

Abstract

The current economic and environmental climate presents challenges and opportunities for the healthcare sector. Healthcare provision inadvertently results in significant environmental harm. The volume of waste produced by healthcare providers is often large and costly to dispose of.

This thesis presents my experience of establishing and leading a recycling and environmental sustainability research project in the New Zealand (NZ) healthcare setting. It is presented as a practice-led case study undertaken to change practice primarily targeting the NZ healthcare sector. It incorporates both quantitative and qualitative data. As such it represents the first of its kind in NZ to explore the impact of a recycling and environmental sustainability programme in the healthcare setting. Two sites were chosen as case study sites - both sites being different in size and function - involved in the delivery of inpatient and outpatient services; further enhancing the originality of the study.

This study is interwoven with the development, delivery, and evaluation of the recycling project and environmental sustainability programme. The theoretical constructs of sustainability, leadership, and change management frame the research project and provide the lens through which to view the project. This professional doctorate reflects the tension of undertaking my normal role and adding the complexity of research. As such it is impossible to separate the two aspects. I became the ‘actor-director’ holding the tension of the practice-research nexus.

Findings show recycling is an essential component of an environmental sustainability programme. Leadership is shown by providing a recycling solution and by managing the changing behaviour among the end-users, from the status quo to pro-environmental behaviour. This study reveals important benefits in terms of costs avoided and decreasing environmental harm. This study found that using a patient indicator of activity is reliable in the NZ healthcare context. This measure is found to be the most beneficial, especially for facility managers, as it allows for more accurate waste management planning. Survey results show ethical and emotive reasons drive pro-environmental behaviours. Respondents believe healthcare organisations need to prioritise recycling. Respondents also assert that the uptake of the project and the programme is greater when there is departmental leadership support and when led by a dedicated sustainability officer.

When considering sustainable healthcare waste management and adopting the theoretical lens of complexity leadership theory, the findings suggest adopting a multi-level system-wide approach to recycling in healthcare whilst situating recycling within the context of a wider environmental sustainability programme. This thesis finds organisational change is required for successful behaviour change results, leadership is needed to ensure effective design and implementation of the change programme, and sustainability programmes require a strategic approach.

A new conceptual model is presented with practical implications, thereby allowing regional and national replication. This research project could be replicated in other settings within and outside the healthcare context. Extended research is needed to establish benchmarks for tracking sustainability performance and to support workplace training and education programmes in sustainability management.

Table of Contents

ABSTRACT.....	I
TABLE OF CONTENTS	III
LIST OF FIGURES	VIII
LIST OF TABLES	X
ATTESTATION OF AUTHORSHIP	XI
ACKNOWLEDGEMENTS.....	XII
CHAPTER 1 INTRODUCING THE PRACTICE PROJECT	1
1.1 INTRODUCTION	1
1.2 SUSTAINABILITY	3
1.3 HEALTHCARE SUSTAINABILITY	3
1.3.1 Recycling projects	4
1.4 COUNTIES MANUKAU HEALTH	6
1.4.1 Counties Manukau Health Sustainability	7
1.5 RESEARCH-PROJECT PROCESS	8
1.5.1 Research-Project Purpose.....	8
1.5.2 Research-Project Questions.....	8
1.6 THESIS STRUCTURE	11
CHAPTER 2 SUSTAINABLE WASTE MANAGEMENT IN HEALTHCARE.....	13
2.1 INTRODUCTION	13
2.2 CLIMATE CHANGE AND HEALTHCARE.....	13
2.3 CARBON FOOTPRINT AND HEALTHCARE	14
2.4 SUSTAINABILITY: A GROWING CONSCIOUSNESS.....	16
2.4.1 Model of Sustainability	18
2.4.2 Healthcare Sustainability	21
2.4.2.1 Healthcare Sustainable Waste Management.....	22
2.5 SUMMARY	24
CHAPTER 3 LEADERSHIP AND CHANGE MANAGEMENT IN HEALTHCARE.....	26
3.1 LEADERSHIP AND HEALTHCARE.....	26
3.1.1 Leadership Theory	26
3.1.1.1 Complexity Leadership Theory.....	27
3.1.1.2 Sustainability Leadership Theory	30
3.1.2 Change Management Theory	31
3.1.2.1 Associated Psychological Theories	35

