

HOSPITAL WASTE MANAGEMENT: A STUDY ON KNOWLEDGE, ATTITUDE  
AND PRACTICES AMONG HEALTH STAFF AND WASTE HANDLERS IN  
JIGME DORJI WANGCHUK NATIONAL REFERRAL  
HOSPITAL, THIMPHU, BHUTAN

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บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาของไท่ช่า (CUIR)

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การศึกษานี้ภาคตัดขวางเชิงคุณภาพและเชิงปริมาณครั้งนี้ เป็นการศึกษาในระดับความรู้ ทักษะ และการปฏิบัติตัวในการจัดการขยะโรงพยาบาลของบุคลากรการแพทย์และคนกำจัดขยะรวมทั้งแนวทางจัดการของเสียในปัจจุบัน ณ โรงพยาบาลแห่งชาติของประเทศภูฏาน โดยใช้เครื่องมือเก็บข้อมูลต่างๆ ได้แก่ แบบสอบถามชนิดที่ผู้ตอบกรอกแบบสอบถามเอง การสัมภาษณ์จากผู้ให้คำตอบโดยตรง การเดินสำรวจ และการสัมภาษณ์เชิงลึก ในการศึกษาครั้งนี้มีกลุ่มประชากรจำนวน 279 คน การศึกษาพบว่า แพทย์ (ร้อยละ 54.2) มีความรู้ในการจัดการขยะโรงพยาบาลอยู่ในระดับสูง ซึ่งสูงกว่า พยาบาล (ร้อยละ 75.3) และเจ้าหน้าที่ทางการแพทย์ (ร้อยละ 69.0) ซึ่งมีระดับความรู้ในระดับปานกลาง สำหรับทัศนคติในการจัดการขยะโรงพยาบาลของบุคลากรการแพทย์นั้น พบว่าส่วนใหญ่อยู่ในระดับปานกลาง และ พบว่า แพทย์ (ร้อยละ 75.0) พยาบาล (ร้อยละ 58.8) และ เจ้าหน้าที่ทางการแพทย์ (ร้อยละ 58.0) มีการปฏิบัติตัวที่ดีและเหมาะสมในการจัดการขยะโรงพยาบาล สำหรับคนกำจัดขยะ พบว่า ประมาณ ร้อยละ 50 มีระดับความรู้สูงในการจัดการขยะโรงพยาบาล แต่มีทัศนคติที่ถูกต้องเพียงร้อยละ 32.4 อย่างไรก็ตามคนกำจัดขยะจำนวนร้อยละ 65.4 มีการปฏิบัติตัวที่ดีและเหมาะสมในการจัดการขยะโรงพยาบาล นอกจากนี้พบว่า อายุและจำนวนปีในการทำงานของบุคลากรการแพทย์และคนกำจัดขยะต่อการปฏิบัติตัวในการจัดการขยะโรงพยาบาลมีความสัมพันธ์อย่างมีนัยสำคัญ (ไคสแควร์, p-value < 0.05) และพบว่าอุบัติเหตุและการเจ็บป่วยจากขยะโรงพยาบาลภายใน 12 เดือนที่ผ่านมา พบในบุคลากรการแพทย์ร้อยละ 43.0 และ คนกำจัดขยะร้อยละ 21.6 ทั้งนี้บุคลากรการแพทย์ร้อยละ 67.4 และ คนกำจัดขยะร้อยละ 75.0 เคยถูกเข็มฉีดยาที่แทงในระหว่างปฏิบัติงาน อย่างไรก็ตามมีการฉีดวัคซีนดับอักเสบบีในบุคลากรการแพทย์ และ คนกำจัดขยะร้อยละ 92.8 และ ร้อยละ 94.6 ตามลำดับ จากการเดินสำรวจโรงพยาบาลพบว่า การจัดการขยะของโรงพยาบาลแห่งนี้ยังไม่เหมาะสมพอ และการสัมภาษณ์เชิงลึกพบว่า มีปัญหาและความท้าทายในการจัดการขยะโรงพยาบาลแห่งนี้อีกหลายด้าน ดังนั้นงานวิจัยนี้ได้มีข้อเสนอในการจัดการขยะโรงพยาบาลทั้งระยะสั้นและระยะยาว ได้แก่ การคัดแยกขยะ ตัดผลากที่ถุง มีมาตรการและการติดตามที่เคร่งครัด มีการจัดอบรม มีการทบทวนแนวทางปฏิบัติด้านการจัดการขยะในปัจจุบัน และ ควรพิจารณาความเป็นไปได้ในการจัดสร้างเตาเผาขยะและระบบบำบัดน้ำเสียของโรงพยาบาลแห่งนี้ในระยะยาวต่อไป

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TARA DEVI LAABAR: HOSPITAL WASTE MANAGEMENT: A STUDY ON KNOWLEDGE, ATTITUDE AND PRACTICES AMONG HEALTH WORKERS AND WASTE HANDLERS IN JIGME DORJI WANGCHUK NATIONAL REFERRAL HOSPITAL, THIMPHU, BHUTAN. ADVISOR: WATTASIT SIRIWONG, Ph.D., 130 pp

This cross-sectional study, including both quantitative and qualitative, explored the level of knowledge, attitude and practices on hospital waste management among the health staff and waste handlers and the current waste management practices in the National Referral Hospital of Bhutan. Self administered questionnaires, face to face interview, a walk-through survey and an in-depth interview were the measurement tools used. A sample size of 279 was recruited for the study. Overall, 54.2% of doctors were found to have high level of knowledge compared to majority of nurses (75.3%) and paramedics (69.0%) who possessed moderate level of knowledge. With majority of health staff possessing neutral attitude, 75.0% doctors, 58.8% nurses and 58.0% paramedics performed good practices on hospital waste management. Among the waste handlers, nearly 50% had high knowledge but only 32.4% showed positive attitude. However, 65.4% of waste handlers performed good practices on hospital waste management. The Chi square test revealed that age and number of years in the present occupation among the health staff, and the age for waste handlers were significantly associated (p-value <.05) with the level of practices. In the study, 43.0% of health staff and 21.6% of waste handlers experienced one or the other kind of injury or illness due to hospital waste within the last 12 months. Among those, 67.4% health staff and 75.0% waste handlers encountered needle pricks. Hepatitis B immunization coverage was 92.8% and 94.6% in health staff and waste handlers respectively. Walk-through survey discovered that waste management in JDWNRH is inadequate and the in-depth interview revealed several challenges to overcome. Some of the recommendations from the study, including both short term and long term, are to emphasize on proper segregation of waste, labeling the waste bags, strict supervision and monitoring, regular training program, review of present waste management guideline, and to consider hospital incinerator and wastewater treatment plant.

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Student's Signature.....

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## CONTENTS

## Page

ABSTRACT IN THAI.....	iv
ABSTRACT IN ENGLISH.....	v
ACKNOWLEDGEMENTS.....	vi
CONTENTS.....	vii
LIST OF TABLES.....	xii
LIST OF FIGURES.....	xiv
LIST OF ABBREVIATIONS.....	xv
<b>CHAPTER I INTRODUCTION.....</b>	<b>1</b>
1.1. General Background.....	1
1.2. Statement of Problem.....	4
1.3. Rationale.....	7
1.4. Research Gap.....	8
1.5. Research Questions.....	9
1.6. Hypothesis.....	9
1.6.1. Hypothesis 1.....	9
1.6.1. Hypothesis 2.....	9
1.7. Research Objectives.....	9
1.7.1. General Objective.....	9
1.7.2. Specific Objectives.....	9
1.8. Conceptual Framework.....	10
1.9. Operational Definition.....	11
<b>CHAPTER II LITERATURE REVIEW.....</b>	<b>13</b>
2.1. Definition of Hospital Waste.....	13

## CONTENTS

## Page

2.2. Hospital Waste Generation.....	13
2.3. Classification of Hospital Waste.....	14
2.4. Composition of Hospital Waste According to source.....	17
2.5. Knowledge, attitude and practices.....	18
2.5.1. Knowledge.....	18
2.5.2. Attitude.....	19
2.5.3. Practice.....	19
2.6. Enabling Factors.....	20
2.7. Injuries and Illnesses due to Hospital Waste.....	21
2.8. Impacts of Hospital Waste on Environment .....	23
2.9. Legislative, regulatory, and policy aspects.....	24
2.10. Steps of hospital waste management.....	25
2.10.1. Segregation.....	25
2.10.2. Collection.....	26
2.10.3. Transportation.....	27
2.10.4. Storage.....	28
2.10.5. Treatment.....	28
2.10.6. Disposal.....	29
<b>CHAPTER III RESEARCH METHODOLOGY.....</b>	<b>31</b>
3.1. Research Design.....	31
3.2. Research Area.....	31
3.3. Study Population.....	32
3.4. Sample Size.....	32
3.5. Sampling Technique.....	32



## CONTENTS

## Page

3.5.1. Inclusion Criteria.....	33
3.5.2. Exclusion Criteria.....	33
3.6. Measurement Tool.....	33
3.7. Data Collection.....	34
3.8. Data Analysis.....	35
3.9. Validity and Reliability.....	37
3.9.1. Validity.....	37
3.9.2. Reliability.....	37
3.10. Ethical Consideration.....	37
3.11. Benefit of the Study.....	38
1.12. Limitations of the Study.....	38
<b>CHAPTER IV RESULTS.....</b>	<b>39</b>
<i>Part 1. Descriptive findings.....</i>	<i>39</i>
4.1. Socio- demographic characteristics.....	39
4.2. Knowledge on hospital waste management.....	41
4.3. Attitude on hospital waste management.....	44
4.4. Practices on hospital waste management.....	48
4.5. Enabling Factors on hospital waste management.....	51
4.6. Injuries/Illnesses due to hospital waste.....	53
<i>Part 2: Inferential Findings.....</i>	<i>56</i>
4.7. Association between socio-demographic characteristics and the level of knowledge.....	57
4.8. Association between the socio-demographic characteristics and the level of attitude.....	58
4.9. Association between the socio-demographic characteristics and the level of practices.....	59
4.10. Association between the level of knowledge and attitude.....	60
4.11. Correlation between knowledge and attitude.....	61

<b>CONTENTS</b>	<b>Page</b>
12. Association between the level of knowledge and practice.....	61
4.13. Correlation between knowledge and practices.....	62
4.14. Association between the attitude and practices.....	62
4.15. Correlation between attitude and practices.....	63
4.16. Association between enabling factors and practices.....	63
<b>Part 3: Qualitative Findings</b> .....	64
4.17. Walk-through survey .....	64
4.17.1. Segregation of hospital waste .....	65
4.17.1. a. Categories of waste bin and their labeling .....	65
4.17.1.b. Awareness on segregation .....	66
4.17.2. Collection of hospital waste.....	67
4.17.3. Transportation of hospital waste.....	69
4.17.4. Storage of hospital waste.....	69
4.17.5. Treatment of hospital waste.....	69
4.17.6. Disposal of hospital waste.....	71
4.17.7. Types of waste in JDWNRH.....	72
4.18. In-depth interview.....	73
<b>CHAPTER V DISCUSSION, CONCLUSION AND RECOMMENDATIONS</b> .....	79
<b>Part 1. Discussion</b> .....	79
5.1. Socio-demographic characteristics.....	79
5.2. Knowledge on hospital waste management.....	80
5.3. Attitude on hospital waste management.....	81
5.4. Practices on hospital waste management.....	82
5.4.1. Segregation.....	82

## CONTENTS

## Page

<i>5.4.2. Collection</i> .....	83
<i>5.4.3. Transportation</i> .....	84
<i>5.4.4. Storage</i> .....	84
<i>5.4.5. Treatment</i> .....	85
<i>5.4.6. Disposal</i> .....	87
5.5. Enabling Factors.....	88
5.6. Injuries/Illness.....	90
5.7. In-depth interview and walk-through survey.....	91
<b>Part 2. Conclusion</b> .....	92
<b>Part 3. Recommendations</b> .....	96
<b>REFERENCES</b> .....	100
<b>APPENDICES</b> .....	107
APPENDIX A: Various types of waste generated in different units/departments of JDWNRH.....	108
APPENDIX B: Questionnaires.....	112
APPENDIX C: Time Schedule.....	132
APPENDIX D: Financial Chart.....	133
APPENDIX E: Ethical Approval Document.....	134
VITAE.....	135

## List of Tables

<b>Table</b>		<b>Page</b>
Table 1.	Estimates of medical waste generation in some Asian countries.....	14
Table 2.	Recommended colour-coding for health-care waste according to WHO.....	27
Table 3.	Proportional sampling technique for hospital staff of JDWNRH.....	32
Table 4(a).	Frequency and percentage of socio-demographic characteristics of health staff.....	40
Table 4(b).	Frequency and percentage of socio-demographic characteristics of waste handlers.....	41
Table 5 (a).	Frequency and percentage of health staff whose answers were correct or incorrect to each question for knowledge.....	42
Table 5(b).	Frequency and percentage of waste handlers whose answers were correct or incorrect to each question for knowledge.....	43
Table 6.	Level of knowledge among health staff and waste handlers.....	44
Table 7(a).	Frequency and percentage of responses to attitude questions by health staff.....	45
Table 7(b).	Frequency and percentage of responses to attitude questions by waste handlers.....	46
Table 8.	Level of attitude among health staff and waste handlers.....	48
Table 9 (a).	Frequency and Percentage of health staff for practice questions.....	48
Table 9(b).	Frequency and Percentage of waste handlers for practice questions.....	50
Table 10.	Level of practices among health staff and waste handlers.....	51
Table11(a).	Frequency and percentage for questions on enabling factors for health staff.....	51
Table11(b).	Frequency and percentage for questions on enabling factors for waste handlers.....	53
Table 12(a).	Frequency and percentage on injury/ illness due to hospital waste among health staff.....	54
Table(12(b).	Frequency and percentage on injury/ illness due to hospital waste among waste handlers.....	54

## List of Tables

<b>Table</b>		<b>Page</b>
Table 13.	Association between socio-demographic characteristics and the level of knowledge.....	57
Table 14.	Association between socio-demographic characteristics and the level of attitude.....	59
Table 15.	Association between the socio-demographic characteristics and the level of practices.....	60
Table 16.	Association between the level of knowledge and attitude.....	60
Table 17.	Correlation between knowledge and attitude.....	61
Table 18.	Association between the level of knowledge and practices.....	62
Table 19.	Correlation between knowledge and practices.....	62
Table 20.	Association between the level of attitude and the practices.....	63
Table 21.	Correlation between attitude and practices.....	63
Table 22.	Association between enabling factors and the level of practices.....	64

## List of Figures

<b>Figure</b>		<b>Page</b>
Figure 1.	OPD and IPD attendants over the last ten years in JDWNRH.....	3
Figure 2.	Hospital waste generated in JDWNRH in 2010.....	6
Figure 3.	Conceptual Framework.....	10
Figure 4.	Classification of hospital waste.....	15
Figure 5	Map of Bhutan.....	31
Figure 6	Map of Thimphu town.....	31
Figure 7.	Exposure to hospital waste among the health staff and waste handlers	55
Figure 8.	Exposure to specific waste among the health staff and waste handlers	56
Figure 9.	Labelling of the waste bin.....	65
Figure 10.	Irregularity in using colour coded plastics.....	66
Figure 11.	Inadequate waste segregation in some units of JDWNRH.....	67
Figure 12.	Unsafe practices in collecting sharps .....	68
Figure 13.	Waste handlers without adequate PPE during collection of hospital waste.....	68
Figure 14.	Waste storage area of JDWNRH.....	70
Figure 15.	Autoclaving the infectious hospital waste in JDWNRH.....	70
Figure 16.	Hospital wastes in the land fill ( <i>Memelakha</i> ).....	71
Figure 17.	Scavengers at <i>Memelakha</i> .....	72

**LIST OF ABBREVIATIONS**

<b>ACO</b>	Assistant Clinical Officer
<b>ADB</b>	Asian Development Bank
<b>AIDS</b>	Acquired Immune Deficiency Syndrome
<b>ATSDR</b>	Agency for Toxic Substances and Disease Registry
<b>BHU</b>	Basic Health Unit
<b>BNCA</b>	Bhutan Narcotic Control Agency
<b>CDC</b>	Center for Disease Control
<b>DANIDA</b>	Danish International Development Agency
<b>DMS</b>	Department of Medical Services
<b>DPH</b>	Department of Public Health
<b>EPA</b>	Environmental Protection Agency
<b>GNH</b>	Gross National Happiness
<b>GNP</b>	Gross National Product
<b>HAI</b>	Hospital Acquired Infection
<b>HBV</b>	Hepatitis B Virus
<b>HCV</b>	Hepatitis C Virus
<b>HIV</b>	Human Immunodeficiency Virus
<b>HR</b>	Human Resource
<b>ICHWM</b>	Infection Control and Hospital Waste Management
<b>ICHCWM</b>	Infection Control and Health Care Waste Management
<b>IPD</b>	In-Patient Department
<b>JDWNRH</b>	Jigme Dorji Wangchuk National Referral Hospital
<b>KAP</b>	Knowledge, Attitude and Practice
<b>MoH</b>	Ministry of Health
<b>MBBS</b>	Bachelor in Medicine and Bachelor in Surgery
<b>NEC</b>	National Environment Commission
<b>NGO</b>	Non Governmental Organization

**LIST OF ABBREVIATIONS**

<b>OPD</b>	Out Patient Department
<b>PPE</b>	Personal Protective Equipment
<b>RGOB</b>	Royal Government of Bhutan
<b>RIHS</b>	Royal Institute of Health Sciences
<b>SARS</b>	Severe acute respiratory syndrome
<b>SPSS</b>	Statistical Package of Social Science
<b>TCC</b>	Thimphu City Corporation
<b>UK</b>	United Kingdom
<b>USA</b>	United States of America
<b>WHO</b>	World Health Organization



# **CHAPTER (I)**

## **INTRODUCTION**

### **1.1. General Background**

Hospitals are institutions that provide health care services to the sick and the needy ones, and in the process wastes are unavoidably generated. Hospital waste has been identified as a potential health and environmental hazards (US EPA, 1992: online). Harhay et al., (2009) mentions that six (Bangladesh, Brazil, China, India, Nigeria and Pakistan) of the ten most populous countries in the world are facing the burden of hospital waste management placing approximately more than 50% of today's population for occupational, environmental and public health risk. Without stable hospital waste management the threats are expected to grow with the increase in population and health care activities.

Compared to the high-income countries health care waste production is usually lesser in middle and low-income countries (WHO, 1999; Sarkar et al., 2006). In the high-income countries all forms of health care waste generation by an individual is 1.1 - 12.0 kg/year and that of hazardous health care waste is 0.5 - 5.5 kg/year, whereas, in the middle income countries it is 0.8 – 6.0 kg/year and 0.3 – 0.4 kg/year of total health-care waste and hazardous health-care waste respectively. For the low-income countries total health-care waste generation by an individual is 0.5 – 3.0 kg/year (WHO, 1999). However, in the developed countries, with the availability of sophisticated technologies, specialized manpower and specific legislation in place, hospital waste is adequately managed (Tudor et al., 2005). In contrast, the developing countries are yet to receive enough attention on the management of hospital waste creating a significant hazard to both human beings and the environment (Silva et al., 2005).

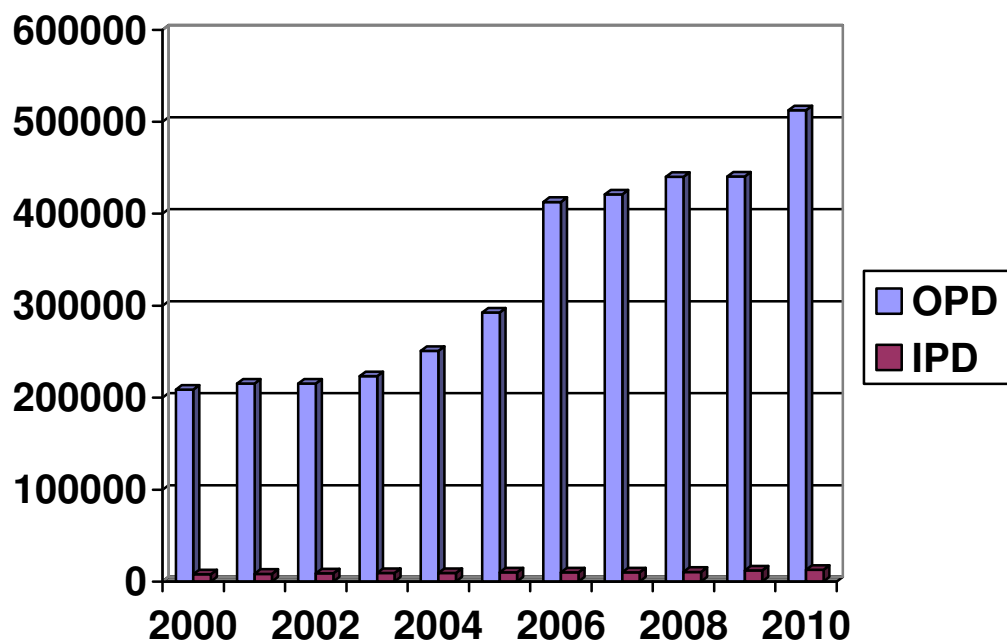
Hospital waste management can differ from country to country depending upon the economic situation, geographical conditions and its culture. Therefore, each country

may require developing its own policies and guidelines suitable to its location and people in order to standardize the practices of hospital waste management (Sharma, 2007). Within the country, a good hospital waste management largely depends on a dedicated waste management team comprising of sound administration with proper planning, well-trained and efficient health care workers, supportive legislation and adequate financing (Mostafa et al., 2008)

Bhutan lies in the eastern Himalayas and is bordered by India to the south, east and west, and China (Tibet) to the north. It is separated from Nepal to the west by the Indian state of Sikkim and from Bangladesh to the south by West Bengal (Encyclopedia of Nations, 2010: online). Bhutan has an area of 38,394 sq. km and the population of 671,083 (Statistical Yearbook of Bhutan, 2009). There are 20 districts in the country. The modern health system in Bhutan began in the early 1960s with just two hospitals in the county, one in the capital, Thimphu, and the other in the south (Wangchuk, 2010). With Gross National Happiness (GNH) as the guiding developmental philosophy of the country rather than the Gross National Product (GNP) (Ura, 2008: online), along with other developmental activities, health care system improved drastically in Bhutan within three to four decades. At present, there are 31 hospitals including one national referral hospital and two regional referral hospitals. There are 180 Basic Health Units (BHU) which provides primary health care in the interior parts of the country (Annual Health Bulletin, 2010).

Jigme Dorji Wangchuck National Referral Hospital (JDWNRH) is the biggest hospital in Bhutan. It is located in the capital city, Thimphu. It was established in 1972 as a General Hospital and was extended to National Referral Hospital in 1994 with the introduction of many new services. It was named in honor of the third king of Bhutan, Jigme Dorji Wangchuk, who introduced the modern developmental activities in the country. JDWNRH caters to the population of Thimphu district, the non-referred patients from neighboring districts and referred cases from all the hospitals in the country. There

are more than 850 staff of various categories working in this hospital. Over the years the number of patients in JDWNRH, both outpatient and in-patient, has increased considerably, as shown in **Figure 1**, due to greater health awareness among the general population, better accessibility through improved transportation system, actual increase in the population and also due to increased services at JDWNRH. (JDWNRH, 2010: online).



**Figure 1: OPD and IPD attendants over the last ten years in JDWNRH.**

*Source:* Record Section, JDWNRH (2011).

A new hospital building has been constructed and started functioning since late 2008 with increased capacity of beds and other facilities. Currently it houses 350 beds for the inpatients and provides various out-patient services. Services provided by JDWNRH include clinical, diagnostics, rehabilitation, immunization, reproductive health activities, pharmacy and other administrative functions (JDWNRH, 2010: online).

Varieties of waste comprising of both general and hazardous characteristics are generated from different sources like wards, outpatient chambers, laboratories, dental, pharmacy, radiology, dialysis, operating rooms, the administrative office and kitchen. Mehta (2005) mentions that, it was in April 2004 that the Ministry of Health (MoH), Royal Government of Bhutan (RGOB) drafted a comprehensive Health Care Infection Control and Waste Management Plan mainly due to the concern for inadequate management of sharp waste associated with threats posed by the HIV/AIDS pandemic and the recognition of increase in Hepatitis B infection worldwide. Thereafter, the National Infection Control and Healthcare Waste Management (ICHWM) Program was established in October 2004, under Department of Medical Services (DMS), MoH, based on an assessment of representative sample of healthcare facilities and stakeholder consultations (Guideline for Infection Control and Healthcare Waste Management, 2006). The National Infection Control Committee was established in the MoH for implementation, monitoring, and evaluation of the national infection control and health care waste management program. A committee is also formed in JDWNRH for infection control and waste management activities (JDWNRH, 2010).

