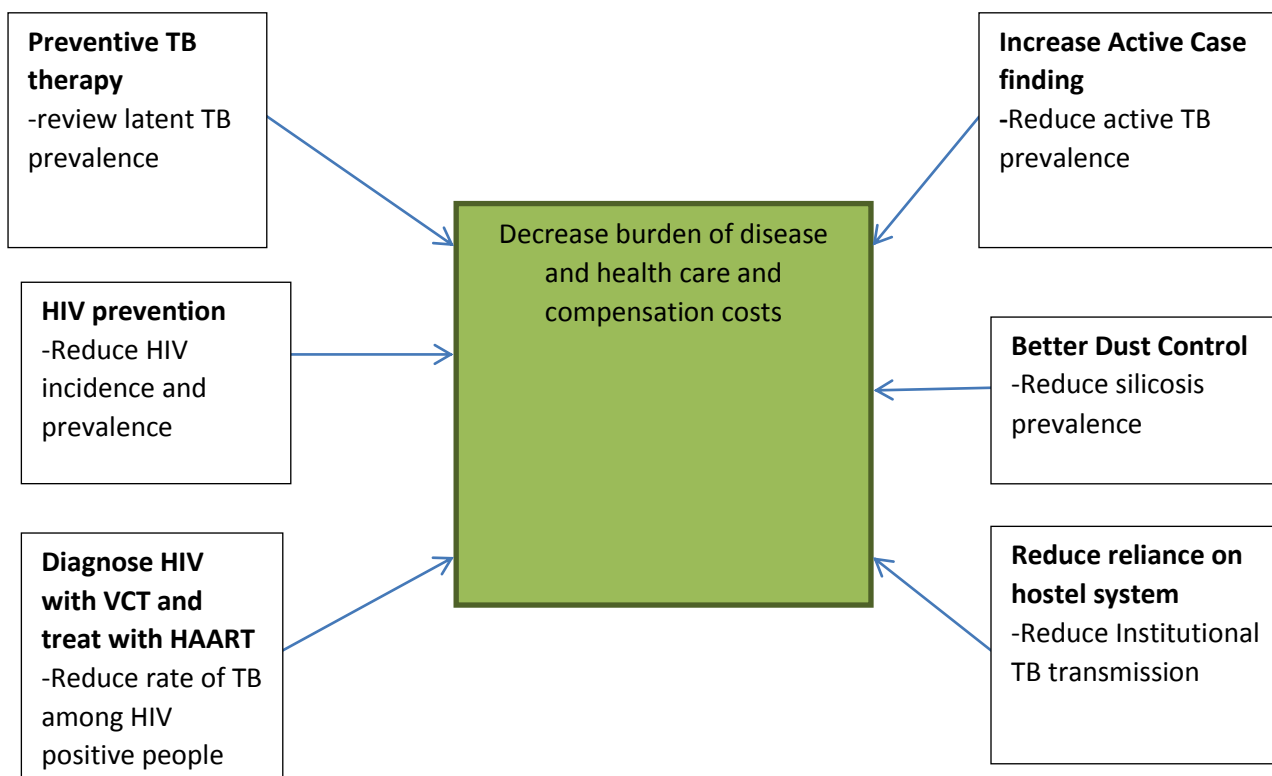


Figure 5.2. Interventions to reduce TB incidence in the mining industry

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 TB¹⁸ 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

According to WHO guidelines for general infection control, 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);
- 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;

¹⁸ WHO. (2004). Practical Guidelines for Infection Control in Health Care Facilities

- 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.

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)¹⁹. 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 management²⁰ (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).