CHAPTER 4	SPECIFICS OF THE CM HEALTH ENVIRONMENTAL SUSTAINABILITY PROGRAMME AND RECYCLING PROJECT	39
4.1	CM HEALTH SUSTAINABILITY MANAGEMENT	39
4.1.1	Recycling at CM Health	40
4.1.1.1	Strategy and Goal.....	42
4.1.1.2	Outcomes.....	44
4.1.1.3	Key Initiatives	45
4.1.1.4	Performance Indicators.....	47
4.1.1.5	Results.....	47
4.2	REFLECTIVE DISCUSSION.....	49
4.3	SUMMARY	51
CHAPTER 5	THEORETICAL REVIEW OF HEALTHCARE WASTE MANAGEMENT.....	52
5.1	INTRODUCTION	52
5.2	SYSTEMATIC REVIEW.....	52
5.3	RESULTS OF THE SYSTEMATIC REVIEW	54
5.3.1	Organisation/Setting/Sampling	55
5.3.2	Design/Techniques of the Extant Literature	56
5.4	INTERPRETATION OF THE LITERATURE REVIEWED	57
5.4.1	Waste impact.....	58
5.4.2	Waste care management.....	60
5.4.3	Sustainability outcome	65
5.4.4	Hypotheses	68
5.4.5	Theoretical lens	69
5.4.5.1	Leadership.....	70
5.4.5.2	Change management	72
5.5	SUMMARY	74
CHAPTER 6	RESEARCH-PROJECT DESIGN AND METHODS	77
6.1	INTRODUCTION	77
6.2	RESEARCH-PROJECT QUESTION.....	77
6.3	CASE STUDY RESEARCH	79
6.4	PHASES OF THE RESEARCH PROJECT	82
6.5	PROCEDURES.....	83
6.5.1	Ethics.....	83
6.5.2	Sampling	84
6.5.3	Survey administration.....	85
6.6	DATA COLLECTION.....	86
6.6.1	Audit Data	86
6.6.2	Survey Data.....	87

6.6.2.1	Pilot Study	87
6.6.2.2	The Survey Tool.....	87
6.6.2.3	Survey Distribution.....	88
6.7	DATA ANALYSIS	89
6.7.1	Audit Data Analysis.....	89
6.7.2	Quantitative Data Analysis	90
6.7.3	Qualitative Data Analysis.....	91
6.7.4	Integration of the Results with the Theory and Practice	92
6.8	SUMMARY	92
CHAPTER 7 RESULTS.....		93
7.1	INTRODUCTION	93
7.2	AUDIT RESULTS.....	93
7.2.1	Waste Weight	93
7.2.2	Fiscal and Environmental Outcomes	99
7.2.2.1	Fiscal Outcomes	99
7.2.2.2	Environmental Outcomes	99
7.3	SURVEY- QUANTITATIVE DATA.....	100
7.3.1	Sampling Results	100
7.3.2	Stage 1: Polychoric Correlation.....	101
7.3.3	Stage 2: The Exploratory Factor Analysis (EFA) Results	102
7.3.4	Stage 3: Mixed Model Regression Results	104
7.3.4.1	Awareness.....	104
7.3.4.2	Work Context	105
7.3.4.3	Segregation Behaviour	106
7.3.4.4	Self-Reported Change in Recycling Behaviour	107
7.4	QUALITATIVE FINDINGS	108
7.4.1	Recycling Project.....	111
7.4.1.1	Organisation.....	112
7.4.1.2	Programme	114
7.4.1.3	Individual Employee.....	116
7.4.2	Environmental Sustainability Programme	116
7.4.2.1	Organisation.....	117
7.4.2.2	Programme	118
7.4.2.3	Individual Employee.....	119
7.5	INTEGRATED FINDINGS	121
7.6	SUMMARY	122
CHAPTER 8 SUSTAINABLE HEALTHCARE WASTE MANAGEMENT: THE CASE FOR CHANGE.....		123
8.1	INTRODUCTION	123
8.2	AUDIT DATA.....	123