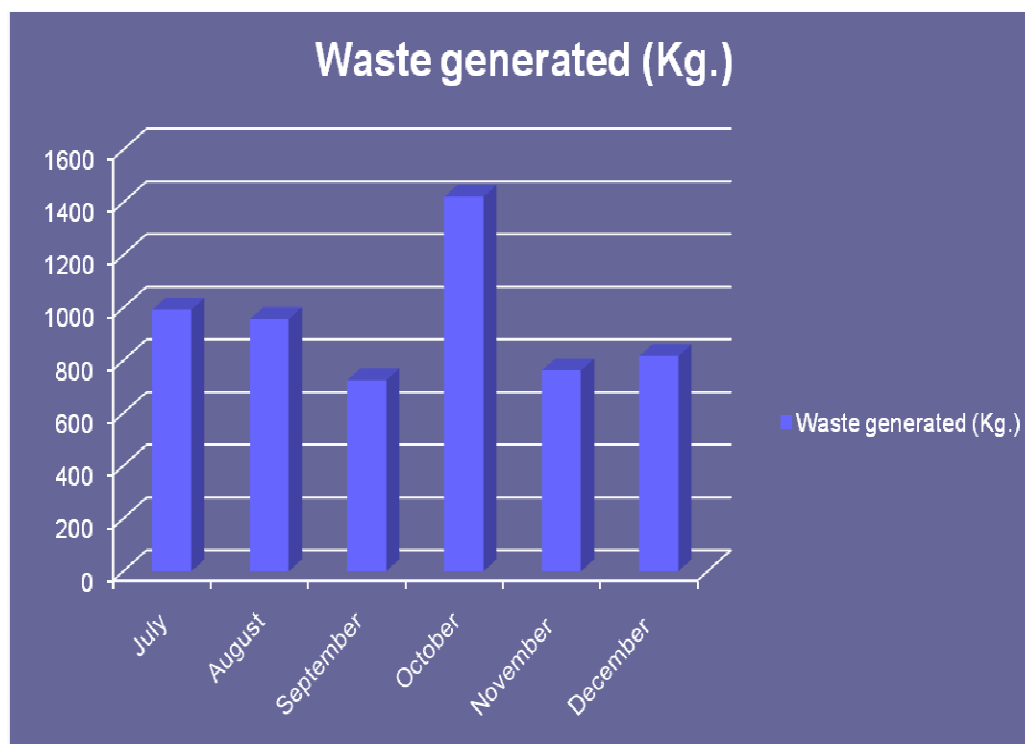
## **1.2. Statement of problem**

The problem of hospital waste management has been an issue in JDWNRH ever since the hospital started functioning. Although there are limited evidences, inadequate knowledge and attitude among the health staff and waste handlers leading to unsafe practices is considered as one among the many other challenges. There are also constraints being faced at different levels such as policies and implementation levels, human and technical resources and lack of specific legislation on hospital waste management. However, this study will focus on the knowledge, attitude and practices among the health staff and waste handlers and the existing waste management system in JDWNRH.

Today, with the increase in services including the bed capacity of JDWNRH there is a tremendous raise in waste production (Norbu, 2010). Hospital waste generation rate increases proportionally with the increase in bed occupancy, as supported by Elimelech et al., (2011). Since its establishment in 1972 until late 1990s, hospital waste was considered as any other general household waste and management was carried out in a way it was convenient, either by open burning, burying or dumping in the pits dug within the hospital premises or any other ways one could think of (Guideline for Infection Control and Health Care Waste Management in Health Facilities, 2006).

Mehta (2005) found that about 80% of the waste produced by JDWNRH is similar to domestic waste that comes from administrative and housekeeping functions and about 20% is hazardous or potentially hazardous mainly due to the presence of infectious waste and other hazardous materials. However, since waste management steps like segregation is not properly carried out at the source, the entire waste produced is potentially hazardous.

The ICHWM Program, since its establishment, has introduced the waste management system in JDWNRH after training various groups of health workers and making necessary supplies available. However, issues still remains that hospital waste are not properly segregated and managed. The sharps and the organic waste including body parts, human placenta, etc are supposed to be buried together in a concrete pit within the hospital premises. Nevertheless, the municipal workers have often come across sharps and human body parts including even the dead fetuses together with the general waste from the hospital due to inadequate segregation system (Sr. Environmental Officer, Thimphu City Corporation (TCC), Verbal communication, 13 February 2011). **Figure 2** shows the amount of hospital waste (solid) generated in JDWNRH from July to December 2010.



**Figure 2: Hospital Waste generated in JDWNRH in 2010**

*Source:* JDWNRH, (2011)

At present, the infectious waste in JDWNRH is treated by autoclave and chemical disinfection. However, treatment has not always been effective due to improper segregation at the source resulting in huge amount of hazardous waste (Focal person, waste management, JDWNRH, verbal communication, 20 March 2011). At the moment the hospital does not have any incinerators. Mehta (2005) mentions that there were low-standard and primitive incinerators in use at JDWNRH without any pollution control devices and unlikely that the required temperatures were achieved for combustion. However, today, probably due to the apprehension of release of dioxins and furans, which are recognized as human carcinogens (ATSDR, 2011), the use of those incinerators have been discontinued. Since then the National Environment Commission (NEC) of Bhutan has not approved for the installment of incinerators in the country.

The liquid hazardous waste generated in JDWNRH, including blood and its products, other body fluids, chemicals and drugs are discharged through the sewers without any treatment prior to disposal (“Hospital Waste” in Training manual for trainers on Infection Control and Healthcare Waste Management in Health Facilities, 2007, p 48).

Currently, the major junk of hospital waste from JDWNRH goes with the municipal waste to the only designated landfill (*Memelakha*) in the country which is about 12 Km away from the capital city, Thimphu. *Memelakha* is an open dump site which was designed to be operated for eight years, however, it is still being used in its 16<sup>th</sup> year due to lack of alternate site. Under the Asian Development Project (ADB) project some rehabilitation works were completed where by construction of proper access road and provision of leachate collection is developed. However, it can never serve the function of sanitary landfill where hazardous hospital waste can be disposed due to the absence of liners and also lack of proper standards for operation of the sanitary landfill. Although the landfill is fenced it is still easily accessible by dogs, cows, birds, rodents and even humans who scavenge the site to collect recyclable waste. (Sr. Environmental Officer, Thimphu City Corporation (TCC), Verbal communication, 13 February 2011).

### **1.3. Rationale**

The variety of waste produced during the course of diagnosis, treatment and immunization of patients requires to be managed adequately so that its impact on the public health and environment is minimized (WHO, 1999; Akter, 2000). Owing to the total population of Bhutan, the number of patients per day, inpatient bed capacity and the limited specialties in JDWNRH, the waste produced is comparably lesser than the neighboring countries in the region. The annual hospital waste generation in Dhaka, India, China and Nepal is 93,075 tons, 330,000 tons, 730,000 tons and 365 tons respectively, Bhutan generates only 73 tons of hospital waste per year (Visvanathan, 2006). However, JDWNRH has its own share of problems in not being able to manage its waste adequately. Dema, (2009) quotes “Bhutan, it appears, is yet to take it seriously” in regard to the hospital waste in JDWNRH. Therefore, considering the extent of adverse

human and environmental risk associated with the hospital waste it is an appropriate time for JDWNRH to establish an effective system before the waste management goes from bad to worse. Simultaneously, it is crucial for JDWNRH to set standards for waste management prior to the upcoming private clinics and hospitals.

The present study aims to assess the knowledge, attitude and practices among the health staff and the waste handlers in JDWNRH. The study will focus on the six key steps, including segregation, collection, transportation, storage, treatment and disposal, that influences safe hospital waste management practices, defined by WHO (2008). It will also explore on some of the enabling factors on the hospital waste management practices and will finally look into the incidence of injuries/illnesses among the health staff and waste handlers acquired due to hospital waste and its management.

#### **1.4. Research Gap**

In Bhutan, research on any field in general is very limited. As such, not much has been studied on hospital waste management. After the establishment of the ICHWM Program, Mehta in 2005 compiled a mission report to support the program in developing a sound and sustainable system for national infection control and health care waste management. The report compiled the infection control practices in the country, reviewed and revised those national infection control guidelines that were formed, assessed various needs like training, infrastructural, financial and other resources and implemented a draft action plan. Another study was conducted on Self Assessment of Behavior in Infectious Waste Management by Health Care Workers of JDWNRH, Thimphu, Bhutan (Dophu, 2004). Recently yet another study on Infectious Waste Management in Bhutan: An Analysis of Policy and Practice has been conducted (Wangmo, 2011) has been conducted and is yet to be published. Therefore, this research adds to the existing few studies that are available.



## **1.5. Research Questions**

- 1.5.1.** What is the level of knowledge, attitude and practices on hospital waste management among the health staff and waste handlers in JDWNRH?
- 1.5.2.** What are the enabling factors that are significantly associated with hospital waste management practices in JDWNRH?
- 1.5.3.** What is the incidence of injuries/illnesses within the last 12 months among the health staff and waste handlers due to waste in JDWNRH?

## **1.6. Hypothesis**

### **1.6.1. Hypothesis 1:**

There is no association between the levels of knowledge, attitude and practices among the health staff and waste handlers on hospital waste management.

### **1.6.2. Hypothesis 2:**

There is no association between socio demographic characteristics and enabling factors with the practices on hospital waste management.

## **1.7. Research Objectives**

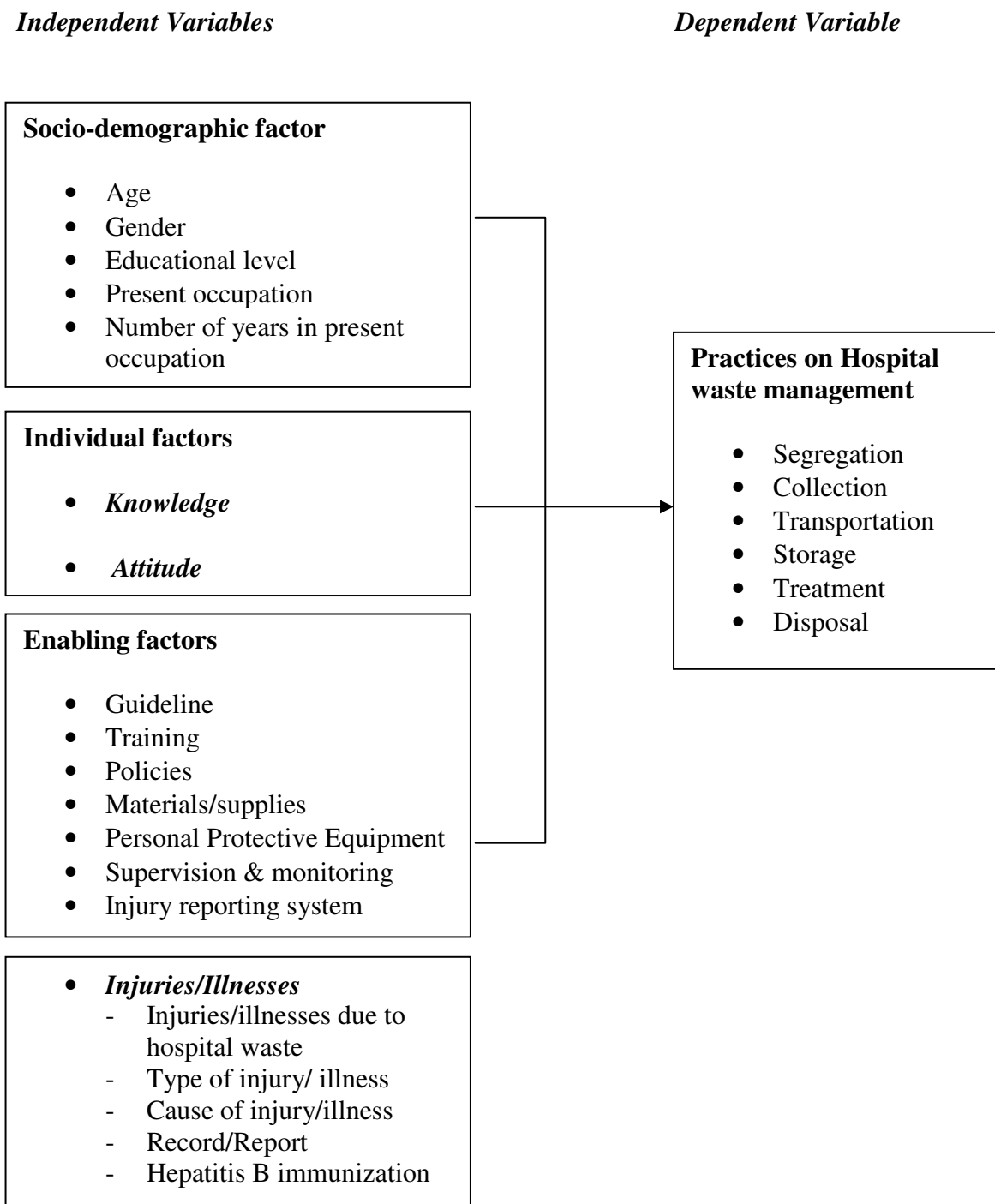
### **1.7.1. General objective**

To determine the level of knowledge, attitude and practices and factors associated with hospital waste management in JDWNRH.

### **1.7.2. Specific objectives**

- 1.7.2.1.** To explore the association between the level of knowledge and attitude of the health staff and waste handlers and their practices on hospital waste management.
- 1.7.2.2.** To determine the association among the socio demographic and enabling factors with practices on hospital waste management.
- 1.7.2.3.** To determine the frequency and percentage of injuries/illnesses among the health staff and waste handlers due to hospital waste within the last 12 months.

## 1.8. Conceptual Framework



**Figure 3: Conceptual Framework**

## 1.9. Operational Definitions

***Hospital waste*** includes any solid or liquid waste that is generated from the hospitals and health care centers during the course of diagnosis, treatment and immunization (Chandra, 1999; Mostafa et al., 2008). It includes both general waste (non-hazardous) and hazardous waste including infectious, sharps, chemicals, radioactive, genotoxic and other pathological waste that are capable of posing substantial hazards to the human and environmental health.

***Health staff*** are doctors (including dentists), nurses and paramedics.

***Para-medics*** are medical technicians, Health assistants (HA), assistant clinical officers (ACO) and basic health workers (BHW).

***Waste Handlers*** are ward boys and cleaners. Ward boys are involved in transporting the specimens of the patients like blood, stool, urine, pus, etc. to the laboratory from the ward. Cleaners are mainly involved in collecting, storage and transporting hospital waste.

***Socio-demographic characteristics*** include age, sex, educational background, number of years in service, area of work and present occupation of the respondents.

***Age*** refers to the age in years of the respondent at the time of interview.

***Gender*** refers to whether the respondent is male or female.

***Educational level*** is the minimum level of education that the respondent has attained at the time of interview. They are classified into Certificate level, Diploma level and Bachelor/Masters Degree/higher for the health staff. For the waste handlers, it is classified into no education, primary education, middle/ higher secondary.

***Present Occupation*** is characterized by doctors, nurses, para medics, ward boys and cleaners.

***Number of years in the present occupation*** refers to the number of years the respondent has been working in the present service at the time of interview.

***Knowledge*** refers to the individual respondent's level of knowledge on the waste management procedure (segregation, collection, storage, transportation, treatment and disposal).

***Attitude*** is the respondent's outlook or approach towards hospital waste management procedure (segregation, collection, storage, transportation, treatment and disposal).

***Practice*** is performing the steps of hospital waste management (segregation, collection, storage, transportation, treatment and disposal) as per the ICHWM guideline.

***Enabling Factors*** are those factors that facilitate the practices of hospital waste management. In this study enabling factors includes guideline on hospital waste management, training on hospital waste management, hospital waste management policies, adequate supply of all the required resources and materials like colour- coded waste bins, plastics, etc., adequate personal protective equipments (PPE), supervision and monitoring system, immunization against Hepatitis B and the system of reporting and recording injuries and illnesses.

***Injuries/Illnesses*** are injuries/ illnesses encountered due to hospital waste and its management during the last 12 months.

## CHAPTER (II)

### LITERATURE REVIEW

#### 2.1. Definition of hospital waste

Hospital wastes are waste materials that are produced from the health-care providing facilities like hospitals, primary health care units, clinics and other such facilities in the course of treating patients and/or providing any other health services like immunizations, etc. (Chandra, 1999; Mostafa et al., 2008). Sarkar et al., (2006) has defined hospital waste more broadly where they have included waste generated not only from the health centers but also from other set-up like first-aid posts and sick bays, ambulance services, mortuary and autopsy centers and biotechnology laboratories. WHO (1999), defines hospital waste as all the waste materials that are generated from health care establishments, research facilities and laboratories and also those from “minor” and “scattered” sources like home health services (dialysis, insulin injections, etc.).

#### 2.2. Hospital waste generation

Hospital waste generation varies not only between country to country but also within the country depending upon several factors like the type of health care facility, hospital specialization, daily admission and the waste management protocol available (WHO, 1999). The most significant factor affecting the generation of hospital waste is the rate of hospital bed occupancy (Elimelech et al., 2011). Determining the generation of hospital waste including quantities and their characteristics is crucial in order to develop regulations and instructions for hospital waste management (Sawalem et al., 2008). The daily hospital waste generation in USA is found to be 4.5 Kg/bed, France and UK 2.5 Kg/bed each, Spain 3.0 Kg/bed (Chandra, 1999) and that in Western Europe is 3–6 kg per bed (WHO, 1999).

Among the Asian countries Bhutan is found to be generating the least amount of hospital waste (Visvanathan, 2006) as shown in **Table 1**. In 2001, a team from DANIDA

estimated the infectious waste generation in Bhutan to be 0.25kg/patient/day in the hospitals and 2 – 6 kg/patient/week in the BHUs. The sharp waste generation was estimated to be 0.02kg/patient/day in the hospitals and 0.05kg/patient/week in the BHUs (Mehta, 2005). In 2005 the infectious waste generated was 17,311 kg/year and sharps were estimated to be 1,385 kg/year from the whole country (Mehta, 2005). Penjor (2007) found that out of about 65 tons of solid waste generated in Thimphu in a day, hospital waste in combination with textile, wood, rubber and other special waste contributed to 6%.

**Table 1. Estimates of medical waste generation in some Asian countries**

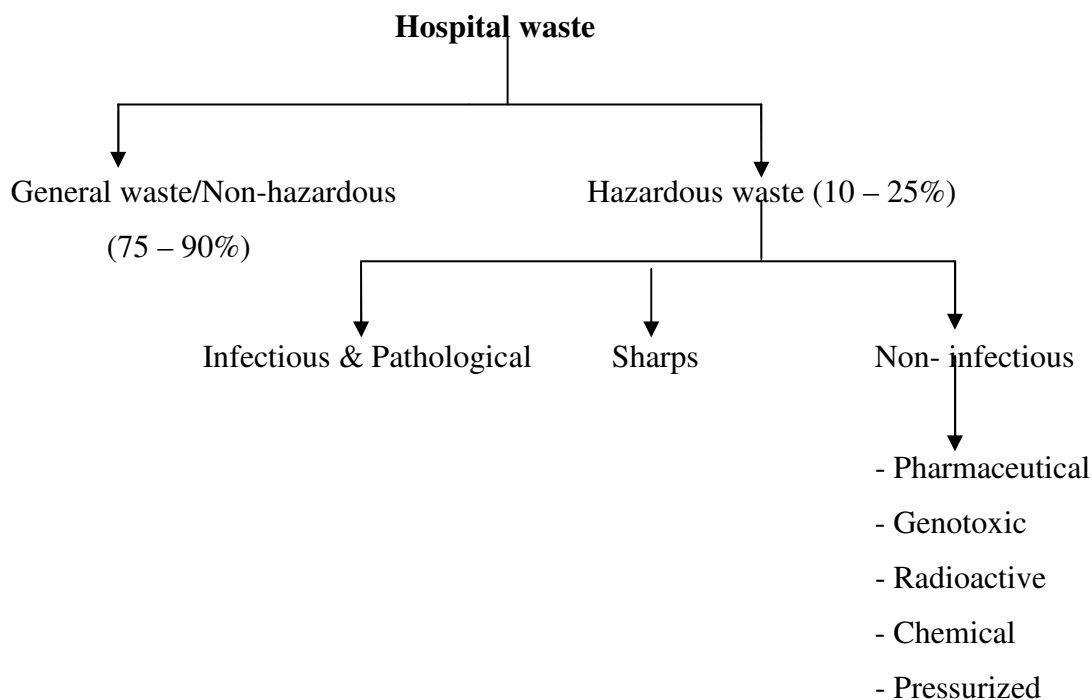
Country	Waste generation (Kg/bed/day)	Total waste generation (tons/year)
Bhutan	0.27	73
China	-	730,000
Colombo	0.36	6,600
Dhaka	0.8 – 1.67	93,075
India	1 - 2	330,000
Malaysia	1.9	-
Metro Manila	-	17,155
Nepal	0.5	365
Pakistan	1.06	250,000
Thailand	0.68	-
Vietnam	2.27	60,000

Source: Visvanathan ( 2006).

### 2.3. Classification of Hospital waste

WHO (1999) clearly cites that 75 – 90% of the waste generated from the hospitals are general waste which is similar to any other domestic waste and only 10 – 15% are hazardous, as shown in **Figure 4**. In order to achieve an effective chain of management

process the hospital waste is broadly categorized into four categories; sharp waste, infectious waste, general waste and hazardous waste (Ananth et al., 2009). However, WHO (2006) furthers breaks down and classifies hospital wastes into eight types besides general waste, as shown in the figure below.



**Figure 4. Classification of hospital waste.** *Source:* WHO, (1999)

**General waste:** It is a non-hazardous waste largely composed of house hold, office and kitchen waste. For example, papers, card box, plastics, wrappers and kitchen waste (Chandra, 1999).

**Infectious waste:** Waste that has a potency to carry pathogens (bacteria, viruses, parasites and fungi) in sufficient amount and are capable of transmitting infectious diseases (WHO, 1999). For example, culture dishes, catheters, drainage tubes, used dressings, surgical sponge, dialysis tubing, etc.

***Pathological waste:*** Waste consisting of human tissues or body fluids. For example, body parts, fetuses, placenta, blood and other body fluids (WHO, 1999).

***Sharps:*** Those waste which are capable of pricking and cutting the skin are considered as sharps (WHO, 1999). For example, needles, scalpels, broken glasses, blades, nails, etc.

***Pharmaceutical waste:*** Drugs or other pharmaceutical products that are expired, contaminated or no longer used (WHO, 1999).

***Genotoxic waste:*** Waste like cytotoxic drugs used for the treatment of cancer patients poses genotoxic properties (WHO, 1999).

***Chemical Waste:*** Waste that contains chemical substances like laboratory reagents, film developer, disinfectants that are expired or no longer needed and solvents are among the group of chemical waste (WHO, 1999).

***Pressurized waste:*** Gas cylinders, gas cartridges and aerosol containers are some of the pressurized hospital waste (WHO, 1999).

***Radioactive waste:*** Waste that contains radioactive substances like unused liquids from radiotherapy, contaminated glassware, packages, or absorbent paper, and stool and urine from patients treated or tested with unsealed radio nuclides (WHO, 1999).

Other common hazardous waste from the hospital includes batteries, broken thermometers and blood-pressure gauges which releases heavy metals like mercury. Non infectious hazardous waste like huge pharmaceutical waste, genotoxic waste, radioactive waste and waste with heavy metals poses potential hazard to human beings and the environment (WHO, 1999). They are non-degradable, can be biologically magnified and



can be lethal, causing detrimental cumulative effects (Tchobanoglous, Theisen and Vigil, 1993).

#### **2.4. Composition of hospital waste according to source**

Although the major component of the waste from any unit is the general waste including paper, plastics, linens, food waste, wrapping materials, etc., hazardous waste from medical ward mainly comprise of infectious waste like dressing materials, intravenous sets, body fluids and sharps. On the other hand, waste from the surgical ward and the operation theatres primarily consist of organs, tissues, dead fetuses and other body parts and body fluids along with sharps. Laboratory waste includes some anatomical organs, extremely infectious waste like tissues, microbiological cultures, stocks of infectious agents, blood and other body fluids and sharps. Some radioactive and chemical waste are also present in laboratories. (WHO, 1999).

Radiological department is another source of hazardous waste where they are available in all three states of matter (solid, liquid, and gas) contaminated with radio nuclides which is the by-product of the medical procedures like *in-vitro* analysis of body tissue and fluid, *in-vivo* organ imaging and tumor localization, and other investigative and therapeutic practices. However, at present the radiological department in JDWNRH produces more of solid waste like X- ray films and chemical waste like fixers, contrast and other gaseous wastes as the hospital do not possess the facility for radiotherapy (Radiologist, JDWNRH, Personal communication, 26 February, 2011).

Pharmaceutical waste includes expired, unused, split and contaminated pharmaceutical products, drugs and vaccines. It also includes all the drugs and equipments used to prepare and administer cytotoxic drugs for chemotherapy in cancer patients. In JDWNRH, there are specific measures taken by the MoH in dealing with wastage of drugs, therefore, pharmaceutical waste is not much of an issue (Healthcare waste management, Guideline for Infection Control and Healthcare Waste Management

in Health Facilities, 2006, pp 64-65). Common hazardous chemicals used in hospitals are formaldehyde, photographic chemicals like fixer, solvents, organic chemicals like disinfectants, insecticides, and inorganic chemicals like acids and alkalis. (WHO,1999). According to the WHO, the amount of pharmaceutical and chemical waste accounts to about 3% of all hospital waste (cited in Elimelech et al., 2011).

Waste containing heavy metals are also included as hazardous chemical waste and are highly toxic. Mercury is a common waste among waste containing heavy metals in the hospitals that is generated from broken equipments like BP apparatus and thermometers. Cadmium and arsenic are other chemicals containing heavy metals that are usually used in the hospitals. (WHO, 1999). With improper disposal these chemicals can remain persistent in the environment (Akter, 2000). Therefore, these wastes require special attention both within the hospitals and after disposal (WHO, 1999).

## **2.5. Knowledge, attitude and practices**

Knowledge, attitude and practices (KAP) studies are highly focused assessment that measure changes in human knowledge, attitudes and practices in response to a specific intervention, demonstration or education (Knowledge, Attitudes and Practices Studies for Water Resources Projects: online). KAP on hospital waste management differ from person to person within the hospital depending upon their educational background and area of work as mentioned by Akter et al., (1999). It is very important that all categories of health workers have adequate knowledge, positive attitude and good practices on hospital waste management system to prevent themselves and their patients from hospital acquired illnesses (Mostafa et al., 2008).

