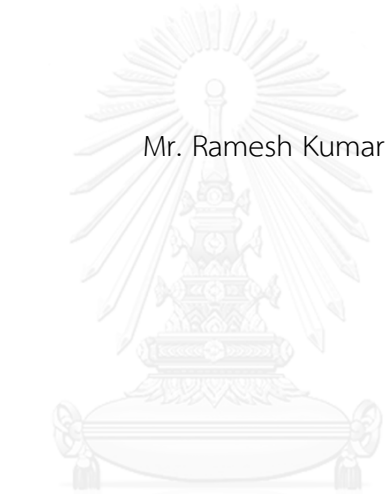
THE EFFECTIVENESS OF INTENSIVE HEALTHCARE WASTE MANAGEMENT MODEL (IHWMM) REGARDING INFECTIOUS HOSPITAL WASTE AT TERTIARY CARE HOSPITALS OF RAWALPINDI PAKISTAN

Mr. Ramesh Kumar



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ประสิทธิผลของรูปแบบการจัดการขยะติดเชื้อในโรงพยาบาลระดับตติยภูมิ ราวันปินดี ประเทศปากีสถาน

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรดุษฎีบัณฑิต
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ราเมศ คูมาร์ : ประสิทธิผลของรูปแบบการจัดการขยะติดเชื้อในโรงพยาบาลระดับตติยภูมิ ราวันปินดี ประเทศปากีสถาน (THE EFFECTIVENESS OF INTENSIVE HEALTHCARE WASTE MANAGEMENT MODEL (IHWMM) REGARDING INFECTIOUS HOSPITAL WASTE AT TERTIARY CARE HOSPITALS OF RAWALPINDI PAKISTAN) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร.รัตนา สำโรงทอง, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ. ดร.บาบาร์ ทัสนีม เชค, หน้า.

ขยะติดเชื้อเป็นปัญหาที่ถูกละเลยในประเทศที่กำลังพัฒนา ซึ่งส่งผลอย่างมากต่อสภาวะแวดล้อม และผลกระทบอื่นๆในวงกว้าง บุคคลากสาธารณสุขมีบทบาทสำคัญในการจัดการขยะติดเชื้อ ในโรงพยาบาล ดังนั้นการอบรม และให้ความรู้แก่บุคคลากรเป็นเรื่องที่ต้องเร่งดำเนินการ การศึกษาครั้งนี้ มีวัตถุประสงค์เพื่อ ประเมินผลของโมเดลการฝึกอบรมแบบเข้มข้นใน โรงพยาบาลระดับตติยภูมิ เมืองราวันปินดี ประเทศปากีสถาน.

การศึกษากึ่งทดลองครั้งนี้ได้มีการทำกิจกรรมแทรกแซงโดยวัดผลก่อนและหลังการทดลอง จากกลุ่มตัวอย่าง 275 ราย โดย138 รายเป็นกลุ่มทดลอง ได้จัดทำกิจกรรมแทรกแซง โดนได้รับการฝึกอบรม 3 เดือน แผ่นพับ และการย้ำเตือนเรื่องในการจัดการขยะติดเชื้อ ในโรงพยาบาล และ 137 ราย เป็นกลุ่มควบคุม ซึ่งมีกิจกรรมการจัดการขยะติดเชื้อ ในโรงพยาบาลตามปกติ การวัดผลก่อนและหลังการทดลองเป็นการวัดความรู้ ทัศนคติ แ ละพฤติกรรม โดยใช้สถิติ การวิเคราะห์สองตัวแปร การวิเคราะห์พหุตัวแปร t-test pair t-test และ chi square.

ผลการศึกษาพบว่า ร้อยละ 92 ตอบแบบสอบถามครบถ้วนหลังจากการทดลอง 3 เดือน จากการสำรวจก่อนการทดลอง บุคคลากร 275 ซึ่งประกอบด้วย แพทย์ พยาบาล เจ้าหน้าที่การแพทย์ และคนงานทำความสะอาด ตอบแบบสอบถาม หลังการทดลอง 3 เดือน 255 รายตอบแบบสอบถาม ซึ่งความรู้ ทัศนคติ แ ละพฤติกรรมในเรื่องการจัดการขยะติดเชื้อ ในโรงพยาบาล ก่อนการทดลอง ไม่มีความแตกต่างกัน แต่หลังการทดลอง 3 เดือน พบว่าความรู้ ทัศนคติ แ ละพฤติกรรม ระหว่างกลุ่มทดลอง กับกลุ่มควบคุม ตลอดจนระหว่างภายในกลุ่มทดลอง มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ p value <0.001.

สรุปได้ว่า โมเดลการฝึกอบรมแบบเข้มข้นใน โรงพยาบาลระดับตติยภูมิครั้งนี้ มีผลในการเพิ่มความรู้ ทัศนคติ แ ละ พ ฤ ติ ก ร ร ม ใ น เ รื่ อ ง ก า ร จั ด ก า ร ข ย ะ ติ ด เ ชื้ อ ในโรงพยาบาลของบุคคลากร ดังนั้นการอบรมให้ความรู้ควรดำเนินการอย่างต่อเนื่องสม่ำเสมอเพื่อลดอันตรายจากขยะติดเชื้อ.

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สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต .....

ปีการศึกษา 2557 ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

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KEYWORDS: HEALTHCARE WASTE / WASTE MANAGEMENT / HEALTHCARE WORKERS / INFECTIOUS WASTE / QUASI-EXPERIMENTAL STUDY

RAMESH KUMAR: THE EFFECTIVENESS OF INTENSIVE HEALTHCARE WASTE MANAGEMENT MODEL (IHWMM) REGARDING INFECTIOUS HOSPITAL WASTE AT TERTIARY CARE HOSPITALS OF RAWALPINDI PAKISTAN. ADVISOR: ASSOC. PROF. RATANA SOMRONGTHONG, Ph.D., CO-ADVISOR: ASSOC. PROF. BABAR TASNEEM SHAIKH, Ph.D., pp.

Infectious waste management has always remained a neglected public health problem in the developing countries, resulting in high burden of environmental pollution affecting general masses. Health workers are the key personnel who are responsible for the management of infectious waste at any hospital, however, their proper training and education is must for an optimal performance. This interventional study was conducted to assess the effectiveness of Intensive healthcare waste management (IHWM) training model at two tertiary care hospitals of Rawalpindi city, Pakistan. This study was quasi-experimental pre and post design with control and intervention groups. Out of 275 health care workers enrolled for the study, 138 workers were assigned for intervention group for 3 months trainings, hands-on practicum and reminders on infectious waste management; whereas 137 workers were assigned to the control hospital where routine activities on infectious health care waste management were performed. Pre and post intervention assessment was done for knowledge, attitude and practices (KAP); and was statistically analyzed. Bivariate and multivariate analysis, independent, paired and unpaired t-test, chi-square with p values, and mean of the responses were calculated. Overall the response rate was 92% at the end of intervention. During the baseline survey, 275 healthcare workers (HCW) included doctors, nurses, paramedics and sanitary workers, and after 3 months of intervention, 255 were reached out to complete the questionnaire. With regard to KAP at baseline, there were no significant differences between two groups at baseline, except for gender and department. However, in the post intervention survey, statistically significance difference (<0.001) between intervention and control group's knowledge, attitude and practices was found. Moreover, within the control group no statistically significant difference was reported (>0.001) after 3 months. Study concluded that IHWM training model has proved to be an effective intervention for improving knowledge, attitudes and practices among health workers regarding infectious waste management. Such training should become a regular feature of all hospitals for reducing the hazards attached with infectious wastes.

Field of Study: Public Health

Academic Year: 2014

Student's Signature .....

Advisor's Signature .....

Co-Advisor's Signature .....

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จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

CONTENTS

Page

THAI ABSTRACT iv

ENGLISH ABSTRACT v

ACKNOWLEDGEMENTS vi

CONTENTS vii

LIST OF FIGURES xiii

LIST OF TABLES xiv

Chapter 1 Introduction 1

1.1 Knowledge Gap 4

1.2 Scope of the study 5

1.3 Research questions 6

1.4 Research objectives 6

1.5 Hypothesis 7

1.6 Expected outcomes 7

1.7 Study Area 7

1.7 Conceptual Framework 10

1.8 Theory for intervention development: 11

1.9 Operational Definitions 13

1.9.1 Socio-demographic variables: 13

1.9.2 Knowledge 14

1.9.3 Practices 14

1.9.4 Intensive healthcare waste management model (IHWM) 15

1.9.5 Environmental factors 15

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Page

1.9.6 Improvement of knowledge and practices of HCWs 16
Chapter 2 Literature review 17
2.1 Global scenario: 17
2.2 National Scenario: 20
2.3 Infectious waste management Practices in Pakistan: 21
2.4 Hospital Waste Management Rules 2005: 23
2.5 Definition of health care waste: 24
2.5.1 Types of Infectious waste: 25
2.5.2Sources of Infectious waste: 27
2.6 Risk caused by poor management of infectious wastes: 28
2.7.1 Segregation: 30
2.7.2 Collection 31
2.7.3 Transportation 31
2.7.4 Storage 31
2.7.5 Treatment 31
2.7.6 Disposal 32
2.8 The Intervention: Intensive Health Care Waste Management (IHWM) Model: ... 32
2.8.1 Components of IHWM model: 33
2.8.2 Activities of IHWM model: 35
Chapter 3 Research Methodology 39
3.1 Research Design 39
3.2 Study Area 40
3.3 Study Population 41

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Page

3.5 Sampling Technique 43
3.6 Study Duration 44
3.7 Research instrument 44
3.7.1 Structured Questionnaire: 44
3.7.2 In-depth Interview: 45
3.7.3 Observations 45
3.8 Validity and Reliability 45
3.9 Data Collection 46
3.10 Data Analysis 46
3.11 Study time line 49
3.12 Ethical Considerations 52
3.13 Benefits of this study 53
Chapter-4 Results 55
4.1 PART I: Descriptive findings 56
4.1.1 General and socio economic characteristics 56
4.1.2 Knowledge about infectious waste management before intervention 59
4.1.3 Attitude regarding the infectious waste management before intervention 60
4.1.4 Practices regarding infectious waste before intervention 61
4.1.5 Enabling factors on infectious waste management 62
4.1.6 Knowledge, attitude and practice scores 62
4.2 PART 2: Effectiveness of IHWM Model 64
4.2.1 Knowledge of subjects regarding infectious waste after intervention 64

Page

4.2.2 Attitude of subjects regarding infectious waste after intervention..... 66

4.2.3 Practices of subjects regarding infectious waste after intervention 68

4.2.4 Mean difference in Knowledge, attitude & Practices of subjects regarding infectious waste with in both groups 70

4.2.5 Mean difference after intervention in Knowledge, attitude & Practices of subjects regarding infectious waste with in both groups 71

4.3 PART 3: Qualitative findings 73

4.3.1 Direct Observations: 73

4.3.1.1 Segregation of infectious waste 74

4.3.1.2 Collection of infectious waste 75

4.3.1.3 Storage of infectious waste 76

4.3.1.4 Disposal of infectious waste 77

4.3.2 In-depth interviews: 79

Chapter 5 Discussion 88

5.1 Socio-demographic characteristics 90

5.3 Effectiveness of the IHWM Model 96

5.3.1 Knowledge and trainings on infectious waste management: 98

5.3.2 Attitude on infectious waste management: 100

5.3.3 Practices on infectious waste management and use of PPE: 102

5.4 Conclusion 105

5.5 Limitations 108

5.6 Strengths 109

5.7 Recommendations 110

5.7.1 For Policy makers 111

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Page

5.7.2 For health care workers 112
5.7.3 Impact of services 113
5.7.4 For researchers 113
5.8 Health System and Policy implications of this research 114
5.9 Acknowledgment 114
REFERENCES 115
APPENDIX 123
APPENDIX I: Informed Consent Form 124
APPENDIX II-A: Questionnaire (Doctors, nurses and paramedical staff) 125
APPENDIX II-B: Questionnaire (Sanitary workers) 134
ANNEX-II-C In-depth Qualitative Questionnaire 140
APPENDIX-III Checklist 141
APPENDIX-IV Time Frame 148
APPENDIX-V Budget (In baht) 149
Appendix –VI Ethical approval letter 150
Appendix VII: Knowledge statement among Health staff 151
Appendix VIII: Knowledge statements among sanitary workers 153
Appendix IX: Attitude among health staff 155
Appendix X: Attitude among sanitary workers 158
Appendix XI: Practices statements among health staff 160
Appendix XII: Practices statements among sanitary workers 162
Appendix XIII: Statements on enabling factors for health staff 164
VITA 168

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

LIST OF FIGURES

Figure 1-1: Map showing the area of study 9

Figure 1-2: Conceptual framework 10

Figure 1-3: Effective training intervention theory 13

Figure 4-1: Segregation practices in both hospitals 74

Figure 4-2: Collection of non-infectious waste 76

Figure 4-3: Storage of infectious waste 77

Figure 4-4: Disposal of infectious waste 79

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

LIST OF TABLES

Table 4.1: Socio-demographic characteristics of the participants (n=275)..... 58

Table 4.2: Level of Knowledge among health staff and sanitary workers in both groups before intervention..... 59

Table 4. 3: Level of attitude among health staff and sanitary workers in both groups before intervention 61

Table 4.4: Level of practices about infectious waste among health staff and sanitary workers in both groups before intervention 62

Table 4.5: Mean differences in Knowledge, attitude and practices between both groups at baseline (before intervention). 63

Table 4.6: Percentage of Knowledge of subjects regarding infectious waste (pre & post) 65

Table 4.7: Knowledge level among the subjects with significance in pre & post intervention 66

Table 4.8: Percentage of Attitude of subjects regarding infectious waste (pre & post) 67

Table 4.9: Attitude level among the subjects with significance in pre and post intervention 68

Table 4.10: Percentage of practices of subjects regarding infectious waste (pre & post) 69

Table 4.11: Practices among the subjects with significance in pre and post intervention 70

Table 4.12: Mean difference in Knowledge, attitude & practices pre and post scores within and across groups 71

Table 4.13: Mean difference after intervention in Knowledge, attitude & Practices of subjects regarding infectious waste with in both groups 72

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Chapter 1

Introduction

Hospital is the place where infectious healthcare waste is being generated due to the provision of medical care services to the patients. This infectious waste needs a special attention for its proper disposal. Improper infectious waste management has posed major environmental threats and is now being reported as a serious public health issue worldwide (1). Most populous countries such as Pakistan, India, China, Nigeria and Bangladesh are having the improper infectious waste management practices in the hospitals that result in occupational and public health challenges for the general masses (2). Health care activities in these hospitals produce a lot of infectious waste lead to a higher risk for infection and injury than any other type of waste. Mishandling of health care waste due to poor and improper information of healthcare workers (HCWs) may have serious health effects on the environment in terms of air, water and land pollution. It has been reported that the health care waste generation rate ranges from 0.5 to 2.0 kg per bed per day globally. (3). Health care waste can be classified as non-infectious and infectious waste. The major portion of this infectious waste 75-90% is non-infectious, while 10-25% is the infectious waste that needs special attention. Non-infectious waste consists of non-hazardous materials which do not have any potentially harmful effects on health and do not need any special management and disposal measures. Infectious waste that is composed of potentially hazardous materials such as sharps, syringes, needles, blades, human parts, waste contaminated with blood, body tissue, body secretion and vomitus of the patients and other contagious and infectious items that need to be disposed properly by the trained personnel (4). Recycling and reuse of

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the syringes is another serious public health problem reported globally, resulting in potential threats to the general public. The main threat is needle prick injuries especially among the Health Care Workers who are handling the waste (5). The hospitals also produce many toxic wastes including used syringes, bandages, intravenous drip bottles, blood bags, biomedical waste such as organs and medical instruments. Particularly, these sharp instruments have reported frequent injuries among the health care workers (6). Infectious waste results in severe health problems due to their highly infectious nature because that contains toxic substances such as microorganisms and chemicals (7). Approximately 12,000 million injections were used every year and constitute about 1% of sharp waste globally. Studies from Pakistan show 52% of doctors had reported the needle prick injuries during the patient handling (8).

Infectious Health care waste is composed of the materials that are produced from medical treatment in the medical units such as offices of general practitioner and dental clinics, chiropractors, acupuncture, at home patient care, from harm reduction programs for drug addicts, maternity homes, diagnostics laboratories, immunization and scientific research (9). Improper and mismanagement of infectious health care waste results in environmental pollution and unpleasant odours due to harmful pathogens that may develop many infections such as typhoid, cholera, tuberculosis and other blood borne diseases namely hepatitis and HIV/ AIDS. Health workers, patients, waste handlers, waste pickers and general masses are prone to acquire these infections. Hence, there is an urgent need to have all kinds of wastes be treated properly (10).

About 1.35 kg of health care waste is generated every day by each bed from the hospitals of Pakistan. There are around 92,000 beds available in the public hospitals of Pakistan which produce 0.8 million tons of waste each day (11). A large amount of health care waste is incinerated but this practice is limited due to the environmental concern because that burning of solid and health care waste produced by health facilities resulting in many health problems. Health care waste incinerators discharge toxic air noxious waste and poisonous ash residues that are the big source of dioxins in the environment. The noxious ash residues are finally disposed off in the landfills which ultimately are converted as a leach into groundwater and contaminate it. Health care wastes has been recognized by the US Environmental Agency as the 3rd leading known cause of dioxin air pollution and add in 10% of mercury poisoning in the environment from human activities (12). The air pollutants influence the local environment and may involve general masses living in the atmosphere. Dioxin is known to be lethal toxic chemicals which affects very badly on the human health and cause cancer, immune system disorders, diabetes, birth defects and interrupt the sexual development (13). The biomedical waste management (BMW) Rules, 2000 propose autoclaving at temperature of at least 132°C (30-60minutes) for disposables, microbiological waste and sharps. However, health care waste such as anatomical and pathological wastes, low-level radioactive waste, organic solvents, laboratory chemicals, and chemotherapy waste should not be recommended for a treatment in an autoclave (14).

Segregation in waste management is an important step and can be effectively ensured through training and education of the health care workers in the organization. Protection of environment through compliance of the hospital waste

management could be achieved through dedicated and intensive trainings of the staff. Studies from many developing countries with same sort of situation reveal that these trainings of health care workers with proper demonstration can lead to better practices regarding health care waste practices. Implementing effective health-care waste management programmes require multi-sectoral cooperation and interaction at all levels (3). Establishment of a national policy and a legal framework, training of hospital personnel, and raising public awareness are essential elements of successful health-care waste management. Improved public awareness of the problem is vital in encouraging community participation in generating and implementing policies and programmes. Management of health-care waste should thus be put into a systematic, multi-faceted framework, and should become an integral feature of health-care services. Change will be gradual and should be technically and financially sustainable in the long term. Hospitals and other health-care establishments have a "duty of care" for the environment and for public health, and have particular responsibilities in relation to the waste they produce (15).

1.1 Knowledge Gap

In Pakistan, there is lack of information related to infectious infectious waste management. However, not a single interventional study has been conducted in the past. To address this grave situation, Pakistan government has passed the bill in parliament and finally introduced a Hospital waste management rules in 2005. Assessment studies reviewed the situation and compiled that the practices in the hospitals are not according to these rules and guidelines and assessed various needs like training of healthcare workers and financial and other resources needed for their implementation. Another study show that health workers including doctors, nurses,

paramedical staff and sanitary workers are only responsible for proper health care waste management in the hospitals but their poor practices regarding segregation, mishandling, transportation, storage and disposal of waste poses big challenge. Hence, dedicated and intensive trainings of staff can positively influence their practices in any organization (16). Researchers had strongly recommended the trainings for health care workers to enhance their practices regarding infectious waste management and also proved that these hospitals are not following the proper waste management rules by government of Pakistan. The issue of segregation is reported at the ward level, where infectious waste is mixed with non infectious waste due to the improper waste management practices of healthcare workers and results infects the entire waste (8).

1.2 Scope of the study

This study has provided the information on health care waste management in better way and filled the existing gap regarding the lack of data in the study area on infectious waste management. Moreover, this study concentrated on support for the health care workers; their capacity building and to improve their practices in infectious waste Management, to solve their problems satisfactorily related to infectious waste. The study will engage with the health workers, who are working in tertiary care hospitals, for their trainings and this intervention will ultimately benefit the health care system of Pakistan by having well trained health care professionals and by improving their waste handling practices.

1.3 Research questions

1.2.1 What is the situation of infectious waste management practices among HCWs working at both control & intervention tertiary hospitals of Rawalpindi Pakistan?

1.2.2 What is the difference of Knowledge, attitude and Practices of health care workers about infectious waste management between control and intervention tertiary care hospitals of Rawalpindi, Pakistan?

1.2.3 What is the difference of Knowledge, attitude and Practices of health care workers about infectious waste management between pre and post intervention both intervention and control tertiary care hospitals of Rawalpindi, Pakistan?

1.2.4 What is the effectiveness of IHWM model among health care workers on infectious waste management in intervention hospital as compared with control tertiary care hospital of Rawalpindi, Pakistan?

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1.4 Research objectives

1.3.1 To describe the situation of infectious waste management practices among HCWs working at both control and intervention tertiary hospitals of Rawalpindi Pakistan.

1.3.2 To determine the difference of Knowledge, attitude and Practices of health care workers about infectious waste management between control and intervention tertiary care hospitals of Rawalpindi, Pakistan

1.3.3 To determine the difference of Knowledge, attitude and Practices of health care workers about infectious waste management between pre and

post intervention both intervention and control tertiary care hospitals of Rawalpindi, Pakistan.

1.3.4 To assess the effectiveness of IHWM model among health care workers on infectious waste management in intervention hospital as compared with control tertiary care hospital of Rawalpindi, Pakistan.

1.5 Hypothesis

1.4.1 There is no difference in Knowledge, attitude and practices among HCWs regarding infectious waste management in both control and intervention hospital of Rawalpindi Pakistan before the intervention.

1.4.2 There is no difference in Knowledge, attitude and Practices among HCWs regarding infectious waste management in both control and intervention hospital of Rawalpindi Pakistan after the intervention.

1.6 Expected outcomes

The expected outcome measure at the end of the research is to improved Knowledge, attitude and practices regarding infectious waste management on segregation, collection, storage and disposal of waste among health care workers working at the tertiary care hospitals of Rawalpindi Pakistan.

1.7 Study Area

Rawalpindi is a metropolitan city of the district Rawalpindi, situated in the northwestern part of Pakistan adjacent to Islamabad Capital territory and Khyberpukhtoonkhwa province are placed on the north side, on the south city is surrounded by Chakwal and Jhelum districts and on the west by the Attock district.

The total area of the district Rawalpindi is 52864 square kilometers. Climate varies from 2.6°C in month of January to above 38.6°C in June. Rawalpindi district consisted on 6 tehsils i.e. Rawalpindi, Gujar Khan, Murree, Kahuta, Taxila, Kotli Sattian and Kallar Syedan and consisted on 168 union councils including 114 rural and 54 urban. The population of Rawalpindi is 3,991,000 (17).

In Rawalpindi city, there are four teaching hospitals; Holy Family hospitals, District Headquarter hospital, Rawalpindi General Hospital and the Railway hospital. These hospitals cater the health care services needs directly and patient referral from the district. In addition, there are 4 tehsil headquarter hospitals (THQ), 10 rural health centers (RHCs), 98 basic health centers (BHUs) and 66 dispensaries providing basic health care services in the district. Holy family hospital and District headquarter hospital were included in the study as an intervention and control hospital, respectively these two hospitals have the similar infectious waste management practices.

Although Rawalpindi city has the best health infrastructure in the province because of its close location to the capital city of Pakistan-Islamabad, the metropolitan still needs more quality services. Quality of services in the government hospitals and other health care institutions is a cause of concern. There is an increasing role for the private sector, but this sector caters most definitely for the more affording sections of the society (18).