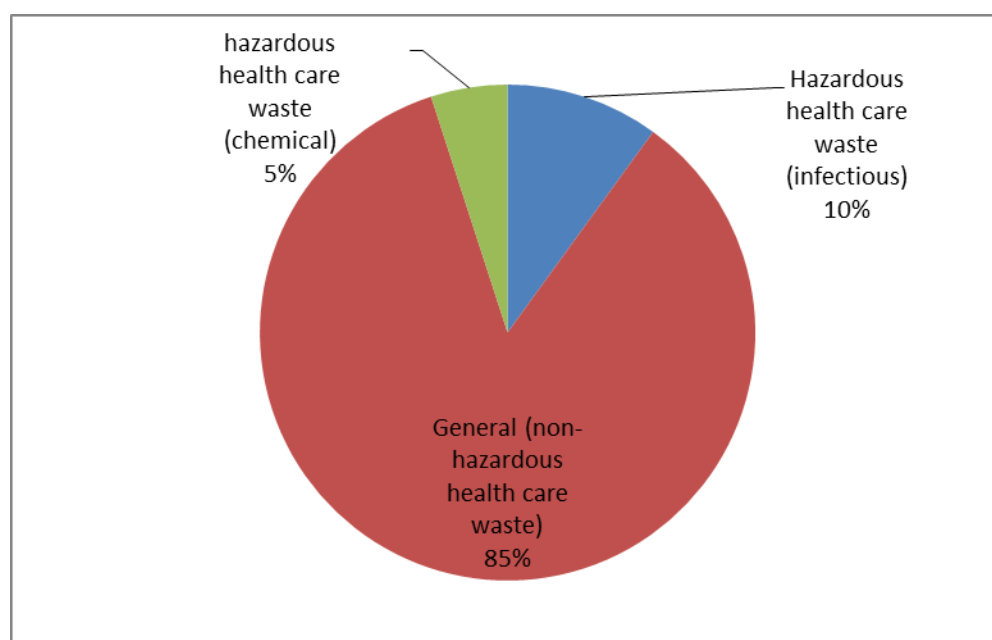


Figure 6.1. Typical waste composition in a Health Care Facilities (Source: WHO, 2014)

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

¹⁹ WHO. (2014). Safe management of wastes from health-care activities.

²⁰ WHO. (2004). Practical Guidelines for Infection Control in Health Care Facilities.

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|-------------------------|--|
| | 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 and TB detection. These activities will require the use of sputum cups and slides among other medical supplies which have to be safely disposed of 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 and sharp objects pricks. Developing and monitoring a sound health-care waste management system is therefore an obligation that must be met 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 Zambia, as stated in the HCWM plan (2015-2019), HCWM starts at collection and storage stage where HCW is generated. The processes involved in HCW collection and storage include: waste collection; segregation; storage; and/or 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 ensure proper treatment of each HCW category. As indicated in the HCWM plan (2015-2019), HCW segregation should be standardised throughout the country, using colour codes (see table 6.2). On the other hand, waste storage encompasses the secure keeping of HCW into appropriate waste receptacles/containers prior to final treatment or disposal; whereas recycling involves recovering the basic material (e.g. cartons or bottles from pharmacy) from a waste stream for reuse in the same

production line or as a different raw material. Chapter 8 of this ICWMP details the guidelines to be followed when handling HCW to be generated from this project.

According to WHO (2004), 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	in health facility	collection + on-site transport	<i>protective equipment; sealed containers; specific easy to wash trolleys</i>
4		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 to be applied. A recommended way of segregating HCW into categories is by sorting and storing the waste into colour-coded, well packed and labelled containers (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 provides details of colour codes that can be used for different HCW streams as per Zambian standards.

Table 6.2. Waste segregation (adapted from Zambia HCWMP, 2015-2019)