### **2.5.1. Knowledge**

Longman (1999) cited in Jariya (2006) defines knowledge as the information and understanding that one gains through learning or experience. Knowledge can be evaluated by the measurement of the brain's ability to memorize things that have been

experienced, known or seen (Jariya, 2006). There are three types of tools used for measuring knowledge, oral test, writing test and practice test (Vungpanich, 1983 cited in Jariya, 2006). Writing test is further categorized into essay or open-ended questions and limited answers or close-ended questions. Close-ended questions with pre defined answers on hospital waste management are preferred for the present study because they are easy to administer, faster and cheaper to analyze (Bowling, 2004 cited in Jariya 2006). Sarma (2010), in his study, found varying knowledge gap among doctors, nurses and waste handlers. Without knowing the harmful effects of hospital waste on human health and the environment the health staff and waste handlers are deprived of the knowledge and attitude on safe handling and disposal practices of hospital waste (Akter, 2000).

### **2.5.2. Attitude**

Attitude has been defined as “the opinions and feelings that you usually have about a particular thing, idea or person” (Longman, 1999 cited in Jariya, 2006). Various rating scales are used to measure attitude, Thurston-type scale, Likert scale and Guttman scale (Jariya, 2006). Likert scale is the most frequently used scale in measuring agreement or disagreement attitude, like strongly agree or strongly disagree, and so will be used for the present study to measure the attitude of the health staff and waste handlers in JDWNRH on hospital waste management.

### **2.5.3. Practice**

Practice has been defined as a regular activity that one does in order to improve one’s skill or ability (Longman, 1999 cited in Jariya, 2006). Practice can be evaluated with great observation using equipments like checklist to record the observed information (Suvan, 1983). In the present study the practices on hospital waste management among the health staff and waste handlers will be evaluated with structured questionnaires and observation.

## 2.5. Enabling Factors

The dictionary meaning of the word “enable” means “to make able”, that will allow, authorize, equip or facilitate someone to do something in a better way (Dictionary. Com., 2011. Online). For the hospital staff the use of guideline on hospital waste management can enable them to perform safer waste management practices because the guideline is suppose to provide comprehensive information on prevention and control of HAI (Guideline for Infection Control and Healthcare Waste Management in Health Facilities, 2006). Training of health staff and the waste handlers routinely on hospital waste management will equip them with better knowledge and positive attitude motivating them to perform good practices. Harhay et al., (2009) found out that health workers were either undertrained or uninformed on waste management and so had limited knowledge on segregation system. Rashid (1996) as cited in Akter (2000) found that because the staff does not have adequate knowledge they are not interested in safe hospital waste management system.

Regular supply of the required resources like the different coloured buckets and plastics, adequate PPE also contributes to effective hospital waste management. Mostafa et al.,(2008) mentions that one of the reasons for inadequate nursing practices on waste management was due to inadequate supplies. Those individuals who are involved in handling hospital waste are at greatest risk of being exposed to infectious waste, chemical and radioactive waste. Therefore they must have an adequate access to all the necessary PPEs (Eleven Recommendations for Improving Health Care Waste Management, 1997, revised in 2002).

Supervision and monitoring is yet another crucial enabling factor for hospital waste management practices. Chandra, (1999) emphasizes the role of hospital waste management committee in developing specific action plan for segregation and other waste management procedures, its implementation followed by routine supervision and monitoring.

## **2.6. Injuries and Illnesses due to hospital waste**

The health staff and the waste handlers are at the greatest risk of being exposed to the hospital waste and acquiring various diseases and illnesses (WHO, 1999; Akter et al., 1998). At present, in Bhutan the occupational and safety standards are recently recognized but still very negligible. Reports are available from the developed countries where serious viral infections like HIV/AIDS, Hepatitis B and C are acquired among the health-care workers, particularly nurses, due to injuries from contaminated sharps. In 1992, in France, there were eight cases of HIV detected among the health care providers due to sharp injuries. In the USA, in 1994, 39 HIV cases were recorded from occupational infection and by June 1996 the cases increased to 51. (WHO,1999)

Hepatitis B Virus (HBV) infection is the major infectious hazard for health-care personnel. During the past decade 100-200 health-care personnel are estimated to have died annually because of the chronic consequences of HBV infection due to exposure to blood and serum-derived body fluids and sharp waste. Therefore, those workers performing tasks involving sharp waste management, exposure to blood or blood-contaminated body fluids like doctors, nurses, lab technicians and waste handlers should be vaccinated routinely against Hepatitis B. For those workers like municipal waste handlers whose exposure to blood is infrequent, timely post-exposure prophylaxis may be considered, rather than routine pre-exposure vaccination. (CDC, 1997).

For the developing countries the assessment of exposure remains difficult due to inadequate and under-reporting of cases, however, it is suspected that there are cases of similar infections related to inappropriately managed healthcare wastes (WHO, 1999). Akter et al., (1998) reports on the health risk associated with hospital waste in Bangladesh including cut injuries, skin diseases, ulcers and even paralysis of limbs due to injuries from sharp waste. Hospital staffs including the waste handlers are also at increased risk of exposure to other biomedical waste like chemicals and radioactive waste

and their associated threats and risks (Haveri and Dwivedi, 2002; Ruoyan et al., 2010; Jones (2007) cited in Harhay et al.).

Hospital waste, if not properly managed can pose a threat to the community by re-emerging epidemics like SARS. Jones (2009) states China's situation on hospital waste management as "curing at the front door and poisoning at the back door". A particular concern is the possible infection among the waste handlers and the general public when the waste is not disposed properly. This perceived risk, especially in developing countries, where other related socio economic problems exists, the risk of infection through contact with untreated clinical waste may greatly be exacerbated (Mbongwe, 2008).

Hospital waste possess risks not only to the health workers and the patients but can also affect the people living nearby (Sarkar et al., 2006), scavengers (children, adults and animals) (Akter et al., 1999) and the environment at large. In most of the developing countries waste are being scavenged by people for their primary source of income and Bhutan is not an exception. These rag pickers face a daily risk, especially in the countries where it is possible to resell some components of the waste, for example, syringes, for illicit drug use (The Issue: online. Retrieved on 14 March 2011). These people do not have any protection while sorting through the waste and are at varying degree of hazards (Akter, 2000) placing themselves in a vulnerable situation. Studies have found even some of the hospital cleaners engaged in mishandling the generated hospital wastes where they retrieve the used sharps (mainly the syringes and needles), saline bags, blood bags and test tubes for resale or reuse (Hassan, 2008).

Among the hospital waste, sharp waste are known to have the highest potential for disease transmission like HIV/AIDS, HBV, HCV as they puncture the skin facilitating portals of entry for the viruses (Akter et al, 1999; WHO, 1999; Mato and Kassenga, 1997). Other common illness associated to hospital waste are gastrointestinal infections, respiratory infections, tuberculosis, throat infection, genital infection, typhoid and other

bacterial and viral diseases (Akter, 1998; WHO, 1999 ). Another important hazard posed by inadequate management of hospital waste today is antibiotic resistance to bacteria (WHO, 1999) leading to increased hospital stay and financial burden to both patient and the hospital.

Some of the chemicals and pharmaceuticals used in the hospitals are dangerous too, as they possess properties like toxic, corrosive, inflammable, reactive, explosive and shock-sensitive (WHO, 1999; Rodenbeck et al, 2005). Pressurized containers like aerosol cans must be carefully disposed as they might explode while incinerating or burning.

## **2.7. Impacts of Hospital Waste on Environment**

Environmental effects related to hospital waste include general nuisance like ground pollution and unbearable odor, invite scavengers like dogs, birds, rodents and flies that can contaminate the water sources. Studies in Bangladesh have shown that due to improper disposal of medical waste, laboratory analysis have confirmed contamination of infectious waste in the environment (Akter et al., 1999).

Penjor (2007), mentions that most of the Bhutanese population remains innocent to the consequences of hazardous waste. It is possible because unlike in the developed countries, like US, where the Environmental Acts requires generators to report on the type of hazardous waste they produce (Carruth and Goldstein, 2007), the hazardous waste generators in Bhutan, like the hospitals and industries are not obligated by law to declare the type and amount of hazardous waste they produce and the risk it possess. However, many Bhutanese are gradually gaining increased awareness through media and internet and concerns are raised by the government, private sectors and NGOs including many educated individuals about the risk associated with hazardous waste on the humans and environmental health.

Due to such detrimental effects to the human health and the environment it is crucial to improve the hospital waste management (Ananth et al., 2009; Akter, 2000). Even for country like UK, Blenkharn (2005) recommended for significant improvement concerning medical waste management in order to reduce the possibility of hospital acquired infection (HAI) and to assure the standard of hospital hygiene. Unlike in the developing countries, UK and other developed countries over the years have been receiving much attention on the management of hospital waste (Blenkharn, 2005). However, challenges remain much higher for the developing countries where enough attention is yet to be received and having got constraints in resources and capacities (Penjor, 2007).

## **2.8. Legislative, regulatory, and policy aspects**

One of the important reasons of the medical waste management policy is to protect the hospital staff, municipal workers, the general public and the environment from getting exposed to disease causing pathogens (Medical Waste Disposal Policy, 1991: online). The basis for improving the hospital waste management is the national legislation of the country which institutes legal controls and permits the waste management agencies, like the MoH, to apply pressure for the implementation. Studies among the developing countries have found that lack of appropriate legislation, policies and laws concerning hospital waste are among some of the hindrances for effective hospital waste management (Hassan, 2008).

In Bhutan, at present, there is no specific legislation on the management of hospital waste. However, it is enacted along with the general waste in the Waste Prevention and Management Act of the Kingdom of Bhutan, 2009, in which MoH is identified as the implementing agency on medical waste management. It is required by the Act that MoH should develop rules and regulations to manage the hospital waste. (NEC, 2010: online). The national policy and strategy on handling health care waste includes development of purchase policy that reduces the problems of waste, segregation



of waste at the source, development of reuse and recycling policy, sanitarily sound collection and storage system of hospital waste with minimal contact for hospital staff, patients and general public, appropriate packaging and transportation, safe and proven treatment technology to render hospital waste non-hazardous to human health and environment (Guideline for Infection Control and Health Care Waste Management in Health Facilities, 2006, pp67-68).

## **2.10. Steps of hospital waste management**

Hospital waste must be handled scientifically, hygienically and timely in order to minimize infections and other related diseases thus reducing deaths in the hospital and in the community (Training Manual for Trainers on ICHWM in Health Care Facilities, 2007 p96). According to WHO (2008), there are six key steps of safe hospital waste management; segregation, collection, transportation, storage, treatment and safe disposal. Appropriate handling, treatment and disposal of waste do not only protect public health but also reduces the cost of management (WHO, 1999).

### **2.10.1. Segregation**

Segregation is the separation and identification of waste at the source by the waste generator according to its characteristics, like, general, infectious, sharps and other hazardous, so that the whole lot does not become hazardous and thereby eases the process of management (WHO, 1999) as well as reduces the cost of management (Askarian et al., 2010).

WHO (1999) ensures that about 75 – 90% of the hospital waste comprise of general waste which is non- hazardous and that only about 10 – 25% is regarded as hazardous possessing risk to the human health and environment. Therefore, it is the effective and efficient system of segregation of waste at the source that has to be carried out by the waste generators which will separate these two categories of waste. However, most of the health care centers lacks effective segregation as per the guidelines and

standards even if the system of segregation is being practiced (EI - Salam, 2009; Mehta, 2005) and some lacks clear guidance to waste segregation (Akter et al., 1999).

Segregation is also a crucial step for effective waste management and minimization of waste because if segregation is ineffective and all waste are mixed 100% of the waste becomes hazardous instead of just 10 – 25% (Giroletti and Lodola, 1993). Once the waste is segregated at the source it should be maintained during storage, transportation and finally disposal (WHO, 1999). Effective segregation can only be achieved by scrupulous training of all the staff in the hospital and also other waste generators like patients and their visitors (Giroletti and Lodola, 1993). When the segregation system is poor it contributes to large amounts of “red-bag” (infectious) waste and subsequently results in overloading of the limited capacity of hospital incinerators and autoclaves (Mbongwe, 2008). Hazardous hospital waste including radioactive waste should be categorized and segregated on the basis of the available options for treatment, conditioning, storage, and disposal (WHO, 1999).

### ***2.10.2. Collection***

When the waste bags are about 3/4 full each bag must be closed tightly and sealed. These bags then must be labelled with information like date of collection, type of waste, place of production and waste destination (WHO, 1999). They must be routinely collected and transported to the designated storage site. Liquid waste should be collected in appropriate containers according to its chemical and radiological characteristics, volume, and handling and storage requirements (WHO, 1999).

Although WHO recommends yellow colored bins for highly infectious waste, brown for chemical and pharmaceutical waste and black for the general waste, as shown in **Table 2**, (WHO, 1999), JDWNRH uses red for infectious, white/ yellow for sharp waste, green for general waste and blue for food waste as shown in **Table 3** (Training manual for trainers on ICHCWM in health facilities, 2007).

**Table 2. Recommended colour-coding for health-care waste according to WHO**

Type of waste	Colour of container and markings	Type of container
Highly infectious waste bag,	Yellow, marked “HIGHLY INFECTIOUS”	Strong, leak-proof plastic or container capable of being autoclaved
Other infectious waste, pathological anatomical waste	Yellow	Leak-proof plastic bag or and container
Sharps	Yellow, marked “SHARPS”	Puncture-proof container
Chemical and pharmaceutical Waste	Brown	Plastic bag or container
Radioactive waste	—	Lead box, labelled with the radioactive symbol.
General health-care waste	Black	Plastic bag

*Source:* WHO (1999).

### ***2.10.3. Transportation***

Within the hospital the waste should be transported using waste trolleys or carts that are specifically meant for waste (WHO, 1999). Results from previous studies shows that various modes of transportation of hospital waste are being practiced, ranging from wheeled and lidded carts in the hospitals in UK (Blenkharn, 2005) to open buckets, a plastic bowls and plastic bags in Bangladesh (Akter 2000). The waste must be transported via the shortest route designed for waste transportation and possibly use separate lifts and ramps (Hospital Waste, Training manual for trainers on ICHCWM in health facilities, 2007, p70). The waste trolleys must be easy to handle, should not have sharp edges that might tear the waste bags and must be washed with disinfectant daily (WHO, 1999). For off-site transportation of waste, WHO (1999) recommends that the waste bags be safely

packed with adequate labeling and authorization for its destination in compliance with the national regulations for transport of hazardous waste.

#### ***2.10.4. Storage***

Once collected, the hospital waste must be stored in a place designated within the hospital. The storage area should have washing facility, passive ventilation and protection from sun and rain. The area must be locked to prevent accessibility for animals, birds, insects and humans to scavenge. The duration of storage for infected hospital waste should not exceed 72 hours in winter and 48 hours in summer in the temperate climate; for warm climate the duration should not be more than 48 hours during cool season and 24 hours during hot season. However if there are refrigerated storage rooms the duration can be prolonged. Other hazardous waste like radioactive waste must be stored in such a way that both human health and the environment are protected. It must not be stored in the vicinity of corrosive, explosive, or readily flammable materials. (WHO, 1999).

#### ***2.10.5. Treatment***

In order to render the infectious waste non-infectious prior to disposal it must be treated (US EPA, 1992). Treatment of hospital waste are carried out in various ways like incineration, autoclaving, chemical disinfection, gamma irradiation and many more depending upon many factors like health and environmental considerations, occupational health and safety considerations, available facilities, disposal options and regulatory requirements (WHO, 1999). Infectious micro organisms can be destroyed by heat, using chemicals and microwave irradiation. Highly infectious waste including cultures and stocks from the laboratory procedures requires wet thermal treatment like autoclave. For other infectious health-care waste, disinfection should be adequate.

Incineration is the method of burning the hospital waste at high temperatures in a controlled environment to change the combustible materials into noncombustible residue or ash. If well designed, maintained and operated incinerators can be used for the

treatment of all categories of hospital waste (Medical Waste Disposal Policy, 2008: online). Incineration without proper pollution controlled devices is not an ideal choice due to the threats from its emission and ash, however, it may be preferred when there are large volume of waste and other facilities are unavailable (WHO, 2004 cited in Harhay et al., 2009). Ruoyan et al., (2010) found out that primary health care centers in China still dispose their healthcare waste by incineration on-site most likely without any pollution control devices. With the operating temperature below 800 degree C, the incinerators can produce dioxins, furans or other toxic pollutants. It was also discovered that incinerators were operated by poorly trained workers and so operations did not fulfill the standards related to environmental protection. Where there is no wastewater treatment plant, blood and other body fluids should be disinfected before being discharged to a sewer or it may also be incinerated (WHO, 1999). Autoclaving is one of the most suitable and preferred method of treatment of waste as it is an environmentally safe procedure (Mehta, 2005).

#### ***2.10.6. Disposal***

Disposing hospital waste appropriately as per its characteristics determines the final stage of the waste management and will have huge impact on the health of people and the environment. Common forms of disposal for hospital waste are land filling, encapsulation, safe burial in the hospital premises and discharge to the sewer (WHO, 1999). Once the hospital waste is treated it can be safely disposed off to the designated landfill (Giroletti and Lodola, 1993). However, for a developing country, like ours, a careful disposal of hospital waste at the municipal landfill may be acceptable if there is genuine lack of treatment facilities because accumulating them in the hospital or elsewhere possess far greater risk of infection, although risk is still involved in contaminating air, water and the scavengers (WHO, 1999). But studies in Bangladesh have found out that hospital waste are mostly disposed in the municipal dustbins without any treatment and other places like road ways, road sides, open fields, river, canal, lakes and pit nearby hospital (Akter, 2000) which is more dangerous to the community.

Small quantities of pharmaceutical waste that are produced on a daily basis may be disposed in the landfill. However, large quantities should never be land filled nor be diluted and flushed through sewerage except for certain mild solutions like vitamins, salts, lipids, etc. Cytotoxic drugs are highly hazardous and so should never be land filled or discharged into the sewerage. Large quantities of pharmaceutical waste and the remaining/unused cytotoxic should be returned to the original suppliers for safe disposal. Waste containing heavy metals like mercury or cadmium should never be burned or incinerated due to the risk of atmospheric pollution with its toxic vapours and should never be disposed in municipal landfills either as they may pollute the groundwater. For pressurized containers, incineration and burning is not at all an option due to the risk of explosion. If no other alternatives they can either be recycled or reused and disposed in the land fill after assuring that the containers are well emptied. (WHO, 1999)

The management of radioactive waste should ideally be subjected to the national strategy that includes appropriate legislation, competent regulatory and operational organizations, and adequately trained personnel and a range of options are required to deal with radioactive waste, depending upon its quantity and its characteristics (WHO, 1999).

## CHAPTER (III)

### RESEARCH METHODOLOGY

#### 3.1. Research Design

This research is a cross-sectional, mixed method study to explore the knowledge, attitude, practices and the current waste management system in JDWNRH.

#### 3.2. Research Area

Jigme Dorji Wangchuk National Referral Hospital, Thimphu, Bhutan

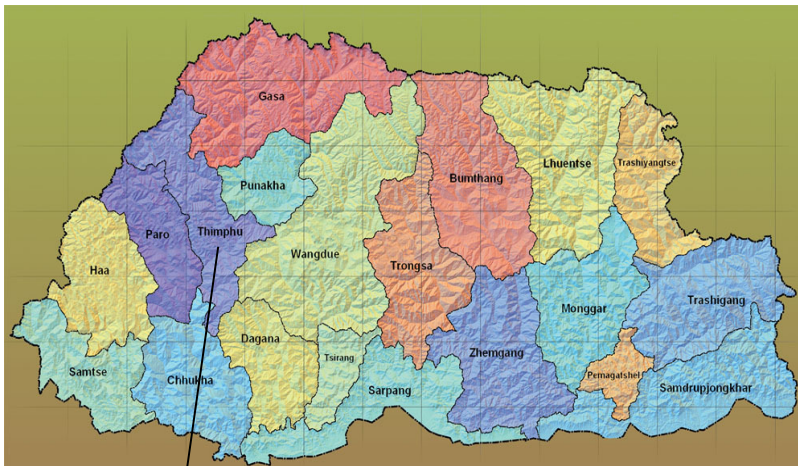


Figure 5. Map of Bhutan



Figure 6. Map of Thimphu town. Source: Google (Retrieved on 06 March 2011).

### 3.3. Study Population

The target population is the health staff and waste handlers of JDWNRH comprising of 665 persons.

### 3.4. Sample size

Sample size is calculated using the ‘Taro Yamane Formula’ where;

$$n = \frac{N}{1 + Ne^2}$$

Where;

- n is the sample size
- N is the population size (total number of health staff and waste handlers)
- e is the significant level (0.05)

From the mentioned formula;

$$n = \frac{665}{1 + (665 \times (0.05)^2)} = 250$$

### 3.5. Sampling Technique

Sampling technique will be proportional sampling considering 10 % drop rate (DR) as shown below in **Table 3**.

**Table 3: Proportional sampling technique for hospital staff of JDWNRH**

Group	Numbers	Proportion or %	Sample size	
				10% DR
Doctors	71	71*250/665	27	30
Nurses	242	242*250/665	91	100
Paramedics	259	259*250/665	97	106
Ward boys	55	55*250/665	21	23
Cleaners	38	38*250/665	14	15
Administrators	5	-	5	-
<b>Total</b>	<b>665</b>		<b>250</b>	<b>274</b>



### **3.5.1. Inclusion Criteria**

1. From all departments/units of JDWNRH (OPD, IPD, Emergency).
2. Preferably head of the departments, chief nurses and unit in-charges.
3. Permanent staff with minimum of six months in JDWNRH.
4. Top five hospital administrative officials.
5. Willing to participate.

### **3.5.2. Exclusion criteria**

1. Students or trainees and on attachment duty in JDWNRH.
2. Age below 18 years old.
3. Somebody on leave at the time of data collection.
4. Not willing to participate

During the time of data collection, the study participants will be recruited by Convenient Sampling.

## **3.6. Measurement Tool**

### **I. Structured questionnaires**, consisting of six parts:

1. Socio demographic characteristics – 5 questions
2. Knowledge – 15 questions for health staff and 12 for waste handlers
3. Attitude - 15 questions for health staff and 12 for waste handlers
4. Practices – 17 questions for health staff and 13 for waste handlers
5. Enabling factors – 22 questions for health staff and 16 for waste handlers
6. Injuries/Illness – 10 questions each to both health staff and waste handlers.

The questionnaires will be developed with the help of literature review on the similar studies conducted in Bhutan and other countries, the WHO guideline on hospital waste management (WHO, 1999) will be followed and questions on knowledge, attitude and practices will all focus as per the policy and guidelines set for hospital waste

management in Bhutan (Guideline for Infection Control and Healthcare Waste Management in Health Facilities, 2006).

**II. In-depth Interview**, using the semi structured questionnaires, for hospital administrative officials to explore the following:

- Views on the present waste management system of JDWNRH.
- Their concerns on the present waste management.
- Challenges faced in the adequate management of hospital waste.

**III. Walk- through survey**, using the checklist, to observe the following steps of waste management:

- Segregation
- Collection
- Transportation
- Storage
- Treatment
- Disposal

### **3.7. Data collection**

Data collection is planned for the month of June, 2011.

1. After it has been pre-tested for reliability, the questionnaires will be distributed to the doctors, nurses and para-medics and ask them to fill all the necessary information and answer all the questions (self administered). Once done the unit in-charges will be requested to collect the answered forms.
2. Face to face interview will be conducted for the waste handlers (ward boys and cleaners) using the structured questionnaires which will be interpreted, by the researcher, in local dialects as most of them cannot read and write English properly.

3. After making an appointment with each of the top five hospital administrators, the Medical Director, Medical Superintendent, Administrative Officer, Nursing Superintendent and Deputy Nursing Superintendent who is the focal person for hospital waste management, an in-depth interview will be conducted with the help of semi structured questionnaires.
4. Using the developed checklist, a walk through survey will be conducted basically to observe the waste management practices in JDWNRH concentrating on all steps including segregation, collection, storage, treatment, transportation and disposal.

### **3.8. Data Analysis**

1. For the knowledge questions, the scoring part is planned as follows:

Knowledge	:	score
Correct answer	:	1 point
Incorrect answer	:	0 point
Don't know	:	0 point

The obtained score will be converted in terms of score level and will be classified into 3 levels (high, moderate and low level of knowledge). As per Srisaard, 1992; Suchat, 1997, a mean $\pm$ SD of the group will be used to classify subjects into 3 groups.

1. On the test for attitude scoring criterion will be as follows:

Strongly agree	:	5 points
Agree	:	4 points
Undecided	:	3 points
Disagree	:	2 points
Strongly disagree	:	1 point

And vice versa marking will be done for negative statement. The obtained score will be converted in terms of score level considering the mean $\pm$ SD will be classified as, positive

attitude, neutral attitude and negative attitude (Kaliyaperumal, 2004; Srisaard, 1992; Suchat, 1997).

2. For practice questions the scoring method will be as follows;

Yes	:	1 point
No	:	0 point

Vice versa marking will be done for negative statement. The obtained score will be converted in terms of score level using the mean $\pm$ SD will be classified as good or poor practices (Suchat, 1997).

3. For enabling factors each question will have either “Yes” or “No” response. The frequency, percentage and association to practices will be determined.