Source: Government of Pakistan 2013

Figure 1-1: Map showing the area of study

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1.7 Conceptual Framework

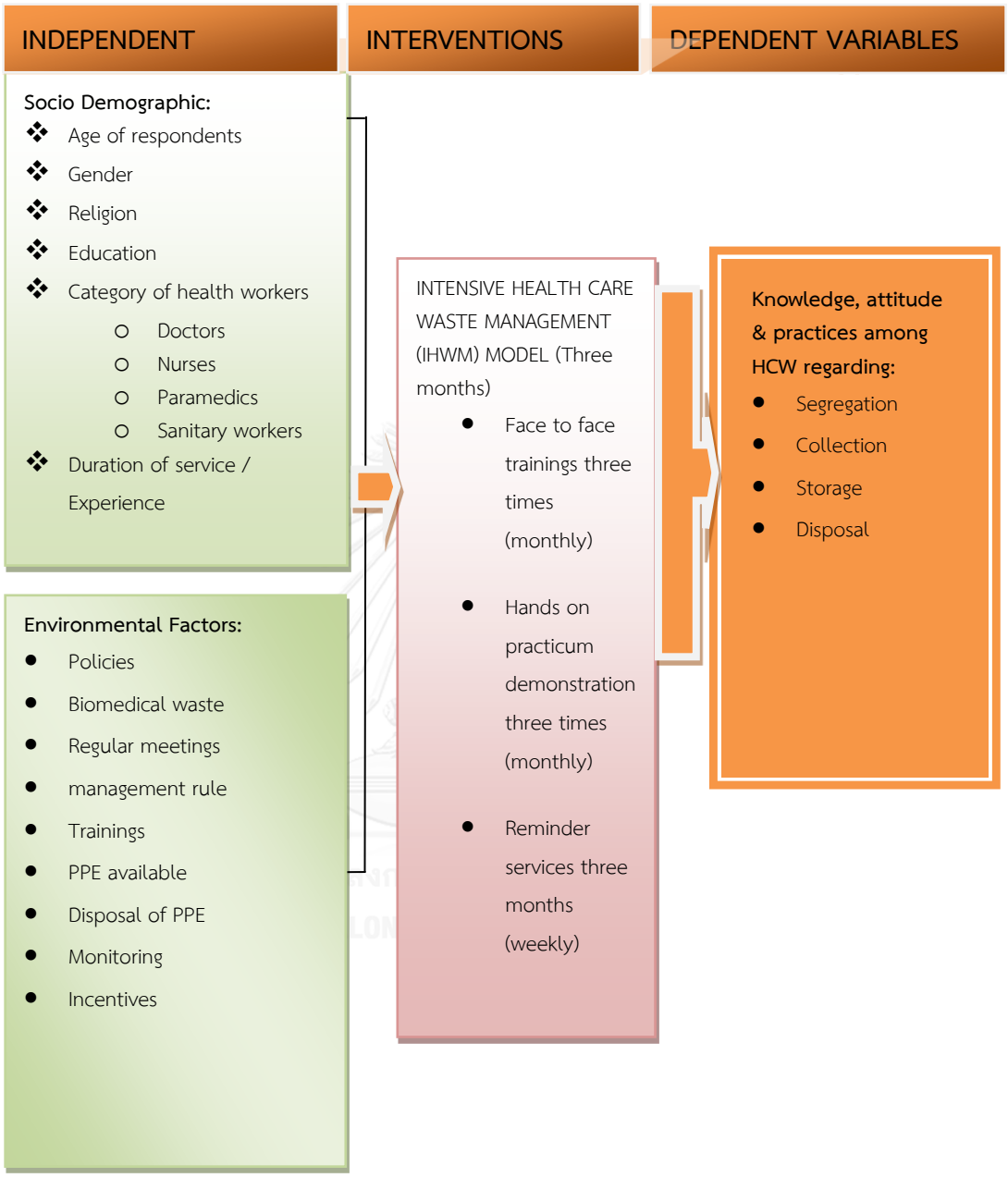

Figure 1-2: Conceptual framework

1.8 Theory for intervention development:

In this study, the approach of intensive healthcare waste management training was modified from earlier studies. The application scheme comprises three approaches: face to face trainings, on hand practicum demonstration, and reminder services. Each of health care worker aims to strengthen the intention to practice. The routine habit of frequency and better quality of practice are expected outcomes.

Face to face trainings have been proven to be one of the most effective strategies for improving the practices and health behavior, especially when combined with other training interventional approaches (15) (19). Similarly, practicum demonstration and use of information materials also play an additional beneficial role for to improving the behavior of individuals in any organization (20). Individual trainings with demonstration are the most efficient approach to instruct and visualize the proper techniques. The main objective is to give health staff the opportunity to practice these skills and to provide an opportunity to facilitators to explain the logical reasoning, provide feedback, real situation and correction and also reinforce messages regarding the proper management and good practices (21). This IHWM intervention program brings positive change in the behaviour of an individual's through trainings. Behaviour change is very difficult task when performed in the individuals. This needs integrated educational program and continuous learning activities. Studies also show that these kind of cognitive behavioral programs are very effective when introduced by a trained and dedicated team in the organization. This program brings positive change within the shorter duration of time (22).

Environment is a major factor in enabling the practices of health care waste management. Facilitators include the availability and easy implementation of the

guidelines. Barriers such as non availability of Personal Protective Equipments (PPE) and hospital waste management bins / materials in the health facilities must be ensured. Therefore, proper distribution and availability should be ensured as per the available HWM rules of these equipments at the hospital (23).

Reminder service through administration and facilitators encourages the health workers in monitoring and controlling their behavior attributed to a particular unhealthy practice. Although, these reminder services have not been previously practice in the health care waste management interventions, it has been successful in assisting individuals in achieving health behavior modification, such as weight control (24). Therefore, this study supplemented the reminder service through administration in the intervention with an expectation that it would help maintain good health waste management practices.

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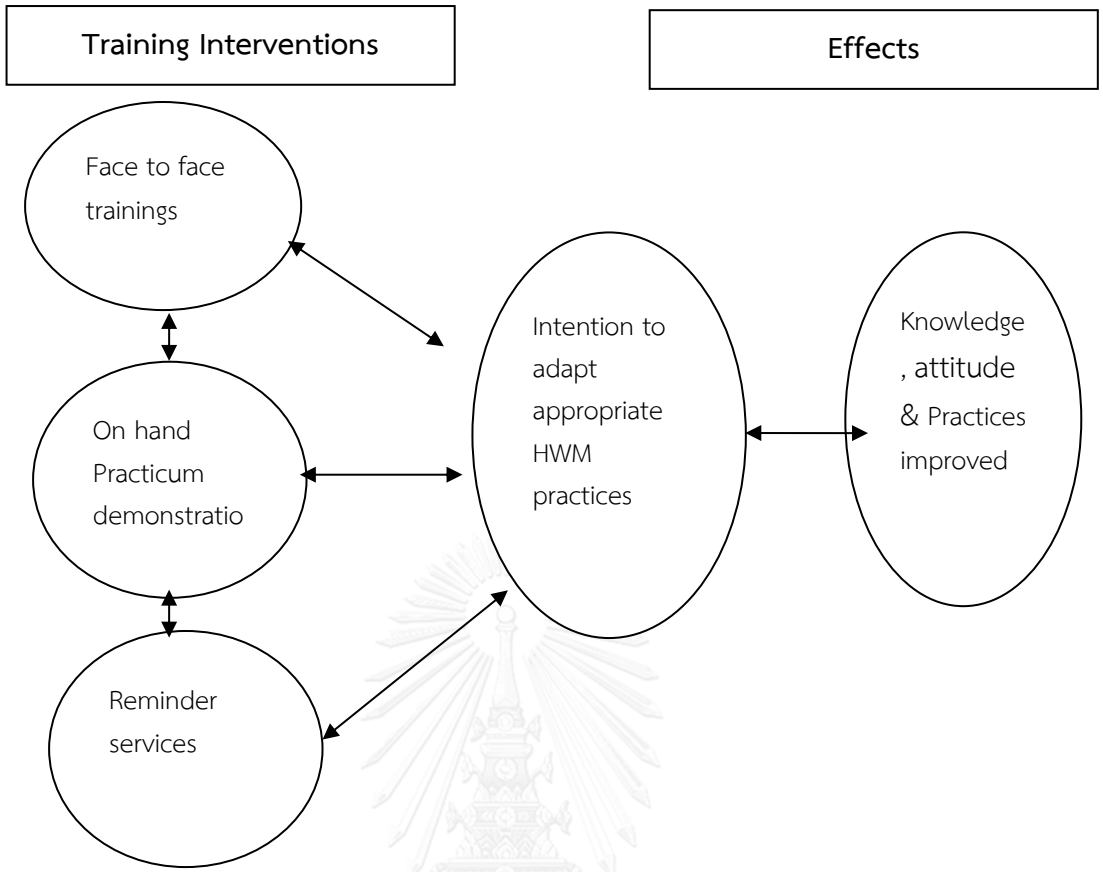

Figure 1-3: Effective training intervention theory

1.9 Operational Definitions

1.9.1 Socio-demographic variables:

These variables include age, sex, educational background, experience, income and occupation of the respondents.

1.9.1.1 Age of Respondents: Age means; the length of time that a person has lived or existed at the time of interview.

1.9.1.2 Gender: Gender means; socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for men and women. Gender of respondents will be verified by checking their National Identity card (NIC) of the respondents during interview.

1.9.1.3 Education: Means the level of education as reported according to the years of education defined by Education department of Pakistan. Five years of education will be considered as Primary education, 10 years education will be considered secondary education, 12 years education will be considered as college level education, 14-16 years will be considered as graduation level and more than 16 years education will be included in postgraduate level studies.

***1.9.1.4 Duration of Service*:** Refers to the years of working at hospital.

1.9.1.4 Category of Healthcare Workers: Refers a health professional is a qualified person who works in the hospital. Categories included during this study are; doctors, nurses, paramedics and sanitary workers who are actively involved in the management of health care waste.

1.9.2 Knowledge: Means the information and level of knowledge of an individual on the waste management (segregation, collection, storage and disposal).

1.9.3 Practices*:* means the performing the step of hospital waste management (segregation, collection, storage and disposal) as per Biomedical waste management rules.

1.9.2.1 Segregation: Segregation refers as the isolation or separation of general and hospital waste at the hospital.

1.9.2.2 Collection: The collection means collecting infectious waste from different areas, where waste can be generated in the hospital through closed waste transportation trolleys.

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1.9.2.3 Storage: Means the method of storing infectious waste at proper site in the hospital.

1.9.2.4 Disposal: Means the methods or arrangement for dispose off for health care waste through incinerator, burial and other means.

1.9.4 Intensive healthcare waste management model (IHWM): Refers to 90 days hospital based training program comprises of following 3 approaches:

1.9.4.1 Face to face trainings: One to two days training consisting of 5 hours contact sessions on the practices, situation analysis, management of HCW conducted three times each after two weeks interval. Hence, total three trainings will be conducted during this intervention period. Sessions will be given on the use of Personal Protective Equipments (PPE) and their advantages, health harms due to HWM, available guidelines and methods of waste management.

1.9.4.2 Hands on practicum demonstration: Health workers should be trained through practical demonstrations on PPE, waste management color coding, use of danger sign, injection safety practices and how to use the methods of waste management will be demonstrated through this approach.

1.9.4.3 Reminder services: Reminder service will be provided at the hospital during their work by the facilitators who have trained them during the training sessions and hospital managers.

1.9.5 Environmental factors are those factors that facilitate the practices of hospital waste management.

1.9.5.1 Policies: Means any waste management plan in terms of support, long term sustainability provision of equipments, information, encouragement, advice and incentives etc.

1.9.5.2 Biomedical waste management rule: Means the knowledge and practices of health workers on Rules by Government of Pakistan known as hospital waste management rules, 2005.

1.9.5.3 Trainings: Means capacity development program for HCWs at hospital level.

1.9.5.4 Meetings: Means interaction between health care workers like Doctors, Nurses, Paramedics and Sanitary workers regarding the management of health care wastes.

1.9.5.5 Personal Protective Equipments: Means specialized clothing or equipments worn by health workers for protection against health and safety hazards in the hospital during handling of infectious waste.

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1.9.5.6 Infectious waste: Refer to waste produced from hospitals like sharps, human body parts, contaminated waste with blood, body secretion and vomiting of patients.

1.9.6 Improvement of knowledge and practices of HCWs: Means to increase the capacity of health workers through training model intervention and to strengthen their practices regarding health care waste through their behavior change.

Chapter 2

Literature review

2.1 Global scenario:

Health care waste is considered to be second most dangerous waste than the atomic waste in the world (25). Hence, the proper handling of medical waste still remains a big challenge. Health care waste is defined as the infectious waste generated through the health care activities in any health care setting that includes; uses syringes, bandages, intravenous drip sets, urine and blood bags, human body parts, chemical and pharmaceutical, medical instruments, sharp objects and diagnostic samples (26). Infectious health care waste management is still a great concern in the developing countries due to the poor practices of health staff that may cause the transmission of severe infections in workers and general masses (27). Literature revealed that about 75 to 90% of health care waste is non-infectious that includes the normal domestic waste generated in the hospitals mostly from housekeeping, maintenance and administration in the hospital. The remaining 10-25% of the waste is infectious health care waste produced in any health care organizations across the world (28). However, the quantity of infectious waste produced is less as compared to the overall health care waste, but the improper waste management practices by health care workers mix this waste with non-infectious waste and hence lead to contaminate whole lot as infectious waste that poses great risk. Health workers are responsible for proper handling of the waste knowledge and practices are very important for their best practices. Study at India reveled that 15% of the HCWs were aware and had good knowledge about waste

generation hazards, legislation and management. Trainings of HCWs can influence positively on their health care management practices in any organization (29).

The implications of improper medical infectious waste management are surprising. All individuals exposed to hazardous health-care waste are potentially at risk, including those within health-care establishments that generate hazardous waste, and those outside these sources who either handle such waste or exposed to it as a consequence of careless management. Nosocomial infections are also known as hospital-acquired infections, hospital-associated infections, and hospital infections—are infections that are acquired within the premises of the medical facilities by the health-care personnel, waste workers and patients. The main source of illness from infectious waste is probably injuries with used needles, which can cause hepatitis and HIV. There are however, multiple other diseases which could be transmitted by contact with health-care wastes. These are urinary tract infections, respiratory tract infections, wound infections, bacteraemia, skin infections, etc (30).

Infectious health waste generation mainly depends on hospitals beds, number of patients treated, type of organization and daily flow of the patients in that particular hospital. Hence, there is positive correlation found between the number of beds and non-infectious health care waste generation per bed per kg per day. There is no direct correlation found between infectious waste and number of beds per kg per day (31). Infectious wastes generation rate in nine general hospitals in Central Macedonia were reported from 0.51 to 1.22 kg/patient/day and their regular quantity of this waste produced by a the hospital is 198.3 kg/day. There is a linear correlation between the generated quantities of infectious wastes (kg/day) and the number of beds for all (12) government hospitals (r_s = 0.884) and for the general

hospitals (r_s = 0.945) were found (32). Study conducted at the capital city of Bangladesh shows that 78-90% of the waste was non-infectious, 5-16% was infectious, 2-6% was sharps and 1-3% was pathological (33). While another hospital of Bangladesh reported, 2490 kg/day health care waste generated, out of 0.57 kg/patient/day, 0.21 kg/patient/day was infectious waste and the rest 0.36 kg/patient/day was non-infectious waste produced. This amount of waste produced in this hospital was positively correlated with the number of beds (r_s = 0.79, $P < 0.01$) (34). Indian study concluded that an average about 0.33 million tons of hospital waste is generated in the country and the waste generation rates varies from 0.5 to 2.0 kg/bed/day (3). An Iranian study in 14 hospitals revealed that the health care waste generation rate was consist of 51.6% of infectious waste, 47.2% non-infectious waste and 1.2% sharps (35). The health care waste production rate in 4 hospitals of Nablus city, Palestine was varied from 0.33 and 0.84 kg/patient/day (36). A study conducted at Dar-es-Salaam, Tanzania on 47 hospitals reported that health care waste generated was 0.134 kg/patient/day, 0.076 kg/patient/day infectious waste and 0.058 kg/patient/day non-infectious waste (37).

World Health Organization (WHO) assessment conducted in 2002 in twenty two countries of the world, shows 64% of the hospitals had no proper waste management system for health care waste disposal. Hospitals in the developing countries including the Asian countries suffer from lack of proper waste management due to the poor practices of health care workers (38). Only 10–25% of infectious waste is infectious and may pose harm effects to healthcare workers. Many healthcare workers in are not aware of such hazards and their risks identification in disease transmission. Dedicated trainings are very important for healthcare workers

for to improve the waste management and the associated risks in any organization (39).

2.2 National Scenario:

Hospitals from Pakistan are producing 250,000 tons of medical waste annually. There are about 92,000 hospitals beds available in the public sector hospitals which produce 1.35 to 2.0 kg per bed per day of health care waste (40). Daily about 4 to 2,000 Kg of waste is generated by various health outlets; of which 75-90% is non-infectious produced by the health care premises, housekeeping, and administrative functions while only 10-25% is infectious and needs more careful disposal. Moreover, failure to dispose off used syringes, blades etc. leads to their reuse enhancing the risk of disease transmission and can contaminate the air, water and environment (41). The hospital waste component is just 15 to 20 per cent, but when the hospital waste is thrown or dumped with the municipal waste, it contaminates the entire lot. Another study also showed that around 2.0 kg of waste/bed/day is produced in Pakistan out of which 0.1- 0.5 can be categorized as infectious waste (8).

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Infectious waste disposal in each country depends upon a number of factors including sensitization level of the health managers as well as other professionals, existing local legislations and available resources. In Pakistan, despite the existence of Pakistan Biosafety Rules 2005[1], neither proper hospital waste management systems have been developed in various health institutions and nor concerned health professionals and managers are aware of the gravity of the situation, resulting

[1] Ministry of Environment. Pakistan Biosafety Rules. S.R.O. (I)/2005. p 1-11.

in a serious situation. The total quantity of waste generated by the health facilities is usually disposed with the municipal waste or burned openly raising environmental concerns. The storage of waste before disposal is usually open and the element of waste segregation followed by appropriate disposal methods for various sections of the waste is almost non-existing (41).

In Pakistan, usually two methods are being used to dispose off the hospital waste i.e. landfills and incineration. In landfill method, hospital waste is buried underground but according to health experts not a single landfill is constructed on scientific lines. Incinerators installed at various places also do not have proper filters and scrubbers and when hospital waste is burnt, toxic gases like dioxin and chemicals are discharged in the air which can be potential carcinogen. Only a few hospitals have proper incinerators. Health experts recommend that the hospital waste should be segregated from the solid waste and stored in special containers. Proper landfills should be constructed and all incinerators working without filters and scrubbers should be immediately shut down (8).

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2.3 Infectious waste management Practices in Pakistan:

A cross-sectional, hospital based survey was conducted by Pakistan Medical Research Council (PMRC) on 137 personnel involved in hospital waste management of 68 randomly selected health-care facilities in urban area of Karachi. Data of 9 hospitals, 11 maternity homes and 29 dispensaries, comprising 137 sanitary workers showed that knowledge of all workers about hospital waste management was poor whereas attitude of 38% and practice of only 2% was good. The study further showed that 25.5% health-care facilities disposed infectious and non-infectious waste without any treatment into public dustbins, 73.7% sanitary workers carried waste in

open buckets for final disposal. None of the sanitary workers had undergone routine medical check-ups except when ill, 67.9% were not provided any protective equipment. It was also found that 96.4% were not interested in health education for the safe disposal of health-care facilities waste; rather they were just doing their jobs for their earning (42).

Another study from Lahore Pakistan highlights that majority (85.5%) of sweepers were aware of the fact that their job is harmful for their health; however, they have to continue it for only economic reasons. Around 71% sweepers did not use any protective covering and thought that only rich nations take such measures. Most of the employees did not understand the meaning of “training” and only 14.5% employees were trained by the hospital authorities. The most dreadful aspect of hospital waste management was that hospital management did not take precautions for waste disposal as told by the sweepers. Majority (76.4%) of the sweepers said that hospital waste is directly thrown into the waste bins and 23.6% said that the part of the waste gets incinerated and rest gets recycled. Thus the study findings suggests that disposal system of solid waste is not efficient and workforce engaged in disposal activity have not been aware on the risk involved and doing the job due to worst socio-economic state (43).

A study conducted in 8 teaching hospitals (>200 beds) of Karachi Pakistan highlights the current practices of hospital waste management which includes segregation approaches, storage arrangements, collection and disposal systems. Study revealed that out of eight hospitals visited 2 were segregating sharps, pathological waste, chemical, infectious, pharmaceutical and pressurized containers at source. For handling potentially dangerous waste, two hospitals provided essential

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protective gears to its waste handlers. Only one hospital arranged training sessions for its waste handling staff regularly. Five hospitals had storage areas but mostly it was not protected from access of scavengers. Five hospitals dispose off their infectious waste by burning in incinerators, two dispose off by municipal landfills and one was burning waste in open air without any specific treatment. No record of waste was generally maintained. Only two hospitals had well documented guidelines for waste management and a proper waste management team. There was no proper training and management regarding awareness and practices of waste disposal (8). Recent study conducted in the 10 hospitals of Rawalpindi highly recommended the trainings for HCWs for to improve their practices regarding infectious health waste management. (16).

2.4 Hospital Waste Management Rules 2005:

The Government of Pakistan developed a Hospital Waste Management rules in 2005. This is an important document in the management of infectious waste in Pakistan. However, it has been found that majority of the health institutions and healthcare workers are not familiar with these rules and around 80% of the healthcare workers do not have the correct knowledge regarding these rules (41). In a recent assessment conducted by Pakistan Medical and Research Council (PMRC) reported that many workers had never used the HCWM rules. These rules also define the clinical waste, their types, management and the associated risks and hazards, handling and segregation, as well as color coding for the different types of waste. Limited numbers of healthcare workers in the hospitals were known regarding the color coding system in the Pakistan (42).

While the rules clearly stipulates color coding for the different types of waste, there is a general misconception that all wastes generated in the hospitals or clinics are “red-bag” type of waste. Even in hospitals where HCWs have of the color coding system in place but they not used properly. The poor understanding or lack of knowledge of the Pakistan HWM rules Practice results in different healthcare facilities applying different standards of practice to the management of infectious waste. These practices result in compromised safety of healthcare workers, and to patients and visitors to healthcare facilities. Typical failures include segregation of hazardous waste in municipal storage facilities, poor transportation, poor handling and lack of appropriate protective clothing for waste handlers (16).

2.5 Definition of health care waste:

Healthcare waste can be defined with the following connotations:

a. Health-care waste includes all the waste generated by health-care establishments, research facilities, laboratories and the waste originating from “minor” or “scattered” sources

b. Health-care waste includes a large component of general waste and a smaller proportion of infectious waste.

c. Non-infectious waste: Between 75-90% of the waste produced by health-care providers is non-risk or “general” health-care waste (44). Non-infectious wastes are materials that have not been in contact with patients, and may include paper and plastic packaging, metal, glass or other wastes which are similar to household wastes. It comes mostly from the administrative and housekeeping functions of health-care establishments and is generated during maintenance of health-care premises.

d. Infectious waste: The remaining 10–25% of infectious waste is regarded as infectious and may create a variety of health risks. It is suspected to contain pathogens (bacteria, viruses, parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. It is suspected to contain pathogens (bacteria, viruses, parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. This category includes cultures and stocks of infectious agents from laboratories; waste from surgeries like tissues (swabs), and materials or equipment that have been in contact with blood or other body fluids; waste from infected patients in wards like excreta, dressings from infected or surgical wounds, clothes heavily soiled with human blood or other body fluids (44). This category includes:

i) Waste from laboratory work

ii) Waste from surgery and autopsies on patients with infectious diseases

iii) Waste from infected patients in wards and emergency.

iv) Waste that has been in contact with infected patients undergoing Haemodialysis

v) Any other instruments or materials that have been in contact with infected persons

2.5.1 Types of Infectious waste:

The main categories are tabulated as under (28):

a. Pathological waste: It consists of tissues, organs, body parts, human fetuses and animal carcasses, blood, and body fluids. Within this category, recognizable human or animal body parts are also called anatomical waste.