8.2.1	Waste Types and Weight	123
8.2.1.1	General Waste	124
8.2.1.2	Medical Waste	125
8.2.1.3	Recycling	126
8.2.2	Benchmarking	127
8.2.3	Fiscal Outcomes	128
8.2.4	Environmental Outcomes	129
8.3	QUANTITATIVE FINDINGS	130
8.3.1	Awareness	130
8.3.2	Work Context	131
8.3.3	Segregation Behaviour	132
8.4	QUALITATIVE FINDINGS	133
8.4.1	Recycling project	133
8.4.1.1	Organisation	133
8.4.1.2	Programme	134
8.4.1.3	Individual Employee	135
8.4.2	Environmental Sustainability Programme	137
8.4.2.1	Organisation	137
8.4.2.2	Programme	138
8.4.2.3	Individual Employee	139
8.5	INTEGRATED FINDINGS	139
8.6	SUMMARY	146
CHAPTER 9	CONCLUSIONS	147
9.1	INTRODUCTION	147
9.2	MAIN CONCLUSIONS	147
9.3	LIMITATIONS OF THIS STUDY	148
9.4	IMPLICATIONS FOR THEORY	150
9.5	IMPLICATIONS FOR SUSTAINABLE HEALTHCARE PRACTICE	153
9.6	DIRECTIONS FOR FUTURE RESEARCH	157
9.7	SUMMARY	158
9.8	EPILOGUE	159
9.9	PRESENTATIONS AND PUBLICATIONS	162
REFERENCES	.....	164
APPENDICES	.....	188
APPENDIX A:	GLOSSARY OF TERMS	188
APPENDIX B:	NEW ZEALAND WASTE LEGISLATION	189
APPENDIX C:	ANNOTATED BIBLIOGRAPHY	194
APPENDIX D:	THE PROGRAMME	201

APPENDIX E: CMDHB AND AUTECH ETHICS APPROVAL	204
APPENDIX F: EMAIL INVITATION	206
APPENDIX G: EVALUATION FORM	211
APPENDIX H: SURVEY.....	212
APPENDIX I: A) OVERVIEW OF THE NVIVO FINDINGS.....	225
APPENDIX I: B) OVERVIEW OF INITIAL QUALITATIVE FINDINGS	226
APPENDIX J: EFA AND REGRESSION ANALYSIS	227
APPENDIX K: DETAILS OF THE RECYCLING WASTE STREAMS	239
APPENDIX L: INCLUSION AND EXCLUSION CRITERIA USED FOR PATIENT ACTIVITY DATA	242
APPENDIX M: GANTT CHART ES PROGRAMME AND RESEARCH 2018	244
APPENDIX N: PRACTICING SUSTAINABLE HEALTHCARE THEATRE PRESENTATION APRIL 4	245

List of Figures

FIGURE 1.1. HEALTHCARE SUSTAINABILITY AND THEMES.	9
FIGURE 2.1. WEAK SUSTAINABILITY: INTERSECTION BETWEEN ENVIRONMENTAL, SOCIAL AND ECONOMIC OUTCOMES.	17
FIGURE 2.2. STRONG SUSTAINABILITY: ALL HUMAN ACTIVITIES CONTAINED WITHIN THE ENVIRONMENTAL DOMAIN.	18
FIGURE 2.3. MODEL: WASTE MANAGEMENT HIERARCHY (ADAPTED FROM EPA NSW, N.D.).	23
FIGURE 3.1. THEORETICAL CONSTRUCTS AND INTERACTIONS CM HEALTH RECYCLING PROJECT.	38
FIGURE 4.1. MAIN AREAS OF FOCUS WITHIN THE CM HEALTH SUSTAINABILITY PROGRAMME.	40
FIGURE 4.2. CM HEALTH SUSTAINABILITY STRATEGIC FRAMEWORK RECYCLING PROGRAMME.	41
FIGURE 4.3. MODEL CM HEALTH SUSTAINABILITY PROGRAMME AND RELATIONSHIP TO RESEARCHER.	43
FIGURE 4.4. MODEL CM HEALTH RECYCLING PROJECT AND RELATIONSHIP TO RESEARCHER.	44
FIGURE 5.1. SCHEMATIC REPRESENTATION OF THE LITERATURE SEARCH.	53
FIGURE 5.2. CONCEPTUAL FRAMEWORK: RECYCLING PROJECT.	58
FIGURE 6.1. RESEARCH PROCESS (CROTTY’S FRAMEWORK) ADAPTED FROM CROTTY, 1998, p. 4.	81
FIGURE 6.2. RESEARCH PROJECT DESIGN.	82
FIGURE 7.1. GENERAL AND MEDICAL WASTE MEASURED IN TONNES AT MIDDLEMORE AND MANUKAU FOR THE THREE REPORTING PERIODS.	94
FIGURE 7.2. TONNES OF PAPER, COMINGLED, CARDBOARD AND TOTAL (COMBINED) RECYCLING OF BOTH SITES FOR THE THREE REPORTING PERIODS.	94
FIGURE 7.3. PAPER, COMINGLED AND CARDBOARD RECYCLING PER SITE, MEASURED IN TONNES FOR THE THREE REPORTING PERIODS.	95
FIGURE 7.4. SOFT PLASTIC AND EXPANDED POLYSTYRENE RECYCLING MEASURED IN TONNES FOR MMH FOR THE THREE REPORTING PERIODS.	95
FIGURE 7.5. KILOGRAMS OF GENERAL WASTE, MEDICAL WASTE, AND OVERALL KILOGRAMS OF RECYCLING AT MMH AND MANUKAU COMBINED PER FULL TIME EQUIVALENT FOR THE THREE REPORTING PERIODS.	96