The results of the scores will be entered into statistical software SPSS (version 16) for the following analysis:

- Descriptive Statistics:

All independent variables will be described in percentage, frequency, mean and proportions.

- Inferential Statistics:

Test for association on knowledge, attitude and enabling factors with the practices will be done using Chi square. In order to see the association between the knowledge, attitude and practices Spearman’s correlation will also be tested.

4. For the in-depth interview and walk-through survey qualitative analysis will be done.

### 3.9. Validity and Reliability test

#### 3.9.1. *Validity*

The ability to measure what it is designed to measure is known as Validity. The structured interview questionnaires are being cross-checked by the thesis committee of the College of Public Health Sciences, Chulalongkorn University, for the accuracy, clarity, and appropriateness of the questionnaire. It is also reviewed by the Research and Ethics committee in the Ministry of Health, Thimphu, Bhutan.

#### 3.9.2. *Reliability Test*

A pre-test was conducted with 30 subjects on the similar staff in a District Hospital, Paro, Bhutan. Cronbach's alpha value was calculated to assess the reliability of the questionnaire's questions on knowledge and attitude on hospital waste management.

$$\text{Formula for Cronbach alpha} = \alpha = \frac{k}{k-1} \left( \frac{1 - \sum S_i^2}{S_x^2} \right),$$

Where, k = the number of questions in questionnaire

S<sub>i</sub> = the variance of marks in each item

S<sub>x</sub> = the variance of mark in the questionnaire

The 30 pre test questionnaire were computed in the statistics Package for the SPSS (version 16) to find the Cronbach alpha value. The Cronbach alpha value of 0.72 was obtained for knowledge questions and 0.70 for attitude questions. Bryan and Cramer (2005) stated that an alpha value of 0.7 or more is acceptable for reliability test for questionnaire.

### 3.10. Ethical Consideration

The ethical consideration was sought from the Health Research and Ethics Board, MoH, Thimphu, Bhutan. Necessary changes and revision were carried out as per the feedback from the board prior to data collection. The study was performed according to the approval from the Ethical Committee of the board. Prior to data collection, the

samples were explained and assured on confidentiality of their identity. An informed consent was taken from all 262 study participants prior to participating in the study.

### **3.11. Benefit of the study**

The issue of hospital wastes has been seriously considered worldwide, and appropriate waste management systems are being developed. However, the system cannot function well with diverse level of knowledge, attitude and practices (KAP) among the health workers and the waste handlers. The KAP surveys will be used to assess the level of knowledge on the concept of hospital waste and its management along with their attitude and practices on the key factors that influences safe hospital waste management, defined by WHO (2008), including waste segregation, collection, storage, treatment, transportation and the disposal system.

A new research will be added on hospital waste management in JDWNRH. The hospital will be able to know the level of knowledge, attitude and practices on hospital waste management among the health and waste handlers. The recommendations that the study will come up with would help the hospital in taking measures to address the waste management issues.

### **Limitations of the study**

Since the study is conducted in the National Referral Hospital, Thimphu, with purposive and convenient sampling it may not be generalized for other hospitals in the country. Also the present study focuses on different categories of health workers and not just specifically on a particular group like cleaners who are more involved in hospital waste management. They may require follow up in future.

## CHAPTER IV

### RESULTS

The result of the study is presented in three parts. Analysis for the health staff (n = 221) and waste handlers (n = 37) are carried out separately as the questions were slightly different and the number of questions varied for the two categories. The overall response rate for the study was 94%.

#### **Part 1: Descriptive findings**

The first part of the result presents the frequency distribution, percentage and the measures of the central tendency of the following:

- Socio- demographic characteristics
- Knowledge on hospital waste management
- Attitude on hospital waste management
- Practices on hospital waste management
- Enabling Factors
- Injuries/illnesses due to hospital waste

#### **1.1.Socio- demographic characteristics**

The frequency distribution for the selected variables of socio- demographic characteristics including age, gender, education level, present occupation and number of years in the present occupation are presented separately for health staff and waste handlers as presented in **Table 4 (a)** and **Table 4 (b)**, respectively. The health staff were between the age range of 21 – 64 years, their mean age was 32.42 years, median was 31.00 years, mode was 24 years and the standard deviation was 8.28. The female to male ratio among the health staff was 1: 1.5. When majority of health staff, 107 (48.4%) were certificate holders, 63 (28.5%) had diploma and the rest 51 (32.1%) were among Bachelors/ Masters and higher education level. The least group of health staff in the study

were doctors, 24 (10.9%), followed by nurses, 97 (43.9%), and the majority were paramedics, 100 (45.2%). The number of years in the present occupation ranged from 1 year to 36 years. The mean was 9.76 years, mode was 2 years and standard deviation was 8.17.

**Table 4 (a). Frequency and percentage of socio-demographic characteristics of health staff**

Socio-demographic characteristics	Number (%)
<i>Age</i>	
20 – 30	110 (49.8)
31 – 40	76 (34.4)
41 – 50	26 (11.8)
>50	9 (4.1)
Range = 21 – 64, Mean = 32.42, Median = 31, SD = 8.28	
<i>Gender</i>	
Male	132 (59.7)
Female	89 (40.3)
<i>Education level</i>	
Certificate	107 (48.4)
Diploma	63 (28.5)
Bachelors/Masters/and above	51 (23.1)
<i>Present occupation</i>	
Doctors	24 (10.9)
Nurses	97 (43.9)
Paramedics	100 (45.2)
<i>No. of years in present occupation</i>	
0 – 10 years	133 (60.2)
11 – 20 years	60 (27.1)
21 – 30 years	26 (11.8)
> 30 years	2 (0.9)
Range = 1 – 36 years, Mean = 9.76, SD = 8.17	

For the waste handlers, the age range was 21 – 41 years with the mean age of 33.30 years, median was 32.00 years and standard deviation of 6.83. Male to female ratio was 1: 1. Looking into their level of education, 21 (56.8%) were found to have primary or secondary level of education and 5 (13.5%) had middle or higher secondary education; however, there were 11 (29.7%) waste handlers who were illiterate. There were more of



ward boys/girls, 23 (62.2%), than the cleaners 14 (37.8%). The range of years in the present occupation was 1 to 19 years and the mean was 8.84 years, mode was 2 years and the standard deviation was 5.21 (See **Table 4 (b)** below).

**Table 4 (b). Frequency and percentage of socio-demographic characteristics of waste handlers**

Socio-demographic characteristics	Number (Percentage)
<i>Age</i>	
20 – 30	14(37.8)
31 – 40	17 (45.9)
41 – 50	6 (16.2)
Mean = 33.30, Median = 32, SD = 8.28, Range = 21 –41	
<i>Gender</i>	
Male	18 (48.6)
Female	19 (51.4)
<i>Education level</i>	
No education	11 (29.7)
Pry and Lower Secondary	21 (56.8)
Middle and higher Secondary	5 (13.5)
<i>Present occupation</i>	
Ward boys/girls	23 (62.2)
Cleaners	14 (37.8)
<i>No. of years in present occupation</i>	
0 – 10 years	23 (62.2)
11 – 20 years	14 (37.8)
Range = 1- 19 years, mean = 8.84, mode = 2 and SD = 5.21	

## 1.2. Knowledge on hospital waste management

Self administered questionnaires were used to evaluate the knowledge of the health staff and waste handlers on hospital waste management. There were 15 questions for health staff and a score of 1 was given to each correct answer and 0 for the incorrect answer. The description of the frequency and percentage of the responses for each question on knowledge on hospital waste management is shown in **Table 5 (a)** for health staff.

**Table 5 (a). Frequency and percentage of health staff whose answers were correct or incorrect to each question for knowledge (n = 221)**

No.	Statement	Correct n (%)	Incorrect n (%)
1.	All waste generated in the hospital are hazardous	112 (50.7)	109 (49.3)
2.	Segregation is a key step in hospital waste management.	213 (96.4)	8 (3.6)
	All infectious waste hazardous waste must be thrown in the red bags/bins.	194 (87.8)	27 (12.2)
4*.	Non-infectious hazardous waste must be thrown with general waste in green bags/bins.	36 (16.3)	185 (83.7)
2.	The sharp boxes should be filled only up to 3/4th full.	197 (89.1)	24 (10.9)
6*.	The infectious agent on sharps is very small and will not cause infections like HIV, HEP B.Hep C, etc.	200 (90.5)	21 (9.5)
7*.	A spill of mercury from a broken BP apparatus should be collected in the red bucket and autoclaved before disposal.	80 (36.2)	141 (63.8)
8*.	In summer, hazardous hospital waste can be stored for not more than 72 hours.	54 (24.4)	167 (75.6)
9.	The hospital waste storage area needs to be well fenced.	214 (96.8)	7 (3.2)
10*.	The hospital waste can be transported via the common route within the hospital.	125 (56.6)	96 (43.4)
11.	Use of PPE during hospital waste transportation protects an individual from exposure to hospital waste.	210 (95.0)	11 (5.0)
12*.	Autoclaves are best recommended for the treatment of pathological waste (body parts, placenta, fetuses, etc).	107 (48.4)	114 (51.6)
13.	It is important to record time, temperature and pressure while autoclaving hospital waste.	188(85.1)	33 (14.9)
14.	Liquid hazardous waste if untreated prior to disposal poses a serious threat to the community.	201 (91.0)	20 (9.0)
15*.	Memelakha (Landfill for Thimphu) is the best option for disposal of all waste from JDWNRH.	159(71.9)	62 (28.1)

\*Negative statement

Similarly, there were 12 questions for waste handlers and a score of 1 was given to each correct answer and 0 for the incorrect answer. The frequency and percentage of each response on knowledge questions is shown in **Table 5 (b)**.

**Table 5 (b). Frequency and percentage of waste handlers who answered correct or incorrect to each question for knowledge (n = 37)**

No.	Statement	Correct	Incorrect
		n (%)	n (%)
1.	All waste generated in the hospital are hazardous	22 (59.5)	15(40.5)
2.	The sharp boxes should be filled only up to 3/4th full.	32 (86.5)	5 (13.5)
3*	The infectious agent on sharps is very small and will not cause infections like HIV, HEP B.Hep C, etc.	35 (94.6)	2 (5.4)
4*	A spill of mercury from a broken BP apparatus should be collected in the red bucket and autoclaved before disposal.	2 (5.4)	35 (94.6)
5*	In summer, hazardous hospital waste can be stored for not more than 72 hours.	26 (70.3)	11 (29.7)
6.	The hospital waste storage area needs to be well fenced.	36 (97.3)	1 (2.7)
7*	The hospital waste can be transported via the common route within the hospital.	36 (97.3)	1 (2.7)
8.	Use of PPE during hospital waste transportation protects an individual from exposure to hospital waste.	37(100)	0 (0)
9*	Autoclaves are best recommended for the treatment of pathological waste (body parts, placenta, fetuses, etc).	4 (10.8)	33 (89.2)
10.	It is important to record time, temperature and pressure while autoclaving hospital waste.	17 (45.9)	20 (54.1)
11.	Liquid hazardous waste if untreated prior to disposal poses a serious threat to the community.	37(100)	0 (0)
12*	Memelakha (Landfill for Thimphu) is the best option for disposal of all waste from JDWNRH.	28 (75.7)	9 (24.3)

\*Negative statement

The obtained scores were then converted in terms of score level and classified into three levels – high, moderate and low knowledge. For the health staff, the possible score ranged between 2 – 15 and a mean ( $\pm$ SD) of  $10.36\pm 2.006$  is used to classify them into three categories. Among the waste handlers, the possible score ranged from 5 – 10 and with a mean of  $8.43\pm 1.237$ , they are classified into three levels of knowledge. **Table 6** shows the frequency and percentage for both health staff and waste handlers on their level of knowledge on hospital waste management. Among the health staff, 30 (13.6%) had high level of knowledge, followed by the majority of them, 153 (69.2%), who had

moderate level of knowledge and 38 (17.2%) were found to have low level of knowledge. Similarly, for the waste handlers, 19 (51.4%), 16 (43.2%) and 2 (5.4%) had high, moderate and low level of knowledge respectively.

**Table 6. Level of knowledge among health staff and waste handlers**

Level of knowledge	Score	Frequency (%)
<b>Health staff (n =221)</b>		
High level of knowledge	12 – 15	30 (13.6)
Moderate level of knowledge	8 – 11	153 (69.2)
Low level of knowledge	2 – 7	38 (17.2)
<b>Waste handlers (n = 37)</b>		
High level of knowledge	9 – 10	19 (51.4)
Moderate level of knowledge	7 – 8	16 (43.2)
Low level of knowledge	5 – 6	2 (5.4)

### 4.3. Attitude on hospital waste management

Both the health staff and the waste handlers were asked for their opinion on hospital waste management. With 15 questions for health staff and 12 for waste handlers, five options were available ranging from strongly agree to strongly disagree to the statement. The statements were both positive and negative. Scoring was done as 5 for strongly agree answer, 4 for agree answer, 3 for undecided answer, 2 for disagree answer and 1 for strongly disagree. A vice versa scoring was given for the negative statements. The frequency and percentage to each attitude questions are displayed in **Table 7 (a)** health staff and **Table 7 (b)** for waste handlers.

**Table 7 (a). Frequency and percentage of responses to attitude questions by health staff (SA = Strongly Agree, A = Agree, UD = Undecided, D = Disagree, SD = Strongly Disagree) (n =221)**

No.	Statement	Frequency (%)				
		SA n (%)	A n (%)	UD n (%)	D n (%)	SD n (%)
1	I have a crucial role in the management of hospital waste.	125 (56.6)	77 (34.8)	16 (7.2)	3 (1.4)	0 (0)
2	Segregation is always the responsibility of waste producer.	113 (51.1)	64 (29)	13 (5.9)	19 (8.6)	12 (5.4)
3*	I am sure that segregation of hospital waste has nothing to do with the financial impact on hospital waste management.	23 (10.4)	36 (16.3)	31 (14.0)	99 (44.8)	32 (14.5)
4*	I think it is safe to break the injection ampoules over the waste bin but no let the pieces fall outside the bin.	26 (11.8)	64 (29.0)	12 (5.4)	75 (33.9)	44 (19.9)
5	I don't feel good when I find somebody throwing hospital waste in the wrong bin.	154 (69.7)	57 (25.8)	1 (0.5)	4 (1.8)	5 (2.3)
6*	It is not important to label the waste bags before collection; after all, they are going to be disposed off.	8 (3.6)	10 (4.5)	8 (3.6)	85 (38.5)	110 (49.8)
7*	Collection of hospital waste can be done when the bins are full and not necessarily routinely to save time.	13 (5.9)	24 (10.9)	11 (5.0)	108 (48.9)	65 29.4)
8*	It is safe to scavenge hospital waste in the storage room for an extra income.	4 (1.8)	7 (3.2)	25 (11.3)	100 (45.2)	85 (38.5)
9*	I think hazardous and non hazardous waste must be collected and transported at the same time.	12 (5.4)	54 (24.4)	43 (19.5)	80 (36.2)	32 (14.5)
10*	No need to wash the waste transportation trolleys since they will get dirty again.	8 (3.6)	2 (0.9)	3 (1.4)	76 (34.4)	132 (59.7)
11*	Having a separate route for hospital waste transportation within the hospital is unnecessary and useless.	7 (3.2)	13 (5.9)	10 (4.5)	104 (47.1)	87 (39.4)
12*	Chemical disinfection is not at all an effective treatment method.	4 (1.8)	39 (17.6)	28 (12.7)	116 (52.5)	34 (15.4)

**Table 7 (a) continued. Frequency and percentage of responses to attitude questions by health staff (SA = Strongly Agree, A = Agree, UD = Undecided, D = Disagree, SD = Strongly Disagree).**

13	I think incineration would be the best option for the treatment of waste in JDWNRH, if approved by NEC.	63 (28.5)	92 (41.6)	42 (19.0)	20 (9.0)	4 (1.8)
14*	Hospital waste disposal is the responsibility of the city corporation (municipality).	12 (5.4)	28 (12.7)	40 (18.1)	97 (43.9)	44 (19.9)
15*	I have enough knowledge on hospital waste management but there is no time to practice it due to shortage of staff.	12 (5.4)	79 (35.7)	23 (10.4)	83 (37.6)	24 (10.9)

\*Negative statements

**Table 7 (b). Frequency and percentage of responses to attitude questions by waste handlers**

No.	Statement	Frequency (Percentage)				
		SA n (%)	A n (%)	UD n (%)	D n (%)	SD n (%)
1.	I have a crucial role in the management of hospital waste.	13 (35.1)	20 (54.1)	2 (5.4)	2 (5.4)	0 (0)
2.	Segregation is always the responsibility of waste producer.	25 (67.6)	12 (32.4)	0 (0)	0 (0)	0 (0)
3.*	I am sure that segregation of hospital waste has nothing to do with the financial impact on hospital waste management.	2 (5.4)	3 (8.1)	3 (8.1)	29 (78.4)	0 (0)
4.	I don't feel good when I find somebody throwing hospital waste in the wrong bin.	29 (78.4)	7 (18.9)	0 (0)	1 (2.7)	0 (0)
5.*	It is not important to label the waste bags before collection; after all, they are going to be disposed off.	0 (0)	4 (10.8)	0 (0)	28 (75.7)	5 (13.5)
6.*	Collection of hospital waste can be done when the bins are full and not necessarily routinely to save time.	0 (0)	1 (2.7)	0 (0)	29 (78.4)	7 (18.9)

**Table 7 (b) continued. Frequency and percentage of responses to attitude questions by waste handlers**

7.*	It is safe to scavenge hospital waste in the storage room for an extra income.	0 (0)	0 (0)	0 (0)	15 (40.5)	22 (59.5)
8.*	I think hazardous and non hazardous waste must be collected and transported at the same time.	0 (0)	16 (43.2)	0 (0)	18 (48.6)	3 (8.1)
9.*	No need to wash the waste transportation trolleys since they will get dirty again.	0 (0)	2 (5.4)	0 (0)	25 (67.6)	10 (27.0)
10.*	Having a separate route for hospital waste transportation within the hospital is unnecessary and useless.	1 (2.7)	1 (2.7)	0 (0)	30 (81.1)	5 (13.5)
11.	I think incineration would be the best option for the treatment of waste in JDWNRH, if approved by NEC.	15 (40.5)	8 (21.6)	2 (5.4)	9 (24.3)	3 (8.1)
12.*	Hospital waste disposal is the responsibility of the city corporation (municipality).	2 (5.4)	9 (24.3)	4 (10.8)	19 (51.4)	3 (8.1)

\*Negative statements

The obtained attitude scores were then converted in terms of positive, neutral and negative attitude as per Kaliyaperumal (2004). The scores on attitude for the health staff ranged from 14 – 30 and a mean of  $23.62 \pm 3.177$  was used to classify the health staff into three categories (Srisaard, 1992; Suchat, 1997). For waste handlers, the score ranged from 8 – 12 and with a mean of  $10.19 \pm 1.288$  they are classified into negative, neutral and positive attitude. **Table 8** displays the frequency and percentage of attitude level of both health staff and waste handlers. It is found that the majority of both health staff and waste handlers accounted for neutral attitude followed by positive attitude and the least were among the negative attitude.

**Table 8. Level of attitude among health staff and waste handlers**

<b>Level of attitude</b>	<b>Score</b>	<b>Frequency (%)</b>
<b>Health staff (n = 221)</b>		
Positive attitude	26 – 30	36 (16.3)
Neutral attitude	21 – 25	150 (67.9)
Negative attitude	14 – 20	35 (15.8)
<b>Waste handlers (n = 37)</b>		
Positive attitude	11 – 12	13 (35.1)
Neutral attitude	10	15 (40.5)
Negative attitude	8 – 9	9 (24.3)

#### **4.4. Practices on hospital waste management**

The questions on practices for the health staff and waste handlers were slightly different depending on the nature of their work. With 17 for health staff and 15 for waste handlers, the questions consisted of both positive and negative statements. For the right practice the respondent was given a score of 1 and for wrong practice 0. The distribution of frequency and percentage on each question on practices for health staff and waste handlers are shown in **Table 9 (a)** and **Table 9 (b)** respectively.

**Table 9 (a). Frequency and Percentage of health staff for practice questions (n = 221)**

<b>No.</b>	<b>Statement</b>	<b>Yes n (%)</b>	<b>No n (%)</b>
1.*	When I mistakenly throw infected waste into the general waste bin, I pick them up so the general waste remains uninfected.	161 (72.9)	60(27.1)
2.	I always look for the right bin to throw the hospital waste.	218 (98.6)	3 (1.4)



**Table 9 (a) continued. Frequency and Percentage of health staff for practice questions (n = 221)**

No.	Statement	Yes n (%)	No n (%)
3.*	In emergencies I break the injection ampoule over the general waste bin but am very careful that pieces are not on the floor.	106 (48.0)	115(52.0)
4.*	When I am busy I cannot always practice waste segregation.	81(81.9)	40 (18.1)
5.	Small amounts of chemical or pharmaceutical waste are collected together with infectious waste.	100 (45.2)	121 (54.8)
6.	I always collect sharps together, regardless of whether or not they are contaminated.	183 (82.8)	38 (17.2)
7.*	Hospital waste bags/bins are never labeled before they are collected and transported to the storage room.	147 (66.5)	74 (33.5)
8.	Waste bags are always checked for tears or punctures before transporting.	183 (82.8)	38 (17.2)
9.	Highly infectious hospital waste are always sterilized/ treated immediately by autoclaving.	168 (76.0)	53 (24.0)
10.	Autoclave for hospital waste in JDWNRH is performed by skilled personnel.	160 (72.4)	61 (27.6)
11.*	I sometimes recap the needles after use before throwing.	94 (42.5)	127 (57.5)
12.*	Most often the hazardous liquid waste from the hospital is not treated before disposal into the drainage system.	217 (98.2)	4 (1.8)
13.	I always use gloves to protect myself from hazardous hospital waste.	135 (61.1)	86 (38.9)
14.	I always use mask to protect myself from hazardous hospital waste.	210 (95.0)	11 (5.0)
15.	I always use aprons to protect myself from hazardous hospital waste.	201 (91.0)	20 (9.0)
16.	I always use gumboots to protect myself from hazardous hospital waste.	167 (75.6)	54 (24.4)
17.	I make sure I wash my hands every time after handling hospital waste.	219 (99.1)	2 (0.9)

\*Negative statement

**Table 9 (b). Frequency and Percentage of waste handlers for practice questions****(n = 37)**

No.	Statement	Yes n (%)	No n (%)
1.	I always wear gloves while handling hospital waste.	37 (100)	0 (0)
2.	I wear mask while handling hospital waste.	34 (91.9)	3 (8.1)
3.	I wear apron while handling hospital waste.	30 (81.1)	7 (18.9)
4.	I wear gum boots while handling hospital waste.	33 (89.2)	4 (10.8)
5.	Waste bags are collected only after labeling them properly.	3 (8.1)	34 (91.9)
6.	Waste bags are always checked for tears or punctures before transporting.	35 (94.6)	2 (5.4)
7.*	Hospital waste bags are dragged during transportation.	0 (0)	37 (100)
8.*	When the waste is small amount I mix the general and hazardous waste together for transportation because it is much convenient.	2 (5.4)	35 (94.6)
9.*	Hospital waste in JDWNRH is stored for not more than two days in summer.	16 (43.2)	21 (56.8)
10.	Autoclave for hospital waste in JDWNRH is performed by skilled personnel.	31 (83.8)	6 (16.2)
11.	Highly infectious hospital waste are always sterilized/ treated immediately by autoclaving.	30 (81.1)	7 (18.9)
12.*	Waste transportation trolleys are not washed daily.	13 (35.1)	24 (64.9)
13.	Human organs, placenta and dead fetus are thrown in the deep burial pit within the hospital premises.	37 (100)	0 (0)
14.*	Most often the hazardous liquid waste from the hospital is not treated before disposal into the drainage system.	31 (83.8)	6 (16.2)
15.	I wash my hands thoroughly after handling hospital waste.	37 (100)	0 (0)

\*Negative statement

The obtained scores were then converted in terms of score levels and is classified as good or poor practices. The scores for the health staff ranged between 6 – 17 and a mean of  $12.67 \pm 2.143$  classified them into two categories. Similarly, for the waste handlers, the scores for practices ranged from 7 – 13 and with a mean of  $9.92 \pm 1.211$ , they

are classified into poor and good practices. **Table 10** displays the frequency and percentage on the level of practices on hospital waste management. While 60.2% of health staff performed good practices 39.8% were found to perform poor practices on hospital waste management. Similarly majority of waste handlers (62.2%) were performing good practices 37.8% performed poorly.

**Table 10. Level of practices among health staff and waste handlers**

Level of Practice	Score	Frequency (%)
<b>Health Staff (n = 221)</b>		
Good Practice	13 – 17	133 (60.2)
Poor Practice	6 – 12	88 (39.8)
<b>Waste handlers (n = 37)</b>		
Good Practice	10 – 13	23 (62.2)
Poor Practice	7 – 9	14 (37.8)

#### 4.5. Enabling Factors on hospital waste management

**Table 11 (a)** and **Table 11 (b)** presents the frequency and percentage of enabling factors on hospital waste management for health staff and waste handlers respectively.