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b. Sharps: These are items that could cause cuts or puncture wounds, including needles, hypodermic needles, scalpel and other blades, knives, infusion sets, saws, broken glass, and nails. Whether or not they are infected, such items are usually considered as highly hazardous health-care waste.

c. Pharmaceutical waste: Pharmaceutical waste includes expired, unused, spilt, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed off appropriately. The category also includes discarded items used in the handling of pharmaceuticals, such as bottles or boxes with residues, gloves, masks, connecting tubing, and drug vials.

d. Genotoxic waste: Genotoxic waste is highly hazardous and may have mutagenic, teratogenic, or carcinogenic properties. It raises serious safety problems, both inside hospitals and after disposal, and should be given special attention. Genotoxic waste may include certain cytotoxic drugs, vomit, urine, or feces from patients treated with cytotoxic drugs, chemicals, and radioactive material.

e. Chemical waste: It consists of discarded solid, liquid, and gaseous chemicals, for example from diagnostic and experimental work and from cleaning, housekeeping, and disinfecting procedures. Chemical waste from health care may be infectious or non-infectious; in the context of protecting health, it is considered to be hazardous if it has at least one of the these properties like toxic, corrosive, flammable and reactive. The types of hazardous chemicals used most commonly in maintenance of health-care centers and hospitals are:

• Formaldehyde used to clean and disinfect equipment and to preserve specimens.

• Photographic fixing and developing solutions used in X-ray departments.

• Organic chemicals generated in health-care facilities including disinfecting and cleaning solutions such as phenol-based chemicals used for scrubbing floors, disinfectants that are expired or no longer needed, solvents.

f. Radioactive waste: Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research, contaminated glassware, packages, or absorbent paper, urine and excreta from patients treated or tested with unsealed radio nuclides used in diagnostic procedures and therapeutic applications.

2.5.2 Sources of Infectious waste:

The sources of infectious waste can be classified as major or minor according to the quantities produced (45).

The major sources are:

a. Hospitals: Different units within a hospital would generate waste of different characteristics. Medical wards generate infectious waste such as bandages, disposable medical items, contaminated packaging, etc. Surgical wards generate mainly anatomical wastes, sharps, etc.

b. Other health-care establishments such as Emergency medical care services, dispensaries, outpatient clinics, Long-term health-care establishments and hospices; mostly general waste with a small percentage of infectious waste.

Laboratories and research centers generate mainly pathological (including some anatomical), highly infectious waste (small pieces of tissue, microbiological cultures, stocks of infectious agents, etc.

d. Blood banks and blood collection services

e. Pharmaceutical and chemical stores generate small quantities of pharmaceutical and chemical wastes, mainly packaging and expired -shelf drugs.

The minor sources are:

a. Small health-care establishments: Physicians' offices generating mainly infectious wastes (e.g. Swabs and sharps), Dental clinics producing waste with heavy metal content (e.g. mercury).

b. Specialized health-care establishments: Convalescent Nursing Homes, and Disabled Persons' Institutions.

c. Non-health activities involving intravenous interventions: Illicit drug users.

2.6 Risk caused by poor management of infectious wastes:

I. Persons at risk: All individuals exposed to hazardous health-care waste are potentially at risk, including those within the health-care establishments that generate hazardous waste, and those outside these sources who either handle such waste or are exposed to it as a consequence of careless management (46). The main groups at risk are the following:

a. Medical doctors, nurses, health-care auxiliary staff, and hospital maintenance personnel

b. Patients in health-care establishments or receiving home care

c. Visitors to health-care establishments

d. Workers in support services allied to health-care establishments, such as laundries, waste handling, and transportation

e. Workers in waste disposal facilities (such as landfills or incinerators) including scavengers.

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II. Occupational Risk: During handling of infectious wastes, health-care personnel and waste workers can come in contact with waste, if it hasn't been packaged safely. Many injuries occur because the syringe needles or other sharps have not been collected in safety boxes, or because these have been overfilled. There is particular concern about infection with human immunodeficiency virus (HIV) and hepatitis viruses B and C, for which there is strong evidence of transmission via health-care waste (47). These viruses are generally transmitted through injuries from syringe needles contaminated by human blood. For serious virus infections such as HIV/AIDS and hepatitis B and C, health-care workers particularly nurses are at greatest risk of infection through injuries from contaminated sharps (48). Other hospital workers and waste-management operators outside health-care establishments are also at significant risk, as are similar to individuals who scavenge on waste disposal sites; although these risks are not well documented. The risk of this type of infection among patients and the public is much lower (49).

III. Risk to the public: The reuse of syringes by the general public represents one of the greatest public health problems in the developing world related to health-care waste. Worldwide, an estimated 10 to 20 million infections of Hepatitis B and C and HIV occur annually from the reuse of discarded syringe needles without prior sterilization (39). If health-care waste is dumped on un-controlled sites or in other areas which can be accessed by the public, the public and in particular children can come in contact with infectious wastes. Also the contact with toxic chemicals, such as disinfectants, may cause accidents when they are accessible to the public (50).

IV. Indirect risks via the environment: In addition to risks from direct contact with health-care waste, waste can also contaminate the environment, such as the water or the air (for instance during waste treatment), and so indirectly impact on health. When infectious wastes are disposed off in a pit which is not lined, the groundwater may become contaminated. As the same groundwater may be used as a resource for drinking water, wastes may indirectly impact on health. If waste is burned or incinerated in an incinerator which does not have an emission control, which is the case with the majority of incinerators in developing countries, the air may become contaminated by a large number of pollutants and cause serious illness in people who inhale this air. While choosing a treatment or disposal method, environment-friendliness is an important criterion (51).

2.7 WHO guidelines for infectious waste management

Infectious waste should be managed by scientific manner because of its nature of infectivity to transmit the diseases. According to WHO guidelines, there are six main steps involved in the management of infective waste, these are; segregation, collection, transportation, storage, treatment and disposal. The effective management of infections waste also decreases the cost on health sectors (52).

2.7.1 Segregation:

Segregation is the separation and identification of the infectious waste at source of waste generation point according to the nature of waste like body tissues, organs, pathological, sharps and other infectious waste so that the entire lot can be prevented from being infected. WHO estimates that there is about 57-90% of the waste is the non-infectious composed of normal waste such as papers, juice packs,

plastic, kitchen items and laundry etc and only 10-25% is the infectious waste that needs to be separated at the primary level.

2.7.2 Collection: When the waste bags or bins about 3/4 filled that needs to be collected by the responsible personnel. That bag should be closed and tightly sealed with identification of proper identification tags on the bag. After this it must be transported to the storage place in the hospital. Liquid waste should be collected in appropriate container according to its chemical composition. Although WHO recommended the yellow bin for highly infectious waste, white yellow for sharp waste, black for general waste but the tertiary care hospital at Rawalpindi Pakistan used the red for infectious, yellow for sharp and green for general waste.

2.7.3 Transportation: Within the hospital infectious waste should be transported through closed trolley system. Theses trolleys should not be transported through the normal patient's entry route. For the offsite transportation it must be recommended that the infectious waste packet should be tightly closed and appropriately marked as per the hospital waste management rules of Pakistan.

2.7.4 Storage: After collection of infectious waste must be placed in proper designed place at the hospital. Storage area should have the washing facilities, temperature control facilities, passive ventilation, protection from sun and rain. The area must be locked to prevent the access of animals, birds, insects and human scavengers. The duration of the storage for infectious waste should not be more than 72 hours in winter and not more than 24 hours in the hot weather. However, this duration can be prolonged by maintaining the temperature of the room.

2.7.5 Treatment: Treatment is the very important to decrease the lethal effects of the infectious waste. Treatment of hospital waste may be done in different forms

like, incineration, autoclaving, disinfection, gamma irradiation and many more depending on the environmental and economical factors.

2.7.6 Disposal: The common form of infectious waste disposal is encapsulation, land filling, safe burial in the hospital premises and discharge to the sewer. Once the hospital treated the infectious waste then it can easily be disposed off to the landfill. However for the developing countries like Pakistan, a careful disposal of infectious waste with municipal waste should be by considering the environmental and occupational issues according to the standards.

2.8 The Intervention: Intensive Health Care Waste Management (IHWM) Model:

After reviewing literature regarding trainings and capacity building, the proposed model has been developed. This model is directed at improving health care workers practices regarding health care waste management in a hospital setting. The set of variables for behavior specific knowledge and practices have important motivation significance. These variables can be modified through trainings and practicum pictorial demonstration.

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IHWM model is based on the following assumptions, which reflect behavioral science perspective;

1. Health workers seek to actively regulate their own behavior and practices through trainings.

2. Health professionals constitute a part of the interpersonal environment during the trainings, which exerts influence on their practices.

3. Self-initiated reconfiguration of trainings interactive patterns is essential to behavior change that ultimately improves their practices.

2.8.1 Components of IHWM model:

There are three main components of this model

1. Face to face training
2. Hands-on practicum demonstration
3. Reminder services at the hospital

1. **Face to face training:** Face to face trainings were on modified Guidance materials, national action plans, national infectious waste management (HCWM) guidelines and building capacity at national level developed by WHO. Facilitator will be responsible for the implementation and conduction of these trainings. These face to face trainings are very effective in the capacity building of workers. During this training pictorial presentation on real health care management scenario in different settings of the country will also be presented to aware them regarding the situation of health care waste. These trainings include:
    - Information on, and justification for, all aspects of the infectious waste policy;
    - Information on the role and responsibilities of each hospital staff member in implementing the HCW rules 2005;
    - Technical instructions, relevant for the target group, on the application of waste management practices.

2. **Hands-on practicum demonstration:** Hands-on practicum demonstration was given by the facilitators in the hospitals after providing the PPE with support from WHO. This method will improve their real practices in management of waste. These demonstration will include:
    - Information on the risks associated with the handling of infectious waste;
    - Procedures for dealing with spillages and other accidents;
    - Instructions on the use of protective clothing (PPE).
    - Administrative procedures (regulations, record keeping, reporting of spillages, accidents and other incidents) as well as technical operation and maintenance of the systems used should also be taught.
    - Segregation methods and use of color coding properly.
    - Practical demonstration on methods of waste and their handling.

3. **Reminder services at hospital:** Another element of this model is to incorporate trainings services with HWM practices at the hospital. Reminder service has been provided at the hospital during their work by the facilitators who have trained them during the training sessions and also by the administrator of the hospital. A weekly meeting will be conducted with healthcare staff, who are involved in the HWM and remind them of their trainings. These facilitators will be approached from there concerned hospitals through Medical Superintendents, their support will be ensured and they will get finical incentives because this is not part of their job description.

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2.8.2 Activities of IHWM model:

Activities were divided into two parts; firstly the intensive trainings have been given according to developed guidelines as per WHO recommendations and the second is hands-on practical demonstration after providing the PPE with support from WHO by following their guidelines (53). Topics were included:

Figure 2-1: Training activities during the intervention

	1st training	2nd training	3rd training	Group
	1-2 days	1-2 days	1-2 days	
Goals	To aware the health care workers and managemen t staff regarding IHWM model	To improve the practices and knowledge of HCWs regarding infectious waste and implementation of HWM rules in the hospital	To know the role of HCWs in Pakistan and international contributions of safe disposable of infectious waste. Types and color coding use in health care waste	Doctors, paramed ical staff and nurses
Power Point presentati on	Explain this project, benefits, details and basic activities involved in this model	Presentation on types, methods, HWM rules and practices of health care waste	To explain the segregation, transportation, collection and disposal methods of infectious waste management	Nurses, Paramed ical staff and Sanitary workers
Pictorial presentati on	To present the exact situation regarding health care waste in the country	To improve the current practices of health workers regarding the health care management	Different methods involved in HWM model through real pictorial presentation	Sanitary workers
Group	Involve	Discussion on the	Discussion on the	Doctors,

discussion	management and health care workers for this activity	role and responsibilities of each worker.	waste management operators and their proper handling	paramedical staff, nurses and sanitary workers
Interactive session 1	Knowledge sharing on HWM in the peers through interactive session	Barriers in knowledge transformation from health workers to the patients regarding infectious care waste	To identify waste management practices and technologies that are safe, efficient, sustainable, economic and culturally acceptable; to enable the participants to identify the systems suitable for their particular circumstances.	Nurses and paramedical staff
Interactive session 2	Knowledge sharing on HWM in the peers through interactive session	Barriers in knowledge transformation from workers regarding health care waste	Methods of collection, transportation, storage and disposal	Sanitary workers
Preventive measures 1	Information on PPE and diseases prevented by proper handling of the waste	Proper management of infectious waste, prevent from needle stick injuries and also to know the proper use of	Epidemiology of diseases transmitted by improper waste management their prevention strategies	Nurses and paramedical staff.

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		PPE		
Preventive measures 2	Diseases prevented by use of PPE	Proper use of PPE and their importance and sensitization of workers to its use.	Diseases spreads without the use of PPE during the infectious waste management.	Nurses and paramedical staff.

Figure 2-2: Practicum activities during the intervention

Hands-on practicum demonstration by Facilitators	
Activities	**Group**
Needle cutter use: The participants will be trained to use the needle cutter properly and their importance in recycling of syringes in the market.	Nurses and paramedical staff
Segregation methods: Proper segregation methods start from the wards by using the separate waste collection bin as per WHO recommendations.	Nurses and paramedical staff
Visual display: Visual display in the form of chart, brochures, booklets and pamphlets will be displayed and provided in the hospitals which will be used for the awareness of the patients and attendants in addition to the hospitals staff.	Nurses paramedical staff and Sanitary workers
Use of autoclave for sterilization: Proper demonstration on the use of autoclave in the hospitals will be given to the workers by team of facilitators.	Sanitary workers
Personal Protective Equipment use: Demonstration on hand washing, proper methods, used of alcohol based hands rubs, practical use of gloves, gowns, masks, long rubber boots, mask and gown use. Facilitators will define their proper handling and their harms on health.	Nurses. Paramedical staff and Sanitary workers
Proper disposal of human organs: Practical demonstration on proper collection, storage and disposal of human organs like placenta etc.	Sanitary workers

Safety Box: As per Biomedical waste management rule the use of safety box for injection waste and their proper disposal demonstration.	Sanitary workers
Use of disinfectant: Use of chlorine as disinfectants in the hospital for cleaning purpose and methods of making this solution.	Sanitary workers
Waste storage: To demonstrate them regarding the temperature control and on proper storage place.	Sanitary workers

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Chapter 3

Research Methodology

This chapter describes the subjects and methods that were used in this study. These include study design, study site, Interventions, study population and sample size, research instruments, content validity and reliability, data collection, data analysis, study process and ethical consideration. The goal of the study is to improve the HCWM practices among HCW through IHWM in the study area.

3.1 Research Design

The research design of the proposed study was Quasi-Experimental with control and intervention design hence employing mixed methods. In this study HCWs were randomly selected from two different hospitals. One hospital was subject to intervention, while the other was used as a control to provide routine infectious waste management practices. The main outcome of the intervention (IHWM model) is obtained by comparing the two groups at the end of the study period. The research question of the proposed study was addressed by involvement of HCWs to test the effectiveness of IHWM.

A = O1	X	O_2
B = O_2		O_2

A = Intervention group

B = Control Group

O1 = Baseline

O2 = Follow up

X = Intervention

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3.2 Study Area

The study was conducted at the two tertiary care hospitals of Rawalpindi district Pakistan. These two selected hospitals have the similar kind of facilities, services, infrastructure and tertiary level care facilities regarding the infectious waste. District Rawalpindi is selected because of its urban status with many tertiary level care facilities and secondly as it is considered as the twin city due to its close location with capital of Pakistan, Islamabad, and finally it was logistically feasible.

District headquarter hospital (DHQH) Rawalpindi (Control Hospital)

DHQH has about 3,300 health workers working in different shifts. The teaching staff is composed of one professor, two assistant professors, two senior registrars, one junior registrar in each unit. Each unit is having one specialist as well. Other technical staff includes nurses, paramedics, ward boy, sanitary staff and guards for each ward. In the labor room there are twenty trained nurses and ten student nurses and in the ward, there are ten trained nurses and ten student nurses supervised by the consultants on 24 hours. In each unit there are 50 beds in the wards. A hospital facility has an incinerator and autoclave for infectious health waste management.

Holy family Hospital (HFH) Rawalpindi (Intervention Hospital)

HFH is the largest hospital in Rawalpindi with around 3,500 health staff. HFH providing the tertiary level care facilities and also provide the diagnostic and curative services. The teaching staff is composed of one professor, two assistant professors, two senior registrars, one junior registrar in each unit. Each unit is having one specialist as well. Other technical staff includes nurses, paramedics, ward boy, sanitary staff and guards for each ward. In the labor room there are twenty trained nurses and ten student nurses and in the ward there are ten trained nurses and ten

student nurses supervised by the consultants on twenty four hours. All the special wards are functional for 24 hours. Hospital has an incinerator and autoclave facilities available for the infectious health waste management.

3.3 Study Population

Health care workers including doctors, nurses, paramedics and sanitary workers were recruited from both intervention and control hospitals. Among all health care workers were working in each tertiary care hospital of Rawalpindi; the proportion of Doctors was 25%, Nurses 35%, Paramedics 30% and 10% are sanitary workers. The sample size was selected according to the proportional size of the each HCW after sample size calculation for their equal representation from all the healthcare workers groups and will be based on the following criteria:

Inclusion criteria

- HCWs from all departments of the hospital (wards, emergency, operation theaters).
- Permanent health workers.

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Exclusion criteria

- Newly hired HCWs during last six months.
- Students or trainees and on attachment duty staff.
- Those who are on medical long leave.

3.4 Sample size calculation

The sample size calculation for the proposed study is based on effect size of the interventions by expecting the outcomes. As the primary outcome of the

interventions was to improve the HWM practices at HFH among HCWs, assumed that 30% estimated proportion of HWM practices among HCWs have been improved after intervention 0.50 if we observe 20% effect size absolute improvement for those on the intervention group.

$$n = \frac{2\left(Z\alpha_{/2}+Z_{\beta}\right)^{2} p(1-p)}{\Delta^{2}}$$

When:

n = Required total number of Health care workers per group for study

P = Proportion difference in practices of infectious waste

P_I = Estimated proportion of HCWM practices among HCWs should be improved after intervention 0.50

P_C = HCWM practices among HCWs in control group before intervention 0.30 (54)

Δ = The difference (effect size) which calculated from $(P_T - P_C)$ = 0.2

Z_{α} = 1.96 at α = 0.05, Z_{β} = 0.84 at β = 0.2 (power 80)

$P = (Pi-PC) / 2 = 0.4$

$$n = \frac{2(1.96+0.84)^{2}0.4(0.6)}{0.04}$$

n = 94 (+ 10% attrition) = 104 in each group

With an additional number to cover drop out, attrition, refusals and inclusion of equal representation from all groups of HCWs, a total of 275 HCWs were recruited for the study at baseline. However, 255 had completed the intervention.

The sample size after calculation with 80% power, alpha error of 0.05. As the primary outcome of the intervention is to improve the infectious waste management practices among HCWs at tertiary care hospitals of Rawalpindi, assumed 50% improvement in infectious HWM practices among HCWs were recorded after the intervention. The required number of HCWs in each group was assigned 137 in control and 138 for intervention group.

Intervention group = 138

Control group = 137

Total subjects = 275

3.5 Sampling Technique

The representative of the study population was enhanced by the use of methods of random sampling. Random sampling gives each of the hospital in the population targeted a calculable (and non-zero) probability of being selected. The sample was selected from two hospitals with similar kind of health care waste management facilities. Sample of 275 HCWs including doctors, paramedics, nurses and sanitary workers from the selected hospitals on the basis of inclusion and exclusion criteria, later have been assigned in two groups through computer generated randomization allocations (138 from Intervention and 137 from control hospital) have been taken based on sample size estimation. Health care workers was assigned for both intervention and control group on the basis of available proportionate size of doctors, nurses, paramedics and sanitary workers for their equal representation.

3.6 Study Duration

This study has been started in September 2013 and completed in May 2014. Baseline has been conducted for one month in September 2013 followed by three months intervention which was started in October 2013 and completed in December 2013. After the intervention, we had followed both hospitals for three months from January to March 2014. Final observation (endline) has been conducted in April 2014 for one month to complete the data collection process. However, we have taken two measurement through structured questionnaire baseline (zero) and endline after three months of intervention (six months after baseline).

3.7 Research instrument

3.7.1 Structured Questionnaire: WHO questionnaire was adapted, modified and were used to measure the knowledge and practices before and after intervention that were mainly focused on the policy and guidelines set by the hospitals waste management rules (52). Structured questionnaire consist of four parts;

- Socio-demographic characteristics 9 questions for doctors, nurses and paramedics and 8 for sanitary workers.

- Knowledge 24 questions for doctors, nurses and paramedics and 20 for sanitary workers.

- Attitude 12 questions for doctors, nurses, paramedics and sanitary workers.

- Practices 20 questions for doctors, nurses and paramedics and 15 for sanitary workers.

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- Environmental factors 19 questions for doctors, nurses and paramedics and 16 for sanitary workers.

The research assistant was recruited from outside the study area that had no affiliation with the hospitals or the staff. The questionnaire was prepared in English and was later translated in to Urdu language after pretest.

3.7.2 In-depth Interview: IDIs (in depth interview) were conducted by using the semi structured guidelines / questionnaire for hospital administrative official to explore their views on infectious health care waste management, their concern on present infectious waste management and challenges during the infectious waste management before start of data collection. These IDIs have been conducted with the help of developed guidelines with hospital management including Medical Superintendent, Executive Director, Deputy Director, Nursing superintendent and Focal person hospital waste management in both hospitals. Total 10 participants were interviewed by using semi structured guidelines and note taking were done (5 from each hospital and each participant were interviewed for 45 minutes) were recorded.

3.7.3 Observations: using the checklist modified from WHO, to observe the different steps involved in the infectious waste management like; Segregation, collection, storage and disposal by trained the research assistant.

3.8 Validity and Reliability

The content validity was obtained through the expert advice in the field from professors at Chulalongkorn Thailand and Health Services Academy Pakistan during the research. The reliability of the questionnaire was checked through pre-testing and piloting on 30 HCWs working in the hospital located adjacent city of Islamabad with

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similar health facilities. The internal consistency reliability coefficients (Cronbach's alpha) of practices questionnaire was 0.91 and attitude questionnaire was 0.87 by using the formula. However, for knowledge questionnaire reliability coefficient was obtained from Kuder Richardson (KR-20), that was used for binomial responses (yes and no) as per formula.

3.9 Data Collection

After the permission from the hospital Administration, the data were collected. The researcher with the help of four research assistant who were graduate by qualification and were trained by the principal researcher. The questionnaires were used both for selected control and intervention groups for the baseline and endline. Self-administered questionnaire were distributed to the doctors, nurses and paramedical staff and ask them to fill the questionnaire. Guided interview was conducted for the sanitary workers by using the structured questionnaire, which was interpreted by the researcher in local language because most of them cannot read English. Ten in depth interview with the help of developed guidelines were conducted with hospital management like, Medical Superintendent, Executive Director, Deputy Director, Nursing superintendent and Focal person hospital waste management after taking the appointment.

3.10 Data Analysis

For the knowledge questions for health staffs (doctors, nurses and paramedics) with 24 questions were used to evaluate their knowledge at baseline and after intervention. The score of 1 was given to each correct answer and 0 for incorrect and don't know responses. Similarly, there were 20 questions for sanitary workers with guided questionnaire were used and a score of 1 was given for correct response and

0 for incorrect response. The obtained score were then changed as per their score level and categorized in three levels; low, moderate and high knowledge. Among health staff the score were ranged between 0-24 and mean SD was used to classify them into three categories. Similarly for sanitary workers, the score ranges from 1 to 20 and were categorized into three levels. 0-24 maximum and minimum score, the high score (above 10) means excellent knowledge, score between 10-15 means fair and low score (below 10) means poor knowledge (55).