Waste code	Types of waste	Colour code	Type of receptacles
A	General waste	Black	Plastic bag of appropriate size
B	Infectious waste		
B1	Sharps	Yellow	Puncture-resistant containers plastics bags
B2	Patient waste	Yellow	Plastic bags and containers
B3	Culture/specimen	Yellow	Plastic bags and containers
C	Pathological	Yellow	Plastic bags
D1	Pharmaceutical	Brown	Plastic bags and containers
D2	Photographic chemical -Photographic developer -Fixer solution -X-ray photographic film	Brown	✓ Plastics containers ✓ To be recycled /reused ✓ To be neutralized
D3	Radioactive waste	Yellow	✓ Containers with radio-active symbol
	✓ Solid-combustible/compactable		✓ Durable plastic bags which can be sealed
	✓ Non-combustible/Non-compactable		✓ Puncture-resistant containers (metal)
	✓ Liquid-aqueous		✓ Thick walled polythene bottles or organic-glass containers but should have secondary containers to prevent them from breaking
	✓ Spent sealed sources		✓ Container in which the sources was originally received
D4	Laboratory waste		
D4.1	✓ Acids	Brown	✓ Containers with appropriate labels
D4.2	✓ Alkalis		✓ Acid label
D4.3	✓ Solvents		✓ Acid label
D4.4	✓ Organic substances		✓ Solvent label
D4.5	✓ Heavy metal (e.g. mercury)		✓ Organic substances label
E	✓ Incinerator ash/sludge	Yellow	✓ Heavy metal label
			✓ Metal containers labelled "sludge ash"

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:

- a. Be easy to load and unload;
- b. Have no sharp edges that could damage waste bags or containers; and
- c. 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 Zambia; 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 DateTime						

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:

- a. General waste which can be disposed of or treated like municipal waste

- b. 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 (i.e. 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. Some of these technologies, which have already been specified in the HCWMP (2015-2019) for Zambia include:

i. Carbon Adsorption, which works well with aromatic solvents, chlorinated organics, phenols, polynuclear aromatics, organic pesticides, chlorinated non-aromatics, high molecular weight aliphatics, chlorine, halogens, antimony, arsenic, bismuth, chromium, tin, silver, mercury and cobalt. Carbon adsorption requires proper treatment and disposal of effluent and backwash. Spent carbon can be regenerated or disposed of as appropriate. Spills and releases must be promptly cleaned; equipment decontaminated as needed and sufficient time must be allowed for the carbon to adsorb contaminants.

ii. Evaporation is acceptable, if inorganic waste mixed with water is treated; all organic vapours from organic solutions are captured, some water content is left to prevent “over-cooking” of sludge, remaining sludge is properly disposed of and secondary containment is provided for the evaporator.

iii. Elementary Neutralization process, which can be used for wastes that are regulated, solely because they exhibit the characteristic of corrosivity from having a pH of less than or equal to 2.0 or greater than or equal to 12.5. The resulting waste must have a pH between 6 and 9 and meet the sewer discharge guidelines prior to discharge. Neutralizing large volumes of concentrated mineral acids is discouraged, since it generates significant heat and fumes which pose serious safety risks. Passive limestone-acid neutralization tanks are not recommended. These tanks are hard to maintain, their effectiveness can significantly be reduced by sulphuric acid and hard-to-reach sediments must be removed and characterized before disposal.

iv. 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;

At present, the use of autoclaving, chemical disinfection or any other non-destructive technology like microwave or radio wave irradiation is not allowed for the treatment of special HCW such as organs, tissues, or amputated human body parts. Incineration or burials are the only accepted techniques for the treatment of such special type of HCW. The need for electricity and water as well, in the secondary waste stream implies additional costs.

v. Microwave and Radio wave Irradiation involves application of a high energy electromagnetic field which provokes the liquid contained within the waste (as well as the liquid cell material of micro-organisms) to oscillate at high frequency, heat up rapidly, and eventually cause destruction of all infectious components of the waste. The technique takes place in enclosed containers at atmospheric pressure and temperatures, below the normal water boiling point. The waste first passes through segregation to remove undesirable material and then it is triturated, pulverized, and compressed prior to its disinfection. Similar to the autoclaving technique, the output from a microwave or radio wave facility is considered non-hazardous and can be land-filled together with municipal waste.

vi. 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

vii. 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.

Incinerators, however, 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. 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.

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

	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 to initiate combustion); Regular Operation and Maintenance must be well planned for sustainability Combustion at a sufficiently high temperatures (between 1,000°C and 1,200°C in the combustion chamber) for a long enough time Sufficient turbulence and oxygen required for complete	Elaborate preparation process to separate and remove undesirable material from waste Waste is pulverized, and compressed prior to disinfection	Solid and highly hazardous HCW (microbiological cultures or sharps) must undergo a relatively complex and expensive preparatory process of segregation, shredding, and milling prior to application of the chemical reagents.