**Table 11(a). Frequency and percentage for questions on enabling factors for health staff (n = 221)**

No.	Question	Yes (%)	No (%)
1.	Do you have the Guideline for Infection Control and Healthcare Waste Management in Health facilities in your work place?	145 (65.6)	76 (34.4)
1.	If yes, how often do you read it?		
	Once a week	17 (11.7)	
	Once a month	38 (26.2)	
	Once in six months	37 (25.5)	
	Once a year	38 (26.2)	
	Never read	15 (10.3)	

**Table 11(a) *continued*. Frequency and percentage for questions on enabling factors for health staff (n = 221)**

No.	Question	Yes (%)	No (%)
2.	How useful is the guideline if you have read it?		
	Very useful	75 (51.7)	
	Useful	53 (36.6)	
	Not sure	1 (0.7)	
	Not very useful	1 (0.7)	
	Not useful at all	15 (10.3)	
3.	Have you attended training on waste management in the last five years?	91 (41.2)	130 (58.8)
4.	How many times?		
	1 - 2 times	78 (85.7)	
	3 – 4 times	9 (9.9)	
	More than 4 times	4 (4.4)	
5.	Do you know the policy for hospital waste management?	142 (64.3)	79 (35.7)
6.	Are there adequate general waste bins in your work place?	210 (95.0)	11 (5.0)
7.	Are there adequate infectious waste bins?	208 (94.1)	13 (5.9)
8.	Are there adequate sharp waste bins?	208 (94.1)	13 (5.9)
9.	Are there adequate non infectious hazardous waste bins?	115 (52.0)	106 (48.0)
10.	Are there adequate food waste bins?	76 (34.4)	145 (65.6)
11.	Are there enough waste transportation trolleys with proper lids?	85 (38.5)	136 (61.5)
12.	Is there a separate lift or ramp designed for hospital waste transportation?	27 (12.2)	194 (87.8)
13.	Is there a waste management plan set up for you work place?	133 (60.2)	88 (39.8)
14.	Are there clearly defined procedures for waste management procedure in your work place?	132 (59.7)	89 (40.3)
15.	Is there supervision or monitoring system for waste management by the ICWM committee of JDWNRH?	171(77.4)	49 (22.2)*
16.	Are there adequate gloves for waste management in your work place?	219 (99.1)	2 (0.9)
17.	Are there adequate mask for waste management in your work place?	214 (96.8)	7 (3.2)
18.	Are there adequate aprons for waste management in your work place?	156 (70.6)	65 (29.4)
19.	Are there adequate gumboots for waste management in your work place?	74 (33.5)	147 (66.5)
20.	Is there a system of reporting any injury or illness due to hazardous hospital waste?	137 (62.0)	80 (36.2)**
21.	Do you think JDWNRH has an effective hospital waste disposal system with minimal harm to the humans and environment?	94 (42.5)	126 (57.0)*

\*1 data missing

\*\*4 data missing

**Table 11 (b). Frequency and percentage for questions on enabling factors for waste handlers (n = 37)**

No.	Question	Yes	No
		n (%)	n (%)
1.	Have you ever attended any kind of training, workshop or seminar for hospital waste management?	35 (94.6)	2 (5.4)
2.	If yes, how many times?		
	1 - 2 times	26 (74.2)	
	3 – 4 times	9 (25.7)	
3.	Are there adequate general waste bins in your work place?	37 (100)	0(0)
4.	Are there adequate infectious waste bins?	37 (100)	0(0)
5.	Are there adequate sharp waste bins?	37 (100)	0(0)
6.	Are there adequate non infectious hazardous waste bins in your work place?	27 (73.0)	10 (27.0)
7.	Are there adequate food waste bins in your work place?	31 (83.8)	6 (16.2)
8.	Are there enough waste transportation trolleys with proper covers and lids in your work place?	1 (2.7)	36 (97.3)
9.	Is there a separate lifts or ramps designed for transporting hospital waste in JDWNRH?	1 (2.7)	36 (97.3)
10.	Is there supervision or monitoring system for waste management by the ICHWM committee of JDWNRH?	36 (97.3)	1 (2.7)
11.	Are there adequate gloves available for hospital waste management?	35 (94.6)	2 (5.4)
12.	Are there adequate mask available for hospital waste management?	36 (97.3)	1 (2.7)
13.	Are there adequate aprons available for hospital waste management?	35 (94.6)	2 (5.4)
14.	Are there adequate gumboots for waste management in your workplace?	37 (100)	0 (0)
15.	Is there a system of reporting any injury or illness due to hazardous hospital waste?	37 (100)	0 (0)
16.	Do you think JDWNRH has an effective hospital waste disposal system with minimal harm to the humans and environment?	4 (10.8)	33(89.2)

#### 4.6. Injuries/Illnesses due to hospital waste

Table 12(a) and Table 12 (b) presents the frequency and percentage of health staff and waste handlers respectively, who were injured /ill due to hospital waste and its management within the last 12 months.

**Table 12 (a). Frequency and percentage on injury/ illness due to hospital waste among health staff (n = 221)**

No.	Question	Yes n (%)	No n (%)
1.	Did you get any kind of injury/illness due to hospital waste within the past 12 months?	95 (43.0)	126 (57.0)
2.	Injury/illness due to needle prick injury?	64 (67.4)	30 (31.6)
3.	Injury/illness due to glass injury?	29 (30.5)	65 (68.4)
4.	Exposure to radiation?	29 (30.5)	65 (68.4)
5.	Injury/illness due to hazardous chemical?	29 (30.5)	65 (68.4)
6.	Injury/illness due to any other hospital waste?	5 (5.3)	9 (93.7)
7.	How many times within the last 12 months?		
	1 – 2 times	53(55.8)	
	3 – 4 times	13 (13.7)	
	>4 times	28 (29.5)	
8.	How did you get the injury /illness?		
	Lack of knowledge	3 (3.2)	
	Lack of PPE	31 (30.5)	
	Negligence	21 (22.1)	
	Accidental	38 (40.0)	
	Others	3 (3.2)	
9.	Did you record or report the injury / illness anywhere?	31 (32.6)	190 (67.4)
10.	Are you immunized against Hepatitis B, as a health worker?	205 (92.8)	16 (7.2)

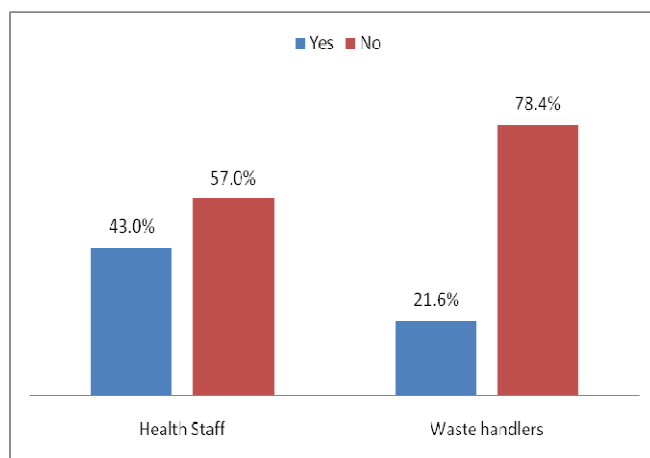
**Table 12 (b). Frequency and percentage on injury/ illness due to hospital waste among waste handlers (n = 37)**

No.	Question	Yes n (%)	No n (%)
1.	Did you get any kind of injury/illness due to hospital waste within the past 12 months?	8 (21.6)	29 (78.4)
2.	Injury/illness due to needle prick injury?	6 (75.0)	2 (25.0)
3.	Injury/illness due to glass injury?	1 (12.5)	7 (87.5)
4.	Exposure to radiation?	1 (12.5)	7 (87.5)
5.	Injury/illness due to hazardous chemical?	1 (12.5)	7 (87.5)
6.	Injury/illness due to any other hospital waste?	0(0)	8 (100)
7.	How many times within the last 12 months?		
	1 – 2 times	7(87.5)	
	3 – 4 times	1 (12.5)	

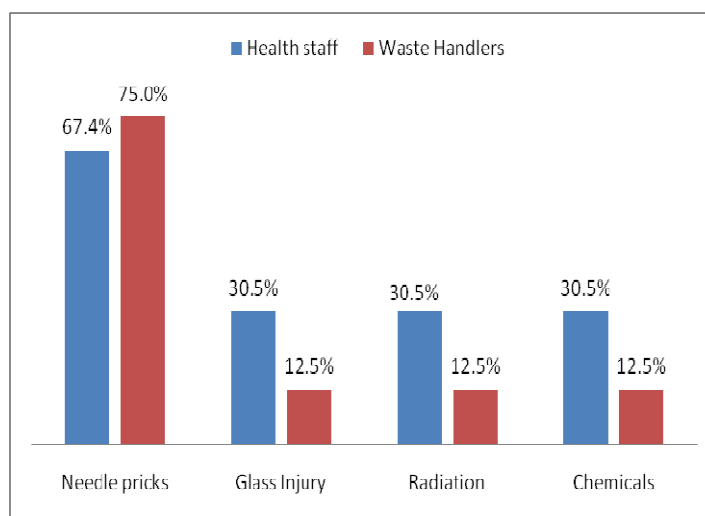
**Table 12 (b) continued. Frequency and percentage on injury/ illness due to hospital waste among waste handlers (n = 37)**

No.	Question	Yes n(%)	No n(%)
8.	How did you get the injury /illness?		
	Lack of knowledge	2 (25.0)	
	Lack of PPE	2 (25.0)	
	Negligence	1 (12.5)	
	Accidental	1 (12.5)	
	Others	2 (25.0)	
9.	Did you record or report the injury / illness anywhere?	0 (0)	8 (100)
10.	Are you immunized against Hepatitis B as a health worker?	35 (94.6)	2 (5.4)

**Figure 7** demonstrates the exposure to hospital waste and its management among the health staff and waste handlers in JDWNRH. 43.0% of health staff and 21.6% of waste handlers were exposed to one or the other kind of injury/illness within the last 12 months. **Figure 8** shows exposure to specific waste among the health staff and waste handlers in JDWNRH within the last 12 months. Among those who were exposed, 67.4% of health staff and 75.0% of waste handlers encountered needle pricks and 30.5% each of health and 12.5% each of waste handlers experienced glass injury, radiation and exposure to chemical waste.



**Figure 7.** Exposure to hospital waste among the health staff and waste handlers.



**Figure 8.** Exposure to specific waste among the health staff and waste handlers

## Part 2: Inferential Findings

Part 2 presents the inferential analysis of the study and includes the following results:

- Association between socio-demographic characteristics and knowledge.
- Association between socio-demographic characteristics and attitude.
- Association between socio-demographic characteristics and practices.
- Association between the level of knowledge and attitude.
- Correlation between knowledge and attitude.
- Association between knowledge and practices.
- Correlation between knowledge and practices.
- Association between the attitude and practices.
- Correlation between attitude and practices.
- Association between enabling factors and practices



#### 4.7. Association between socio-demographic characteristics and the level of knowledge

The association between socio-demographic characteristics and the level of knowledge on hospital waste management among the health staff and waste handlers was analyzed using Chi Square test with the significance level of  $\leq 0.05$ . It was found that among the health staff, all the five socio-demographic characteristics including age, gender, education level, present occupation and number of years in present occupation were significantly associated with the level of knowledge on hospital waste management with  $p$ -value  $< 0.05$ , as presented in **Table 13**. Among the waste handlers, none of the socio-demographic characteristics including age ( $p$ -value = 0.118), gender ( $p$ -value = 0.294), education level ( $p$ -value = 0.181), present occupation ( $p$ -value = 0.165) and number of years in present occupation ( $p$ -value = 0.505) were statistically significant to the level of knowledge on hospital waste management.

**Table 13. Association between socio-demographic characteristics and the level of knowledge for health staff (n = 221)**

Socio-demographic Characteristics	Count	Knowledge n (%)			$\chi^2$	$p$ -value (95% CI)
		Low	Moderate	High		
<i>Age</i>	20- 30 yrs.	110	29 (26.4)	68 (61.8)	13 (11.8)	20775 (0.001-0.003)
	31- 40 yrs.	76	8 (10.5)	59 (77.6)	9 (11.8)	
	41- 50 yrs.	26	1 (3.8)	21 (80.8)	4 (15.4)	
	>50 yrs.	9	0 (0)	5 (55.6)	4 (44.4)	
<i>Gender</i>	Female	89	13 (14.6)	57 (64.0)	19 (21.3)	7.792 (0.018-0.023)
	Male	132	25 (18.9)	96 (72.7)	11 (8.3)	
<i>Education level</i>	Certificate	107	22(20.6)	80 (74.8)	5 (4.7)	24.881 (0.00-0.00)
	Diploma	63	11 (17.5)	44 (69.8)	8(12.7)	
	Bachelors, Masters and above	51	5 (9.8)	29 (56.9)	17 (33.3)	

**Table 13 continued. Association between socio-demographic characteristics and the level of knowledge for health staff (n = 221)**

Socio-demographic Characteristics		Count	Knowledge n (%)			$\chi^2$	p-value (95% CI)
			Low	Moderate	High		
<i>Present Occupation</i>	Doctors	24	0 (0)	11 (45.8)	13 (54.2)	41.403 (0.00-0.00)	0.000
	Nurses	97	15 (15.5)	73 (75.3)	9 (9.3)		
	Paramedics	100	23(23.0)	69 (69.0)	8 (8.0)		
<i>No. of yrs. in present occupation</i>	0-10yrs.	133	18 (13.5)	97 (72.9)	18 (13.5)	15.094 (0.026-032)	0.020
	11- 20 yrs.	60	12 (20.0)	37 (61.7)	11 (18.3)		
	21- 30 yrs	26	6 (23.1)	19 (73.1)	1 (3.8)		
	>30 yrs.	2	2 (100.0)	0 (0)	0 (0)		

#### **4.8. Association between the socio-demographic characteristics and the level of attitude**

Among the health staff, only age was found to have significant association with the level of attitude as displayed in **Table 14**. Gender ( $p$ -value = 0.093), education level ( $p$ -value = 0.083), present occupation ( $p$ -value = 0.337) and number of years in the present occupation ( $p$ -value = 0.813) were not significantly associated with the level of attitude. Similarly, for the waste handlers, none of the socio-demographic characteristics, age ( $p$ -value = 0.357), gender ( $p$ -value = 0.420), education level ( $p$ -value = 0.191), occupation ( $p$ -value = 0.105) and number of years in the present occupation ( $p$ -value = 0.947) are statistically significant to their level of attitude on hospital waste management.

**Table 14. Association between socio-demographic characteristics and the level of attitude**

Socio-demographic Characteristics	Count	Attitude n (%)			$\chi^2$	p-value (95% CI)
		Negative	Neutral	Positive		
<b>Health staff (n = 221)</b>						
Age	20 – 30 yrs	110	26 (23.6)	70 (63.6)	14 (12.7)	12.648 0.049 (0.045-0.053)
	31 – 40 yrs	76	5 (6.6)	57 (75.0)	14(18.4)	
	41 – 50 yrs	26	3 (11.5)	18 (69.2)	5(19.2)	
	>50 yrs	9	1 (11.1)	5 (55.6)	3 (33.3)	

#### **4.9. Association between the socio-demographic characteristics and the level of practices**

For health staff, age and number of years in the present occupation were found to be significantly associated with the level of practices on hospital waste management as shown in **Table 15**. Rest of the socio-demographic characteristics like gender ( $p$ -value 0.318), level of education ( $p$ -value = 0.282) and present occupation ( $p$ -value = 0.289) did not show significant association with the level of practices. Similarly, for the waste handlers, only age was significantly associated with the level of practices as also shown in **Table 15**. There was no significant association between gender ( $p$ -value = 0.420), level of education ( $p$ -value = 0.215), present occupation ( $p$ -value = 0.108) and number of years in the present occupation ( $p$ -value = 0.172) with the level of practices for the waste handlers.

**Table 15. Association between the socio-demographic characteristics and the level of practices**

Socio-demographic Characteristics		Count	Practice n (%)		$\chi^2$	p-value (95% CI)
			Poor	Good		
<b>Health staff (n = 221)</b>						
Age	20 - 30 yrs	110	65 (59.1)	45 (40.9)	36.446	0.000 (0.00-0.00)
	31 – 40 yrs	76	19 (25.0)	57 (75.0)		
	41 – 50 yrs	26	4 (15.4)	22 (84.6)		
	>50 yrs	9	0 (0)	9 (100)		
Service Years	0 - 10 yrs	133	47 (35.3)	86 (64.7)	9.310	0.025 (0.014-0.019)
	11 – 20 yrs	60	23 (38.3)	37 (61.7)		
	21 – 30 yrs	26	16 (61.5)	10 (38.5)		
	>30 yrs	2	2 (100)	0 (0)		
<b>Waste handlers (n = 37)</b>						
Age	20 – 30 yrs	14	8 (57.1)	6 (42.9)	5.917	0.052 (0.064-0.074)
	31 – 40 yrs	17	6 (35.3)	11 (64.7)		
	41 – 50 yrs	6	0 (0)	6 (100)		

#### 4.10. Association between the level of knowledge and attitude

The level of knowledge is found to have a significant association ( $p$ -value = 0.045, health staff,  $p$ -value = 0.008, waste handlers) with the level of attitude on hospital waste management, as shown in **Table 16**.

**Table 16. Association between the level of knowledge and attitude**

Level of knowledge	Count	Attitude n (%)			$\chi^2$	p-value (95% CI)
		Negative	Neutral	Positive		
<b>Health staff (n = 221)</b>						
Low knowledge	38	12 (31.6)	22 (57.9)	4 (10.5)	9.749	0.045 (0.040- 0.048)
Moderate knowledge	153	20 (13.1)	108 (70.6)	25 (16.3)		
High knowledge	30	3 (10.0)	20 (66.7)	7 (23.3)		

**Table 16 continued. Association between the level of knowledge and attitude**

Level of knowledge	Count	Attitude n (%)			$\chi^2$	p-value (95% CI)
		Negative	Neutral	Positive		
<b>Waste handlers (n = 37)</b>						
Low knowledge	2	1 (50.0)	1 (50.0)	0 (0)	13.684	0.008 (0.002-0.005)
Moderate knowledge	16	8 (50)	5 (31.2)	3 (18.8)		
High knowledge	19	0 (0)	9 (47.4)	10 (52.6)		

#### 4.11. Correlation between knowledge and attitude

The correlation between the knowledge and attitude levels were analyzed using the spearman correlation because the spearman correlation is appropriate for both normally and non-normally distributed data. **Table 17** shows that there was weak (0.172) positive correlation ( $p$ -value =0.010) between the level of knowledge and attitude for the health staff and moderate (0.552) positive correlation ( $p$ -value = <0.001) for the waste handlers too.

**Table 17. Correlation between knowledge and attitude**

			Knowledge	Attitude	p-value
<b>Health staff (n = 221)</b>					
Spearman	Knowledge	Correlation	1.000	0.174*	0.009
Correlation		Coefficient			
<b>Waste handlers (n = 37)</b>					
Spearman	Knowledge	Correlation	1.000	0.552**	0.000
Correlation		Coefficient			

\*Correlation is significant at the 0.01 level (2 tailed)

\*\*Correlation is significant at the 0.01 level (2-tailed).

#### 4.12. Association between the level of knowledge and practices

The level of knowledge among the health staff is found to have a significant association ( $p$ -value = <0.001) with the level of practices on hospital waste management as shown in **Table 18**. However, among the waste handlers, there was no significant

association ( $p$ -value  $n= 0.481$ ) between the level of knowledge and practices on hospital waste management.

**Table 18. Association between the level of knowledge and practices**

Level of knowledge	Count	Practice n (%)		$\chi^2$	$p$ -value (95% CI)
		Poor	Good		
<b>Health staff (n = 221)</b>					
Low knowledge	38	24 (63.2)	14 (36.8)	13.788	0.001 (0.000-0.001)
Moderate knowledge	153	58 (37.9)	95 (62.1)		
High knowledge	30	6 (20.0)	24 (80.0)		

#### 4.13. Correlation between knowledge and practices

There was a weak (0.206) positive correlation ( $p$ -value =  $<0.001$ ) between the level of knowledge and practices for the health staff, as shown in **Table 19**, but not for the waste handlers ( $p$ -value =0.904).

**Table 19. Correlation between knowledge and practices**

			Knowledge	Practice	$p$ -value
<b>Health staff (n = 221)</b>					
Spearman	Knowledge	Correlation	1.000	0.247*	0.000
Correlation		Coefficient			

\*Correlation is significant at the 0.01 level (2-tailed).

#### 4.14. Association between the attitude and practices

Among the health staff there was a significant association between the attitude level and the level of practices ( $p$ -value = 0.002) as presented in **Table 20**. For the waste handlers there was no significant association between the attitude level and the level of practices on hospital waste management ( $p$ -value = 0.290).

**Table 20. Association between the level of attitude and the practices**

Attitude level	Count	Practice n (%)		$\chi^2$	p-value (95% CI)
		Poor	Good		
Negative attitude	35	20 (57.1)	15 (42.9)	12.580	0.002 (0.002-0.004)
Neutral attitude	150	62 (41.3)	88 (58.7)		
Positive attitude	36	6 (16.7)	30 (83.3)		

#### 4.15. Correlation between attitude and practices

There was also weak (0.189) positive correlation ( $p$ -value = 0.005) between the level of attitude and practices among the health staff, as shown in **Table 21**, however, not for the waste handlers ( $p$ -value =0.125).

**Table 21. Correlation between attitude and practices**

			Attitude	Practice	p-value
<b>Health staff (n = 221)</b>					
Spearman	Attitude	Correlation	1.000	0.235*	0.000
		Coefficient			

\*Correlation is significant at the 0.01 level (2-tailed).

#### 4.16. Association between enabling factors and practices

As per the conceptual framework, 8 out of 22 questions on enabling factors were considered to see the association with the level of practices and is presented in **Table 22**. Adequate supply of aprons ( $p$ -value = 0.036) and injury reporting system ( $p$ -value = 0.015) were significantly associated with the level of practices among the health staff. None of the enabling factors were statistically significant ( $p$ -value >0.05) with the practices for the waste handlers.

**Table 22. Association between enabling factors and the level of practices among health staff**

Enabling factors		Count	Practice n (%)		$\chi^2$	<i>p</i> -value**
			Poor	Good		
Guideline	No	76	33 (43.4)	43 (56.6)	0.627	0.471
	Yes	145	55 (37.9)	90 (62.1)		
Training	No	130	58 (44.6)	72 (55.4)	3.031	0.095
	Yes	91	30 (33.0)	61 (67.0)		
Policy	No	78	36 (46.2)	42 (53.8)	1.797	0.197
	Yes	141	52 (36.9)	89 (63.1)		
Non infectious hazardous waste bin	No	106	48 (45.3)	58 (54.7)	2.538	0.131
	Yes	115	40 (34.8)	75 (65.2)		
Supervision/ monitoring	No	49	24 (49.0)	25 (51.0)	2.347	0.138
	Yes	171	63 (36.8)	108 (63.2)		
Aprons	No	65	33 (50.8)	32 (49.2)	4.608	0.036*
	Yes	156	55 (35.3)	101 (64.7)		
Gumboots	No	147	57 (38.8)	90 (61.2)	0.199	0.665
	Yes	74	31 (41.9)	43 (58.1)		
Injury reporting system	No	80	41 (51.2)	39 (48.8)	6.015	0.015*
	Yes	137	47 (34.3)	90 (65.7)		

\*Statistically significant with *p* value  $\leq 0.05$

\*\* All test were associated with Fisher's Exact test

### Part 3: Qualitative Findings

The last part of the analysis presents the observations from the walk-through survey and responses during the in-depth interview.

#### 4.17. Walk-through survey

A walk-through survey was mainly carried out to observe the steps of waste management using the checklist that was designed and to observe the types of waste generated in various units and departments in JDWNRH. For segregation, collection and



transportation observations were made in 12 different units and departments identified for the study, including medical ward, surgical ward, pediatric ward, maternity ward, birthing center, emergency ward and other departments including lab, radiology, dialysis, operation theatre and minor operation theatre in the OPD. For storage, treatment and disposal the locations were all the same for all waste generated from the hospital.

#### 4.17.1. Segregation of hospital waste

##### *4.17.1. a. Categories of waste bin and their labeling*

It was observed that in most of the units where the walk-through survey was conducted there were colour coded waste bins; red for infectious, green for general and yellow/white cardboard boxes for sharps with adequate labeling on the waste bins, as shown in **Figure 9**. Accordingly, red plastics were used for infectious and green plastics for general waste bins. However, it was also observed that few units resorted in using different coloured plastics as the desired colour plastics ran out of stocks, as shown in **Figure 10**.



**Figure 9. Labeling of the waste bin**





**Figure 11. Inadequate waste segregation in some units of JDWNRH**

#### **4.17.2. Collection of hospital waste**

The waste from all the units was usually collected twice a day (morning and evening) except when there was an acute shortage of waste handlers it was done once a day. General waste consisting of papers, plastics, cardboards, food covers and wrapping materials were the most commonly generated waste from all the units. It was noticed that during the collection time the waste bags were sealed with how much ever the waste was in the bag either more than  $\frac{3}{4}$  th or less. As such, sealing the waste bags when  $\frac{3}{4}$  th full, was not strictly adhered. In some of the units sharps were collected until the box was full despite the fact that it must be collected when  $\frac{3}{4}$  th full and one of the units even had the sharp waste box full and widely opened as shown in **Figure 12**. Another unit was found to collect its needles and syringes separately in a wide card board box, as also shown in Figure 12, to be destroyed later when the collection was adequate with the help of needle destroyer.

Corresponding to the quantitative data none of the units labeled their waste bags prior to collection. On the use of PPE, since the waste is collected by the waste handlers, observation was focused on them and was noticed that use of PPE was not as strictly

practiced unlike their responses in the practice questionnaires. Although, few of them used gloves, none of the waste handlers were found to wear mask, apron and gumboots during the study period (See **Figure 13**).