Health care workers have been asked for their attitude regarding infectious waste management through 12 questions designed on 5 point Likert scale ranging from strongly agrees to strongly disagree with both positive and negative statements. Scores were given to the negative statements accordingly. Score was given 5 for strongly agree, 4 for agree, 3 for uncertain, 2 for disagree and 1 for strongly disagree as follow:

Strongly Agree : 5

Agree : 4

Undecided : 3

Disagree : 2

Strongly Disagree : 1

The resulted attitude score were calculated as high and low attitude. The number on attitude for workers were ranges from 1-60 and mean was used to classify them into two groups; high attitude and low attitude. Mean and SD of the group was used to classify the subjects into 2 groups. (55).

The questions on practices in both health staff and sanitary workers were different due to their nature of work. For health staff 20 questions were designed while for

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sanitary workers only 15 questions were designed with both positive and negative statements. For correct response the score was given 1, while for incorrect response, the score was given 0, accordingly the marking were done for negative measurement. The obtained score was converted in terms of score level using the mean; Standard Deviation was classified as good or poor practices. High and low score for practices were applied. The score for health staff ranges from 1-20 and classified into two categories. Similarly, for sanitary workers, the scores for practices ranges from 1-15 and classified into poor and good practices.

For environmental factors, each question has either Yes or No response. The frequency, percentages were determined. The result of the score was entered into statistical package for social science (SPSS, version 17) for descriptive analysis and all the independent variables was described in percentage, frequency, mean and proportion.

Inferential statistics like Mc- Nemar chi square tests was used to compare the difference at baseline and after intervention assessments in both intervention and control group. Paired simple *t* test was used to analyze the difference between knowledge and practices of infectious waste management before and after intervention within group.

Qualitative data was collected before to start the study during the month of September 2013. For in-depth interview and observation, qualitative analysis was done by content analysis. Responses from the participants were analyzed manually. Nodes and sub nodes were developed using the constant comparison technique. After coding, themes were generated from the most popular answers given during

the interviews. The results were compiled thematically and triangulated with the qualitative observations and quantitative results. Agreements and dissonances were checked and mentioned accordingly.

3.11 Study time line

Phase I: Base line Survey (4 weeks)

This baseline survey phase one was further divided into three steps as follow:

Step 1: Baseline introductory seminar

Researcher conducted a one day introductory seminar in these hospitals on 2nd august 2013. During this introductory seminar, researcher shared the details of the projects with participants and hospital administration.

Step 2: Training of data collectors:

Data collectors were trained by the researcher on the data collection tools for two days on September 2013. The researcher shared the study objectives with data collectors in detail and process of collection was elaborated to them during this training.

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Step 3: Data collection for baseline survey

During this step the data collection was done according to the study protocol and was started from September 2013. Principal researcher randomly checked the data collectors for the purpose of to ensure the smoothness and to provide them further guidance.

Phase II: Intervention Phase (12 weeks)

This intervention phase was divided into four steps as follow:

Step 1: Intervention introductory meeting (I day during the first week of intervention)

An intervention introductory meeting was conducted with the staff of both hospitals of Rawalpindi on 25th September 2013. The purpose of the introductory meeting was to inform them about the purpose, objectives and benefits of the project. They were briefed about the elements of the IHWM model. They were allowed to ask question and give suggestion about the study. Finally, they were asked to support and participate in this study.

Step 2: Team Building (3 days during the first week of intervention)

A multi-disciplinary team that included a nurse, IHWM model facilitator and a doctor were selected with the consultation of higher authority of these selected hospitals on 26-28th September 2013. In order to provide sufficient information and knowledge on improving infectious waste management practices, a comprehensive training workshop was conducted to apply IHWM model properly.

Step 3: Training of Facilitators (3 days during the week two)

The training session was conducted by the researcher at both intervention and control hospitals for 3 days from 26-28th September 2013. During these sessions, the researcher informed and trained the facilitator on IHMM model before the start of intervention.

Step 4: Intervention (three months)

In the interventional phase, effective training interventions on IHWM model were given to the participants. This training model intervention with proven efficacy was used for improving infectious waste management practices among HCWs from 1st October 2013 to 31st December 2013. This included a face to face presentation and a practical hands-on approach. These interventions were included training module in English, Urdu and pictorial form and video clips on practical handling. These

interventions introduced while in using the IHWM model during the interventional phase. In control arm, only the routine infectious waste management (IWM) services were provided. Principal researcher closely monitored both arms to check the intervention efficacy throughout the period of study. The IHWM model depicts the HCWs including doctors, nurses, paramedics and sanitary workers as the sole responsible for the implementation of the project. The duties of the team were assigned as followed:

1) Hospital management: The main responsibility for the hospital management was assigned to supervise and regularly monitoring of the IHWM model with coordination of researcher and ensure smooth working. Management had also ensured the availability of infectious waste equipment such as; gloves, masks, long rubber boots, aprons, safety boxes, waste collection bins and autoclaves.

2) Doctor: The doctors followed all the protocol of the WHO HWM practical manual and IHWM Model.

3) Nurses: Following were the duties of the nurses during the intervention

    - Counsel the patients regarding hospital waste
    - Ensure the proper segregation at their work place
    - Instruct the sanitary workers for waste collection on time.
    - Follow the proper waste segregation methods
    - Record keeping of health care waste

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4) Sanitary workers: Following were the duties of Sanitary workers:

- Collect waste on time.
- Keep the proper waste bins at proper places.
- Dispose the human organs like placenta.
- Autoclave the infectious material before disposal.
- Clean the waste management trolleys.
- Supervise the waste collection site.
- Use the incinerator on time for waste disposal.
- Use the disinfectants like chlorine.

Phase III (4 weeks): End line Survey

The purpose of this phase was to review on the study's objectives and outcomes which were conducted after three months period of intervention and was conducted in April 2014 after three months follow up. One more workshop was arranged with the health care team, and hospital management. The lesson learn from the project were reviewed and suggestions for improvement were asked. Sustainability of the project was asked to be ensured even after the project has been completed.

3.12 Ethical Considerations

Ethical clearance was taken from the National Research Ethics Committee, Health Services Academy Pakistan reference letter F.No.3-107/2013-IERC/HSA dated 18th

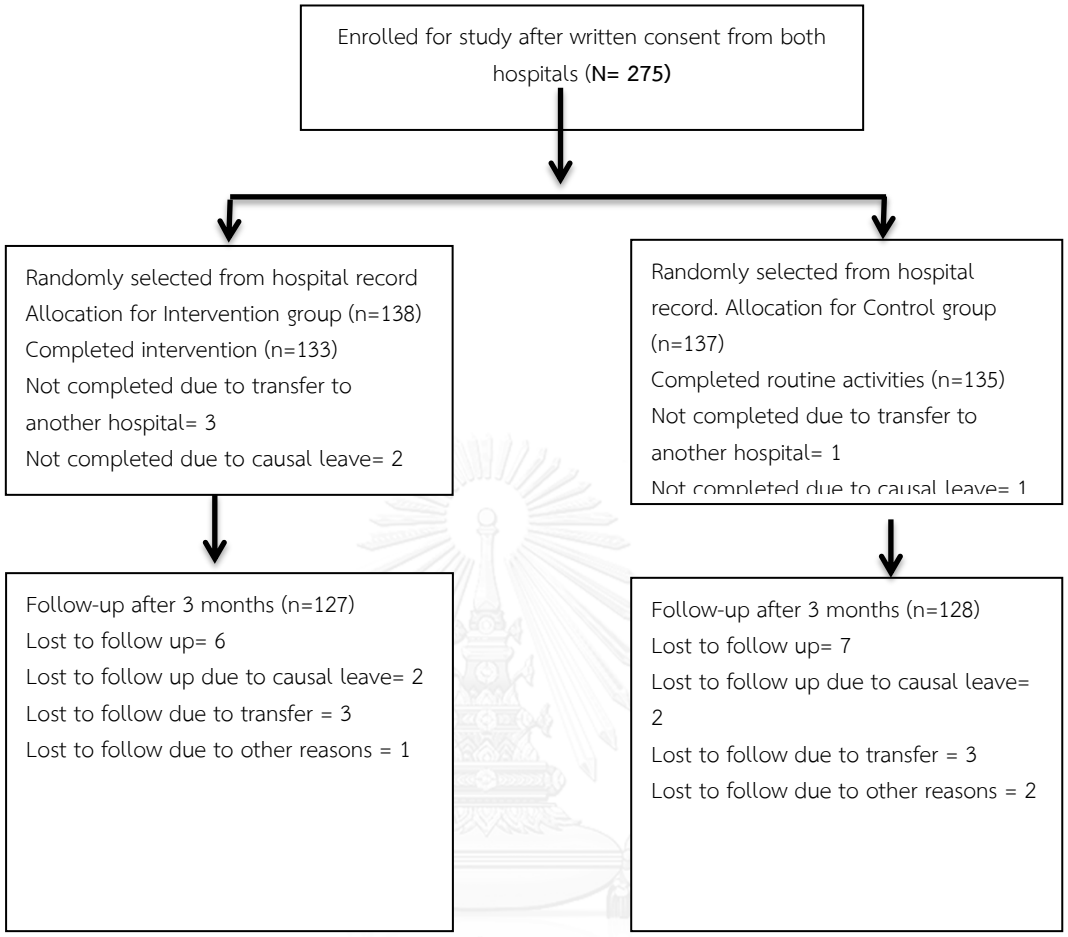
September 2013 attached as **Appendix VI**. Permission to carry out the study was obtained from the Administration of both selected hospitals. The respondent was adequately informed for the objectives, methods and benefits of the study prior to the questionnaires distribution and a written consent was obtained from each respondent. The subjects were ensured to their rights to refuse and recline from the study at any time during the course of this study. Using code numbers the confidentiality and anonymity was ensured.

3.13 Benefits of this study

Following were the observed benefits from this study:

- Utilization of HCWs services properly in hospitals as an implementation of this model will ultimately improve the infectious health care waste management practices among other health staff.
- This model would help in better hospital waste management practices among health workers.
- This study has provided statistically good evidence for to improve infectious health care waste management practices through trainings.
- Policy makers can use this evidence to make such trainings mandatory for all tertiary care hospitals in the country to improve infectious waste management practices, and to reduce hazards associated.

Figure 3.1: Flow chart of the subjects and evaluation



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Chapter-4

Results

The results included the analysis and interpretation of the data and analysis derived from 275 health care workers working at the tertiary care hospitals of Rawalpindi Pakistan. Two groups pre and post data, study was used to assess the effectiveness of IHCWM model Intervention on, change in knowledge, attitude and practices towards the infectious waste management. A structured questionnaire was used to collect the data the follow-up survey was conducted. The healthcare workers who didn't attend the interventional sessions were traced through their mobile phone by the data collectors. Eleven HCWs from intervention hospital and nine HCWs from control hospital were lost due to transfer posting and due to the absence from duty leave, refusal and other domestic problems at their home. However 255 HCWs from 275 HCWs were successfully followed. The response rate at the end of study was calculated as 92%. The results are presented in three parts:

Part 1 is the general and socio economic characteristic of the HCWs at baseline, experience, department, occupation and level of education in both intervention and control hospitals. These results were statistical analyzed to find out any significant difference between the intervention and control group at the start of the intervention regarding their current knowledge, attitude and practices on HCWM vis-à-vis enabling factors.

Part 2 presents the results for the effectiveness of the IHCWM model. The effectiveness is assessed by the difference in knowledge, attitude & practices of HCWs who completed the training in intervention hospital as compared to the

control hospital. And also change in healthcare worker's knowledge, attitude and practices regarding infectious waste management within both groups. Further association of knowledge, attitude and practices with infectious waste management is also explored.

Part 3 explained about the qualitative findings through direct observation and in depth interview to know the situation of infectious waste management at both hospitals.

4.1 PART I: Descriptive findings

Descriptive findings were measured through the pre-tested, validated, piloted tool and following variables were measured.

- General and socio economic characteristics
- Knowledge on infectious waste management
- Attitude on infectious waste management
- Practices on infectious waste management
- Enabling factors on infectious waste management

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4.1.1 General and socio economic characteristics

This section revealed the frequency distribution of selected variables describing the background of the HCWs before the intervention. The frequency of distribution for the selected variables of socio demographic characteristics including age, gender, education level, present occupation and number of years of working experience in this profession are shown for doctors, nurses, paramedics and sanitary workers are presented in Table 4.1. (44.5%) of The HCWs among both control and intervention

hospitals were below than 25 years of age, (23.3%) were belong to 26-35 years of age and (32.2%) were more than 35 years of age. No statistical difference in the age has been shown with in two groups (p= >0.05). There were no significant difference found between the occupation and groups. Above half (55.6%) of the study populations were male and (44.4%) were female by gender and were statistically found highly significant (p=< 0.05). Above one third (35.5%) of HCWs had qualification of graduation 14 to 16 years of education, (38.2%) had secondary education i.e. 12 years of education, (18.2%) had primary 5years of education while only (8.1%) had postgraduate qualification 18 years of education and we found no significance associated with education of HCWs (p = >0.05). Concerning the income of HCWs, nearly half (47.3%) had income of more than 20,000 Pakistan rupees per month, (26.6%) had income between 10,000 to 20,000 and (26.1%) of the participants had income less than 10,000 rupees per month. There is no significant difference shown between the income and groups (p= >0.05). Regarding the department where these HCWs were working, (36.1%) were working at medicine and pediatrics department, (32.5%) were working at surgery, obstetrics and gynecology department, (26.3%) were working with emergency and Operation Theater; while only (5.1%) belonged to administration department. There was statistical difference seen between the department where they work and the hospitals (p=<0.05). It was found that (31.2%) of the HCWs were nursing staff, (28.5%) was doctors, (21.1%) paramedics and (19.2%) were sanitary workers who participated in the study.

Table 4.1: Socio-demographic characteristics of the participants (n=275)

		Intervention		Control		Total		p value
		N	%	N	%	n	%	
Age	*<25*	65	47.1%	58	42.2%	123	44.5%	0.706
	26-35	29	21.2%	33	24.3%	62	23.3%	
	>36	44	31.7%	46	34.1%	90	32.2%	
Gender	*Male*	65	47.2%	90	66.4%	155	55.6%	0.002
	Female	73	52.8%	47	34.3%	120	44..4%	
Educational status	*Post-graduation*	11	7.3%	12	9%	23	8.1%	0.844
	Graduation	48	35.2%	51	37.1%	99	35.5%	
	Secondary	53	38.2%	50	36.2%	103	38.2%	
	Primary	26	19.3%	24	18.2%	50	18.2%	
Income	*<10,000*	33	24.7%	39	29.3%	72	26.1%	0.212
	10-20 K	33	23.1%	41	30.1%	74	26.6%	
	>20,000	72	52.2%	57	42.1%	129	47.3%	
Department	*Medicine*	67	48.7%	33	24.2%	100	36.1%	<0.001
	Surgery	45	33.1%	46	34.1%	91	32.5%	
	Emergency & Operation theater	20	14.1%	51	37.1%	71	26.3%	
	Administration	6	4.1%	7	5.2%	13	5.1%	
Experience	*<5 years*	47	33.5%	54	40.1%	101	37.1%	0.638
	5-10	50	36.1%	47	34.2%	97	34.5%	
	>10 years	41	30.4%	36	25.9%	77	28.4%	
Profession	*Doctors*	41	29.1%	39	29.1%	80	28.5%	0.996
	Paramedics	28	20.2%	28	20.1%	56	21.1%	
	Nurses	43	31.3%	43	30.8%	86	31.2%	
	Sanitary workers	26	19.1%	27	19.9%	53	19.2%	

*significant value at p value < .05

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4.1.2 Knowledge about infectious waste management before intervention

Self-administered questionnaire for health staff (doctors, nurses and paramedics) with 24 questions were used to evaluate their knowledge at baseline and after intervention. The score of 1 was given to each correct answer and 0 for incorrect answer. The detail of each and every question on knowledge about infectious waste management with frequency and percentages are attached as **Appendix VII**. Similarly, there were 20 questions for sanitary workers with guided questionnaire were used and a score of 1 was given for correct response and 0 for incorrect response. The frequency and percentage of each response can be seen in **Appendix VIII.**

Table 4.2: Level of Knowledge among health staff and sanitary workers in both groups before intervention

Knowledge Level Score	Intervention group	Control group	p value
Health Staff	**n=112**	**n=110**	
Low (1-7)	8	8	0.999
Moderate (8-17)	98	96	
High (17-24)	6	6	
Sanitary workers	**n=26**	**n=27**	
Low (1-6)	11	11	0.573
Moderate (7-13)	14	16	
High (14-20)	1	0	

*significant value at p value < .05

The obtained score were then changed as per their score level and categorized in three levels; low, moderate and high knowledge. Among health staff the score were ranged between 1-24 and mean SD was used to classify them into three categories. Similarly for sanitary workers, the score ranges from 1 to 20 and were categorized into three levels. Table 4.2 shows the frequency and percentages for both health

staff and sanitary workers on their level of knowledge about infectious waste management. During the baseline in health staff 6 had high knowledge in intervention group and 6 in control group, followed by majority of them 98 had moderate level of knowledge in intervention group and 96 in control. Similarly, for sanitary workers, 1, 14 and 1 had high, moderate and low knowledge in intervention group while in control group had high 0, moderate 16 and low 11 respectively.

4.1.3 Attitude regarding the infectious waste management before intervention

Health care workers have been asked for their attitude regarding infectious waste management through 12 questions designed on 5 point Likert scale ranging from strongly agrees to strongly disagree with both positive and negative statements. Score was given 5 for strongly agree, 4 for agree, 3 for uncertain, 2 for disagree and 1 for strongly disagree. Scores were given to the negative statements accordingly. For baseline and 3 month after intervention, the frequency and percentages have been displayed in the appendix IX for health staff and Appendix X for sanitary workers for both control and intervention group.

The resulted attitude score were calculated as high and low attitude. The number on attitude for workers were ranges from 1-60 and mean was used to classify them into two groups; high attitude and low attitude. Table 4.3 shows the frequency with scores level for attitude in both health staff and sanitary workers in both intervention and control group. It was found that in both groups, the mostly healthcare workers had low attitude and very few had high attitude regarding infectious waste management.

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Table 4. 3: Level of attitude among healthcare workers in both groups before intervention

Attitude Level Score	Intervention group	Control group	p value
Health Staff	**n=112**	**n=110**	
Low attitude (1-30	61	61	0.495
High attitude (31-60)	51	49	
Sanitary workers	**n=26**	**n=27**	
Low attitude (1-30)	22	24	0.478
High attitude (31-60)	4	3	

*significant value at p value < .05

4.1.4 Practices regarding infectious waste before intervention

The questions on practices in both health staff and sanitary workers were different due to their nature of work. For health staff 20 questions were designed while for sanitary workers only 15 questions were designed with both positive and negative statements. For correct response the score was given 1, while for incorrect response, the score was given 0. The distribution, frequency and percentages for baseline and after 3 months intervention measurements were given for each question on practice for health staff in Appendix XI and for sanitary workers in Appendix XII respectively.

Final scores obtained were calculated and assigned as poor and good practices accordingly. The score for health staff ranges from 1-20 and classified into two categories. Similarly, for sanitary workers, the scores for practices ranges from 1-15 and classified into poor and good practices. Table 4.4 shows the number of subjects and their level of practices on infectious waste management in both groups.

Table 4.4: Level of practices about infectious waste among health staff and sanitary workers in both groups before intervention

Practice Level Score	Intervention group	Control group	p value
Health Staff	**n=112**	**n=110**	
Poor (1-11)	43	43	0.512
Good (12-20)	69	67	
Sanitary workers	**n=26**	**n=27**	
Poor (1-8)	24	25	0.680
Good (9-15)	2	2	

*significant value at p value < .05

4.1.5 Enabling factors on infectious waste management

The distribution, frequency and percentages for pre and post measurements were given for each question on enabling factors for health staff in **Appendix 13** and for sanitary workers in **Appendix 14** respectively with both intervention and control group.

4.1.6 Knowledge, attitude and practice scores

The subjects were tested using independent sample t test before the intervention to find any significant difference regarding knowledge, attitude and practices. The score was added to find the mean score. There were no any significant differences have been found between both groups at the baseline. Hence it shows the similar level of KAP before the intervention (Table 4.5).

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Table 4.5: Mean differences in Knowledge, attitude and practices between both groups at baseline (before intervention).

Variables	Intervention group			Control group				
	Mean SD	95% CI Low	Up	Mean SD	95% CI Low	Up	Chi square	p value
Health Staff	**n=112**			**n=110**				
Knowledge	12.80 (3.28)	-882040	.91845	12.75 (3.29)	-82042	0.91847	.003	.999
Attitude	27.38 (7.63)	-1.94216	2.11002	27.30 (7.63)	-1.94227	2.11013	.022	.495
Practice	11.26 (4.04)	-1.01611	1.53365	11.00 (5.49)	-1.02026	1.53780	.011	.512
Sanitary workers n=26				**n=27**				
Knowledge	8.30 (3.12)	-82987	2.26007	7.59 (2.45)	-83972	2.26992	1.11	.573
Attitude	27.80 (8.27)	-3.84722	5.90705	26.77 (8.95)	-3.84488	5.90471	.211	.478
Practice	2.50 (3.82)	-2.19243	2.00724	2.59 (3.78)	-2.19302	2.00784	.002	.680

*significant value at p value < .05

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4.2 PART 2: Effectiveness of IHWM Model

Comparing knowledge, attitude and practices about infectious waste management within groups and across groups, before and after three months of interventions), assessed effectiveness of the IHWM model.

4.2.1 Knowledge of subjects regarding infectious waste after intervention

Appendix 7 and 8 shows us the percentage of subject who answered correctly to knowledge items concerning segregation of infectious waste, collection of infectious waste, storage of infectious waste and disposal towards infectious waste were determined in Table 4.6. The knowledge part of the questionnaire for health staff is comprised of 24 statements regarding infectious waste 12 positive statements and 12 negative statements and questionnaire for sanitary worker is consisted on 20 statements regarding infectious waste 10 positive and 10 negative statement. It is further divided in to four groups; segregation of the infectious waste means they know about the importance of this step and then collection which is an important in management of infectious waste and they know how the infectious and non-infectious waste is being collected from the hospital and storage and disposal their different methods and importance at the hospital. The details of these particular responses are presented in Appendix 7 for health staff and Appendix 8 for sanitary workers.

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Table 4.6: Percentage of Knowledge of subjects regarding infectious waste (pre & post)

# Knowledge statement	Correct answers			
	Intervention group		Control group	
Health Staff	**Pre (n=112)**	**Post (n=101)**	**Pre (n=110)**	**Post (n=102)**
1 Segregation of infectious waste	45.5%	66.1%	43.3%	43.3%
2 Collection of infectious waste	55.0%	78.6%	54.5%	56.8%
3 Storage of infectious waste	58.8%	78.4%	58.6%	59.0%
4 Disposal of infectious waste	57.0%	85.0%	65.4%	57.0%
Sanitary workers	**Pre (n=26)**	**Post (n=26)**	**Pre (n=27)**	**Post (n=26)**
1 Segregation of infectious waste	36.0%	61.0%	34.8%	34.0%
2 Collection of infectious waste	45.3%	66.5%	41.0%	43.0%
3 Storage of infectious waste	39.8%	64.2%	36.8%	35.6%
4 Disposal of infectious waste	43.2%	68.2%	39.7%	39.2%

Knowledge of infectious waste was divided in to three levels low, moderate and high. Table 4.7 shows that most of subjects, before the intervention in health staff 5.1% in the intervention group had high knowledge however after the intervention 69.5% had high knowledge. Similarly in sanitary workers 4.1% in the intervention group had high knowledge after intervention 49.5% had high knowledge. In the control group of both healthcare workers were observed that there were no change in knowledge have been reported and the number of subjects who had high knowledge remained same.