	LANDFILLING	INCINERATION	STERILIZATION (AUTOCLAVE AND MICROWAVE)	CHEMICAL DISINFECTION
		combustion to be achieved and for minimization of flue gas pollutants		
local availability of spare parts	N/A	Flue gas emission controls and imported spares and supplies required. Need for importation of some spare parts may lead to high cost and downtime	Spare parts not readily available	Spare parts not readily available
local availability of operational skills	Skills available	Complex technology for low income countries where skills are lacking High level of operator training and skills required	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 disposal of untreated HCW	For properly operated, and maintained units, complete destruction of highly infectious waste can easily be guaranteed	Used in laboratories mostly on small scale	Most suitable for treating liquid wastes such as blood, urine stools or hospital sewage.
environmental impacts	Not recommended regardless of category/ classification of the waste. Only recommended when the economic situation of the country does not permit access to environmentally safer technologies Open to	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 from pollutants such as dioxins and furans as well as heavy metals Requires disposal of bottom ash/slag and fly ash in a sanitary landfill	minimal generation of wastewater and with the appropriate conditioning it can be recycled into the system Low gas emissions Waste must finally be taken to landfill site	Requires special treatment of hazardous wastewater streams. Waste must finally be taken to landfill site

	LANDFILLING	INCINERATION	STERILIZATION (AUTOCLAVE AND MICROWAVE)	CHEMICAL DISINFECTION
	scavengers and animals, pests and rodents High potential for surface water pollution and groundwater contamination hence needing special attention e.g. by providing groundwater quality monitoring wells. Waste must be disinfected before burial	Requires good site security to keep away animals (such as birds, rodents, insects and other vermin) Air emissions from the incinerator (PM, SO ₂ , CO ₂)		

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.

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.

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:

- 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
- 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 (table 6.5) 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 HCWMP (2015-2019) for Zambia 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 Steering Committee - to be responsible for supervising and managing HCWM in Zambia under the directorate of disease surveillance, control and research. The Committee will be composed of Permanent Secretaries for MOH and MCDMCH just to mention a few. The other members have been mentioned in the HCWMP (2015-2019) for Zambia.
- Provincial Steering Committee-The Provincial Medical Officer will be responsible for appointment of Chief Environmental Health Officer who will oversee HCWM activities.
- District HCWM Committee – to be responsible for developing laboratory waste management plans, preparing annual budgets, Supervising HCWM practices in the district including CHAZ 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 CHAZ 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.

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 8.3

Table 6.5. Laboratory Waste Management and Monitoring Plan

Issue	Responsible Authority for Implementation	Estimated 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 MANAGEMENT PLANNING AND PRELIMINARY ACTIVITIES						
Develop facility specific ICWMP for the project health facilities, following guidelines of this ICWMP	Infection Control Teams and Respective Laboratory Managers	1,000	MOH & NTP	Continuously during development of plans	Draft and final Plans	N/A
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
Construct two chamber 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	a. Purchase requisitions, delivery notes and receipts b. 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 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 materials and implement public awareness campaigns	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
Plan for 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
WASTE COLLECTION AND MOVEMENT						
Segregation and storage of waste into marked bins	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of waste streams used	N/A
Use colour coded waste bins in appropriate positions	Laboratory Manager	N/A	MoH	Quarterly	Number of bins in recommended places	100
Place disposable and re-usable materials separately	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of cases of misplacement of re-usable	N/A
Disinfect TB work surface areas with appropriate chemicals	Laboratory Supervisor	N/A	Laboratory Manager	Daily	Number of disinfections done per day	N/A