**Figure 12. Unsafe practices in collecting sharps**



**Figure 13. Waste handlers without adequate PPE during collection of hospital waste**

#### **4.17.3. Transportation of hospital waste**

Waste trolleys without cover were used for transporting hospital waste from various units within the hospital. A truck then transported the waste to the storage area. During transportation the waste bags were properly sealed. However, after the waste was transported waste trolleys were never washed during the observation period. JDWNRH did not have a separate route designed for its waste transportation and was found that all categories of waste were transported via the common route. In regard to use of PPE, except few who used gloves the waste handlers did not use mask, apron and gumboots during transportation of waste as well.

#### **4.17.4. Storage of hospital waste**

All categories of hospital waste from JDWNRH except for the pathological waste were supposed to be stored in the waste bin provided by the TCC. The waste bin was located in an open area in front of the waste autoclave unit. The waste bags comprising of both red (after autoclave) and green were dumped there and the TCC trucks collected them daily for disposal in the landfill (memelakha). There was no fencing for the storage area but has a hospital boundary wall at the posterior side as shown in **Figure 14**. It was actually discovered that the waste bin was supposed to be inside the fenced compound in front of the waste autoclave unit. However, the researcher was told that due to inconveniences faced for the waste picker truck to turn the waste bin was kept outside. The waste bags were randomly found both inside and outside the waste bins.

#### **4.17.5. Treatment of hospital waste**

It was known that the treatment of infectious hospital waste in JDWNRH was done by a steam autoclave. All those waste that came in red plastics and the sharp waste boxes were identified as waste for autoclave. The hospital just has a single autoclave machine with one operator who was trained on the job. The researcher found that when the single machine goes out of order the waste bags and boxes are mounded until it is

maintained and when the lone operator was away arrangements were made to perform the task from the hospital maintenance unit. During the walk-through survey, it was observed that the operator did not wear any of the PPEs while autoclaving infectious hospital wastes, as shown below in **Figure 15**.



**Figure 14. Waste storage area of JDWNRH**



**Figure 15. Autoclaving the infectious hospital waste in JDWNRH**

#### 4.17.6. Disposal of hospital waste

Except for pathological waste (body parts, placenta, etc.), it was noted that the ultimate disposal of all category of waste from JDWNRH, including sharps, was land filling at *Memelakha*, the only municipal land fill in the country, as mentioned in Chapter 1. Every day two TCC trucks carried hospital waste from JDWNRH to the land fill. At the land fill the red and green plastics and the sharp waste boxes were prominently visible and even the needles, syringes and other infectious waste were randomly found, as shown in **Figure 16**. Besides laborers who were working for the maintenance work, the landfill was crowded with human and animal scavengers, as seen in **Figure 17**. Except for one or two who wore some kind of gloves, none of the waste pickers used proper PPEs to protect themselves from exposure to various kinds of waste there (see Figure 17).

The disposal of the pathological waste including human organs and placenta was in the deep burial pit within the hospital campus. The pit was found to be a nuisance within the hospital and the nearby area including a school due to terrible smell. The walk-through survey also discovered that the liquid hazardous waste from JDWNRH, like body fluids, and other chemicals and reagents was straightaway flushed down the sewerage system without any treatment.



**Figure 16. Hospital wastes in the land fill (*Memelakha*).**



**Figure 17. Scavengers at Memelakha.**

#### **4.17.7. Types of waste in JDWNRH**

During the walk-through survey in JDWNRH it was observed that the waste generated were quite similar among the units except few differed depending on their specialty. **Appendix A** shows in detail the various categories of waste generated from each unit in JDWNRH. General waste in all the units basically consisted of papers, plastics, card boxes and some cloth pieces. Infectious waste like syringe, gauze, cotton, bandages, IV sets and IV canulas were generated from all units, whereas, others like used catheters and drainage tubes were found in some units like surgical ward, operation theatre and maternity ward. The common sharp wastes in almost every unit were needles, blades and glass pieces from broken injection ampoules. Cytotoxic waste like chemotherapy drugs and their vials were available in many of the units except few like birthing center, operation theatre, neonatal ward, laboratory, dialysis unit, etc. Disinfectant like bleaching solution was a common chemical waste but chemical containers, laboratory reagents and film developer were found in the specific departments. Pathological waste like ascitis fluid, pleural fluid, cerebro spinal fluid was seen in the laboratory.



#### **4.18. In-depth interview**

This research also included an in-depth interview with the administrative officials of JDWNRH. The main objective of in-depth interview was to explore their perception, concerns and challenges on the present waste management system in JDWNRH. Although the Medical Director of the hospital could not be interviewed, other four management officials including the Medical Superintendent, Chief Administrative Officer, Nursing Superintendent, Deputy Nursing Superintendent who is also the focal person for waste management in JDWNRH participated for the study. Ten semi structured interview questionnaires were used as a guideline and the interview was recorded. The findings on the in-depth interview are compiled as below:

##### ***1. What do you have to say about the present system of waste management in JDWNRH?***

- Three respondents stated that they feel the waste in JDWNRH is adequately managed.
- One of the officials said that the steps of waste management like segregation, collection, transportation and treatment are performed as per the guideline.
- Other mentioned that although the guideline was emphasized to be followed there was a lack of adherence.
- One of them said *“since there are no complaints against the waste management of JDWNRH I feel we are in the right direction”*.

##### ***2. What are your concerns on the present waste management system of JDWNRH?***

- One of the administrators said, *“I am concerned of whether the segregation, transportation and disposal of waste are carried out properly”*.

- *“Since at the moment the sharp waste is disposed at the municipal landfill after being autoclaved I am concerned that there will be needle prick injuries at the landfill”* said another.
- *“To identify a space within the hospital to dispose sharp waste is a concern for me as an administrator”* was one of the interviewee’s responses.
- Another stated, *“I am concerned on the health risk imposed to the patients and the staff themselves for not adequately adhering to the guidelines on hospital waste management”*.

**3. *Do you think that there is a requirement to have a separate legislation for managing hospital waste?***

- All the participants felt that a separate legislation is required.
- However, they mentioned that drafting of a regulation for waste management for the country along with NEC, TCC and other stake holders is underway, and discovered that one of the participants (focal person for waste management in JDWNRH) is an active member.
- The focal person mentioned that although the new regulation was not a separate document for the hospital waste, it is designed for various sectors like agriculture, animal husbandry, etc. and there will be a chapter for the individual sector where management of infectious waste and other non infectious hazardous waste is thoroughly discussed.
- *“Once the regulation is finalized and comes into force I feel that it will be much more convenient for us to manage our waste in a better way”*, said one of the participants.

**4. *At present there is no appropriate treatment of hazardous liquid waste in JDWNRH. Do you have idea why was this not envisaged during the planning***

***and construction stage? Is there any future plan to develop a proper wastewater treatment plant for hazardous liquid waste generated from JDWNRH?***

- None of the participants were exactly aware why the treatment for hazardous liquid waste was not really envisaged during the planning and construction stage.
- However, one said *“may be during the planning phase the infection control and waste management program in the ministry had to intervene but were not informed”*.
- *“May be the designers for the hospital construction, who came from outside the country, were not aware and the relevant persons were not involved”* another participant said.
- However, two participants mentioned that the liquid hazardous waste like body fluids is decontaminated with bleaching solution and chemicals are diluted prior to disposal into the common sewerage system.
- All the participants were sure that a wastewater treatment plant for JDWNRH is not in the immediate plan at the moment although one or two of them felt its importance.

***5. The deep burial pit designed for pathological waste from JDWNRH is located amidst residences, public thoroughfare and a school. This pit seems to be a nuisance (foul smell) for public and the school. Is there any immediate plan to solve this problem?***

- All the participants agreed that the deep burial pit for the pathological waste has been a nuisance (foul smell) in the community.
- However, one of them said *“there is a wall constructed beside the pit so that people won’t get into the pit”*.
- All the responses were in line for identifying a site to relocate the pit and everybody mentioned that the budget for the new pit is already available.

- One of them said *“we should be able to construct a new burial pit within this financial period”*.

**6. *What is the system of training the health staff and the waste handlers of JDWNRH on hospital waste management? How often are they trained?***

- *“We don’t have a planned schedule for the training of health staff and waste handlers”* as said by one of the participants.
- Another said, *“We don’t get budget to train the staff annually”*.
- One of the participants told that *“initially the ICHWM program in the ministry used to organize such trainings and we use to refresh our staff and waste handlers from time to time”*.
- It was clear that the training activity was carried out by the focal person for waste management who was one of the participants.
- *“Whenever we conduct training we do it in batch wise and try to cover all categories of health workers including the doctors”* said the focal person.

**7. *What do you have to say regarding the supplies of materials required for hospital waste management?***

- *“Supplies of materials like waste bins and plastics for waste management has always been a problem for us due to lack of funds”* said the focal person for waste management.
- When one participant said *“it is all handled by the focal person”* others mentioned that getting colour- coded plastics on time had always been a problem which often resulted in using different coloured plastics.
- *“When the red plastics are out of stock many a times the green plastics are used instead of red for infectious waste but the staff and the waste handlers knows that this green plastic has to go for autoclave”*, as said by one of the interviewees.

**8. *How would you like to integrate with the Thimphu City Corporation (TCC) in managing the hospital waste in a better way?***

- One of the participants mentioned that, unlike in the past where the TCC used to collect hospital waste only once a week for disposal, today, things have improved to a great extent after much integration of efforts from both the hospital and the TCC.
- *“At present there are two vehicles daily from the city corporation to pick our waste from the hospital”* as stated by the focal person.
- One mentioned that since the waste from the hospital is ultimately managed by the TCC, they are doing it generously and the hospital makes sure that the infected waste are decontaminated prior to disposal.
- *“We are also working closely with the TCC and other organizations like NEC on the issue of hospital waste management and so have come up with the drafting of the new regulation which is underway in order to have our waste managed in a better way”* said one of the interviewees.

**9. *What are some of the challenges for waste management in JDWNRH at present?***

- The focal person for waste management said *“we are not sure on how to manage the cytotoxic vials and ampoules and also the containers of some chemicals since there is no incinerator and also how and where to dispose the huge amount of injection vials”*.
- One mentioned on the huge amount of waste that is generated daily from the hospital and the limited disposal options that are available.
- One of them also mentioned on the lack of good monitoring system on waste segregation. *“Monitoring is also poor in ensuring that the waste that goes from the hospital for disposal to land fill are properly decontaminated”* he said.
- Shortage of manpower was another challenge mentioned by two of them.

- Three of them mentioned that irregularities in supplies have always been a challenge.
- *“We also have problems with transportation of waste because we use the same vehicle that we use for other purposes”* as said by the focal person as well.
- One of them mentioned that they have a problem with the recyclable wastes.
- Identifying a place to finally dump the hospital waste safely was a challenge expressed by one respondent.

***10. Please mention any other comments or suggestions that I can incorporate in my study to make a difference in the hospital waste management in JDWNRH?***

- All the participants suggested that the findings of the study should be presented to all the staff and waste handlers so that everybody knows the situation of waste management in JDWNRH.
- One said *“I think it is very important for our staff to have adequate knowledge on waste management, so with your study findings we will be able to know how we can improve in providing training to our staff periodically for waste management”*.
- Another remarked *“may be after your study routine monitoring has to be done on the level of knowledge and their practices”*.
- Another participant mentioned that the present guideline for infection control and hospital waste management was developed long time ago and is time to revise it. *“So it would be good if you can contribute your findings during the next review of the guideline”* she said.

## **CHAPTER V**

### **DISCUSSION, CONCLUSION AND RECOMMENDATIONS**

#### **Part 1. Discussion**

This is a cross-sectional and mixed method study to explore the level of knowledge, attitude and practices among the health staff and waste handlers. It also looked into the steps of waste management practices in JDWNRH. Self-administered questionnaires were distributed to the health staff and face to face interview using the questionnaire was conducted for the waste handlers. As recommended by Dopfu (2004) in his study, the present study developed a separate questionnaire for the health staff and the waste handlers, as the job responsibilities differ among them. He also recommended for qualitative study to be conducted. Therefore, a walk-through survey to observe the steps of waste management (segregation, collection, transportation, treatment and disposal) using a checklist and an in-depth interview with the administrative officials to unfold their views, concerns and challenges on the present waste management system of the hospital, were included. Both quantitative and qualitative analysis was done for the study.

#### **5.1. Socio-demographic characteristics**

The majority of the health staff were in the younger age group of twenty to thirty years and the most common age was 24 years. More than one-third of the health staff in the study were males. Certificate holders were the maximum number of health staff in the study as it is the highest level of qualification awarded to the paramedics trained in the Royal Institute of Health Sciences (RIHS), the only training institute for the health workers in the country. Many of the nurses working in JDWNRH were also awarded Certificate Course in the past which has been discontinued today. Since there is no medical college in the country there are countable number of doctors in JDWNRH and so as in other hospitals of the country, as such doctors constitutes the least number of health

staff in the study. While the senior health staff had been working for 36 years the junior most was just there for a year. The majority were serving for the first ten years in the present occupation.

Similarly among the waste handlers, when the oldest was found to be 41 years old the youngest was just 21 years old. There were almost same number of males and females. When majority of waste handlers had primary education few of them (13.5%) attended middle or higher secondary schools, however, 29.7% of waste handlers were illiterate. At present, the minimum qualification required for a waste handler in Bhutan is at least Middle Secondary or Class X (HR Officer, JDWNRH, Personal Communication).

## **5.2. Knowledge on hospital waste management**

Knowledge refers to the understanding of a particular subject (KAP Studies for Water Resources Projects: online). 65.6% of the health staff in the study said that they have the guideline for waste management in their workplace and only 10.3% have never read it. However, only 50% of them defined hospital waste correctly. It is clearly stated in the guideline that only 10 – 25% of hospital waste is hazardous and the rest 75 -90% is same as any other domestic waste (Guideline for Infection Control and Health Care Waste Management in Health Facilities, 2006, p 64; WHO, 1999). The waste handlers, despite 30% being illiterate, almost 60% gave correct answer to hospital waste definition.

Only 16.3% of health staff, in the study, were aware that non infectious hazardous waste should not be thrown in the general waste bin, possibly because the waste management guideline do not emphasize on the management and disposal options for non infectious hazardous waste. Management of mercury spills was an important question concerning the knowledge on waste management, because the hospital still uses many of the instruments like BP apparatus, thermometers, etc. with mercury inside. However, 63.8% health staff and almost 95% of waste handlers did not know how to manage mercury spills. Perhaps, the limited knowledge among the respondents could be because



the waste management guideline does not specify on its management. It just mentions that mercury is potentially highly toxic and so should be treated specifically (Guideline for Infection Control and Health Care Waste Management in Health Facilities, 2006, p 65). As such the waste handlers may also have missed this important information during their trainings. Literature review on mercury management clarifies that spilled mercury from medical instruments like thermometers and BP instruments must be securely recovered and *must not* be disposed in the red bags and *never* be incinerated or autoclaved (Mercury Management: Home Care, Nursing Homes, and Mental Health Clinics, online).

More than 50% of health staff and almost 90% of waste handlers did not know that autoclaves are not recommended for pathological waste like body parts and placenta. This category of waste need not be autoclaved but disposed off either by incineration or securely buried (WHO, 1999). Autoclaves are not recommended for the treatment of pathological waste, due to the recognizability factor after treatment, and that pathological waste may contain low levels of radioactive material or cytotoxic compounds (Basura Medical Waste Resource, online).

Unlike in Bangladesh, where more than 80% of the respondents in the hospitals had poor knowledge on the characteristics of the hospital waste (Akter et al., 1999), majority of the respondents in the present study including the waste handlers possess moderate to high level of knowledge on hospital waste and its management.

### **5.3. Attitude on hospital waste management**

Attitude is described as feelings towards a particular subject, as well as any preconceived ideas that the participants may have towards it (KAP Studies for Water Resources Projects: online). 64% of health staff and 78% of waste handlers disagreed that proper segregation will have a financial impact on hospital waste management. Segregation of waste, which is the “essence of waste management”, as quoted by

Chandra (1999), is a crucial step in waste management which will separate waste into reusable and recyclable, whereby, reducing the volume of the actual waste to be disposed off resulting in reduced expenditure for its management. WHO (1999) clearly points out that appropriate handling, treatment, and disposal of waste by type reduces costs and does much to protect public health. The concept of 3Rs - *reduce, reuse and recycle*, are the best waste prevention practices that saves money (Waste reduction & recycling tips for hospitals, 2011: online).

It was also interesting to discover that more than 95% of both health staff and waste handlers “*did not feel good to see somebody throwing hospital waste in the wrong bin*”. However, observations during the walk-through survey discovered that only about 50% or even less actually cared to throw hospital waste in the right bin. The attitude for labeling the waste bags prior to collection was positive in more than 88% of the respondents, however, it was acknowledged by the waste handlers as well as observed during the walk-through survey that labeling the waste bags were not practiced at all.

#### **5.4. Practices on hospital waste management**

Practice has been defined as the ways in which the knowledge and attitudes are demonstrated through actions (KAP Studies for Water Resources Projects: online). The discussion for the practices is based on the steps of waste management that includes segregation, collection, transportation, storage, treatment and disposal.

##### **5.4.1. Segregation**

It was revealed that majority of the health staffs are still doubtful when it came to segregation of hospital waste because 72.9% of health staff picked the infected waste from the general waste bin after they have mistakenly thrown it so that the general waste remained uninfected. The infectious waste would have already contaminated the general waste and so the ideal option is to consider the general waste as contaminated and to autoclave it prior to disposal (WHO, 1999). Nearly half (48.0%) of the health staff in the

study broke the injection ampoules over the general waste bin being careful that the glass pieces did not fall on the floor but in the general waste bin. This practice was found to be unsafe and has to be stopped immediately. Interestingly, it was also found that more than 80% of the health staff in the study could not segregate the waste when they were busy. This justification may prove to be detrimental to the health of many individuals, including the hospital and municipal waste handlers and waste pickers.

Literature emphasizes that segregation of hospital waste at the source is critical, no matter what final treatment and disposal strategies are, in order to safeguard the occupational health of the health care workers, especially the waste handlers (Eleven Recommendations for Improving Health Care Waste Management, 1997). Segregation is even more important in the developing countries as the wastes are mostly disposed in the landfill (US EPA, 1992: online). As observed during the walk-through survey, due to the presence of all categories of waste from the capital city, *Memelakha* is an attraction for dogs, rodents, flies and human waste pickers who are susceptible to high risk of injuries and illnesses.

#### ***5.4.2. Collection***

More than half of the staff did not collect small amounts of chemical or pharmaceutical waste together with infectious waste. When large amount of chemical and pharmaceutical requires special disposal techniques small amount can be safely collected with the infectious waste (WHO, 1999). Labeling the waste bags is considered an important step to be initiated as it was discovered that very often due to irregular and limited supplies of colour coded plastics that green plastics were used instead of red for the infectious waste. A hospital official in a recent news paper, *Business Bhutan*, said “*sometimes we run out of red bags and have to use the green ones for bio-hazardous waste but we label it properly*”. However, it was just discovered during the walk-through survey that labeling the waste bags is yet to be materialized. WHO (1999) emphasizes that waste bags should not be removed unless they are labeled with the necessary

information like name of the unit, date, type of waste, treatment and disposal option. Therefore, the system of labeling the waste bags needs to be adopted in JDWNRH so that the huge amount of infectious waste reaching the landfill is adequately decontaminated.

Regarding the use of PPE, 100% of waste handlers said they wore gloves while collecting hospital waste and 91.9%, 81.1% and 89.2% used masks, aprons and gum boots respectively. However, in reality, observation discovered that the waste handlers did not adequately protect themselves while handling hazardous hospital waste.

#### ***5.4.3. Transportation***

Waste bags were always checked for tears or puncture before transporting, as responded by 80% of the study participants and was simultaneously confirmed during the walk-through survey too. The netted-wheeled trolleys without cover were used to transport waste within the hospital contrary to the pictures shown in the training manual for trainers on infection control and health care waste management in health facilities (p 69), which shows coloured trolleys with secure covers. The trolleys are required to be washed and disinfected daily (Guideline for Infection Control and Health Care Waste Management in Health Facilities, 2006, p 78) but only 35.1% of waste handlers said they did so, although, washing the waste trolley was never observed during the walk-through survey. A recently constructed JDWNRH did not design a separate route for transporting its waste and so the loaded trolleys with red and green plastics, buckets with pathological waste like placenta and the sharp waste boxes are wheeled amidst the crowded ramps and lifts of the hospital. A hospital truck then carried those waste bags to the storage site. It was also discovered that this truck was not only meant for waste transportation but was serving its purpose for carrying other stuffs for patient kitchen and the general stores.

#### ***5.4.4. Storage***

Ideally, the hospital waste must be stored within the hospital premises in a room big enough to house the amount of waste produced and the frequency of collection.

Hospital waste should be protected from rain, sun and the scavengers. The waste bags must be placed in a room which is impermeable, hard-standing floor that is easy to clean and disinfect. The room should be possible to lock and the entry of unauthorized people, animals and rodents prohibited. The waste store house should have water supply for cleaning purposes. (WHO, 1999). Hospital waste storage for JDWNRH is an open area located beside a hospital boundary wall without proper fencing and is easily accessible for waste pickers and animals. The waste pickers may not attempt to scavenge the area during the working days as there are people on duty nearby. However, it is concerned that these waste pickers might attempt during long weekends and holidays as there is no proper fencing. However, except on long weekends and holidays the waste was transported everyday to the landfill by the TCC trucks.

#### ***5.4.5. Treatment***

As presented in Chapter 4, the treatment for hazardous waste in JDWNRH is only by autoclaving, mainly for infectious waste. “All red bags” and “sharp waste boxes” were the criteria to identify waste for autoclave, as discovered during the walk-through survey. Those infected waste collected in green plastics due to shortage of red ones and the lack of labeling the waste bags ultimately found its way to *Memelakha*, the land fill, without being treated. This is found to be a biggest concern for the municipal waste handlers and the scavengers at *Memelakha*. Majority of health staff and waste handlers (74.0%) said that autoclave for hospital waste in JDWNRH is performed by skilled personnel and was subsequently discovered that the lone operator gained his expertise on the job but still did not deem to use any of the PPEs while autoclaving the waste.

For other treatment options, 70% and 62% of health staff and waste handlers respectively considered incineration to be the best option for the treatment of waste in JDWNRH, if approved by NEC. As clearly explained in Chapter 1, the use of incinerators for medical waste is not been approved by the NEC of Bhutan due to air pollution apprehension and other environmental impacts. However, at this juncture, it is

arguable considering the current hospital waste management scenario in Bhutan. The final disposal option for waste from JDWNRH is land filling where all categories of waste including sharps goes there except pathological waste. As discussed above, many of these wastes missed decontamination, threatening the health of humans, animals and the environment at large. The pathological waste including body parts, placenta and dead fetuses are disposed in the deep burial pit within the hospital premises but this pit has been creating a nuisance in the area due to its foul smell over a period of time. There are permanent residences and a Lower Secondary School (Changzamtog) severely affected. The issue was repeatedly articulated in the newspapers voicing peoples' complaints. Norbu (2010) quotes an expression of one of the students, "*It smells a lot and it's awful to pass by the site*". For its relocation, identifying a suitable site was one of the challenges raised during the in-depth interview. In another article, Pindarica (2011) states, "pathological waste such as blood and blood products along with sharp waste such as needles, syringes, scalpels, saws, blades and broken glasses are common healthcare waste at the landfill" in a recent news paper, *Business Bhutan*.

An incinerator has the benefit of reducing the volume of waste up to 90%, and is applicable to all types of hospital waste including sharps and pathological waste (Ali, 1999). As raised by one of the in-depth interviewees, the management of cytotoxic vials and ampoules was yet another challenges faced. Perhaps, due to the increasing trend of cancer patients in the country (Annual Health Bulletin, 2011), and JDWNRH being the tertiary hospital, cytotoxic waste will obviously keep increasing. Ali (1999) clearly mentions that cytotoxic waste must be separately collected and labeled as "*cytotoxic material, handle with care at all times, dispose off by incineration only*".

On the other hand, ordinary incinerators without pollution control devices are known to emit numerous toxic chemicals into the environment which causes adverse health effects including cancers among children and adults (Allsopp et al., 2001). The modern hospital incinerators with a complex technology to meet the current stringent

environmental pollution regulations are very expensive (Ali, 1999). A feasibility study for hospital incinerator in JDWNRH done by Department of Public Health suggested the use of modern scientific incinerator, which has its own pollution control devices. However, since it is very expensive and may not be affordable by the RGOB possibility were explored among the private firms and was found to be feasible (Director, Public Health, MoH, Bhutan, Personal Communication).

#### ***5.4.6. Disposal***

As discussed above, it was discovered that hospital waste in JDWNRH is disposed in two ways, deep burial within the hospital premises and land filling at *Memelakha*. In-depth interview disclosed that since the deep burial pit of the hospital is almost full the sharp waste boxes that used to be dumped there can no more be done so. So, besides the pathological waste like body parts and placenta all the rest of the waste including sharps are dumped in the landfill. The waste management guideline specifically mentioned that, the sharp waste once autoclaved can be disposed off like any other general waste (Guideline for Infection Control and Health Care Waste Management in Health Facilities, 2006, p 73), which means that it can be disposed at the landfill. However, WHO (1999) contradicts that sharps should undergo incineration whenever possible along with other infectious waste or buried securely and that it will not go to the landfill. Encapsulation is another way to manage sharps (WHO, 1999). Since *Memelakha* is just a dump site with humans and animals scavenging everyday it is obviously not a right place for sharp waste and other non infectious hazardous wastes. There is a high risk for young waste pickers to catch the attention of the used needles and syringes, widely available at the landfill, for illicit drug use, as Bhutan is not spared from illicit drug users (BNCA, 2009).