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Table 4.7: Knowledge level among the subjects with significance in pre & post intervention

Knowledge Level	Intervention group		Control group		p value
	Pre	Post	Pre	Post	
Health Staff	**n=112**	**n=101**	**n=110**	**n=102**	
Low	8	0	8	8	
Moderate	98	30	96	88	<0.001
High	6	71	6	6	
Sanitary workers	**n=26**	**n =26**	**n=27**	**n=26**	
Low	11	1	11	11	
Moderate	14	12	16	15	<0.001
High	1	13	0	0	

*significant value at p value < .05

4.2.2 Attitude of subjects regarding infectious waste after intervention

Attitude towards infectious waste was measured with 12 statements for both health staff and sanitary workers, each statement had 5 responses strongly agree (SA), agree (A), neutral (N), disagree (D) and strongly disagree (SD). There were total of four positive and eight negative statements. The minimum score was 1 and maximum score was 5. Similarly, for negative statements SA was scored was 1, A = 2, N= 3, D=4 and SD was scored 5 and vice-versa. Each attitude component was divided in to two groups; high and low by calculating the mean. The percentage of high attitude of the subjects regarding segregation, collection, storage and disposal of infectious waste can be seen in the Table 4.8. The percentage of the subject who had high attitudes has increased in both the groups of health staff and sanitary workers. Details of the subject‘s response in each attitude item are presented in Appendix IX.

Table 4.8: Percentage of Attitude of subjects regarding infectious waste (pre & post)

#	Attitude statement	Percentage of attitude			
		Intervention group		Control group	
	Health Staff	Pre (n=112)	Post (n=101)	Pre (n=110)	Post (n=102)
1	Segregation of infectious waste	71.0%	78.5%	82.5%	77.7%
2	Collection of infectious waste	49.3%	55.3%	37.1%	47%
3	Storage of infectious waste	45.5%	48.2%	46.3%	47%
4	Disposal of infectious waste	59.2%	65.7%	59.5%	56.2%
	Sanitary workers	Pre n=26	Post n=26	Pre n=27	Post n=26
1	Segregation of infectious waste	66.2%	72.0%	77.7%	65.1%
2	Collection of infectious waste	62.0%	70.6%	65.1%	71.5%
3	Storage of infectious waste	73.0%	76.4%	77.0%	80.7%
4	Disposal of infectious waste	52.5%	53.5%	57.7%	58.75%

Attitude level of healthcare workers towards infectious waste was also divided in two groups high and low attitude by calculating mean score. According to the Table 4.9 most subject in the intervention and control group of health staff had low attitude 55% and 45% subjects had high attitude while in sanitary workers group 85% in intervention and 89% in control group had low attitude. After the intervention 82% in health staff and 58% in sanitary workers had high attitude in the intervention group and attitude in the control group among health staff 43% and sanitary workers 12% were found with high attitude.

Table 4.9: Attitude level among the subjects with significance in pre and post intervention

Attitude	Intervention		Control		p
	Pre	Post	Pre	Post	value
Health Staff	**n=112**	**n=101**	**n=110**	**102**	<0.001
Low attitude	61	18	61	58	
High attitude	51	83	49	44	
Sanitary workers	**n=26**	**n=26**	**n=27**	**n=26**	0.010
Low attitude	22	11	24	23	
High attitude	4	15	3	3	

*significant value at p value < .05

4.2.3 Practices of subjects regarding infectious waste after intervention

Appendix 11 and 12 represents the percentage of subject who answered correctly to practice items concerning segregation of infectious waste, collection of infectious waste, storage of infectious waste and disposal towards infectious waste were determined in Table 4.10. The practice part of the questionnaire for health staff is compromised of 20 statements regarding infectious waste 15 positive statements and 05 negative statements and questionnaire for sanitary worker is consisted on 15 statements regarding infectious waste 10 positive and 5 negative statement. It is further divided in to four groups; segregation of the infectious waste means they practically do this step and then collection which is an important step in management of infectious waste and their proper practices regarding the infectious and non-infectious waste collection are important. Practices regarding the storage and disposal of infectious waste are more important for sanitary workers. The details of these particular responses are presented in Appendix XI for health staff and Appendix XII for sanitary workers.

Table 4.10: Percentage of practices of subjects regarding infectious waste (pre & post)

#	Practices statement	Correct answers			
		Intervention group		Control group	
	Health Staff	**Pre**	**Post**	**Pre**	**Post**
		(n=112)	**(n=101)**	**(n=110)**	**(n=102)**
1	Segregation of infectious waste	51.5%	71.8%	52.3%	57.0%
2	Collection of infectious waste	67.1%	78.5%	50.0%	57.1%
3	Storage of infectious waste	53.5%	72.5%	47.5%	51.0%
4	Disposal of infectious waste	55.0%	71.0%	55.0%	55.2%
	Sanitary workers	**Pre**	**Post**	**Pre**	**Post**
		n=26	**n=26**	**n=27**	**n=26**
1	Segregation of infectious waste	8.4%	69.3%	7.4%	8.4%
2	Collection of infectious waste	81.4%	59.5%	19.1%	15.4%
3	Storage of infectious waste	6.0%	18.0%	3.5%	2.0%
4	Disposal of infectious waste	21.0%	60.2%	20.8%	19.4%

Practices of infectious waste were divided in two levels poor and good practices. Table 4.11 shows that most of subjects before the intervention in health staff 62% in the intervention group had good practices however after the intervention 87% had good practices. Similarly in sanitary workers 8% in the intervention group had high knowledge after intervention 39% had good practices. In the control group of both healthcare workers were observed that there was only 1% change in good practices.

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Table 4.11: Practices among the subjects with significance in pre and post intervention

Practices	Intervention		Control		p value
Health Staff	**Pre (n=112)**	**Post (n=101)**	**Pre (n=110)**	**Post (n=102)**	
Poor practices	43	13	43	39	<0.001
Good practices	69	88	67	63	
Sanitary workers	**Pre (n=26)**	**Post (n=26)**	**Pre (n=27)**	**Post (n=26)**	0.044
Poor practices	24	16	25	24	
Good practices	2	10	2	2	

*significant value at p value < .05

4.2.4 Mean difference in Knowledge, attitude & Practices of subjects regarding infectious waste with in both groups

Table 4.7, 4.9 & 4.11 presents the statistical change of knowledge, attitude and practices regarding infectious waste management before and after the intervention by comparing mean score. Table 4.12 shows the mean difference at pre and post intervention in knowledge, attitude and practices among the health staff and sanitary workers in both control and intervention group. Mean score was calculated by adding up the statements. Wilcoxon signed Rank test was used to determine the mean difference between the knowledge, attitude and practices of the subjects before and after the intervention there was a significant difference in knowledge and practices p = <0.001 for the intervention group. There was no any significant difference between before and after in the control group have been shown. For attitude of the subjects paired sample t-test was used to determine the mean difference in attitude before and after the intervention. In the

intervention group there was a significant difference p = <0.001 however in the control group there was no significant difference was measured.

Table 4.12: Mean difference in Knowledge, attitude & practices pre and post scores within and across groups

Variables	Intervention			Control		
Health Staff	Pre Mean (SD)	Post Mean (SD)	p value	Pre Mean (SD)	Post Mean (SD)	p value
Knowledge	12.80 (3.28)	18.59 (2.25)	<0.001	12.75 (3.29)	12.88 (3.32)	0.932
Attitude	27.38 (7.63)	34.12 (4.17)	<0.001	27.30 (7.63)	27.00 (7.54)	0.738
Practices	11.26 (4.04)	14.81 (2.50)	<0.001	11.00 (5.49)	11.05 (5.58)	0.912
Sanitary workers						
Knowledge	8.30 (3.12)	12.96 (3.07)	<0.001	7.59 (2.45)	7.50 (2.41)	0.47
Attitude	27.80 (8.27)	31.84 (4.91)	0.021	26.77 (8.95)	26.80 (9.12)	1.000
Practices	2.50 (3.82)	9.23 (3.03)	<0.001	2.59 (3.78)	2.46 (3.7)	1.000

*significant value at p value < .05

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4.2.5 Mean difference after intervention in Knowledge, attitude & Practices of subjects regarding infectious waste with in both groups

Table 4.13 shows the mean difference after intervention in knowledge, attitude and practices among the health staff and sanitary workers in both control and intervention group. Mean score was calculated by adding up the statements. Paired sample t-test was used to determine the mean difference between the knowledge, attitude and practices of the subjects after the intervention there was a significant difference in knowledge, attitude and practices p = <0.001 after intervention.

Table 4.13: Mean difference after intervention in Knowledge, attitude & Practices of subjects regarding infectious waste with in both groups

Variable	Intervention	Control	
Health Staff	Post Mean (SD)	Post Mean (SD)	p value
Knowledge	18.59 (2.25)	12.88 (3.32)	0.002
Attitude	34.12 (4.17)	27.00 (7.54)	<0.001
Practices	14.81 (2.50)	11.05 (5.58)	<0.001
Sanitary workers			
Knowledge	12.96 (3.07)	7.50 (2.41)	<0.001
Attitude	31.84 (4.91)	26.80 (9.12)	0.017
Practices	9.23 (3.03)	2.46 (3.7)	<0.001

*significant value at p value < .05

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4.3 PART 3: Qualitative findings

One of our study objective was to describe the situation of infectious waste management with in both control and intervention hospital. However, this qualitative data were collected through direct observation by using the WHO checklist (Annex-III) and in depth views through conducting the IDIs from administration in both control and intervention groups through developed qualitative question guide (Annex II c). This qualitative data was collected before to start the study during the month of September 2013. For in-depth interview and observation, qualitative analysis was done by content analysis. Responses from the participants were analyzed manually. Nodes and sub nodes were developed using the constant comparison technique. After coding, themes were generated from the most popular answers given during the interviews. The results were compiled thematically and triangulated with the qualitative observations and quantitative results. Agreements and dissonances were checked and mentioned accordingly.

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4.3.1 Direct Observations:

These observations were conducted through an adopted WHO checklist of different steps of infectious waste management within hospitals on the steps of segregation, collection, storage and disposal of infectious waste. Different departments including from medical ward, surgery, pediatrics, gynecology, urology, gastroenterology, operation theaters, Opthmology, ear, nose & throat, accident and emergency, orthopedics, radiology, laboratory, dialysis, labor room, OPD, plastic surgery, dermatology and neurosurgery were visited. Observational surveys were conducted during the baseline before the start of the intervention program. Segregation was

observed in all the departments separately; while their storage and disposal facilities were combined in each hospital.

4.3.1.1 Segregation of infectious waste

During the visit, it was noted that almost every department has four colour coded waste bins; red for infectious, black for general, yellow for sharps and white safety box for injection safety, but there were no proper labeling on the waste bins. Accordingly, red bin were used for infectious and black bin for general waste bins. It has also been noted in few other departments that they were not using proper coding for waste segregation and were used only two bins of different colors. There were no separate bins used by different departments for other hazardous waste such as; pharmaceutical waste, chemical waste and radioactive waste. They were using either red or yellow bin for these kinds of wastes. It was observed that black waste bin was found at the patient bed side where all the general waste was properly thrown by the patients and the red bin with infection safety box was placed at the nursing station. However, these bins were not placed on properly and can expose the risk of infections to patients and staff. During the direct observations it was also noted that the infectious waste was not properly segregated due to poor practices of HCWs. Mainly infectious waste was thrown in general waste bin such as drip sets, syringes and some of the patient's blood stained objects.

Figure 4-1: Segregation practices in both hospitals

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4.3.1.2 Collection of infectious waste

Collections of infectious waste were routinely performed in both hospitals on three different times: early in the morning, afternoon and evening collections were observed during the visit accordingly. Sanitary workers were involved in collection and transportation of waste and were using common trolley without cover for collection of both infectious waste and non-infectious waste in both the hospitals. Trolleys were driven through common routes with in the hospitals and were not usually washed after the waste transportation. General waste includes common papers, used plastics bags, hard papers and files, food boxes, kitchen items, fruits waste and domestic use items. During the collection of waste, the plastic collection bags were not properly sealed and few punctures and holes were also observed and

all were filled full. However, no proper WHO guidelines were followed during the collection and transportation of waste. Some of the wards were only collecting the infectious waste, once the bins were filled by the staff. During the waste collection, no proper labeling were used on the waste collected and there were no proper PPE used by the staff during the waste handling. Sanitary workers were not using the gloves, long rubber boots, aprons and masks during the collection of infectious waste.

Figure 4-2: Collection of non-infectious waste

4.3.1.3 Storage of infectious waste

There are separate storage points located in both hospitals. Storage room for infectious waste was used for infectious waste; while general waste were dumped in open container placed with in the vicinity of both hospitals, where this container were picked by the municipality for disposal. There were no proper fencing constructed for the storage waste point except hospital boundary wall. Some of the infectious waste such as used syringes, blood drip sets, medicines vials and urine bags were also found mixed with general waste containers during the visit. There

were no temperature control systems existing for infectious waste storage especially for pathological waste at the storage area before disposal. However, it was also found that HCWs were not properly following the guidelines for storage of waste before disposal.

Figure 4-3: Storage of infectious waste

The capacity of storage area in both hospitals was not properly capturing the infectious waste produced every day with in these facilities. In intervention hospitals, air condition was installed in the storage room but not functional for temperature regulation before disposal of organs.

4.3.1.4 Disposal of infectious waste

In both hospitals the autoclave and incinerators were used for the final disposal of infectious waste. However, the researcher was found that hospital has only one

autoclave and incinerator that might affects of infectious waste disposal in case of any technical problem in these equipment. However, the land filling for general waste was used by the munciplicity of Rawalpindi Pakistan. Researcher has found that almost all the sanitary workers who are working for infectious waste disposal were not using the proper equipments like gloves, aprons, long rubber boats and masks. HCWs told that they don't have these PPE available in the hospital. During the visit in hospitals it was noted that the waste produced were similar from all the departments in both control and intervention hospitals. Though, some departments had different waste like laboratory and radiology department depending on their nature of health care provisions. Disinfectant like bleaching solution was also used for local disinfection within the wards and also was used for the cleaning purpose.

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Figure 4-4: Disposal of infectious waste

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4.3.2 In-depth interviews:

During the in-depth interviews, it was highlighted the hospital staff were not practicing properly regarding the infectious waste management at both hospitals. This poor handling was due their lack of knowledge about WHO guidelines and hospital waste management rules 2005. Though, the administration was more conscious about the healthcare workers safety but due to the lack of funding; these hospitals were not providing the PPE regularly to the staff for infectious waste management. Regarding the steps of waste management; segregation and disposal of the waste

were identified as the most complicated steps that need rigorous training of the staff at their working places.

The importance of regular trainings has been highlighted and it was also recommended by the administrative officials of studied hospitals that the regular refresher trainings should be conducted on routine basis for the capacity building of staff. Time constraints, funding, lack of capacity, proper guidance and regular monitoring and evaluation were the major hindrance for to conduct the regular trainings in their organizations. It was also recorded that some visual demonstration should also be given to the staff for better management of the infectious waste management. During the interviews, the regular meeting at the hospital for proper infectious waste management has been encouraged for timely decisions and progress of the staff. Health care workers motivation through providing the award or incentives in the form of cash or recognition ward should be recommended by the expert for achievement of the better practices.

In depth interview with the help of developed guidelines were conducted with hospital management including Medical Superintendent, Executive Director, Deputy Director, Nursing superintendent and Focal person hospital waste management in both hospitals. 10 semi structured interview (5 from each hospital) were recorded. The qualitative findings on the in-depth interview were analyzed as:

1. ***What are your opinions about infectious waste management at the hospital?***

    - Focal person from intervention hospital was replied, "*I am always concerned with the patient and worker's safety during the infectious waste handling*".

- Nursing superintendent from control hospital said, “The infectious waste is being managed as per the WHO guidelines”.

- “*Segregation is the big issues at our hospital and healthcare workers do not perform as per the WHO guidelines*”, Medical superintendent of control hospital stated.

- *“Recycling of used syringes with in hospital is more concerned for me as a chief of this hospital”,* Executive Director from intervention hospital explained.

- *“Needle prick injuries are most common challenge during the infectious waste management at our hospital”,* stated by Deputy Director of intervention hospital.

- Nursing superintendent and deputy director from control hospital said; “The infectious waste is satisfactorily managed with in the hospital by healthcare workers”.

- *“I am more concerned regarding the steps of infectious waste management like; segregation, collection, storage and disposal at the hospital”,* sated by the Medical Superintendent from intervention hospital.

- *“Infectious waste is not properly managed at our hospital due to lack of information among workers in the hospital”,* stated by Deputy Director of intervention hospital.

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2. ***What are the problems and challenges faced by you in infectious waste management at this hospital?***

- All the participants believed that there should be enough budgets for infectious waste management.

- Medical superintendent of control hospital said, *"I am always concerned about the availability of PPE for workers during the waste handling".*

- *"Most of time we don't have the enough funds for purchasing the PPE and waste bins",* stated by Executive director of control hospital.

- Nursing superintendent of intervention hospital said *"it is all the infectious waste handled by the Nursing staff".*

- Focal person from control hospital said "*there should be proper labeling on dust bin displayed in the hospital"*.

- *"Availability of waste bins and needle cutter has always been the problem during the everyday working", nursing superintendent of control hospital said.*

- *"We don't follow the color coding of waste bins due to non-availability of the proper color coded bins that create confusion in the workers during the waste segregation and results improper waste handling",* said by the Medical superintendent of control hospital.

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- *"We have already paid the penalty imposed by Pakistan environmental protection agency of 1 Million Pakistan rupees due to not following the hospital waste rules 2005"*, Focal person from intervention hospital stated.

3. ***How you trained the health care workers in infectious waste management at this hospital?***

    - "*We don't have the sufficient funds for the training of staff in infectious waste management"*, said by Executive Director of intervention hospital.

    - *"I am more concerned about the training of all health care workers at the hospital regarding infectious waste management",* maintained by focal person from intervention hospital.

    - *"These trainings would be more beneficial for better waste management practices at the hospital"*, maintained by the Medical superintendent of control hospital.

    - *"We will conduct training to the staff when donor's funding is available",* Executive Directors of both hospitals said.

    - *"We don't have enough time for training of staff as we are mostly busy in health care provision of the general public",* explained by the other Medical superintendent of intervention hospital.

- All the respondents agreed that there should be regular training program for health care workers on regular basis.

4. ***How the health care waste management practices can be improved? Has hospital got any guideline on hospital waste management?***

    - The whole group agreed that there should be regular trainings on infectious waste management through actual participation of the workers and national case studies should be shared with them. It was also discussed that there should be regular incentives in form of cash, award and appreciation for the workers.

    - "*Practices can be improved through regular visual demonstration on actual steps on infectious waste management",* said by the focal person from control hospital.

    - *"I am more concerned about the regular monitoring and supervision during the working hours"*, said by the Medical superintendent of intervention hospital.

    - *"Best worker of the month should be announced every month, and this will improve the practices of the workers regarding infectious waste"*, said by the focal persons from control hospital.

    - "Health care waste management rules 2005 and WHO guidelines are available in the hospitals but I think these are only for managerial staffs who are involved in the management of day to day affairs", said by the Medical superintendent of intervention hospital.

5. What is the role of regular meetings in health care waste management?

- All the participants have agreed that regular meetings are helpful for improving the management of waste.

- *"I am very confident that these regular meetings are more important for timely management of infectious waste management",* said by the Deputy Director from control hospital.

- Medical superintendent said*, "I think these meetings are very important for improving knowledge of our staff at the hospital".*

- *"We can share the progress and work on the infectious waste management in the meetings and everyone has the opportunity to share his/her view point's",* said by the Medical superintendent on control hospital.

6. In your opinion, how can infectious waste managed?

- *"Infectious waste can be managed by properly following the hospital waste management rules 2005 and WHO guidelines which needs budget"*, said by the Nursing superintendent of control hospital.

- *"I am more concerned about the regular allocation of budget on this issue",* said by the Executive Director of control hospital.

- *"Regular trainings of the staff will definitely improve the waste management practices",* shared by focal persons HCWM of both hospitals.

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- *"To ensure the availability and provision of PPE will be more beneficial for the management of this issue"*, said by the Medical superintendent of intervention hospital.

- *"We should develop for policy based on evidence through research in this neglected field and it will definitely improve the infectious waste management practices in the hospital",* said by one of the focal person of intervention hospital.

7. ***In your opinion, what will be the importance of the trainings of health care workers for infectious care waste management in your hospital?***

    - All the participants agreed that the trainings regarding health care waste management are very important but there is lack of evidence based research in the importance of these trainings.

    - *"Definitely these trainings would be good option and will be helpful for staff",* said by the Medical superintendent of control hospital.

    - *"I am concerned about the evidence based research, we don't have any evidence but I think trainings are most important",* said by the Executive Director of intervention hospital.

    - *"Trainings course are very important and without these workers can't perform in efficient way",* focal person from control hospital explained.

- *"Trainings can easily change the practices of staff through increasing their knowledge on infectious waste",* said by the Deputy Director of control hospital.

Chapter 5

Discussion

This chapter explained the study findings from the research questions and generated hypothesis. This discussion part is also triangulated with the published research and evidence based findings and theoretical support on infectious waste management. Conclusion has been drawn in the light of research findings from our interventional study and recommendations with limitation have also been discussed for the future researchers, further relevant activities and policy implications in the field of infectious waste management. But foremost, we have discussed the background of this study and the reason why we had conducted this study.

As the link between human health and environmental quality is made clearer, the commitment to safeguarding the natural environment is growing in major institutions such as the health care establishments. In Pakistan, there has been some improvement in the health care system over the years. However it is ironic that the health care settings, which restore and maintain community health, are also threatening their well-being. Every hospital and clinic, no matter what size, is intended to be a place of healing and is supposed to safeguard the health of community. This is the fundamental purpose of a health care system. However, the waste produced by the medical care centers if handed improperly, can pose an even greater threat than the original diseases themselves. The ability of an institution to provide a good standard of health care is undermined if there is a poor standard of hygiene and a high risk of avoidable infection to patients and medical workers.

Achieving a good standard of cleanliness in health care institutions is an important component in controlling infection. Waste produced in medical departments is one

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of the sources of infection. It's potential to cause infection increases if it is not properly handled and removed regularly from each medical area. It is not the only source of infection but one that can be easily avoided with a little effort and forethought. Poor infectious waste management practices pose a huge risk to the health of the public, patients, professionals and contribute to the environmental degradation.

Pakistani hospitals are facing big problem of health care waste management which results in high burden of hospital acquired infections to the workers, attendant and patients. It is therefore the responsibility of the major hospitals and other healthcare facilities, both in public and private sectors, to implement the set protocols and standards as their first priority even well before starting healthcare delivery to the patients. Pakistan Hospital Waste Management Rules 2005 are found partially implemented with no proper monitoring or financial backup. The implementation of these rules is a major challenge.

The objective of this study was to assess the effectiveness of IHWM model intervention on healthcare workers regarding infectious waste management. This was a quasi-experimental, control and intervention group with two groups' pre and post. A total of 275 subjects participated in this study during the baseline survey in both hospitals. Two groups pre and post data, study was used to assess the effectiveness of IHCWM model Intervention on, change in knowledge, Attitude and practices towards the infectious waste management. A structured questionnaire was used to collect the data the follow-up survey was conducted. The healthcare workers who didn't attended the interventional sessions were traced through their mobile phone by the data collectors. Eleven HCWs from intervention hospital and

nine HCWs from control hospital were lost due to transfer posting and due to the absence from duty because of leave, refusal and other domestic problems at their home. However 255 HCWs from 275 HCWs were successfully followed. However the response rate at the end of study was calculated as 92%.