Issue	Responsible Authority for Implementation	Estimated Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/output	Estimated Monitoring Cost per facility in USD
and methods.						
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
Sterilize or disinfect waste before it leaves the laboratory	Laboratory Supervisor	N/A	Laboratory Manager	Weekly	Disinfections statistics Inspection report	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
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 specifically designated for waste movement	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of positions filled on the establishment	N/A
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	Laboratory	N/A	Laboratory Manager	Daily	Number of carts using the	N/A

Issue	Responsible Authority for Implementation	Estimated Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/ output	Estimated Monitoring Cost per facility in USD
(loaded carts) movement	Supervisor				designated route	
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 responsible for environment	Monthly	Number of complaints against poor waste treatment/ disposal	N/A
Cover disposal pits regularly to prevent access by people, animals and birds.	Laboratory Supervisor	N/A	Laboratory Manager DHO or Ministry responsible for environment	Monthly	Number of pits covered as recommended	N/A
DISPOSAL SITE LOCATION						
All year round accessibility to disposal site.	PEHO/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 	PEHO/PEHO	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						
Disinfect re-usable materials such as slide holders, forceps	Laboratory Supervisor	N/A	Laboratory Manager	Monthly	Number of disinfections done per month	N/A

Issue	Responsible Authority for Implementation	Estimated Cost per facility in USD	Responsible Authority for Monitoring	Recommended Frequency/times of Monitoring	Monitoring Indicators/output	Estimated Monitoring Cost per facility in USD
etc.						
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
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 environment	Quarterly	Number of complaints against health and safety	N/A
Prevent 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 control	MOH	N/A	a. Ministry responsible for Water Resources b. Ministry or department responsible for environment	Quarterly	Water quality	N/A

7 TRAINING IN HEALTH-CARE WASTE MANAGEMENT

7.1 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 for an Infection Control and Waste Management Programme 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 Infection Control and 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 HCWM programme. The programme will be targeted at:

- a. Imparting knowledge on health-care risks in all the waste streams;
- b. Training in minimising generation of waste, sorting and segregating waste streams and its importance in HCWM;
- c. 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;
- d. Developing positive attitude to caring for the environment and protecting the health and safety in the workplace; and
- e. Decontamination of generated wastes.

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

7.1.1 Areas of training

Laboratory, medical and support staff

Health-care facility staff and all the people involved in HCWM require 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 the 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 effective 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, knowledge and awareness raising on hazards linked to health-care waste 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 for the case of scavengers, or accidental as a consequence of unsafe disposal methods. The general public should be made aware of the consequences of HCW on their lives and that of their children. Immediate and long term dangers of 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 of 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 offered, 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 the communities should be effectively done to ensure that it adequately deals with their needs, priorities, and preferences. Local people should be provided with relevant project information in language(s) and in a manner understandable by 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 communities.

7.1.2 Management and Training for Institutions and Agencies

Success in implementation of the 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 affected in one way or another 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 7.1.

7.1.3 Follow-up and refresher courses

Periodic repetition of courses will provide refresher 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.

7.1.4 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 of training the various groups is given in Table 7.1.

Table 7.1. Areas of training and target groups

Target Group	Areas of Training	Duration	Cost ²¹ (US\$)
Laboratory/ Environmental health Officers/ Medical Staff/ancillary 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, treatment, transportation and Disposal of HCW 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 ²²
Community 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			120,000.00

²¹ Includes training material and trainer’s fees

²² Includes Information Education and Communication materials as well as facilitator’s fees

8 GUIDELINES FOR PROJECT IMPLEMENTATION

The Regional TB in Mining Project will be implemented through the Zambian Ministry of Health and National TB program. This Infection Control and Waste Management Plan will be implemented in the provinces/districts in which the project will be operating.

Drawing on the findings of the existing situation in the HCWMP (2015-2019) for Zambia, 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) have adequate equipment and measures for TB infection control and sound HCWM; and ensuring that project HCFs have adequate planning and staff training.

8.1 Guidelines for TB infection control

Following good practices on TB infection control (chapter 5 of this document) and national TB and leprosy programme TB manual (2010) for Zambia; 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.

8.1.1 Infection control in a community setting

8.1.1.1 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:

- 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.

8.1.1.2 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.