Concerning the liquid hazardous waste, though one of the administrators, during the in-depth interview, assured that the infected liquids are decontaminated with bleaching solution and other hazardous liquids diluted prior to disposal into the drainage system, 96% of the respondents said that it is drained down the drainage system without

any decontamination. Observations also discovered that the patients' body fluids were flushed down the toilet pots without any decontamination. Similarly, other non infectious hazardous liquids like chemicals and discarded cytotoxic drugs are also disposed in the same way. WHO (1999) explains that when small amounts of chemicals from cleaning and disinfections can be regularly discharged into sewers other liquid waste like infectious liquids, cytotoxic drugs and liquids with radioactive properties must never be discharged into the sewerage system. In a long run, it may be wise for JDWNRH to develop a wastewater treatment plant to treat all kinds of hazardous liquids generated in the process of treating the patients.

## **5.5. Enabling Factors**

Enabling factors are those that make things easier or possible to perform or conduct certain tasks (Dictionary. Com., 2011. Online). Guideline on hospital waste management was accessible to more than 65% of health staff in the study and almost 90% of them have read it at least once. To read a useful material is not always an ideal choice for many Bhutanese, and even if desired by some, acute shortage of staff and busy working hours in JDWNRH does not always permit the staff to read such materials. Nevertheless, it is crucial to be familiar with the guidelines in order to perform the tasks correctly. However, as highlighted above, the present guideline on waste management may be considered for review.

In regard to training on hospital waste management, only 41.2% of health staff, recruited for the study, received training for at least once during the last 5 years compared to 95% of waste handlers and so the latter are found to have adequate knowledge on waste management. Akter (2000) supports that insufficient and inadequate training and awareness among the health care providers and waste handlers leads to inappropriate waste management in the hospital. From the in-depth interview it was learnt that training the health staff and waste handlers on waste management was not a planned activity of the hospital and so there is no separate budget allotted. Since waste management is an



important part of the system that cannot be ignored, possibilities are to be explored to include the training program among other annual activities of the hospital. Regular training programs for all categories of health workers including waste handlers would definitely keep them updated and refreshed.

Among the health staff 64.3% said that they knew the policy for hospital waste management. The policies and strategies for waste management mentioned in the guideline, if well incorporated by everybody, can result in better waste management. Regarding the supplies and materials for hospital waste management, majority of the health staff and waste handlers answered that there are adequate waste bins for general, infectious and sharps waste. During the walk-through survey it was noted that, non infectious hazardous waste, which generally is ignored as said by Akter (2000), needs to be addressed in JDWNRH. As classified in Chapter 2, this category of waste includes pharmaceutical, genotoxic, radioactive, chemical and pressurized wastes and the management of each category must be considered according to its individual properties like toxic, corrosive, inflammable, reactive or genotoxic (WHO, 1999). An additional waste bin, brown colour, as per WHO standard, for non infectious hazardous waste is required for all the units in JDWNRH as there are increased amount of this category of waste being generated (see **Appendix A**).

Concerning PPE for hospital waste management, more than 90% of both health staff and waste handlers responded that they had adequate supply of gloves and mask. However, none of the PPEs were used adequately for waste management. Chi square test revealed that adequate supply of apron was statistically significant ( $p$ -value = .036) with the level of practices for health staff. As observed during the walk-through survey, PPE including gloves and mask were adequately available in all the units. As for aprons and gumboots adequate stocks were available in the stores to be issued if requested by any unit. Those who already received not always wore them while handling hospital waste. One of the causes of injuries/illnesses (discussed later) from hospital waste was due to

lack of PPE. However, the study revealed that despite adequate PPEs people did not use them adequately for waste management.

While 80.2% of the respondents said that there was supervision or monitoring system for hospital waste management by the ICHWM committee, the administrators on the other hand, mentioned that supervision and monitoring need to be emphasized. It was observed that the focal person for the waste management is a Deputy Nursing Superintendent, who was shouldering other equally important responsibilities at the same time which may be preventing her from adequate concentration to waste management. Since waste management itself is a big and demanding responsibility it is strongly felt that if one with adequate waste management background is just assigned as the focal person, he/ she may be able to address the issue holistically and work towards fostering a sound waste management for JDWNRH. Therefore the hospital needs to reconsider and support the job responsibility for the focal person on hospital waste management.

## **5.6. Injuries/Illness**

The main aim of including injuries/illnesses in this study was to determine the incidence on injuries and illnesses due to hospital waste within the last 12 months. The WHO estimates that 40% of hepatitis cases and 12% of HIV cases worldwide are caused by occupational exposure to infectious waste, especially sharps, posing risk to anyone who comes into contact with it (The Issue: online). Out of 221 health staff and 37 waste handlers in the study, 43% and 21.6% respectively were found to have experienced one or the other kind of injury or illness due to hospital waste within the last 12 months. Among those, an alarming 67.4% of health staff and 75% of waste handlers, were struck with needle pricks during waste management. Although, more than 90% of both health workers and waste handlers are vaccinated against Hepatitis B virus, till date there isn't any information on the status of HIV infection among health workers in Bhutan as discovered from Program officer, HIV/AIDS in a personal communication. In the USA,

the annual number of HBV infections as a result of exposure to health-care waste is between 162 and 321 (WHO, 1999). In the study, 30.5% of health staff and 12.5% of waste handlers encountered glass injuries from wastes, possibly contributed by breaking the injection ampoules over the general waste bins, as discussed earlier. Other exposures to radiation, hazardous chemical, anesthesia gases, etc becomes difficult to assess at this stage.

### **5.7. In-depth interview and walk-through survey**

Most of the developing countries in the world do not have specific guidelines to manage hazardous hospital waste (Medical Waste: Challenges Faced around the World, 2010, online). In Bhutan, the present guideline, which is third edition, provides many useful information although it is now time to review. The upcoming regulation on the waste management being drafted was positively anticipated by the administrators of JDWNRH. The new regulation, as was told by the interviewees, includes specific guidelines on managing all categories of waste adequately.

The hospital administrators acknowledged that the present waste management in JDWNRH is adequate, but they also highlighted several concerns and challenges. As the walk-through survey was made it was however revealed that waste management in JDWNRH requires further emphasis. Moreover, 57% of health staff and 89% of waste handlers commented that waste management in JDWNRH is inadequate. Several challenges like huge amount of waste, limited disposal options, inadequate/irregular supplies and poor supervision and monitoring were identified that required to be addressed immediately. One of the challenges mentioned by the administrators during the in-depth was problem with recyclable waste. Due to limited recycling facilities in the country, currently the recyclables collected by the waste pickers are sold across the Indian border which is found to be quite feasible provided the waste is safe.

Not that there isn't any complaints as one of the interviewees mentioned, hospital waste management is an important issue yet inadequately addressed and often articulated among the newspapers of the country. Right from segregation through collection, transportation, storage treatment and disposal, each step needs to be reinforced with an extra effort of everyone's commitment and strict supervision and monitoring by the infection control and the waste management committee of the hospital. Mostafa et al. (2008) correctly mentions that a good hospital waste management largely depends on a dedicated waste management team comprising of sound administration with proper planning, well-trained and efficient health care workers. On the other hand, WHO (1999) emphasizes that, the hospital and other such establishments have a "Duty of Care" for the health of the general public and the environment with the waste they generate to ensure that the process of waste management does not cause any undesirable consequences to the human health and environment.

## **Part 2. Conclusion**

Among the health staff, more than 95% knew that segregation of waste is a key step in waste management. Almost 88% knew that all infectious waste must be thrown in the red bags/bins. Nearly 90% were aware that sharp boxes should be filled only up to 3/4th full. It was obvious to almost 90% that the infectious agent on sharps is very small and will not cause infections like HIV, Hepatitis B and C, etc. Regarding the PPE, 95% knew that it protects an individual from exposure to hospital waste and 91% of health staff also knew that liquid hazardous waste if untreated prior to disposal poses a serious threat to the community. 72% confirmed that *Memelakha*, is not the best option for disposal of all waste from JDWNRH.

However, as discussed above, only 50.7% of health staff defined hospital waste correctly. Almost 84% did not know that non-infectious hazardous waste must not be thrown with general waste in green bags/bins. Only 36% knew that a spill of mercury from a broken BP apparatus should not be collected in the red bucket and that it cannot

be autoclaved. More than 50% of the health staff did not know that autoclaves are not recommended for the treatment of pathological waste (body parts, placenta, fetuses, etc).

Similarly, among the waste handlers, 87% were aware that sharp boxes should be filled only up to 3/4th full. 95% were confident that the infectious agent on sharps, although very small, will still cause infections like HIV, Hepatitis B and C. 97% of them also knew that hospital waste cannot be transported via the common route within the hospital. 100% of waste handlers knew that use of PPE during hospital waste transportation protects an individual from exposure to hospital waste and that liquid hazardous waste if untreated prior to disposal poses a serious threat to the community. *Memelakha* was not the best option for disposal of all hospital waste for 76% of waste handlers. Nevertheless, there were majority of waste handlers (95%) who did not know how to manage mercury spills. Almost 90% were not aware that pathological waste is not meant to be autoclaved prior to disposal.

Overall, the present study found out that, among the health staff, 54.2% of the doctors in JDWNRH had high level of knowledge and 45.8% had moderate knowledge. Among the nurses, 9.3% had high level of knowledge, 75.3% had moderate and 15.5% had low knowledge. Similarly, among the paramedics, 8.0%, 69.0% and 23.0% had high, moderate and low level of knowledge respectively. Among the waste handlers, 51.4% possessed high knowledge, 43.2% had moderate and 5.4% low level of knowledge.

Regarding the attitude towards hospital waste management, among the health staff, more than 90% had a positive attitude that he/she had a crucial role in the management of hospital waste. 80% said that segregation is always the responsibility of waste producer. When somebody threw hospital waste in a wrong bin, 95% of health staff did not feel good. On labelling the waste bags, 88% of the health staff said that it is important to label the waste bags even if they are to be disposed. 14% were undecided whether segregation of hospital waste had anything to do with the financial impact. 11%

could not decide whether it was safe to scavenge the hospital waste in the storage area. Almost 20% also could not decide whether hazardous and non hazardous waste can be collected and transported at the same time. 19% remained undecided whether incineration is the best option for JDWNRH, if approved by the NEC. 40% of health staff believed that it is safe to break the injection ampoules over the waste bin but no let the pieces fall outside the bin. For collection of waste, 16% thought that hospital waste can be collected whenever that bins were full and not necessarily routinely.

Among the waste handlers, 89% said that he/ she, as an individual, had a crucial role in the management of hospital waste. 100% said segregation is always the responsibility of waste producer. 97% said that hospital waste must be collected routinely and not whenever the bins were full. Nearly 33% thought that incineration is not the best option for JDWNRH even if approved by the NEC and 6% remained undecided. For the disposal of hospital waste almost 30% thought *Memelakha* was the best option, however, 11% remained undecided.

As per the aggregate scores, among the health staff, 20.8% of doctors are found to have positive attitude, followed by 62.5% with neutral attitude and 16.7% with negative attitude. Among the nurses, 19.6% had positive attitude, 69.1% had neutral and 11.3% had negative attitude. Similarly, among the paramedics, 12.0%, 68.0% and 20.0% showed positive, neutral and negative attitude respectively. Among the waste handlers, 53.1% depicted positive attitude, 45.9% showed neutral and 18.9% had negative attitude towards hospital waste management.

For practices on hospital waste management, among the health staff, almost 99% looked for the right bin to throw the hospital waste. Nearly 83% collected all sharp waste together irrespective of whether they were contaminated or not. However, as discussed above, 73% picked the infected waste that was mistakenly thrown in the general waste bin so that the general waste remained uninfected. In emergencies, 48% broke the

injection ampoules over the general waste bin, although, they were careful that the glass pieces did not fall on the floor. 82% could not segregate waste when they were busy. 98% said that most often the hazardous liquid waste from the hospital is not treated before disposal into the drainage system. Among the waste handlers, more than 80% said they wear adequate PPE while handling with the hospital waste. 65% said they wash the waste trolleys daily. For labeling the waste bags, 92% said they do not label them prior to collection. 84% discharged the hazardous liquid waste through the sewerage system without treatment.

Overall, 75.0% of doctors performed good practices, whereas, 25.0% performed poor practices. Among the nurses, 58.8% performed good practices but 41.2% performed poor practices. Among the paramedics, 58.0% and 42.0% performed good and poor practices respectively. Among the waste handlers 62.2% performed good practices, however, 37.8% were performing poor practices on hospital waste management.

The study discovered that there was significant association between the level of knowledge, attitude and practices on hospital waste management among both health staff and waste handlers when tested with a Chi square test ( $p\text{-value} \leq 0.05$ ). Not all the socio-demographic characteristics were found to have significant association with practice but age and number of years in the present occupation among the health staff and age for the waste handlers were found to have a statistically significant association with the level of practices on hospital waste management.

Adequate supply of aprons and the injury reporting system in JDWNRH were significantly associated with the practices among the enabling factors for the health staff. For the waste handlers, none of the enabling factors were significantly associated with the level of practices on hospital waste management.

More than one-third of the study participants were found to have experienced one or the other kind of injury or illness due to hospital waste. Among those, an alarming rate of 67% health staff and 75% waste handlers were struck with needle pricks. They also encountered glass injury and were exposed to radiation and chemical waste. The coverage for Hepatitis B immunization was 92.8% among the health staff and 94.6% in waste handlers.

Qualitative analysis revealed that waste management in JDWNRH needs to be addressed further. Several challenges are to overcome before achieving a sound and effective waste management system for JDWNRH.

### **Part 3. Recommendations**

The study has come up with some recommendations which are categorized into short term and long term recommendations according to the priority.

Short term recommendations are:

#### ***5.8.1. Emphasize on proper segregation of waste***

As discussed at large, segregation is the first and the most crucial step of waste management. With good segregation system, other steps that follow can be, to a great deal, managed adequately. Since the waste segregation practice is already in place, further emphasis on strict segregation practices through determined dedication from all categories of health workers including intense support from the administration will obviously boost the current waste management system of the hospital. Since  $\frac{3}{4}$ th of the hospital waste, which is a substantial amount, is non hazardous, with strict segregation practices in place, much of the waste including paper, plastic bottles, saline bottles, etc. can be retrieved for reuse and recycling. It will not only reduce the waste but ultimately reduce in exploiting the natural resources.



### ***5.8.2. Labeling the waste bags***

As extensively discussed earlier, due to irregular and limited supply of the colour coded plastics, often red plastics were substituted by green plastics which were not autoclaved and finding its way to the landfill without any treatment. Therefore, introducing the system of labeling the waste bags with necessary information like date, name of the unit, type of waste, treatment and disposal options, such avoidable errors can be prevented and thus render all infectious waste safe for disposal at *Memelakha*.

### ***5.8.3. Waste bin for non infectious hazardous waste***

Also discussed extensively, the non infectious hazardous waste like chemicals and pharmaceutical waste, cytotoxic drugs, radiological waste and wastes with heavy metals, although constitutes a small portion of the hospital waste, requires special handling with separate collection and disposal techniques due to its toxic, genotoxic, corrosive, inflammable, reactive, explosive and shock-sensitive properties. At the moment in JDWNRH it is found that this category of waste did not receive much attention and as such its management has been ignored. Therefore, a separate bin, may be brown colour, as per WHO standard, must be initiated for non infectious hazardous waste and managed accordingly.

### ***5.8.4. Strict supervision and monitoring***

Since the hospital already has the infection control and waste management committee carrying out its responsibilities, it is felt that having strict and routine supervision and monitoring can be instrumental in fostering proper segregation of waste, which is a priority to be considered in JDWNRH. Other lapses on waste management practices may also be addressed with adequate supervision and monitoring system.

Long term recommendations that the study have recognized are:

***5.8.5. Regular training program for the staff and waste handlers***

Although training was not statistically significant to practices it was found that those participants who attended training performed good practices compared to those who did not. Moreover knowledge was found to be associated with attitude and practices; therefore, regular training for all categories of health workers including waste handlers would enhance their knowledge further resulting in developing positive attitude and good practices on hospital waste management.

***5.8.6. Review of present waste management guideline***

As discussed at large, the present guideline on infection control and health care waste management, 2006, do not emphasize on the management and disposal options for non infectious hazardous waste like cytotoxic, radiological, chemical wastes and waste containing heavy metals like mercury. As mentioned earlier that present guideline has limited and also some archaic information and as such indicates time to be reviewed. With the coming up of the new waste management regulation a review of the guideline may be necessity.

***5.8.7. Focal person for just waste management***

Since hospital waste management is a very huge responsibility, an individual shouldering other equally important responsibilities may not be able to contribute holistically to such a demanding task. If the focal person for waste management in JDWNRH is assigned this single, yet very important responsibility, he/she would definitely be able to focus on routine training activities, supervision and monitoring and other activities to address the current situation of waste management.

#### ***5.8.9. Proper waste storage area***

The present location for the waste storage in JDWNRH requires to be developed to store the waste hygienically. Similar to the size of the present autoclave unit the storehouse can be adjacent to it as it already has a washing facility attached. Investing on a proper roof and a strong fencing for hospital waste would not only prevent from the spread of diseases and other hazards it would also set a good example as a National Referral Hospital to other District Hospitals and the upcoming private hospitals.

#### ***5.8.10. Considering an incinerator***

As discussed thoroughly, taking into account the present scenario of hospital waste management in the country, JDWNRH would really benefit if one of the private companies in Bhutan takes the initiative in installing scientifically qualified incinerator in managing its ever growing amount of hazardous waste.

#### ***5.8.11. Wastewater treatment plant***

Since JDWNRH is the tertiary care hospital of Bhutan, huge amount of liquid waste including infectious and non infectious hazardous liquids is generated. It is crucial to maintain high standard ensuring the absence of significant quantities of toxic chemicals, pharmaceuticals, radionuclides, cytotoxic drugs, and antibiotics in the discharged sewage. Therefore, in a long run, a wastewater treatment plant may be a wise option to be considered for JDWNRH.

#### ***5.8.12. Future Research***

The future researchers are suggested to concentrate on the following:

- The waste handlers of JDWNRH.
- Waste management in other Regional and District Hospitals in Bhutan so as to compare and then establish uniformity in hospital waste management system throughout the country.
- To conduct interventional studies.

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## **APPENDICES**

## APPENDIX A

### Various types of waste generated in different units/departments of JDWNRH.

Sl. No.	Unit/ Department	Type of waste available	Amount
1.	Medical ward	General waste- paper, plastics and plastic containers, cardboard, saline bottles, cloth pieces/rags.	½ bucket *
		Infectious waste- Syringes, gauze, cotton, bandages, IV sets, IV canula, catheters and drainage tubes.	¼ bucket *
		Sharp waste- Needles and blades/scalpels.	½ box
		Genotoxic waste- Chemotherapy drugs and empty vials.	3 vials
		Chemical waste- Disinfectant (bleaching solution).	½ bucket **
2.	Maternity ward	General waste- paper, plastics and plastic containers, cardboard, saline bottles.	Fullbucket *
		Infectious waste- syringes, gauze, cotton, bandages, IV sets, IV canula and catheters.	½ bucket*
		Sharp waste- Needles, blades/scalpels.	½ box
		Genotoxic waste- chemotherapy drugs.	5 vials
		Chemical waste- disinfectant (bleaching solution). Povidion containers.	½ bucket**
3.	Neonatal ward	General waste- paper, plastics, cardboard and bottles.	¼ bucket*
		Infectious waste- Syringe, gauze, cotton bandages, IV sets, IV canula.	½ bucket*
		Sharp waste- needles, used ampoules, blades.	< ½ box
4.	Surgical ward	General waste- paper, plastics, cardboard, saline bottles.	Full bucket*
		Infectious waste- syringes, gauze, cotton, bandages, IV sets, IV canula, catheters, drainage tubes.	½ bucket 100L vol.
		Sharp waste- Needles, ampoules, blades/scalpels	¼ box
		Genotoxic waste- chemotherapy drugs and empty vials	2 vials
		Chemical waste- disinfectant (bleaching solution) Povidion containers	¼ bucket**

**Various types of waste generated in different units/departments of JDWNRH *continued.***

5.	Pediatric ward	General waste- papers and plastics Saline bottles (separately collected for sale by waste handler).	Few 2 plastic bags full
		Infectious waste- just emptied	empty
		Sharp waste- needles, broken glasses, ampoules	>3/4
		Chemical waste- disinfectant (bleaching solution) Povidion containers	½ bucket**
		Cytotoxic waste- chemotherapy drugs	3 vials
6.	Birthing center	General waste- Paper, plastics and cardboard Saline bottles (collected by waste handler)	½ bucket* 1 ½ plastic bag
		Infectious waste - syringes, cotton, gauze, bandages, IV sets, IV canula, catheters	¼ bucket*
		Sharp waste- Needles and ampoules collected in the cartoon box.	¼ cartoon box
7.	Emergency ward	General waste- saline bottles Paper, plastics and plastic bottles, juice packets.	½ plastic ½ bucket*
		Infectious waste- syringes, gauze, cotton, bandages, IV seta, IV canula and drainage tubes	¼ bucket*
		Sharp waste- needles, ampoules and blades	½ box
		Chemical waste- Disinfectat (bleaching solution)	½ bucket**
8.	Lab (bio-chemistry)	General waste- paper and plastics	½ bucket*
		Infectious waste- syringes, cotton	<1/4bucket*
		Sharp waste- Needles	½ box
		Pathological waste- Ascitis fluid, pleural fluid, cerebro spinal fluid	A vial each
		Chemical waste- disinfectant (bleaching sol.) and reagents	-
9.	Radiology (X-ray)	General waste- paper and plastics	Approx. 5kg all together
		Infectious waste- syringes	Approx. 1 kg all together
		Sharps- needles	< ¼ box
		Chemical waste- film developer	Drainage connected to sewerage system
		General waste- paper, plastics, cardboard and rags	¾ bucket*
		Infectious waste- syringes, gauze, cotton, vomit-soaked tissues dialysis tubings	¼ bucket*

**Various types of waste generated in different units/departments of JDWNRH *continued.***

<b>Sl. No.</b>	<b>Unit/ Department</b>	<b>Type of waste available</b>	<b>Amount</b>
9.	Radiology (X-ray)	Sharp waste- needles, blades/scalpels	½10Lcan
		Chemical waste- disinfectant (bleaching solution)	½ bucket**
		Heavy metals- broken BP apparatus	1 no.
11	Operation theatre (in each room)	General waste- paper, plastics, cardboard, saline bottles	½ bucket*
		Infectious waste- syringes, gauze, cotton, bandages, IV sets, IV canulas, catheters, drainage tubes	½ bucket
		Sharp waste- needles, blades/scalpels, glass pieces, ampoules	>¾ box
		Pathological waste- body parts, placenta.	> ½ bucket*
		Chemical waste- anesthesia gases, disinfectants and chemical containers	-
		Liquid hazardous waste- urine in the bag, blood and blood products	-
12	Minor OT	General waste- paper, plastics, rags, plaster cast	>¾ bucket**
		Infectious waste- gauze, cotton, bandages, drainage tubes, blood and blood products, pus	2 buckets** almost full
		Sharp waste- needles, blades/scalpels	<½ box
		Chemical waste- disinfectant (bleaching solution) Povidion and aerosol containers	½ bucket**

\*Bucket of 100 L volume

\*\*Bucket of 10 L volume

**APPENDIX B**  
**QUESTIONNAIRES**  
**(Health staff)**

**Hospital Waste Management: A Study on the Knowledge, Attitude and Practices among Health Staff and Waste Handlers in Jigme Dorji Wangchuk National Referral Hospital, Thimphu, Bhutan**

Date.....Interviewer ID No.....

**Part 1. Socio demographic Questions**

1. How old are you?  
.....years.
2. What is your gender?  
 1. Male  
 2. Female
3. What is your educational level?  
 1 Certificate level  
 2. Diploma level  
 3. Bachelor, Masters and above
4. What is your present occupation?  
 1. Doctor  
 2. Nurse  
 3. Paramedic (*please specify*).....
5. How many years have you been working in your present occupation?  
.....years.

**Part 2. Knowledge questions (Please tick (√) for either Yes, No or Don't know)**

No.	Question	Yes	No	Don't know
1.	All waste generated in the hospital are hazardous.			
2.	Segregation is a key step in hospital waste management.			
3.	All infectious waste except sharps must be thrown in the red bags/bins.			
4.	Non-infectious hazardous waste must be thrown with general waste in green bags/bins.			

**Part 2. Knowledge questions *continued* (Please tick (√) for either Yes, No or Don't know)**

No.	Question	Yes	No	Don't know
5.	The sharp boxes should be filled only up to 3/4 <sup>th</sup> full.			
6.	The infectious agent on sharps is very small and will not cause infections like HIV, Hep B, Hep C, etc.			
7.	A spill of mercury from a broken BP apparatus should be collected in the red bucket and autoclaved before disposal.			
8.	In summer, hazardous hospital waste can be stored for not more than 72 hours.			
9.	The hospital waste storage area needs to be well fenced.			
10.	Hospital waste can be transported via the common route within the hospital.			
11.	Use of gloves, mask, aprons and gumboots during hospital waste transportation protects an individual from exposure to hospital waste.			
12.	Autoclaves are best recommended for the treatment of pathological waste (body parts, placenta, fetuses, etc.).			
13.	It is important to record time, temperature and pressure while treating hospital waste by autoclave.			
14.	Liquid hazardous waste if untreated prior to disposal poses a serious threat to the community.			
15.	<i>Memelakha</i> (landfill for Thimphu) is the best option for disposal of all waste from JDWNRH.			