5.1 Socio-demographic characteristics

Majority of the HCWs participated in the study from both control and intervention hospitals were belong to young age group below 25 years and there was no significant difference in the two groups. The possible reason behind the involvement of younger healthcare workers is because senior staff has been promoted as senior managers and supervisors. It was found that majority of the HCWs were nursing staff and doctors in the study. There were no significant difference found between the occupation and groups. The number of nurses and doctors were more in both hospitals as they are only responsible for patient care in the hospitals as compare to sanitary workers and paramedics. Above half of the study populations were male by gender and were statistically found highly significant difference. Above one third of HCWs had qualification of graduation and secondary education and was found no significance with education of HCWs. Concerning the income of HCWs, nearly half had income more than 20,000 Pakistan rupees per month. There is no any significant difference was shown between the income and groups. Regarding the department where these HCWs were working, majority from intervention hospital working in medicine department while in control hospital majority of the HCWs were working in emergency department. The control hospital was located in center of city and providing emergency services to many patients as compare to intervention hospital which where staff working in medicine wards were more in numbers. There was

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statistically difference has been seen between the department where they work and the hospitals. During the baseline of the study we found there was a significant difference in two characteristics of the subjects between the control group and intervention group. The difference was in departments of working within the hospitals and by gender within health worker. Studies has found the similar socio-demographic information during their surveys (56).

5.2 Situation of infectious waste management:

First objective of our study was to know about the situation of infectious waste management among healthcare workers at tertiary care hospitals of Rawalpindi. We have conducted the direct observations through a validated checklist and conducted in-depth interviews with the experts who were involved in the infectious waste management in both hospitals. These direct observations and in depth interviews have been conducted in both control and intervention hospital before to start the intervention for one single time. Participants during the in-depth interview have agreed that they were not following the WHO guidelines properly for infectious waste management. Administrators also raised some of their concerns and issues related to the waste management. They all had concerns that there should be regular trainings for building the capacity of workers in infectious waste management. This was also observed during the visit that hospital staff needs a dedicated training in both hospitals. Multiple issues such as, segregation of waste at point source, inappropriate collection due to lack of sufficient waste collection bags, transportation by single trolley, storage place, disposal issues and lack of PPE were identified through direct observations s well as during in-depth interview. Practices of health force on different steps from segregation, collection, storage and disposal needs dedicated trainings at

their work place and also timely supervision is highly required for their capacity building. Though the infectious waste management is highly depended on committed workers and dedicated health management team in the institute (57). Every health care organization has duty of care the patients and provides comfort, attract, environment friendly with infection free atmosphere (58). One of the issues raised by the participants was the recycling of the used syringes that leads to frequent needle prick injuries among sanitary workers in the hospital. It was highlighted that these workers should be aware about the fate of this re use syringes. This could be prevented through regular monitoring and evaluation on the disposal methods in hospital (59).

Most of the participants have shared that they were working in the infectious waste management and their knowledge is as per the standards of WHO. A culture of an awareness seminars, programs and meetings about this important issue should be adopted in the hospitals. All the participants have agreed to adopt the trainings and regular courses in infectious waste management at the hospital but they do not have sufficient funds for support these activities. During the direct observation, it was found that the workers were throwing infectious waste in the wrong bin. Hence, it was proved that workers need regular trainings to improve their practices on infectious waste disposal. Some of the participants also highlighted that infectious waste is the neglected issue and they do not have enough time as they are busy with serious patients. Study conducted in a developed country also revealed that health workers were unaware about the consequences of poor waste segregation with in hospital before their training, but these workers became more aware after their training in waste management and responded clearly on the different steps.

Education of the hospital staff has improved their practices and knowledge about medical waste management and also builds their confidence level. It has been proposed that hospital can adopt infectious waste management trainings and save their maximum resources by giving the awareness to their employees and workers (60). Another study which supports our findings and proved that without training the workers cannot perform in an efficient way and their health care waste management practices remained inappropriate (61).

Accessibility of guidelines on infectious waste management was a big hurdle in the surveyed hospitals. Only half of the health staff including doctors had studied these guidelines. Government of Pakistan has introduced infectious waste management rules 2005, but many of the respondents were not aware about these rules. However, during the in depth interview, some of administrative staff were aware about these rules and were the opinion that these rules are only for administration staff not for the workers. As most of the health professional was busy in health care provision of the patients and they do not have sufficient time available for to read these rules and guidelines at their work place. Though, these guidelines and relevant materials are very important for workers to perform their job in efficient way. Policy about the waste management was included in the infectious waste management rules 2005 (62). Better waste management practices can be achieved by implementing these rules properly in the hospitals. African study has concluded that the policy in waste management would be the best tool for proper management of infectious waste at the hospital (63).

There were concerns by all the workers on the availability of PPE at their work place. Most of the workers do not have the color coded waste bins at their work place. The non-availability of these equipments was considered as major enabling factors for their inappropriate practices at the hospitals. During the direct observations, it was also highlighted that the workers do not have enough waste bins at their work place. When discussed with the administration during the in depth interviews, they said hospital does not have the budget to purchase these bins on regular basis. Literature supported that infectious waste has many types; like pathological waste, pharmaceutical waste, chemical waste, Genotoxic waste and others and these all different types should be disposed separately in different bins (53).

Most of the respondents have reported that they have enough quantity of gloves available at hospitals, but they were not using these gloves during the waste handlings. It was also observed during the direct observation in these hospitals that the workers have not worn these gloves during the waste collection. This risky behviour among the workers is itself a big cause of injection prick during the waste handling. One study in Pakistan has proved that the healthcare workers are the high risk groups in hepatitis B and C infections at the hospitals due to frequent needle prick injuries (64). Study supports our findings that the health care workers were not using the PPE properly because of their lack of knowledge regarding the consequences of this risky behaviour (29).

Others factors regarding trainings of infectious waste were low attendance of the health staff whereby a minimum number of the sanitary workers have attended the trainings. This might be one of the reasons for their poor mishandling of waste. Another study supports our findings that the lack of trainings and awareness among

the health professionals and staff results in the inappropriate infectious waste management practices in the hospitals (16). An Ethiopian study also concluded that the waste management practices among the health workers working in the hospitals are not up to the standards (26). During the in depth interviews, it was highlighted that these hospitals have no budget allocation for the regular trainings for the staff and also these trainings were not included in their regular planned activities. However, the infectious waste management is a priority need of every hospital and this should be included in their annual budgetary allocation under separate heads. These regular trainings and refreshers are very important for updating the knowledge and practices of health professional about infectious waste management at their work place. Hence, such trainings should be performed by the hospital on regular intervals.

Most of the health staff claimed that their hospital has a separate committee of infection waste management and regular health care waste management plan exists, but there was hardly any regular monitoring and supervision performed by the administration. It was also observed that both hospitals have designated focal person in infectious waste management but they do not have power and budget to perform. Since the waste management is a separate entity within the hospital, it was suggested by the participants during in depth views that hospital should develop a separate department for better outcomes. However, this continuous supervision and monitoring could increase the motivation of health staff and ultimately affects their better working output on time (65, 66). Regular watch over through these committee on the health care workers has brought good results on improvement of infectious waste management at the hospital (67). A neighboring country has reported similar

issues because of the lack of legislative process and poor implementation regarding the medical waste management in the hospitals results recycling of the waste and re sold by the scavengers. Hospital should ensure the implementation of waste management plan that could revert the situation of poor infectious waste at hospital (34). It is responsibility of every hospital to properly dispose off the infectious waste being generated during the patient care to avoid the health and environmental hazards. Well-developed plan should be followed and executed within the organization for better results (68).

5.3 Effectiveness of the IHWM Model

IHWM training model was based on the literature review mainly of WHO, and modified from the previous training models based on behavioral change theories (69). The frequency of routine work and improved quality of practice regarding the infectious waste management were expected outcomes of this training. We implemented this training model for three months in the intervention hospital only; while the regular activities went on in the control hospital. Three training sessions each with 6 hours contact were conducted for HCWs in the intervention arm with four week interval between the two training. Training was followed by hands-on practicum demonstration for 6 hours duration each on the use of Personal Protective Equipment (PPE) and different steps of infectious waste management. PPE were also provided during the study to see the proper effectiveness of this training model. Third approach of this training model was the reminder services on infectious waste management which were given through administrators of the concerned departments during morning meeting regularly for three months. Trainings modules were adopted

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from WHO manual and guidelines on hospital waste management and hospital waste management rules 2005 (62).

The IHWM model has three approaches, trainings, on hand practicum and reminder services for to improve the knowledge, attitude and practices of HCWs regarding the infectious waste management. Face to face trainings of IHWM model has been proven to be one of the most effective strategies for improving the practices and health behavior, especially when combined with other training interventional approaches (15) (19). Similarly, practicum demonstration and use of information materials also play an additional beneficial role for to improving the behavior of individuals in any organization (20). Individual trainings with demonstration are the most efficient approach to instruct and visualize the proper techniques. The main objective is to give health staff the opportunity to practice these skills and to provide an opportunity to facilitators to explain the logical reasoning, provide feedback, real situation and correction and also reinforce messages regarding the proper management and good practices (21). This IHWM intervention program brings positive change in the behaviour of an individual's through trainings. Behaviour change is very difficult task when performed in the individuals. This needs integrated educational program and continuous learning activities. Studies also show that these kind of cognitive behavioral programs are very effective when introduced by a trained and dedicated team in the organization. This program brings positive change within the shorter duration of time (22). Environment is a major factor in enabling the practices of health care waste management. Facilitators include the availability and easy implementation of the guidelines. Barriers such as non availability of Personal Protective Equipments (PPE) and hospital waste management bins / materials in the

health facilities must be ensured. Therefore, proper distribution and availability should be ensured as per the available HWM rules of these equipments at the hospital (23). Reminder service through administration and facilitators encourages the health workers in monitoring and controlling their behavior attributed to a particular unhealthy practice. Although, these reminder services have not been previously practice in the health care waste management interventions, it has been successful in assisting individuals in achieving health behavior modification, such as weight control (24). Therefore, this study supplemented the reminder service through administration in the intervention with an expectation that it would help maintain good health waste management practices. We have discussed the effectiveness of these components on the IHWM and to compare the literature available for to improve the knowledge, attitude and practices among health care workers.

5.3.1 Knowledge and trainings on infectious waste management:

Training sessions of the health care workers have been used as the key component of the model intervention during this study. This program has been statistically proved that the regular trainings and education can increase the knowledge of health professionals at their work place in the intervention hospital. However, no change has been reported in the control hospital. During this study, we have implemented the IHWM model by conducting three face to face trainings which included six hours education after one month of interval. Studies have also supported our findings by giving their concluded suggestions in their research that the regular trainings and their effectively implementation can positively influence the behaviour of staff and also helps in improved practices of the workers regarding waste management at their working organization (16, 70). Pakistani researchers have concluded that the

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mishandling of infectious waste at the hospital could only be controlled through rigorous education and dedicated trainings of staff at their duty stations. Though the effectiveness of trainings in infectious waste management is still a misnomer, and there was not a single interventional study has been conducted in the past (64). Health professionals are the front man who can be affected by the hospital acquired infections frequently, their proper knowledge is more important while preventing them from these deadly infections which can only be possible through continuing education. However, the regular information through training, seminars, workshops and continuous trainings on infectious waste management for to build their skills level is needed otherwise they even not know the common terminology of the infectious waste management (71). Work environment and regular performance of staff could be improved through constant guidance in the form of education and teaching (72).

Knowledge about the segregation of infectious waste was reported poor among the sanitary workers as compared to the health staff at the baseline while both groups have improved their knowledge from 20% (health staff) and 25% (sanitary workers) after the intervention. Segregation of the mercury during the breakage of thermometer was the most technical question and knowledge among the workers were recorded as poor on this question. This poor knowledge of the workers is possibly due to the lack of information related to the management of this waste in WHO guidelines (53). Majority of the health staff and sanitary workers were not aware about the pathological waste such as body tissue and placenta etc should be autoclaved for disposal in the hospital. However, this special waste should be properly incinerated or can be buried in case the incinerator is not available at the

facility and autoclave is not recommended treatment for the pathological waste, radioactive and cytotoxic materials (9). One study discovered that a majority of the medical students too were not aware about the proper disposal of mercury at the hospital. This might be due to their poor exposure towards the waste handlings and involvement in the real management of infectious waste at the hospital (73). Findings are consistent with our study which shows that the poor knowledge among health professional regarding the waste management has been associated risks and is known to be the highly contributing reason to poor disposal practices. Our findings are in concurrence with another research which was conducted to evaluate hospital workers' awareness of health and environmental effects of improper infectious waste disposal in Cameroon (74). Another study also supports our finding that health staff has significant knowledge on proper segregation on color coding with in the hospital as compare to their auxiliary staff (75).

Our findings are consistent with other similar studies which have also shows the significance of knowledge and awareness of infectious waste in health professionals working at tertiary care hospitals. On analysis from tertiary care hospitals in Karachi have found that health care staff was not much aware about the infectious waste practices especially collection storage and disposal during their work place (8). Studies from developing countries with in the similar situation have also reported the similar kind of results and conclude that the hospital workers lack skills, knowledge and attitude to efficiently handle the infectious waste at their work place (76-78).

5.3.2 Attitude on infectious waste management:

Reminder services have been tested during this intervention as one of the component for IHWM model. During the reminder services a refresher messages on

infectious waste management has been delivered by health management during the daily meeting with health workers and regular duty rounds. This unique approach was adopted with the aim to improve the attitude of the staff about infectious waste management within the hospital. This component has resulted in statistically significant changes in the attitude of health staff after intervention in the hospital while there was no significant change reported in the control hospital. There, this IHWM model has remains successful while improved the HCW's attitude at their working place. There is no research previously conducted for testing the efficacy of such reminder services for infectious waste management. However, these reminder services were tested and proved successful in weight reduction research by changing the individual's behavior modification. Hence the studies came with good outcome in the attitude differences through giving the daily reminder services in the research (24).

Our study has reported the negative attitude of the staff regarding infectious waste management in both hospitals during the baseline survey. Sanitary workers were not properly following the WHO guidelines for infectious waste storage and disposal. However, the attitude in the intervention hospital has been improved through implementation of IHWM program. Studies from other neighboring countries with similar kind of situation are also with agreement in that there was no apprehension in hospital workers on different steps of waste for proper management due to their negative attitude at the work place (79). Another Ethiopian published survey had reported that the workers were not properly storing the infectious waste and ultimately disposing the similar waste with in hospital which exposed many

hazardous to the population and staff. This can be reverted by changing the attitude of the workers about infectious waste at their work place (80).

Pakistani studies conducted in the similar context support our findings related to situation of waste management in big hospitals of the country and explained that mostly these hospitals lack the system of infection control and waste management and also do not have the separate teams for management. Further, these hospitals also lack a proper storage place for storage of infectious waste within the facilities before proper disposal (81). Hospital waste is recycled by the scavengers in developing countries and was reported by researchers frequently. This recycled waste is responsible for infections in the general masses and may contaminate the surrounding environment (64). Mishandling due to negative attitude of the workers resulted in the frequent needle prick injuries and other frequently harms them. This poor handling has evidence of environment contamination and poses the major risk hazardous to the general public and community (82). Study has concluded that the exposure of poor handling due to the attitude of health workers has major risk of developing the infections in staffs, patients, attendants and the people living near by the hospitals (25).

5.3.3 Practices on infectious waste management and use of PPE:

Hand on practicum component of IHWM model was used to improve the practices of health professional at their work place by giving them actual demonstration on the use of PPE and also on the different steps of the infectious waste management. This was statistically tested that the usage of PPE during the study on actual practicum in intervention hospital has improved the proper practice of infectious waste handling in the health professional while there were no significant changes reported in the

control arm. PPE has been supplied to all the workers with aims to continue the regular usage of these equipments at the intervention hospital. These PPE at their working place such as dust bins, aprons, masks, rubber boats etc were supplied entire the period of intervention. Due to the factors like non-availability of these PPE in the control hospital, there was no significant change in practices reported. Research has also supported that the practical demonstration on the proper method is the most resourceful technique to train and envisage the actual steps for to improve the individual perceptions. It was found that those workers were not properly following the steps of infectious waste management due to the non-availability of red dust bin at their work place. However, the worker's practices have a positive influence on accessibility of PPE at their duty station. PPE should be provided by regular budgetary allocation for every hospital by the administration (83). Recent study conducted at one of the tertiary care hospital has also supported our findings, during this study sharp waste management practices among the janitorial staff were improved by providing the equipment on injection safety (84).

There was a slight change in mean score of knowledge; attitude and practices with in the control group. This is likely due to the consistency of the knowledge among the workers working in this hospital due to the frequent transmission of same kind of cross sectional surveys. Secondly the trainings through IHWM model have not been given to these employs in control hospital as compare to the intervention hospital for to improve their knowledge, attitude and practices. Literature shows that the regular practical training has proved positive affect on the practices of workers and their behviour during their work (85). Trainings through face to face contact when given combine with other interventional approaches has synergistic effective

strategies for improving the practices and health behavior as compare to intervene the single strategy for the behaviour change (19). One study support our results that the trainings could improve the practices of staff in infection safety through their positive behaviour change (84). A qualitative study proved that there was lack of evidence in practical training results in the poor practices about different steps of medical waste management in the hospital. Most problems identified during that research were lack of the knowledge regarding infectious waste exposure, their effects and the workers were not aware on the use of PPE during waste collection process. Study concluded that practical training should be given to the employees for their better practices regarding the use of PPE (86).

Sanitary workers had poor practices as compared to the health staff regarding the infectious waste handling in both control and intervention hospitals during the baseline assessment. This difference was due to their less involvement in the trainings and awareness meetings at the hospital and one other possible explanation is their educational level. Study also support our findings and reported that janitorial staff had poor practices about infection control in the hospital (84). Though, their knowledge regarding infectious waste handling was more but their practices has not been reported well. Study with the similar finding suggest that even higher level of awareness on hospital waste management among health workers had reported their poor practices on standard safety measures during the waste handling. Author has highly recommended that a committee should be constituted to monitor and implement the regular practical trainings for the workers (67).

During our study, it was found that the workers were not aptly aware and as a result were not practicing waste segregation, collection, storage and disposal as per the

WHO guidelines. There was no proper supervision and leadership from both hospitals management for executing the infectious waste management practices. However, we have implemented our intervention through full involvement of the administration in one of the intervention hospital only. It was expedient and reasonable for the workers to attend and actively contribute in the IHWM program. Studies from developing countries with similar kind of situations also divulge that trainings of healthcare workers with proper follow up, can lead to better infectious waste management practices within the health facilities (36, 87).

5.4 Conclusion

The main purpose of the study was to find the effectiveness of the IHWM model intervention on infectious waste management. There were two hospitals has been included in this study one hospital has received the intervention program for other hospital it was continuing their routine activities. A total of 275 subjects participated in this study. The questionnaire data was collected at two times during the start of study and after 3 months follow-up. Self-administered questionnaire were given to the health staff and guided questionnaire was taken at their work place. Twenty of the HCWs were lost during the follow up 9 for the control and 11 for the intervention hospital. The other measurements of the study were knowledge, attitude and practices on the segregation, collection, storage and disposal of on infectious waste management.

Healthcare workers who were working on regular basis in both hospitals were enrolled in this study. They were informed about the study and written consent was taken prior to conduct the survey. This study hypothesized that the model would be effective on improving infectious waste management among health workers working

at the tertiary care hospitals of Rawalpindi Pakistan. There was no significant difference in both hospitals before the intervention regarding knowledge, attitude and practices on infectious waste management.

Most of the HCWs were within the age below 25 years and were graduate working in both hospitals. Their average income was above 20,000 thousand Pakistan rupees that are equivalent to 200 US$. Most of the subjects were male and working in different department of the hospitals. The finding of the study revealed that HCWs in the intervention group had significantly increased their knowledge, attitude and practices about infectious waste management from the control group. There was also positive significant change within the intervention group regarding knowledge, attitude and practices of the subjects.

Regarding Knowledge most of the HCWs did say that infectious waste management was important but their information regarding segregation, collection, storage and disposal was low. After the intervention there was a significant difference with the intervention group but there was no change in the control group. This concludes that the HCWs had better knowledge regarding infectious waste after the intervention.

Attitude of the subjects also increased in the intervention group and was statically significant. Attitude was changed because of IHWM model intervention. However, there were no any change has been reported in the control group. Apparently, it was known that knowledge and attitude are an intermediate point on any scale that seeks to evaluate the effectiveness of any care program. Knowledge and attitude are not independent of other factors particularly for utilization.

Good practices about infectious waste management among health professionals have been an important determinant for hospital. In this study there was significant difference in all steps of practices in the intervention group. After the intervention HCWs had improved practices towards proper segregation, improved collection, correct storage of waste and appropriate disposal of infectious waste. However there was no any significant change has been reported regarding practices on infectious waste management in the control hospital. In this study there was no financial support provided to HCWs, however the training materials, brochures intermittent supply of PPE in the intervention hospital, were being provided free. The drop in study may be due to their personal reasons, posting transfer and due to their causal leave. Practices has been improved within the group in intervention group and found statistically significant. However, no change has been reported in the control arm.

In the control there was also no statistical difference after the intervention. The practices among workers remains constant during the 6-month period it may be because health workers had constant knowledge, attitude and practices and were not being trained during this period on the infectious waste management. This might be one of the reasons why infectious waste management practices remain same in the control group. Secondly, workers who participated in the study from control hospital were mostly affiliated with emergency and operation theaters and were practically involved more in the infectious waste management activities.

Training of healthcare workers can increase knowledge of workers regarding infectious waste management and different steps of waste management. Reminder services proved a better approach while in improving the practices of workers. On hand

practicum with support from hospital administration during the model intervention helped effecting attitude and practices. This concludes that the intervention was effective in improving the infectious waste management practices at tertiary care hospitals of Rawalpindi Pakistan by using existing services within both hospitals effectively and efficiently.

This study has concluded that IHWM model is an effective program shows statistical significant change in intervention group and sustainable program for improving the Knowledge, attitude and practices of health workers through face to face trainings, on hand practicum and reminder services about infectious waste management within organization. Therefore, it is proposed that the health policy makers should replicate this knowledge translation program in other hospitals of the country to manage the big threats of poor infectious waste handling. The results of this study suggest that use of an IHWM training model could improve KAP in regulated medical waste management. Such improvement could translate into improved performance. Therefore, it is proposed that the health policy makers and hospital authorities must replicate this knowledge translation program in other hospitals of country to manage the big menace because of ineffective and unprotected infectious waste handling.

5.5 Limitations

- Some extent generalizability to other government hospitals. The study has been conducted two tertiary care hospitals and the issues identified during the study are almost similar in all the same kind of facilities across the country. Hence, these findings after intervention may be applied at every level of healthcare facility in the country.

- Waste water treatment at the hospital has not been included in our study.

- This was self-financed study where the researcher has no provision to provide incentives to the study participants.

- Some confounding factors were beyond the scope of study.

- Twenty subjects were lost to the follow-up few were on causal leave, some has transferred to another hospitals and some has refused to continue in the study. No tests were conducted to find difference between those who were lost and who completed the follow up.

- As both the hospital were located at the same city, there was a probability of contamination between the groups. However, the distance between both hospitals was more than 5 kilometers. There were only these two hospitals, which have similar characteristics and were comparable. The influence of contamination on this study was little.

- It must be mention that this intervention might not have benefited all the health care workers due to the nature and time constraints for the intervention.

5.6 Strengths

- Although assessment study has been conducted in various groups of medical professionals in Pakistan, but there is no single study that focused on training intervention on infectious waste management.

- Baseline findings have already published in international the peer reviewed Scopus indexed journal.

- This was Quasi-experimental study with control and intervention group, is itself strength of this study.

- In addition to this the mixed approach involving both quantitative as well as observation and in-depth interviews tools and finally their triangulation in the discussion is one the major strengths of the study.

- Randomization before intervention both in control and intervention hospital among the health care workers was the strength of this study.

- Results obtained from quantitative tools were also compatible with observations and in-depth interviews and have similar outcomes during this study.