8.1.1.3 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.

8.1.1.4 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 travel.
- b. When travelling by road, ensure that masks are on and windows down to promote maximum ventilation.

8.1.2 TB infection control in hospital

8.1.2.1 Managerial level:

- a. Ensure that each facility has an infection control committee (headed by an 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 cougher triage areas; and
- d. Encourage all health workers to undergo HIV testing and counselling.

8.1.2.2 Administrative control measures:

- a. Recognise TB suspects at an early stage and accelerate the diagnostic process (see section 8.1.1);
- b. Separate TB suspects and patients from other patients in congregate settings;
- c. Sputum collection to be done in designated areas;
- d. Triage TB suspects to access diagnostic services quickly;
- e. Encourage cough etiquette to TB suspects and patients;
- f. If possible, provide face masks (N95) to all hospitalised TB suspects;
- g. If possible also, visitors and staff entering the isolation rooms should wear particulate masks;
- h. 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.

8.1.2.3 Environmental 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.

8.2 Guidelines for HCWM

Based on the HCWM plan (2015-2019) and Infection Prevention Control guidelines for Zambia and international good practices, the following are specific minimum procedures and guidelines to be followed by staff involved in HCWM for this project.

8.2.1 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 the HCW category.

8.2.2 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 for 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 for HCWs must be stored in good lighting and ventilation rooms
- h. Rooms and areas containing HCWs must be 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 ;
- 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 on concrete platforms and near a source of water for ease of cleaning.

8.2.3 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 to the treatment and disposal sites daily;
- 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.

8.2.4 Treatment and disposal

During the waste treatment 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 for burial;
- b. Chemical waste must be incinerated at high temperature or must be disposed into sealed pits;
- c. General waste which includes 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.

8.2.5 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 approved 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.

8.2.6 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.

8.3 Specific actions

Table 8.1 shows specific actions to be taken, by who and when for the entire project period of 5 years.

Table 8.1. Specific actions for infection control and waste management

Main activity	Sub-activity	Responsibilities
Promote proper sputum handling from communities to laboratories	<ol style="list-style-type: none"> 1. Provide guidelines for proper sputum handling to project beneficiaries 2. Establish courier systems for sputum collection & transportation 	MOH & OHSI
Preparation for procurement of Occupational Health equipment, PPE and other materials for standard precautions	<ol style="list-style-type: none"> 1. Purchase of PPE including N95 masks or standard face masks, soap for hand washing, and supplies for HCW 2. Purchase of equipment for silicosis development 	MOH & OHSI
Improve HCW collection/segregation, storage, transportation, treatment and disposal	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Train, through international short courses, health care personnel in infection control 2. Train mine health inspectors 3. Conduct a training needs assessment (all relevant stakeholders including health workers and potential project beneficiaries) and then develop a training plan 4. Develop training modules in English and appropriate local languages 	Ministry of Health & Training Institutions

	5. Replicate on a regular basis (quarterly) training activities, through designated trained staff, using the train the trainer approach	
Monitoring and Evaluation	1. Establish a TB 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, Zambia Environmental Management Agency (ZEMA), and Environmental and Natural Resources Management Department (ENRMD)
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 ZEMA
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, miners, ex-miners, and health providers about appropriate infection control and HCW management methods	Ministry of Health- Communication department

8.4 Implementation arrangement

8.4.1 Institutional framework

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

8.4.1.1 Central level

The Ministry of Health (MOH)

MOH will take the overall responsibility for coordinating and ensuring successful implementation and attainment of the objectives of this ICWMP. Staff from the Central Unit should visit the

provinces at least twice a year and any district as need arises. They should use a standardized approach to supervising; using a checklist and should give feedback to the Provincial Health Management Team and the District Health Management Team. At the end of each visit a written report of the supervision visit should be sent to the Provincial Health Management Team and District Health Management Team. The Director of Public Health and Research should be briefed and should receive a copy of supervisory visit report.

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

Environmental and Natural Resources Management Department (ENRMD)

The **ENRMD** 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 Zambia.