**Part 3. Attitude questions. (Please tick (√) for either Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) or Strongly Disagree (SD).**

No.	Attitude items	SA	A	UD	D	SD
1.	I have a crucial role in the management of hospital waste.					
2.	Segregation is always the responsibility of the waste producer.					
3.	I am sure that segregation of hospital waste has nothing to do with the financial impact on hospital waste management.					
4.	I think it is safe to break the injection ampoules over the waste bin but no let the pieces fall outside the bin.					
5.	I don't feel good when I find somebody throwing hospital waste in the wrong bin.					
6.	It is not important to label the waste bags before collection; after all, they are going to be disposed off.					
7.	7. Collection of hospital waste can be done when the bins are full and not necessarily routinely to save time.					



**Part 3. Attitude questions. (Please tick (√) for either Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) or Strongly Disagree (SD).**

No.	Attitude items	SA	A	UD	D	SD
8.	It is safe to scavenge hospital waste in the storage room for an extra income.					
9.	I think hazardous and non hazardous waste must be collected and transported at the same time.					
10.	No need to wash the waste transportation trolleys since they will get dirty again.					
11.	Having a separate route for hospital waste transportation within the hospital is unnecessary and useless.					
12.	Chemical disinfection is not at all an effective treatment method.					
13.	13. I think incineration would be the best option for the treatment of waste in JDWNRH, if approved by NEC.					
14.	Hospital waste disposal is the responsibility of the city corporation (municipality).					
15.	I have enough knowledge on hospital waste management but there is no time to practice it due to shortage of staff.					

**Part 4. Practice questionnaires (Please tick (√) either yes or no**

No.	Questions	Yes	No
1	When I mistakenly throw infected waste into the general waste bin, I pick them up so the general waste remains uninfected.		
2	I always look for the right bin to throw the hospital waste.		
3	In emergencies I break the injection ampoule over the general waste but am very careful that pieces are not on the floor.		
4	When I am busy I cannot always practice waste segregation.		
5	Small amounts of chemical or pharmaceutical waste are collected together with infectious waste.		
6	I always collect sharps together, regardless of whether or not they are contaminated.		
7	Hospital waste bags/bins are never labeled before they are collected and transported to the storage room.		
8	Waste bags are always checked for tears or punctures before transporting.		
9	Highly infectious hospital waste are always sterilized/ treated immediately by autoclaving.		
10	Autoclave for hospital waste in JDWNRH is performed by skilled personnel.		
11	I sometimes recap the needles after use before throwing.		

**Part 4. Practice questionnaires *continued* (Please tick (✓) either yes or no**

No.	Questions	Yes	No
12	Most often the hazardous liquid waste from the hospital is not treated before disposal into the drainage system.		
13	I always use gloves to protect myself from hazardous hospital waste.		
14	I always use mask to protect myself from hazardous hospital waste.		
15	I always use aprons to protect myself from hazardous hospital waste.		
16	I always use gumboots to protect myself from hazardous hospital waste.		
17	I make sure I wash my hands every time after handling hospital waste.		

**Part 5. Questions on enabling factors**

1. Do you have the Guideline for Infection Control and Healthcare Waste Management in Health facilities in your work place?
  - Yes
  - No (Skip Q2 &3)
2. If yes, how often do you read it?
  - Once a week
  - Once a month
  - Once in six months
  - Once in a year
  - Never read (Skip Q3 & 4)
3. How useful is the guideline if you have ever read it?
  - Very useful
  - Useful
  - Not sure
  - Not very useful
  - Not useful at all
4. Have you attended training on waste management in the last five years?
  - Yes
  - No (Skip Q5& 6)
5. If yes, how many times?
  - ..... Times
6. Do you know the policy for hospital waste management?
  - Yes
  - No
7. Are there adequate general waste bins in your work place?
  - Yes
  - No
8. Are there adequate infectious waste bins?
  - Yes
  - No

**Part 5 continued. Questions on enabling factors**

9. Are there adequate sharp waste bins?
  - Yes
  - No
10. Are there adequate non infectious hazardous waste bins?
  - Yes
  - No
11. Are there adequate food waste bins?
  - Yes
  - No
12. Are there enough waste transportation trolleys with proper lids?
  - Yes
  - No
13. Is there a separate lift or ramp designed for hospital waste transportation?
  - Yes
  - No
14. Is there a waste management plan set up for you work place?
  - Yes
  - No
15. Are there clearly defined procedures for waste management procedure in your work place?
  - Yes
  - No
16. Is there supervision or monitoring system for waste management by the ICWM committee of JDWNRH?
  - Yes
  - No
17. Are there adequate gloves for waste management in your work place?
  - Yes
  - No
18. Are there adequate mask for waste management in your work place?
  - Yes
  - No
19. Are there adequate aprons for waste management in your work place?
  - Yes
  - No
20. Are there adequate gumboots for waste management in your work place?
  - Yes
  - No
21. Is there a system of reporting any injury or illness due to hazardous hospital waste?
  - Yes
  - No
22. Do you think JDWNRH has an effective hospital waste disposal system with minimal harm to the humans and environment?
  - Yes
  - No

**Part 6. Questions on Injuries/Illnesses due to hospital waste**

1. Did you get any kind of injury/illness due to hospital waste within the past 12 months?
  - Yes
  - No
2. Injury/illness due to needle prick injury?
  - Yes
  - No
3. Injury/illness due to glass injury?
  - Yes
  - No
4. Exposure to radiation?
  - Yes
  - No
5. Injury/illness due to hazardous chemical?
  - Yes
  - No
6. Injury/illness due to any other hospital waste?
  - Yes
  - No
7. How many times with the last 12 months?
  - 1 – 2 times
  - 3 – 4 times
  - >4 times
8. How did you get the injury /illness?
  - Lack of knowledge
  - Lack of PPE
  - Negligence
  - Accidental
  - Others
9. Did you record or report the injury / illness anywhere?
  - Yes
  - No
10. Are you immunized against Hep B as a health worker?
  - Yes
  - No

**Thank you very much for the information.**

## QUESTIONNAIRES

(Waste handlers)

### Hospital Waste Management: A Study on the Knowledge, Attitude and Practices among Health Staff and Waste Handlers in Jigme Dorji Wangchuk National Referral Hospital, Thimphu, Bhutan

Date.....Interviewer ID No.....

#### Part 1. Socio demographic Questions

1. How old are you?  
.....years.
2. What is your gender?  
[ ] 1. Male  
[ ] 2. Female
3. What is your educational level?  
  
[ ] 1 No Education  
[ ] 2. Primary Education  
[ ] 3. Middle/Higher secondary Education  
What is your present occupation?  
[ ] 1. Ward boy  
[ ] 2. Cleaner
4. How many years have you been working in your present occupation?  
.....years.

#### Part 2. Knowledge questions. Please tick (✓) for either Yes, No or Don't know

No.	Question	Yes	No	Don't know
1.	All waste generated in the hospital are hazardous.			
2.	The sharp boxes should be filled only up to 3/4 <sup>th</sup> full.			
3.	The infectious agent on sharps is very small and will not cause infections like HIV, Hep B, Hep C, etc.			
4.	A spill of mercury from a broken BP apparatus should be collected in the red bucket and autoclaved before disposal.			
5.	In summer, hazardous hospital waste can be stored for not more than 72 hours.			
6.	The hospital waste storage area needs to be well fenced.			

**Part 2. Knowledge questions *continued*. Please tick (✓) for either Yes, No or Don't know**

7.	Hospital waste can be transported via the common route within the hospital.			
8.	Use of gloves, mask, aprons and gumboots during hospital waste transportation protects an individual from exposure to hospital waste.			
9.	Autoclaves are best recommended for the treatment of pathological waste (body parts, placenta, fetuses, etc.).			
10.	It is important to record time, temperature and pressure while treating hospital waste by autoclave.			
11.	Liquid hazardous waste if untreated prior to disposal poses a serious threat to the community.			
12.	<i>Memelakha</i> (landfill for Thimphu) is the best option for disposal of all waste from JDWNRH.			

**Part 3. Attitude questions. Please tick (✓) for either Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) or Strongly Disagree (SD)**

No.	Attitude items	SA	A	UD	D	SD
1.	I have a crucial role in the management of hospital waste.					
2.	Segregation is always the responsibility of the waste producer.					
3.	I am sure that segregation of hospital waste has nothing to do with the financial impact on hospital waste management.					
4.	I don't feel good when I find somebody throwing hospital waste in the wrong bin.					
5.	It is not important to label the waste bags before collection; after all, they are going to be disposed off.					
6.	Collection of hospital waste can be done when the bins are full and not necessarily routinely to save time.					
7.	It is safe to scavenge hospital waste in the storage room for an extra income.					
8.	I think hazardous and non hazardous waste must be collected and transported at the same time.					
9.	No need to wash the waste transportation trolleys since they will get dirty again.					
10.	Having a separate route for hospital waste transportation within the hospital is unnecessary and useless.					
11.	I think incineration would be the best option for the treatment of waste in JDWNRH, if approved by NEC.					
12.	1 Hospital waste disposal is the responsibility of the city corporation (municipality).					

**Part 4. Practice questionnaires. (Please tick (√) either yes or no)**

No.	Questions	Yes	No
1	I always wear gloves while handling hospital waste.		
2	I wear mask while handling hospital waste.		
3	I wear apron while handling hospital waste.		
4	I wear gum boots while handling hospital waste.		
5	Waste bags are collected only after labeling them properly.		
6	Waste bags are always checked for tears or punctures before transporting.		
7	Hospital waste bags are dragged during transportation.		
8	When the waste is small amount I mix the general and hazardous waste together for transportation because it is much convenient.		
9	Hospital waste in JDWNRH is stored for not more than two days in summer.		
10	Autoclave for hospital waste in JDWNRH is performed by skilled personnel.		
11	Highly infectious hospital waste are always sterilized/treated immediately by autoclaving.		
12	Waste transportation trolleys are not washed daily.		
13	Human organs, placenta and dead fetus are thrown in the deep burial pit within the hospital premises.		
14	Most often the hazardous liquid waste from the hospital is not treated before disposal into the drainage system.		
15	I wash my hands thoroughly after handling hospital waste.		

**Part 5. Questions on enabling factors**

1. Have you attended training on waste management in the last five years?
  - Yes
  - No (Skip Q5& 6)
2. If yes, how many times?
  - ..... Times
3. Are there adequate general waste bins in your work place?
  - Yes
  - No
4. Are there adequate infectious waste bins?
  - Yes
  - No
5. Are there adequate sharp waste bins?
  - Yes
  - No
6. Are there adequate non infectious hazardous waste bins?
  - Yes
  - No

**Part 5 continued. Questions on enabling factors**

7. Are there adequate food waste bins?
  - Yes
  - No
8. Are there enough waste transportation trolleys with proper lids?
  - Yes
  - No
9. Is there a separate lift or ramp designed for hospital waste transportation?
  - Yes
  - No
10. Is there supervision or monitoring system for waste management by the ICWM committee of JDWNRH?
  - Yes
  - No
11. Are there adequate gloves for waste management in your work place?
  - Yes
  - No
12. Are there adequate mask for waste management in your work place?
  - Yes
  - No
13. Are there adequate aprons for waste management in your work place?
  - Yes
  - No
14. Are there adequate gumboots for waste management in your work place?
  - Yes
  - No
15. Is there a system of reporting any injury or illness due to hazardous hospital waste?
  - Yes
  - No
16. Do you think JDWNRH has an effective hospital waste disposal system with minimal harm to the humans and environment?
  - Yes
  - No

**Part 6. Questions on Injuries/Illnesses due to hospital waste**

1. Did you get any kind of injury/illness due to hospital waste within the past 12 months?
  - Yes
  - No
2. Injury/illness due to needle prick injury?
  - Yes
  - No
3. Injury/illness due to glass injury?
  - Yes
  - No



**Part 6. Questions on Injuries/Illnesses due to hospital waste *continued***

4. Exposure to radiation?
  - Yes
  - No
5. Injury/illness due to hazardous chemical?
  - Yes
  - No
6. Injury/illness due to any other hospital waste?
  - Yes
  - No
7. How many times with the last 12 months?
  - 1 – 2 times
  - 3 – 4 times
  - >4 times
8. How did you get the injury /illness?
  - Lack of knowledge
  - Lack of PPE
  - Negligence
  - Accidental
  - Others
9. Did you record or report the injury / illness anywhere?
  - Yes
  - No
10. Are you immunized against Hep B as a health worker?
  - Yes
  - No

**Thank you very much for the information.**

**In-depth interview questions**

**Hospital Waste Management: A Study on the Knowledge, Attitude and Practices among Health Staff and Waste Handlers in Jigme Dorji Wangchuk National Referral Hospital, Thimphu, Bhutan (Top five hospital administrators)**

1. What do you have to say about the present system of waste management in JDWNRH?
2. What are your concerns on the present waste management system of JDWNRH?
3. Do you think that there is a requirement to have a separate legislation for managing hospital waste?

**In-depth interview questions *continued***

4. At present there is no appropriate treatment of hazardous liquid waste in JDWNRH. Do you have idea why was this not envisaged during the planning and construction stage? Is there any future plan to develop a proper treatment system for hazardous liquid waste that is generated from JDWNRH?
5. The deep burial pit designed for pathological waste from JDWNRH is located amidst residences, public thoroughfare and a school. This pit seems to be a nuisance (foul smell) for public and the school. Is there any immediate plan to solve this problem?
6. What is the system of training the health staff and the waste handlers of JDWNRH on hospital waste management? How often are they trained?
7. What do you have to say regarding the supplies of materials required for hospital waste management?
8. How would you like to integrate with the Thimphu City Corporation (TCC) in managing the hospital waste in a better way?
9. What are some of the challenges for waste management in JDWNRH at present?
10. Please mention any other comments or suggestions that I can incorporate in my study to make a difference in the hospital waste management in JDWNRH?

**Walk-through Survey**

**Hospital Waste Management: A Study on Knowledge, Attitude and Practices among Health workers and Waste Handlers in Jigme Dorji Wangchuk National Referral Hospital, Thimphu, Bhutan.**

**Checklist for Observation on Hospital waste management in JDWNRH**

Unit/Department:		No. of beds:		Patient turnover:	
No.	Practices	Yes	No	Comments	
<i>A</i>	<i>Segregation Practices</i>				
1.	Does the unit have separate containers for hazardous waste, general waste, and sharp waste?				
2.	Are all the types of containers clearly labeled?				
3.	Specify which bin is used for which type of waste <ul style="list-style-type: none"> <li>• Red bin for infectious waste</li> <li>• Green for general waste</li> <li>• Yellow box for sharp waste</li> <li>• Blue for food waste</li> <li>• Brown for chemical and pharmaceutical waste</li> </ul>				

**Checklist for Observation on Hospital waste management in JDWNRH *continued***

Unit/Department:

No. of beds:

Patient turnover:

No.	Practices	Yes	No	Comments
<b>A</b>	<b><i>Segregation Practices</i></b>			
4.	Are the waste containers located at the convenient places for the staff?			
5.	Sharps containers are made of a puncture-resistant material (cardboard, plastic, or metal).			
6.	The staff are well aware of the hospital waste segregation practices.			
7.	The hospital staff strictly follows the segregation practices.			
<b>B</b>	<b><i>Collection Practices</i></b>			
1.	Hospital waste is collected twice daily. Time.....			
2.	Which category of waste is generated mostly?			
3.	Are the waste bags sealed when 3/4 full?			
4.	Leak-proof containers with plastic inside are used for collection of infectious waste.			
5.	Sharp containers are filled up to ¾th level.			
6.	Before collection all the waste containers are properly labeled.			
7.	While collecting waste, the waste handlers use the following PPE; <ul style="list-style-type: none"> <li>• Mask</li> <li>• Gloves</li> <li>• Apron</li> <li>• Gumboots</li> </ul>			
<b>C</b>	<b><i>Storage Practices</i></b>			
1.	The storage site is located in a safe place within the hospital where it is minimally accessible to staff, clients, and visitors.			
2.	All storage containers/bags have lids and are well covered.			
3.	Different categories of waste are stored in their respective containers.			
4.	Waste is never stored at the storage sit for more than 48 hours before final disposal.			
5.	Storage sites are protected by a barrier such as a fence or wall to keep animals and children out.			
6.	There is someone responsible for hospital waste storage procedures in JDWNRH.			
7.	Staff responsible for storing waste use the following PPE; <ul style="list-style-type: none"> <li>• Mask</li> <li>• Gloves</li> <li>• Apron</li> <li>• Gumboots</li> <li>• Others (specify)</li> </ul>			

**Checklist for Observation on Hospital waste management in JDWNRH *continued***

Unit/Department:

No. of beds:

Patient turnover:

No.	Practices	Yes	No	Comments
8	There is a washing facility in the waste storage room.			
<b>D.</b>	<b><i>Transportation Practices</i></b>			
1.	Waste trolleys are used to transport waste from the generation site to storage site.			
2.	When transporting waste containers within the facility, the containers/bags are closed sealed properly.			
3.	Waste trolleys are washed thoroughly every day.			
4.	Hospital waste is transported via separate route designed for waste transportation and not via the common route.			
5.	The waste bags are labeled well before being transported to the storage area.			
6.	While transporting waste, the personnel involved use the following PPE; <ul style="list-style-type: none"> <li>• Mask</li> <li>• Gloves</li> <li>• Apron</li> <li>• Gumboots</li> <li>• Others (specify)</li> </ul>			
7.	The hospital waste is transported as per the ICHWM Guideline.			
<b>E.</b>	<b><i>Treatment Practices</i></b>			
1.	What are the different treatment facilities available <ul style="list-style-type: none"> <li>• Autoclave</li> <li>• Chemical disinfection</li> <li>• Others (specify)</li> </ul>			
2.	Are there enough autoclaves for the amount of waste generated?			
3.	There are trained personnel to autoclave hospital waste.			
4.	Do the staff involved in hospital waste treatment use The following PPE; <ul style="list-style-type: none"> <li>• Mask</li> <li>• Gloves</li> <li>• Apron</li> <li>• Gumboots</li> <li>• Others (specify)</li> </ul>			
5.	Are the liquid hazardous waste treated prior to disposal?			
6.	Are there any problems for the treatment of hospital waste in JDWNRH? If yes, list them down;			
<b>F.</b>	<b><i>Disposal Practices</i></b>			
1.	Hospital waste is disposed as per the characteristics of waste.			
2.	All solid waste from the hospital is disposed in the landfill.			

**Checklist for Observation on Hospital waste management in JDWNRH *continued***

Unit/Department: \_\_\_\_\_ No. of beds: \_\_\_\_\_ Patient turnover: \_\_\_\_\_

3.	Sharp wastes are disposed carefully in the burial pit within the hospital.			
4.	The burial pit is at least 50 meters away from any water source.			
5.	Every time waste is added to the pit, it is covered with a 10-30-cm layer of soil.			
6.	Liquid medical waste and hazardous chemical waste are poured down a drain, toilet, or sink.			
7.	The personnel involved in hospital waste disposal use the following PPE; <ul style="list-style-type: none"> <li>• Mask</li> <li>• Gloves</li> <li>• Apron</li> <li>• Gumboots</li> <li>• Others (specify)</li> </ul>			

**Checklist for waste present in each unit**

Name of the unit - \_\_\_\_\_

No	Waste Item	Yes	No	Not Sure	Amount	Remarks
<b>I</b>	<b>General waste</b>					
1	Paper					
2	Plastics					
3	Cardboard					
4	Food waste					
5	Saline bottles					
6	Cloth pieces/rags					
7	Others(specify)					
<b>II</b>	<b>Infectious waste</b>					
1	Syringes					
2	Gauze					
3	Cotton					
4	Bandages					
5	I/V sets					
6	I/V canula					
7	Culture dish					
8	Catheters					
9	Drainage tubes					
10	Used dressing sets					
11	Used Forceps					
13	Dialysis tubings					

**Checklist for waste present in each unit *continued***

Name of the unit -

14	Others (specify)					
<b>III</b>	<b>Sharps</b>					
1	Needles					
2	Blades/Scalpels					
3	Bones					
4	Others (specify)					
<b>IV</b>	<b>Pathological waste</b>					
1	Body parts (Amputated limbs, etc)					
2	Dead fetus					
3	Placenta					
4	Blood and blood products					
5	Stool					
6	Urine					
7	Others (specify)					
<b>V</b>	<b>Pharmaceutical waste</b>					
8	Expired drugs					
9	Contaminated drugs					
10	Unused drugs					
11	Others (specify)					
<b>VI</b>	<b>Genotoxic waste</b>					
1	Cytotoxic drugs					
2	Others (specify)					
<b>VII</b>	<b>Chemical waste</b>					
1	Disinfectants					
2	Film developer					
3	Laboratory reagents					
4	Solvents					
5	Others (specify)					
<b>VIII</b>	<b>Waste with heavy metals</b>					
1	Broken thermometers					
2	Broken BP apparatus					
3	Others (specify)					
<b>IX</b>	<b>Pressurized containers</b>					
1	Gas cylinders					
2	Gas cartridges					
3	Aerosol cans					
4	Others (specify)					
<b>X</b>	<b>Radioactive waste</b>					
1	Stool tested with radio nuclides					
2	Contaminated glassware					
3	Urine tested with radio nuclides					
4	Packages					
5	Absorbent papers					
6	Others (specify)					

## APPENDIX C

### Time Schedule

Research Activities	Jan 2011	Feb	Mar	April	May	June	July	Aug	Sept
Literature review	←→								→
Proposal writing and Proposal exam			←→						
Ethical Approval					←→				
Data collection						←→			
Data analysis and Thesis defense							←→		
Report writing and Printing									←→

**APPENDIX D**  
**Financial Chart**

<b>Sl. No.</b>	<b>Activity</b>	<b>Unit Cost</b>	<b>Number of Unit</b>	<b>Total costs</b>	<b>USD</b>
1.	Airfare	15,000 +7500	2 way	22,500	776
2.	Gift for participants (pen)	10	275	2750	95
3.	Stationeries – printing and Photocopying (Lump sum)	-	-	15,000	517
4.	Payment for Research assistant and refreshment	500* 5	3	7500	260
5.	Miscellaneous (unforeseen)	-	-	5000	175
<b>TOTAL</b>				<b>52,750(THB)</b>	<b>1823(USD)</b>



## APPENDIX E

### Ethical Approval



རྒྱལ་ཡོད་འབྲུག་གཞི་རྒྱུ་རྒྱུ་རྒྱུ་  
ལྷན་ཁག་གི་འཕྲིན་ལུགས་ལྷན་ཁག་

ROYAL GOVERNMENT OF BHUTAN  
MINISTRY OF HEALTH  
THIMPHU BHUTAN  
P.O BOX: 726



REBH/Approval/11/010

Date: 10<sup>th</sup> June 2011

#### REBH Approval Letter

<b>PI:</b> Ms. Tara Devi Laabar <b>Institute:</b> Chulalongkorn University <b>Country:</b> Thailand	<b>Study Title:</b> Hospital Waste Management: A Study on Knowledge, Attitude and Practices among Health Staff and Waste Handlers in Jigme Dorji Wangchuk National Referral Hospital, Thimphu, Bhutan	
<b>REBH's Decision</b> Approved with conditions	<b>Protocol Version No</b> 003 <b>Dated:</b> 7 <sup>th</sup> June 2011	<b>Informed Consent</b> <b>Version No:</b> 1 <b>Dated:</b> 7 <sup>th</sup> June 2011
	<b>Mode of Review:</b> <input type="checkbox"/> Full Board Review Meeting .... <input checked="" type="checkbox"/> Expedited Review	
<b>Conditions for Approval</b> <ol style="list-style-type: none"> <li>1. No biological material shall be used for other research purpose beyond which is specified in this protocol.</li> <li>2. Any new research study with stored biological material from this study will need a new approval from the REBH before study begins.</li> <li>3. Any adverse outcome during the course of the study must be immediately reported to the REBH.</li> <li>4. In the event of any form of complaints/issues from the study participants received or communicated to REBH, the board will have the right to investigate.</li> <li>5. Training to be provided to data collectors on informed consent.</li> <li>6. Referral should be done to nearest health facilities for further examination in case of any disease detected in course of your study.</li> <li>7. Final report of the study both in soft and hard copy must be submitted to REBH at the end of the study before publishing.</li> <li>8. Any changes to the proposal or to the attachments (informed consent and research tools such as forms) should be approved by REBH before implementation</li> <li>9. The approval for this proposal is valid ONLY for ONE year from the approval date.</li> <li>10. You should submit the periodical report to REBH every ONE MONTH</li> </ol>		

(Dr. Phurb Dorji)  
Chairperson-REBH

Chairperson  
Research Ethics Board of Health  
Ministry of Health

For further information please contact:  
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## VITAE

Name : Mrs. Tara Devi Laabar

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Educational Qualification : Bachelors in Nursing  
Royal Institute of Health Sciences (RIHS) in  
collaboration with the Latrobe University,  
Australia.

Masters in Public Health - Environment and  
Occupational Health, College of Public  
Health, Chulalongkorn University, Bangkok,  
Thailand.

Work Experience : Worked in District Hospital, Paro, as Staff  
Nurse – 2000.

Worked in JDWNRH as Staff Nurse –2001-  
2002.

Worked in District Hospital, Bumthang, as  
Chief Nurse –2003-2007.

Worked in JDWNRH as Sr. Staff Nurse –  
2008- 2010 September.

MPH Course – Oct. 2010 – Sept 2011

Lecturer in RIHS, Royal University of  
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onwards.