5.7 Recommendations

This study is just an entry into this field and evaluation performed over longer periods in multiple hospitals and at different levels of care would definitely yield even richer evidence. Long follow up after the intervention will potentially present an impact inference of this training model. Although the results of a hospital based intervention cannot be considered as a solid foundation for making decisions in health planning, the results of this study suggest that these similar interventions should be conducted in others hospitals of country to increase levels of knowledge and practices among health workers working at hospitals of Pakistan. Problems like financial constraints, lack of trainings, implementation issues and availability of PPE have been seen in these hospitals are almost resembled with all of the same kind of

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Chulalongkorn University

hospitals in the country. However, we can recommend that this model should be replicated in these hospitals across the country.

5.7.1 For Policy makers

- Although the results of a single interventional study cannot in themselves be considered as a solid foundation for making decisions in health planning, the results of this study suggest that similar kind of interventions should be carried out to increase levels knowledge, practices among health professionals at tertiary care hospitals. Since IHWM model has a strong proved to be effective with practices on waste management, it is imperative to reinforce relevant infectious waste management policies, improving infectious waste management practices.

- This model should be replicate as the part of continuing education plan in these hospitals.

- Proper time for infectious waste management should be given at all hospital levels.

- This interventional study has proven that effectiveness of trainings among health workers working at tertiary care hospital. Similar kind of facilities can replicate this model in their institutions for to improve the practices of health workers about infectious waste.

- Refresher / trainings should be carried out from time to time for to build the capacity of hospital staff and empowering them to work more efficiently in the infectious waste management.

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Chulalongkorn University

- Administration support should be provided to the staff involved in the infectious waste management and there should be a regular coordination meeting conducted with different departments of the hospital.

- This intervention can be replicated and implemented in other hospitals for improving the knowledge, attitude and practices of health staff regarding infectious waste management.

- A separate budgetary head should be allocated for the management of health care waste with in every hospital.

- The policy makers should use this research as an evidence to develop strategies for improving infectious waste management practices within organization.

- Hospital working under Public Private Partnership, contracting autonomy has actually demonstrated good infectious waste management practices and may add this model for good results.

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5.7.2 For health care workers

- Priority should be given to improving relationships between management and staff and increasing decision-making latitude among staff members. Developing staff and empowering them to make decisions about their work is necessary to achieve quality outcomes. It is recommended that employees' should have a scope of enrichment and be of interest.
- Segregation should be improved at all level within the hospital by implementing this training model.

- There should be reward in form of incentives or award policy introduced with in the hospital for better performance of the workers regarding infectious waste management.

5.7.3 Impact of services

- Continuous service evaluations and monitoring of infectious waste management can be useful to determine aspects of the services that need improvement. Involving the healthcare workers in a cooperative, team approach will allow for consideration of ways to improve aspects relating working performance. Improving the work environment so that it provides a context in line with the aspirations of workers is likely to increase their behaviour and consequently have a positive effect on individual, organizational and quality of health care services.
- There should be uninterrupted supply of PPE has been ensured for proper sustainability of this model.

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Chulalongkorn University

5.7.4 For researchers

- This study may serve as a base for future studies in different organizations on a larger scale. Further analysis of data is needed, as there are numbers of issues that can be explored further.
- Cost befit analysis studies for this model intervention should also be conducted.
- This research should be carried out in other hospitals for longer period of time get the outcome for better practices among workers.

- A randomized control trial could be designed for to test the effectiveness of any given intervention in future studies.

- This research will provide evidence based findings and will include in the literature review.

5.8 Health System and Policy implications of this research

There are positive implications on health system and policies in Pakistan on improvement of practices of health workers regarding infectious waste management. Their attitude and knowledge may directly effect on the Health system and healthy policies of the country. The dispositional approach to attitudes has played an important role in refocusing attention in organizational behavior on person factors, in addition to situational factors, as determinants of attitudes and behaviors. These all factors contribute toward the poor practices of the employees due to limited knowledge and improper practices on waste handling at the organization.

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จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

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APPENDIX

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APPENDIX I: Informed Consent Form

Sample no .....

Responsible person(s) and institute:

Dr Ramesh Kumar

PhD. Public Health

College of Public health sciences,

Chulalongkorn University Bangkok 10400, Thailand

Date of consent ..../...../...

I (Mr. /Mrs. /Ms.) .....

Home address .....

Contact No .....

I have read and understood all statements in the informed consent form. I have also been explained the objectives and methods of the study, as well as possible risk and benefits that may happen to myself upon the participation in the study. I understand that the information the information will be kept confidential and my name will no be disclosed in any case. I shall be given a copy of the signed informed consent form.

I have the right to withdraw from the project at any time without any adverse effects upon myself.

Signature..... (Respondent) (Informant) .....

Signature..... (Researcher) (Dr Ramesh Kumar)

APPENDIX II-A: Questionnaire (Doctors, nurses and paramedical staff)

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

SECTION I: DEMOGRAPHIC INFORMATION	
1. How old are you?	.....years
2. What is your gender?	1. Male 2. Female
3. What is your ethnicity?	1. Punjabi 2. Sindhi 3. Balochi 4. Pushto 5. Others
4. What is your level of Education?	1. Primary Education 2. High School Education 3. College Level 4. Graduation 5. Post graduation
5. What is your Income?	1. 10,000 or less 2. 10,000-20,000 3. More than 20,000
6. Name of the hospital	1. Holy family Hospital Rawalpindi 2. District headquarter hospital Rawalpindi
7. Department	1. Medical Ward 2. Surgical Ward 3. Gynecology Ward 4. Emergency 5. Administration 6. Operation Theater 7. Others----------

8. What is your present occupation?	1. Doctor 2. Paramedics 3. Nursing Staff
9. Experience	1. Junior level health workers (<5 years) 2. Mid level health workers (5-10 years) 3. Senior level health workers (>10 years)

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Chulalongkorn University

SECTION II: KNOWLEDGE QUESTIONS (Please tick for either Yes, No or Don't know) (Guidelines: Infectious waste means materials such as sharps, syringes, needles, blades, human parts, waste contaminated with blood, body tissue, body secretion, vomiting of the patients and other contagious material.				
No	Question	Yes	No	DK
1 -	All waste produced in the hospital are infectious.			
2-	Infectious waste contaminated with blood must be thrown in general waste bins.			
3	Infectious waste with patient's body fluid must be thrown in red bins.			
4-	Infectious waste with patient's vomiting must be thrown in general waste bin.			
5	Non-infectious waste (juices packet, bread, milk packet etc) must be thrown with general waste in green bins.			
6	Injection safety boxes (for disposal of used injection) should be filled 3/4th full.			
7	Infectious waste (sign of danger) symbols must be displayed on the waste bin.			
8-	Use of sharp objects like disposal syringe needle can cause infections like Hepatitis B and C.			
9	Sharps like knives, blades and bottles must be thrown in yellow bin.			
10-	Broken thermometer and mercury should be collected in red bin.			
11	Infectious waste (sharps, body tissue) must be collected in separated closed trolley.			
12-	Infectious waste (used plastic bottle drug vials and			

	ampoules) can be transported through common route within hospital.			
13	Infectious waste (body secretion, injection used with HIV patient) must be collected by wearing the hand gloves.			
14	Infectious waste (sharps, needles, blood stained instruments) must be transported by wearing the apron.			
15	Infectious waste (body tissue etc) must be transported by wearing the mask.			
16	Infectious waste with patient's body parts poses the serious threat to health workers.			
17	Autoclaves are the best recommended for the treatment of pharmaceutical waste (drugs, vaccine, serum, masks, gloves).			
18-	Landfill is the best option for disposal of all waste from hospital.			
19-	Infectious waste (used syringe and blade) can be stored at the ward.			
20-	Infectious waste (body tissue, blood contaminated material) can be stored at separate room for more than 72hours.			
21-	Non-Infectious waste (plastic bags, food material) storage area should be protected with fenced.			
22-	Infectious waste (patient body secretion) should be disposed by incinerator along with normal waste.			
23	Infectious waste (placentas) should be dispose through burial pit.			
24	Infectious instruments (Scissors, used blood bags) must be sterilized by autoclave.			

SECTION III: ATTITUDE QUESTIONS (Please tick for either Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) or Strongly Disagree (SD).						
	Attitude Questions	SA	A	UD	D	SD
1	I have crucial role in management of infectious waste.					
2	I am sure that segregation of infectious waste is an important step for management of health care waste.					
3	I think it is safe to break the injection ampoule over the waste bin.					
4	I don't feel good when I find someone through waste in wrong bin.					
5	It is not important to label the waste bags before collection.					
6	Collection of waste bins can be done when the bins are full.					
7	I think infectious and non-infectious waste must be transported at the same time.					
8	No need to wash the waste transportation trolleys since they will get dirty again.					
9	Having a separate route for infectious waste transportation within hospital is unnecessary and useless.					
10	I think incineration would be the best option for the treatment of infectious waste.					
11	Infectious waste disposal is the responsibility of the city municipality.					

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12	Chemical disinfection is not at all an effective treatment method.					

SECTION IV: PRACTICE QUESTIONS (Please tick for either Yes, No)

No	Question	Yes	No
1	I always throw infectious waste contaminated with blood in red bin.		
2-	I always throw the infectious waste like body fluids with general waste bin.		
3	Sometimes I mistakenly throw infected waste (used syringe) into the general waste bin.		
4	Infectious waste (blood contaminated materials) bags are never labeled before they are collected from the ward.		
5-	I always throw the sharp waste like scissors, knives, blade in red waste bin.		
6	I always throw the used syringes in injection safety box.		
7	I always recap the needles after taking the blood sample of patient.		
8	I always use separate bin for vaccine vials and ampoules and drugs.		
9-	Sometime I break the injection and thrown it in general waste bin.		
10	Autoclave for the hospital waste is performed by the skilled health staff.		
11	I always use gloves when contact with infectious waste (body tissue, body secretion).		
12-	I throw the body tissue like placenta with general waste bin.		

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13-	Infectious waste like body fluids not treated in the hospital before their disposal.		
14	I always use apron during the emergency and operation theater.		
15	I always call the sanitary workers to collect the infectious waste after every 24 hours.		
16	I always wash my hands after handling the infectious waste.		
17	I use vaccination against the infectious diseases like Hepatitis B.		
18	I always use mask when contact with infectious waste contaminated with body fluids.		
19	Waste bags are always checked for tears or punctures before transportation.		
20	I always look the right bin to throw the infectious waste.		

SECTION V: QESTIONS ON ENVIRONMENTAL ENABLING FACTORS

(Please tick the response)

No.	Question	Response
1	Do you have the guidelines for infectious waste management at your work place?	1. Yes 2. No (skip Q2 & 3)
2	If yes, how many times you read?	1. One time 2. Many times
3	Do you think these guidelines are important?	1. Very important 2. Not important at all
4	Do you read the Biomedical waste management rules	1. Yes

	2005?	2. No (Skip Q5,6)
5	Do you think these rules are important at your work place?	1. Very important 2. Not important at all
6	Do you think these rules are important for health care waste management?	1. Very important 2. Not important at all
7	Have you attended training on waste management in last five years?	1. Yes 2. No (Skip Q8,9)
8	If yes, how many times?	1. times
9	Do you know the policy for hospital waste management?	1. Yes 2. No
10	Does your hospital have any hospital waste management committee exist?	1. Yes 2. No
11	Are there sufficient waste management bins are available at your work place?	1. Yes 2. No
12	Are there sufficient sharp waste bins available?	1. Yes 2. No
13	Are there sufficient injection safety boxes are available?	1. Yes 2. No
14	Is there sufficient number of waste transport trolleys available?	1. Yes 2. No
15	Is there exists a separate waste management plan at your work place?	1. Yes 2. No

16	Are there sufficient aprons available at your work place?	1. Yes 2. No
17	Are there sufficient gloves available at your work place?	3. Yes 4. No
18	Are there sufficient long rubber boots available at your work place?	1. Yes 2. No
19	Are there sufficient masks available at your work place?	1. Yes 2. No

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APPENDIX II-B: Questionnaire (Sanitary workers)

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

SECTION I: DEMOGRAPHIC INFORMATION	
1. How old are you?	.....years
2. What is your gender?	1. Male 2. Female
3. What is your ethnicity?	1. Punjabi 2. Sindhi 3. Balochi 4. Pushto 5. Others
4. What is your level of Education?	1. Primary Education 2. High School Education 3. College Level 4. Graduation 5. Post graduation
5. What is your Income?	1. 10,000 or less 2. 10,000-20,000 3. More than 20,000
6. Name of the hospital	1. Holy family Hospital Rawalpindi 2. District headquarter hospital Rawalpindi
7. Department	1. Medical Ward 2. Surgical Ward 3. Gynecology Ward 4. Emergency 5. Operation Theater 6. Others----------

8. Experience	1. .....years

SECTION II: KNOWLEDGE QUESTIONS (Please tick for either Yes, No or Don't know)

(Guidelines: Infectious waste means materials such as sharps, syringes, needles, blades, human parts, waste contaminated with blood, body tissue, body secretion, vomiting of the patients and other contagious material.

No	Question	Yes	No	DK
1	All waste produced in the hospital are infectious.			
2-	Infectious waste contaminated with blood must be collected with general waste.			
3	Infectious waste (used syringes with HIV patients) must be collected in red bag.			
4	Non-infectious (plastic bags, food material) waste must be collected with general waste in green bags.			
5	Injection safety boxes (for disposal of used injection) should be filled 3/4th full.			
6	Infectious waste (sign of danger) symbols must be displayed on the waste bin.			
7-	Use of disposal syringe can cause infections like Hepatitis B and C.			
8	Sharps like knives, blades and bottles must be thrown in yellow bin.			
9-	Broken thermometer and mercury should not be autoclaved before disposal.			
10-	Infectious waste (body tissue, placenta) must be collected in separated open trolleys.			
11-	Infectious waste (body secretion, body fluids) can be transported through common route within hospital.			
12	Infectious waste (blood stained materials) must be collected by wearing the hand gloves.			

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13	Infectious waste (sharps, needles, blades) must be collected by wearing the apron.			
14-	Non-infectious (milk packet, juice packet and waste from food items) waste should not be collected by wearing the mask.			
15-	Sometime infectious waste (body organs and tissues) can be collected by wearing the long rubber boot.			
16	The infectious waste (sharps, used needles, used drip sets) storage area needs to be well fenced.			
17	Autoclaves are the best recommended for the treatment of infectious waste.			
18	Landfill is the best option for disposal of all waste from hospital.			
19	Incineration is the best option for infectious waste disposal.			
20-	Infectious waste (patients issue and secretion) can be stored at separate room for more than 72hours.			

SECTION IV: PRACTICE QUESTIONS (Please tick for either Yes, No)			
No	Question	Yes	No
1	I always use long rubber boats during infectious waste (sharps, used needles, scissors and blades) collection.		
2	I always use gloves during collection of infectious waste like body tissues.		
3	I always wear apron during the transportation of infectious waste (used syringes, used bottles and sharps).		
4	I always wear mask during the infectious waste (drugs, vials and ampoules) transportation.		
5	I always collect the hospital bins when the bins are full with infectious waste (blood contaminated materials, body		

	tissues).		
6	Infectious waste (sharps, blades, scissors and needles) collected bins are collected after the labeling.		
7-	I always collect sharp together with infectious waste (body tissue).		
8-	Sometime I mix infectious waste (blood contaminated) with general waste during transportation.		
9	I always use the autoclave for infectious waste like placenta and body tissues.		
10	I always check the leakage in waste bags before transporting the waste.		
11	I always wash the infectious waste transport trolley.		
12	I always depose the infectious waste like placenta in burial pit.		
13	I always wash my hands after handling the waste.		
14	I always store the infectious waste (body secretion, body tissues and organs) for more than 72 hours.		
15-	Most of the infectious waste like body fluids is not treated before disposal		

SECTION V: QESTIONS ON ENVIRONMENTAL FACTORS

(Please tick the response)

No.	Question	Response
1	Have you attended training on infectious waste management in last five years?	1. Yes 2. No (Skip Q2,3)
2	If yes, how many times?	2. times
3	Do you these trainings are important?	1. Very important 2. Not important at all

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4	Is there monitoring and supervision system is placed at your work place for infectious waste management.	1. Yes 2. No
5	Are there sufficient infectious waste management trolleys are available at your work place?	1. Yes 2. No
6	Are there sufficient sharp waste bins available?	1. Yes 2. No
7	Are there sufficient injection safety boxes are available?	1. Yes 2. No
8	Is there sufficient number of waste collection bags available?	1. Yes 2. No
9	Are there sufficient general waste bins available?	1. Yes 2. No
10	Are there sufficient aprons available at your work place?	1. Yes 2. No
11	Are there sufficient gloves available at your work place?	1. Yes 2. No
12	Are there sufficient long rubber boots available at your work place?	1. Yes 2. No
13	Are there sufficient masks available at your work place?	1. Yes 2. No
14	Are there sufficient infectious waste bins available?	1. Yes 2. No
15	Are you getting incentives from administration for hospital waste management?	3. Yes 4. No (skip Q 22)
16	Do you think this is important for infectious waste management?	1. Very important 2. Not important at all

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SECTION III: ATTITUDE QUESTIONS (Please tick for either Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (D) or Strongly Disagree (SD).						
	Attitude Questions	SA	A	UD	D	SD
1	I have crucial role in management of infectious waste.					
2	I am sure that segregation of infectious waste is an important step for management of health care waste.					
3	I think it is safe to break the injection ampoule over the waste bin.					
4	I don't feel good when I find someone through waste in wrong bin.					
5	It is not important to label the waste bags before collection.					
6	Collection of waste bins can be done when the bins are full.					
7	I think infectious and non-infectious waste must be transported at the same time.					
8	No need to wash the waste transportation trolleys since they will get dirty again.					
9	Having a separate route for infectious waste transportation within hospital is unnecessary and useless.					
10	I think incineration would be the best option for the treatment of infectious waste.					
11	Infectious waste disposal is the responsibility of the city municipality.					
12	Chemical disinfection is not at all an effective treatment method.					

ANNEX-II-C In-depth Qualitative Questionnaire

IN-DEPTH QUALITATIVE QUESTIONNAIRE FOR HEALTH MANAGER	
S.No	Questions
1	What are your opinions about infectious waste management at the hospital?
2	What are the problems and challenges faced by you in infectious waste management at this hospital?
3	How you trained the health care workers in infectious waste management at this hospital?
4	How the health care waste management practices can be improved? Has hospital got any guideline on hospital waste management?
5	What is the role of regular meetings in health care waste management?
6	In your opinion, how can infectious waste managed?
7	In your opinion, what will be the importance of the trainings of health care workers for infectious care waste management in your hospital?

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APPENDIX-III Checklist

OBSERVATIONS THROUGH CHECK LIST

Checklist for observation on infectious hospital waste management at tertiary care hospitals of Rawalpindi Pakistan.

Unit/Department: No. of Beds: Patient turnover:

No	Practices	Yes	No
A	*Segregation Practices*		
1.	Does the unit have separate containers for infectious waste, general waste, and sharp waste?		
2.	Are all types of containers clearly labeled?		
3.	Specify which bin is used for which type of waste • Red bin for infectious waste • Green for general waste • Yellow box for sharp waste • Blue for food waste • Brown for chemical and pharmaceutical waste		
4.	Are 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 is well aware of the hospital waste segregation practices.		
7.	The Hospital staff strictly follows the segregation practices.		
B.	*Collection Practices*		
1.	Hospital waste is collected twice daily. Time.....		
2.	Non infectious waste is generated mostly?		
3.	Are the waste bags sealed when ¾ full?		
4.	Leak-proof containers with plastic inside are used for		

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	collection of infectious waste.		
5.	Sharp containers are filled up to ¾th level.		
6.	Before collection all the waste containers are properly labeled.		
No	Practices	Yes	No
7.	While collecting waste, the waste handlers use the following PPE; • Mask • Gloves • Apron • Long rubber boots		
C.	*Storage Practices*		
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 site for more than 48 hours before final disposal.		
5.	Storage sites are protected by barrier such as fence or wall to keep animals and children out.		
6.	There is someone responsible for hospital waste storage procedures at hospital.		
7.	Staff responsible for storing waste use the following PPE; • Mask • Gloves • Apron • Long rubber boots • Others(Specify)		
8.	There is a washing facility in the waste storage room.		

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D.	*Transportation Practices*		
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/bag are closed sealed properly.		
3.	Waste trolley 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.		
No	Practices	Yes	No
6.	While transporting following waste, the personnel involved use the following PPE; • Mask • Gloves • Apron • Long rubber boots • Others(specify)		
7.	The hospital waste is transported as per the Hospital waste management rules.		
E.	*Treatment practices*		
1.	What are the different treatment facilities available • Autoclave • Chemical disinfection • Other(specify)		
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		

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	following PPE; • Mask • Gloves • Apron • Long rubber boots • Others (Specify)		
5.	Are the liquid infectious waste treated prior to disposal?		
6.	Are there any problems for the treatment of hospital waste in this tertiary hospital? If yes, list them down;		
F.	*Disposal Practices*		
1.	Hospital Waste is disposed as per characteristics of waste.		
2.	All solid waste from the hospital is disposed in the landfill.		
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 10-30cm layer of soil.		
6.	Liquid medical waste and infectious chemical waste are poured down a drain, toilet, or sink.		
No	Practices	Yes	No
7.	The personnel involved in hospital waste disposal use the following PPE; • Mask • Gloves • Apron • Long rubber boots • Others(specify)		

Checklist for the infectious waste

No	Waste Item	Yes	No	Not Sure
I	General Waste			
1	Paper			
2	Plastics			
3	Cardboard			
4	Food waste			
5	Saline bottles			
6	Cloth pieces/rags			
7	Others(specify)			
II	Infectious waste			
1	Syringes			
2	Gauze			
3	Cotton			
4	Bandages			
5	I/V sets			
6	I/V cannula			
7	Culture dish			
8	Catheters			
9	Drainage tube			
10	Used dressing sets			
11	Used forceps			
12	Dialysis tubings			
13	Others(specify)			
III	Sharps			
1	Needles			

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No	Waste Item	Yes	No	Not Sure
2	Blades/Scalpels			
3	Bones			
4	Others(specify)			
IV	Pathological waste			
1	Body parts (Amputed limbs, etc)			
2	Dead fetus			
3	Placenta			
4	Blood and blood products			
5	Stool			
6	Urine			
7	Others(specify)			
V	Pharmaceutical waste			
1	Expired drugs			
2	Contaminated drugs			
3	Unused drugs			
4	Others(specify)			
VI	Genotoxic waste			
1	Cytotoxic drugs			
2	Others(specify)			
VII	Chemical waste			
1	Disinfectants			
2	Film developers			
3	Laboratory reagents			
4	Solvents			
No	Waste Item	Yes	No	Not

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				Sure
5	Others(specify)			
VIII	Waste with heavy metals			
1	Broken thermometers			
2	Broken BP apparatus			
3	Others(specify)			
IX	Pressurized containers			
1	Gas cylinders			
2	Gas cartridges			
3	Aerosol cans			
4	Others(specify)			
X	Radioactive waste			
1	Stool tested radio nuclides			
2	Contaminated glassware			
3	Urine tested with radio nuclides			
4	Packages			
5	Absorbent papers			
6	Others(specify)			

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APPENDIX-IV Time Frame

		Mar 2013	Apr2013	May 2013	June2013	July 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	June 2014	July 2014	Aug 2014	Sept 2014	Oct 2014	Nov 2014	JAN 2015
1	Literature review																						
2	Proposal writing																						
3	Proposal Examination																						
4	Ethical approval																						
5	Pre test questionnaire																						
6	Baseline data collection																						
7	Intervention																						
8	Submission article publication																						
9	Follow up period																						
10	Endline data collection																						
11	Data analysis																						
12	Thesis writing																						
13	Published first manuscript																						
14	Submission 2nd manuscript																						
15	Publication																						
16	Submission of thesis																						
17	Thesis examination																						

APPENDIX-V Budget (In baht)

Expenditure	Cost
Traveling	50,000
Research assistants	20,000
Facilitators allowances	50,000
Stationary	40,000
Printing of materials	20,000
Intervention expenditure	100,000
Miscellaneous charges	30,000
Publication cost	10,000
Total	320,000

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Appendix –VI Ethical approval letter

Government of Pakistan
Ministry of National Health Services, Regulation & Coordination
HEALTH SERVICES ACADEMY
F-No. 3-107/2013-IERC/HSA

18-09-2013

TO WHOM IT MAY CONCERN

Health Services Academy is an academic institute affiliated with Quaid-i-Azam University, Islamabad offering Post Graduate courses in various disciplines of Public Health. Dissertations/Thesis writing is an integral component of Ph.D program during 2nd and 3rd year of their research work. In this regard the Institutional Ethical Review Committee (IERC) of Health Services Academy meeting for Ethical Clearance of Research Proposals/synopsis was held on 17th September, 2013 at 11:00 am in the Committee Room of HSA.