8.4.1.2 Provincial level

Provincial Health Offices (PHOs) will be responsible for coordinating implementation of the ICWMP in their respective provinces. The Provincial TB focal person will provide direct supervision for TB infection control while the Chief Environmental Health Officer (CEHO) will be the focal contact point for HCWM activities.

8.4.1.3 District level

District Health Offices (DHOs) will be responsible for coordinating implementation of the ICWMP at district level. District TB focal person will conduct at least monthly supportive visits to facilities in his/her district health facilities. During these visits, he/she should use a standardised checklist for monitoring TB infection control.

8.4.1.4 Community level

At community level, Neighbourhood Health Committees (NHCs) have been established, to facilitate linkages between the communities and the health services providers. It will be the responsibility of each and every NHC to ensure sound HCWM. The Committee must ensure that guidelines (minimum standards) set in this ICWMP are followed and respected. Health centre staffs will be responsible for supervision of community based TB activities. They should conduct regular visits (preferably fortnightly) and provide reports to the district.

8.4.2 Implementation timeline and budget

Table 8.2 provides the implementation timeline for this ICWMP for the entire project period; and the estimated budget for implementing the ICWMP is provided in table 8.3. The budget items are based on the HCWMP (2015-2019) for Zambia and the Zambia Investment Plan for the proposed regional TB in mining project.

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 8.2. 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 roles of the secretariat (i.e. MOH and NTP) responsibilities and scope of ICWM activities in the project.	█																				
2.	Identification of inter-sectoral coordination roles, measures and implementation as well as monitoring modalities (e.g. for National steering committee and NHCs)	█	█																			
3.	Finalization of Roadmap for implementation of ICWMP		█																			
4.	Developing training manuals, capacity building plans and sensitization/ awareness manuals (including for TB & infection control and HCWM)			█																		
5.	Training and capacity building in ICWMP at national, district and health centre levels-including potential project beneficiaries			█	█			█	█				█	█								
6.	Needs assessment for Infection Control and HCWM in health facilities for 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 ICWMP					█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
12.	Midterm evaluation of ICWMP											█										
13.	Final evaluation of ICWMP and report																					█

Table 8.3. Proposed implementation budget (in US dollars) for this ICWMP

ACTIVITIES	Total (USD)	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5
Capacity building and training						
Train health workers in infection control	100,000	25,000	25,000	25,000	25,000	0
Train ex-miners & health workers in conducting behavioural change	600,000	200,000	150,000	100,000	100,000	50,000
Train mine health inspectors	800,000	200,000	200,000	150,000	150,000	100,000
Training on proper HCWM	8,133,335	1,626,667	1,626,667	1,626,667	1,626,667	1,626,667
<i>Subtotal-capacity building and training</i>	9,633,335	2,051,667	2,001,667	1,901,667	1,901,667	1,776,667
Procurement of consumables, occupational health and safety equipment & HCW supplies						
Procurement of laboratory supplies	250,000	50,000	50,000	50,000	50,000	50,000
Procurement of consumables and other equipment e.g. waste bins, trolleys & PPE	4,751,700	950,340	950,340	950,340	950,340	950,340
Sputum collection and transportation	800,000	250,000	200,000	150,000	100,000	100,000
<i>Subtotal-procurement of consumables, occupational health and safety equipment & HCW supplies</i>	5,801,700	1,250,340	1,200,340	1,150,340	1,100,340	1,100,340
IEC-communication activities	700,000	150,000	150,000	150,000	150,000	100,000
Monitoring and evaluation						
Monitoring and evaluation for TB project activities	1,000,000	200,000	200,000	200,000	200,000	200,000
HCWM database in health management information system	43,490	8,698	8,698	8,698	8,698	8,698
<i>Subtotal-Monitoring and evaluation</i>	1,043,490	208,698	208,698	208,698	208,698	208,698
Independent final evaluation & report write-up	30,000	0	0	0	0	30,000
GRAND TOTAL	17,208,525	3,660,705	3,560,705	3,410,705	3,360,705	3,215,705