The research topic **"The effectiveness of Intensive Healthcare Waste Management (IHWM) Model regarding infectious waste at tertiary care hospitals of Rawalpindi Pakistan"** submitted by **Dr. Ramesh Kumar** has been approved by the Institutional Ethical Review Committee (IERC) and he is directed to visit the concerned department to collect the current, appropriate and relevant data for his research topic.

Sincerely,

18/9/13

Health Services Academy ★ Govt. of Pakistan, Islamabad ★

Dr. Assad Hafeez
Executive Director

Dr. Assad Hafeez
Executive Director
Health Services Academy

Health Services Academy, Chak Shahzad, Islamabad, Pakistan Tel: (92-51)9255590-94, Fax: (92-51)9255591
Email: academy@hsa.edu.pk Website: www.hsa.edu.pk

Appendix VII: Knowledge statement among Health staff

S	Knowledge variables	Intervention n (%)		Control n (%)	
		Pre (baseline) n=112	Endline (after 3 m followup) n=101	Pre (baseline) n=110	Endline (after 3 m followup) n=102
1	All waste produced in the hospital are infectious*.	77(68.8%)	87(86.1%)	76(69.0%)	70(68.6%)
2	Infectious waste contaminated with blood must be thrown in general waste bins*.	40(35.5%)	64(63.3%)	40(36.3%)	35(34.3%)
3	Infectious waste with patient's body fluid must be thrown in red bins.	42(35.5%)	63(62.3%)	28(25.4%)	26(25.4%)
4	Infectious waste with patient's vomiting must be thrown in general waste bin*.	73(64.7%)	76(75.2%)	73(66.3%)	67(65.6%)
5	Non-infectious waste (juices packet, bread, milk packet etc) must be thrown with general waste in green bins.	47(41.6%)	63(62.3%)	46(41.8%)	45(44.1%)
6	Injection safety boxes (for disposal of used injection) should be filled 3/4th full.	67(59.8%)	76(75.2%)	65(59.0%)	63(61.7%)
7	Infectious waste (sign of danger) symbols must be displayed on the waste bin.	54(47.7%)	69(68.3%)	53(48.1%)	48(47.0%)
8	Use of sharp objects like disposal syringe needle can cause infections like Hepatitis B and C*.	69(61.8%)	81(80.1%)	67(60.9%)	63(61.7%)
9	Sharps like knives, blades and bottles must be thrown in yellow bin.	24(25.1%)	49(48.5%)	23(20.9%)	21(20.5%)
10	Broken thermometer and mercury should be collected in red bin*.	34(30.9%)	55(54.4%)	33(30.0%)	33(32.3%)
11	Infectious waste (sharps, body tissue) must be collected in separated closed trolley.	75(67.2%)	85(84.1%)	74(67.2%)	69(67.6%)
12	Infectious waste (used plastic bottle drug vials and ampoules) can be transported	53(47.3%)	75(74.2%)	52(47.2%)	51(50.0%)

	through common route within hospital*.				
13	Infectious waste (body secretion, injection used with HIV patient) must be collected by wearing the hand gloves.	71(63.3%)	89(87.8%)	69(62.7%)	67(65.6%)
14	Infectious waste (sharps, needles, blood stained instruments) must be transported by wearing the apron.	69(61.8%)	82(81.1%)	67(60.9%)	65(63.7%)
15	Infectious waste (body tissue etc) must be transported by wearing the mask.	67(59.8%)	91(89.1%)	65(59.0%)	62(60.7%)
16	Infectious waste with patient's body parts poses the serious threat to health workers.	72(64%)	93(92.0%)	71(64.5%)	67(65.6%)
17	Autoclaves are the best recommended for the treatment of pharmaceutical waste (drugs, vaccine, serum, masks, gloves).	77(68.8%)	85(83.1%)	76(69.0%)	69(67.6%)
18	Landfill is the best option for disposal of all waste from hospital*.	65(58%)	90(89.1%)	63(57.2%)	58(56.8%)
19	Infectious waste (used syringe and blade) can be stored at the ward*.	72(64%)	79(78.2%)	71(64.5%)	67(65.6%)
20	Infectious waste (body tissue, blood contaminated material) can be stored at separate room for more than 72hours*.	67(59.8%)	92(91.0%)	66(60.0%)	59(57.8%)
21	Non-Infectious waste (plastic bags, food material) storage area should be protected with fenced*.	66(58.5%)	81(80.1%)	65(59.0%)	60(58.8%)
22	Infectious waste (patient body secretion) should be disposed by incinerator along with normal waste*.	64(56.6%)	96(95.0%)	62(56.3%)	58(56.8%)
23	Infectious waste (placentas) should be dispose through burial pit.	33(30.4%)	68(67.3%)	31(28.1%)	27(26.4%)
24	Infectious instruments (Scissors, used blood bags) must be sterilized by autoclave.	69(61.8%)	89(88.1%)	67(60.9%)	64(62.7%)

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Appendix VIII: Knowledge statements among sanitary workers

	Knowledge Variables	Intervention		Control	
		Pre (baseline) n=26	Post (3 months follow up) n=26	Pre (baseline) n=27	Post (3 months follow up) n=26
		Correct answers			
1	All waste produced in the hospital are infectious*.	8(30.8 %)	15(57.6%)	8(29.6%)	7(26.9%)
2	Infectious waste contaminated with blood must be collected with general waste*.	10(38.5%)	17(65.3%)	10(37.0%)	10(38.5%)
3	Infectious waste (used syringes with HIV patients) must be collected in red bag.	10(38.5%)	16(61.5%)	10(37.0%)	10(38.5%)
4	Non-infectious (plastic bags, food material) waste must be collected with general waste in green bags.	9(34.6%)	16(61.5%)	9(33.3%)	8(30.8%)
5	Injection safety boxes (for disposal of used injection) should be filled 3/4th full.	10(38.5%)	16(61.5%)	10(37.0%)	10(38.5%)
6	Infectious waste (sign of danger) symbols must be displayed on the waste bin.	10(38.5%)	16(61.5%)	9(33.3%)	8(30.8%)
7	Use of disposal syringe can cause infections like Hepatitis B and C*.	10(38.5%)	16(61.5%)	10(37.0%)	9(34.6%)
8	Sharps like knives, blades and bottles must be thrown in yellow bin.	10(38.5%)	15(57.6%)	10(37.0%)	9(34.6%)
9	Broken thermometer and mercury should not be autoclaved before disposal*.	11(42.3%)	18(69.2%)	11(40.7%)	11(42.3%)
10	Infectious waste (body tissue, placenta) must be collected in separated open trolleys*.	11(42.3%)	18(69.2%)	11(40.7%)	11(42.3%)
11	Infectious waste (body secretion, body fluids) can be transported through common route within hospital*.	11(42.3%)	18(69.2%)	11(40.7%)	10(38.5%)
12	Infectious waste (blood stained materials) must be collected by wearing the hand gloves.	12(45.5%)	18(69.2%)	11(40.7%)	11(42.3%)
13	Infectious waste (sharps, needles, blades) must be collected by wearing the apron.	13(50%)	17(65.3%)	13(48.1%)	13(50.0%)
14	Non-infectious (milk packet, juice packet and waste from food items) waste should not be collected by wearing the mask*.	11(42.3%)	15(57.6%)	9(33.3%)	10(38.5%)
15	Sometime infectious waste (body organs	13(50%)	18(69.2%)	11(40.7%)	12(45.5%)

	and tissues) can be collected by wearing the long rubber boot*.				
16	The infectious waste (sharps, used needles, used drip sets) storage area needs to be well fenced.	13(50%)	19(73.0%)	12(44.4%)	11(42.3%)
17	Autoclaves are the best recommended for the treatment of infectious waste.	13(50%)	18(69.2%)	12(44.4%)	11(42.3%)
18	Landfill is the best option for disposal of all waste from hospital*.	12(45.5%)	19(73.0%)	11(40.7%)	11(42.3%)
19	Incineration is the best option for infectious waste disposal.	9(34.6%)	16(61.5%)	9(33.3%)	8(30.8%)
20	Infectious waste (patients and secretion) can be stored at separate room for more than 72hours*.	9(34.6%)	16(61.5%)	9(33.3%)	8(30.8%)

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Appendix IX: Attitude among health staff

#	Attitude variables	Intervention										Control									
		Pre (baseline) n=112					Post (after 3 months follow up) n=101					Pre (baseline) n=110					Post (after 3 month followup) n=102				
		SA	A	UD	D	SD	SA	A	UD	D	SD	SA	A	UD	D	SD	SA	A	UD	D	SD
1	Role in management of infectious waste*.	73	34	5	0	0	16	33	15	28	9	71	34	5	0	0	66	32	4	0	0
2	Segregation of infectious waste is an important.	46	45	18	3	0	12	68	8	13	0	44	45	18	3	0	42	41	16	3	0
3	Safe to break the injection ampoule over bin*.	60	27	18	3	4	18	14	6	47	16	60	25	18	3	4	57	25	14	3	3
4	Feel not good when I find someone through waste in wrong bin.	36	52	18	3	3	28	11	3	55	4	34	52	18	3	3	33	50	14	3	2
5	It is not important to label the waste bags	38	16	20	18	20	26	10	18	43	4	38	16	20	17	19	37	15	15	17	18

จุฬาลงกรณ์มหาวิทยาลัย
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	before collection*.																				
6	Collection of waste bins when the bins are full*.	10	54	19	24	5	39	7	8	37	10	10	53	19	23	5	8	52	14	23	5
7	Infectious & non-infectious waste must be transported at a time*.	37	20	11	35	9	13	5	29	43	11	37	19	11	34	9	36	17	9	32	8
8	No need to wash the waste transportation trolleys*.	8	43	20	23	18	11	43	8	33	6	8	43	20	22	17	7	41	18	20	16
9	Separate route for infectious waste transportation within hospital is unnecessary*.	39	14	16	31	12	23	15	15	48	0	39	14	16	30	11	38	13	13	28	10
10	Incineration would	31	51	19	7	4	30	40	17	10	4	29	51	19	7	4	27	49	16	6	4

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

	be the best option for the treatment of infectious waste.																			
11	Infectious waste disposal is the responsibility of the city municipality*.	53	18	20	20	1	5	6	8	82	0	53	18	20	18	1	51	17	17	17	0
12	Chemical disinfection is not at all an effective treatment method.	9	52	30	20	1	16	51	13	21	0	9	51	29	20	1	9	47	26	20	0

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Appendix X: Attitude among sanitary workers

#	Attitude variables	Intervention										Control									
		Pre (baseline) n=26					Endline after 3 months follow up n=26					Pre (baseline) n=27					Endline after 3 months followup n=26				
		SA	A	UD	D	SD	SA	A	UD	D	SD	SA	A	UD	D	SD	SA	A	UD	D	SD
1	Role in management of infectious waste*.	9	5	5	3	4	3	15	2	5	1	10	6	3	3	5	10	5	3	3	5
2	Segregation of infectious waste is an important.	10	7	5	2	2	6	14	2	3	1	11	8	4	2	2	11	8	4	1	2
3	Safe to break the injection ampoule over bin*.	11	8	3	2	2	2	4	10	9	1	11	10	2	2	2	11	10	2	2	1
4	Feel not good when I find someone through waste in wrong bin.	8	9	5	2	2	3	18	2	2	1	10	11	4	1	1	9	11	4	1	1
5	It is not important to label the waste bags before collection*.	7	11	2	2	4	7	2	7	6	4	7	12	1	2	5	7	11	1	2	5
6	Collection of waste bins when the bins are full*.	4	9	11	1	1	5	2	8	9	2	5	9	11	1	1	5	9	10	1	1
7	Infectious & non-infectious waste must be transported at a time*.	7	11	6	1	1	5	2	9	9	1	9	11	5	1	1	8	11	5	1	1
8	No need to wash the waste transportation trolleys*.	7	12	5	1	1	8	3	4	10	1	9	12	4	1	1	9	11	4	1	1
9	Separate route for infectious	11	5	8	1	1	9	2	3	11	1	13	6	6	1	1	13	6	5	1	1

	waste transportation within hospital is unnecessary *.																				
10	Incineration would be the best option for the treatment of infectious waste.	7	8	9	1	1	7	15	2	1	1	7	9	9	1	1	6	9	9	1	1
11	Infectious waste disposal is the responsibility of the city municipality* .	7	4	8	5	2	9	2	3	10	2	7	7	6	5	2	6	7	6	5	2
12	Chemical disinfection is not at all an effective treatment method.	6	7	8	2	3	10	2	2	10	2	7	8	7	2	3	6	8	7	2	3

จุฬาลงกรณ์มหาวิทยาลัย
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Appendix XI: Practices statements among health staff

S	Practices variables	Intervention n (%)		Control n(%)	
		Pre (baseline) n=112	Post (after 3 m followup n=101	Pre (baseline) n=110	Post (after 3m followup n=102
		Correct answers			
1	I always throw infectious waste contaminated with blood in red bin.	93(83.0%)	92(91.0%)	92(84.1%)	85(83.1%)
2	I always throw the infectious waste like body fluids with general waste bin*.	54(48.2%)	73(72.1%)	40(36.0%)	67(64.2%)
3	Sometimes I mistakenly throw infected waste (used syringe) into the general waste bin.	26(23.2%)	57(56.1%)	40(36.0%)	37(36.3%)
4	Infectious waste (blood contaminated materials) bags are never labeled before they are collected from the ward.	55(49.1%)	73(72.1%)	69(63.0%)	64(63.3%)
5	I always throw the sharp waste like scissors, knives, blade in red waste bin*.	37(33.3%)	61(60.0%)	27(25.1%)	24(24.2%)
6	I always throw the used syringes in injection safety box.	83(74.1%)	81(80.1%)	77(70.1%)	73(72.1%)
7	I always recap the needles after taking the blood sample of patient.	81(72.2%)	79(78.2%)	77(70.1%)	71(70.0%)
8	I always use separate bin for vaccine vials and ampoules and drugs.	64(57.1%)	73(72.1%)	64(58.1%)	58(57.3%)
9	Sometime I break the injection and thrown it in general waste bin*.	46(41.2%)	77(76.3%)	48(44.2%)	58(57.2%)
10	Autoclave for the hospital waste is performed by the skilled health staff.	49(44.3%)	65(64.3%)	12(18.2%)	20(20.0%)
11	I always use gloves when contact with infectious waste (body tissue, body secretion).	82(73.1%)	78(77.2%)	67(61.3%)	62(61.1%)
12	I throw the body tissue like placenta with general waste bin*.	54(48.4%)	70(69.1%)	64(58.2%)	60(59.2%)
13	Infectious waste like body fluids not treated in the hospital before their disposal*.	28(25.1%)	57(56.1%)	33(30.0%)	30(29.2%)
14	I always use apron during the emergency and operation theater.	84(75.2%)	83(82.2%)	78(71.1%)	73(72.2%)

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

15	I always call the sanitary workers to collect the infectious waste after every 24 hours.	45(40.0%)	69(68.1%)	36(33.1%)	34(33.3%)
16	I always wash my hands after handling the infectious waste.	80(71.1%)	81(80.0%)	70(64.1%)	66(65.4%)
17	I use vaccination against the infectious diseases like Hepatitis B.	77(69.2%)	83(82.1%)	77(70.2%)	72(71.1%)
18	I always use mask when contact with infectious waste contaminated with body fluids.	79(70.1%)	88(87.2%)	77(70.3%)	72(71.2%)
19	Waste bags are always checked for tears or punctures before transportation.	40(36.1%)	69(68.2%)	35(32.1%)	33(32.1%)
20	I always look the right bin to throw the infectious waste.	48(42.2%)	87(86.1%)	34(31.1%)	72(71.2%)

จุฬาลงกรณ์มหาวิทยาลัย
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Appendix XII: Practices statements among sanitary workers

S	Practices variables	Intervention		Control	
		Pre (baseline) n=26	Post (after 3 m followup) n=26	Pre (baseline) n=27	Post (after 3 m followup n=26
1	I always use long rubber boats during infectious waste (sharps, used needles, scissors and blades) collection.	2(7.6%)	16(61.5%)	2(7.4%)	2(7.6%)
2	I always use gloves during collection of infectious waste like body tissues.	5(19.2%)	12(46.1%)	6(22.2%)	5(19.2%)
3	I always wear apron during the transportation of infectious waste (used syringes, used bottles and sharps).	3(11.5%)	16(61.5%)	3(11.1%)	3(11.5%)
4	I always wear mask during the infectious waste (drugs, vials and ampoules) transportation.	8(30.7%)	18(69.2%)	8(29.6%)	7(26.9%)
5	I always collect the hospital bins when the bins are full with infectious waste (blood contaminated materials, body tissues).	4(15.3%)	16(61.5%)	5(18.5%)	5(19.2%)
6	Infectious waste (sharps, blades, scissors and needles) collected bins are collected after the labeling.	7(26.9%)	14(53.8%)	7(25.9%)	6(23.0%)
7	I always collect sharp together with infectious waste (body tissue)*.	4(15.3%)	16(61.5%)	5(18.5%)	5(19.2%)
8	Sometime I mix infectious waste (blood contaminated) with general waste during transportation*.	2(7.6%)	18(69.1%)	2(7.4%)	2(7.6%)
9	I always use the autoclave for infectious waste like placenta and body tissues*.	5(19.2%)	14(53.8%)	6(22.2%)	5(19.2%)
10	I always check the leakage in waste bags before transporting the waste.	3(11.5%)	16(61.5%)	3(11.1%)	3(11.5%)
11	I always wash the infectious waste transport trolley.	8(30.7%)	17(65.3%)	8(29.6%)	7(26.9%)
12	I always depose the infectious waste like placenta in burial pit.	3(11.5%)	15(57.6%)	3(11.1%)	3(11.5%)

จุฬาลงกรณ์มหาวิทยาลัย
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13	I always wash my hands after handling the waste.	8(30.7%)	16(61.5%)	8(29.6%)	7(26.9%)
14	I always store the infectious waste (body secretion, body tissues and organs) for more than 72 hours.	0(0)	19(73.0%)	0(0)	0(0)
15	Most of the infectious waste like body fluids is not treated before disposal*.	3(11.5%)	17(65.3%)	7(25.9%)	4(15.3%)

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Appendix XIII: Statements on enabling factors for health staff

S	Enabling factors	Intervention n (%)		Control n (%)	
		Pre (baseline) n=112	Endline (after 3 m followup n=101	Pre (baseline) n=110	Endline (after 3 m followup n=102
1	Do you have the guidelines for infectious waste management at your work place?	48(42.8%)	48(47.5%)	46(41.8%)	38(37.2%)
2	If yes, how many times you read?				
	1. One time	47(41.9%)	47(46.5%)	45(40.9%)	38(37.2%)
	2. Many times				
3	Do you think these guidelines are important?	47(41.9%)	66(65.3%)	45(40.9%)	38(37.2%)
4	Do you read the Biomedical waste management rules 2005?	48(42.8%)	62(61.2%)	45(40.9%)	44(43.1%)
5	Do you think these rules are important at your work place?	47(41.9%)	47(46.5%)	45(40.9%)	44(43.1%)
6	Do you think these rules are important for health care waste management?	47(41.9%)	47(46.5%)	45(40.9%)	44(43.1%)
7	Have you attended training on waste management in last five years?	48(42.8%)	77(76.2%)	46(41.8%)	45(43.1%)
8	If yes, how many times?				
	1. One time	47(41.9%)	45(44.5%)	45(40.9%)	44(43.1%)
	2. Many times	0	21(20.7%)	0	
9	Do you know the policy for hospital waste management?	100(89.2%)	91(90%)	99(90%)	93(91%)
10	Does your hospital have any hospital waste management committee exist?	83(74.1%)	78(77.2%)	81(74.2%)	77(76.2%)
11	Are there sufficient waste management bins are available at your work place?	55(49.1%)	73(72.2%)	54(49%)	52(51.2%)
12	Are there sufficient sharp waste bins available?	74(66%)	83(82.1%)	72(65.4%)	69(67.6%)
13	Are there sufficient injection safety boxes are available?	69(61.6%)	80(79.2%)	67(60.9%)	64(62.7%)
14	Is there sufficient number of waste transport trolleys available?	40(35.7%)	55(54.4%)	38(34.5%)	36(35.2%)
15	Is there exists a separate waste management plan at your work place?	66(58.9%)	66(65.3%)	46(41.8%)	62(61.1%)
16	Are there sufficient aprons available at your work place?	40(35.7%)	58(57.5%)	39(35.5%)	38(37.2%)
17	Are there sufficient gloves available at your work place?	64(57.1%)	72(71.2%)	62(56.3%)	59(57.3%)
1	Are there sufficient long rubber boots	32(28.5%)	42(41.5%)	31(28.1%)	31(30.3%)

8	available at your work place?				
19	Are there sufficient masks available at your work place?	75(66.9%)	82(81.1%)	74(67.2%)	71(69.6%)

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Appendix XIV: Statements on enabling factors for sanitary workers

S	Enabling factors	Intervention			Control
		Correct answers			
		Pre (baseline) n=26	Post (after 3 months interventio n) n=26	Pre (baseline) n=27	Endline (after 3 months interventio n) n=26
1	Have you attended training on infectious waste management in last five years?	4(15.2%)	26(100%)	4(14.8%)	4(15.2%)
2	If yes, how many times? One time Many times	4(15.2%)	0	4(14.8%)	4(15.2%)
		0	26(100%)	0	0
3	Do you these trainings are important?	3(12.3%)	26(100%)	4(14.8%)	4(15.3%)
4	Is there monitoring and supervision system is placed at your work place for infectious waste management.	3(12.3%)	26(100%)	3(11.2%))	3(12.3%)
5	Are there sufficient infectious waste management trolleys are available at your work place?	3(12.3%)	15(58.4%)	2(7.2%)	2(7.9%)
6	Are there sufficient sharp waste bins available?	2(7.9%)	23(88.6%)	2(7.2%)	2(7.9%)
7	Are there sufficient injection safety boxes are available?	10(38.7%)	23(88.6%)	10(37.4%)	9(34.8%)
8	Is there sufficient number of waste collection bags available?	12(46.3%)	22(85.4%)	12(44.2%)	12(46.1%)
9	Are there sufficient general waste bins available?	13(50%)	21(81.3%)	13(48.1%)	13(50%)
10	Are there sufficient aprons available at your work place?	9(34.8%)	24(92.3%)	9(33.1%)	8(31.4%)
11	Are there sufficient gloves available at your work place?	12(46.3%)	26(100%)	12(44.2%)	12(46.3%)
12	Are there sufficient long rubber boots available at your work place?	10(38.7%)	25(96.1%)	10(37.1%)	9(34.8%)
13	Are there sufficient masks available at your work place?	13(50%)	25(96.1%)	13(48.4%)	13(50%)
14	Are there sufficient infectious waste bins available?	10(38.7%)	24(92.4%)	10(37.1%)	10(38.7%)

15	Are you getting incentives from administration for hospital waste management?	9(34.8%)	26(100%)	11(41.2%)	11(42.3%)
16	Do you think this is important for infectious waste management?	16(62.3%)	26(100%)	20(74.3%)	20(77.4%)

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