9 CONCLUSION AND RECOMMENDATIONS

In preparing this ICWMP, It has been established that there is urgent need for the Government of Zambia to move significantly in its efforts to eliminate TB/MDR-TB/XDR-TB and improve environmental, health and safety practices in both the mining and health sectors. Based on the review of the Zambian HCWMP (2015-2019) and other policy documents, the current situation for TB infection control measures in Zambia cannot guarantee safety among health-care workers, patients, and general population. It is also evident from the findings of this study that the current health-care waste management procedures present high risks of infection; hence the urgent need for improvement in management of health-care waste.

It has also been established, through the gap analysis and study of the existing situation that lack of policy and legal framework hinders effective health-care waste management in Zambia. The urgent approval of the revised guidelines on HCWM would therefore be crucial in ensuring proper health-care waste management procedures in all the health facilities in general and for the laboratories in particularly.

Implementation of this Infection Control and Waste Management Plan is therefore, a highly positive step towards ensuring effective TB control and improvement of health-care waste management services delivery. For effective TB infection control and proper health care waste management there is need for effective coordination among all key stakeholders. These key stakeholders include and are not limited to health-care staff, patients and general public, relevant ministries, and the mining companies. All the key stakeholders need to join hands in maintaining the highest standards of infection control prevention and health-care waste management practices. 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 services provision is well planned and infection control and health-care waste management plans are adhere to;
- c. All health-care wastes are properly handled and disposed of according to the ICWMP 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. Monitoring and evaluation for implementation of the ICWMP is effectively conducted to ensure compliance with the guidelines.

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LIST OF APPENDICES

Appendix 1. List of people consulted

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Mtundu Mwape	Ex-miners Association Ndola and Kitwe	Chairperson		
Brighton Ngulibe	Ex-miners Association Ndola and Kitwe	Former miner		
D. Chuku	Solwezi Miner- Ex-miners	Working under Contractor		
E. Mwale	Solwezi Miner- Ex-miners	Working under Contractor		
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Wilson Kaputula		Taxi driver	0979898774	
Mushota Patrick		Taxi driver	0965571657	
Henry M. Chipili		Taxi driver	0965688042	
Jackson Mbiza	MOH	Waste handler		
Margaret Simukoko	Wusakile Hospital Mine	Senior Nursing Officer (Safety, environmental and Quality Assurance)		
Margaret Mutema	Wusakile Mine Hospital	Chief Laboratory Technician		
Champo	Kitwe Central Hospital	Principal Hospital Administrator		
Sharon Musakanga	Kitwe District Medical Office	TB/HIV/LEPROSY Coordinator	0955753563	
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Appendix 2. Overview of the Zambia health delivery system

The health services in Zambia are delivered in a services delivery structure which aims at providing health services as close to the family as possible and with a primary health care approach. The health care services falls into five main categories namely: i) **Health posts**-intended to cater for populations of 500 households (3,500 people) in rural areas and 1,000 households (7,000 people) in urban areas; ii) **Health centres**- they include Urban Health Centres (UHC), which are intended to serve a catchment population of 30,000 to 50,000, and Rural Health Centres (RHC) serving a catchment area of 29 km radius or with a population of 10000; iii) **First level or referral hospitals**-which are found in most districts and intended to serve a population of between 80,000 and 200,000 with medical, surgical, obstetric, and diagnostic services, including clinical services to support referrals from lower levels; iv) **Second level hospitals**-these are general hospitals at provincial level and are intended to serve a catchment area of 200,000 to 800,000 people, with services in internal medicine, general surgery, paediatrics, obstetrics and gynaecology, dental, psychiatry and intensive care services. These hospitals are also referral centres for first level institutions, including provision of technical back-up and training functions; and v) **Third level hospitals**-which are central and specialist hospitals intended to serve catchment populations of above 800,000 people. They have sub-specialisations in internal medicine, surgery, paediatrics, obstetrics, gynaecology, intensive care, psychiatry, training and research. These hospitals are referral centres for second level hospitals.