FIGURE 7.6. WEIGHT OF GENERAL WASTE, MEDICAL WASTE AND RECYCLING (KG) PER FULL TIME EQUIVALENT, PER YEAR FOR MIDDLEMORE AND MANUKAU.....	97
FIGURE 7.7. KILOGRAMS OF GENERAL WASTE, MEDICAL WASTE, AND OVERALL KILOGRAMS OF RECYCLING FOR BOTH SITES PER PATIENT ACTIVITY FOR THE THREE REPORTING PERIODS.	98
FIGURE 7.8. KILOGRAMS OF GENERAL WASTE, MEDICAL WASTE, AND OVERALL KILOGRAMS OF RECYCLING COMPARING BOTH SITES PER PATIENT ACTIVITY PER YEAR.....	98
FIGURE 7.9. FREQUENTLY USED TERMS REGARDING THE RECYCLING PROJECT.....	111
FIGURE 7.10. FREQUENT TERMS REGARDING THE GREEN PROGRAMME.	117
FIGURE 7.11. SUGGESTIONS MADE BY RESPONDENTS ON PREFERRED WAYS OF INFORMATION SHARING.	118
FIGURE 7.12. CM HEALTH ENVIRONMENTAL SUSTAINABILITY PROGRAMME - TARGET AREAS AS IDENTIFIED BY THE RESPONDENTS ACROSS THE TWO SURVEYS.	119
FIGURE 7.13. FINAL FRAMEWORK: INTERDEPENDENCIES, REQUIREMENTS AND APPROACH OF THE RECYCLING PROJECT AND ES PROGRAMME.	120
FIGURE 8.1. INTEGRATED FINDINGS CONNECTING THE ‘THEORY’ TO THE ‘PRACTICE’ AND THE ‘OUTCOMES’.	140
FIGURE 8.2. RECYCLING PROJECT CONCEPTUAL FRAMEWORK DEPICTING MAIN RESEARCH-PROJECT FINDINGS.	141

List of Tables

TABLE 2.1. ATTRIBUTES OF SUSTAINABILITY	20
TABLE 6.1. QUESTIONS AND THEIR CATEGORIES	88
TABLE 6.2. DATA ANALYSIS OVERVIEW	89
TABLE 7.1. CARBON IMPACT OF WASTE TO LANDFILL ACTIVITIES MEASURED IN TCO ₂ E OR KGC0 ₂ E PER SITE, PER FTE AND PA FOR EACH YEAR	99
TABLE 7.2. EFA DERIVED FACTORS.....	103
TABLE 7.3. CONSTRUCTS ELICITED FROM THE EFA.....	104
TABLE 7.4. CONTRASTS FOR AWARENESS.....	105
TABLE 7.5. CHANGES IN AWARENESS 2014-2015	105
TABLE 7.6. CONTRASTS FOR WORK CONTEXT	106
TABLE 7.7. CHANGE IN WORK CONTEXT 2014-2015	106
TABLE 7.8. CONTRASTS FOR SEGREGATION BEHAVIOUR	107
TABLE 7.9. CHANGE IN SEGREGATION BEHAVIOUR 2014-2015	107
TABLE 7.10. SELF-REPORTED CHANGE IN RECYCLING BEHAVIOUR COMPARING 2015 TO 2014	107
TABLE 7.11. RESPONDENTS DIFFERENTIATED BY GENDER, PROFESSIONAL CATEGORY AND SITE TO EACH SURVEY’S OPEN-ENDED QUESTIONS	108
TABLE 7.12. EXAMPLES TAKEN FROM THE INITIAL FRAMEWORK (RECYCLING AND ENVIRONMENTAL SUSTAINABILITY).....	110

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by any other person (except where explicitly defined in the acknowledgements). Neither does it contain any material which to a substantial extent has been accepted for the award of any other degree or qualification of a university or higher learning institution.

Signed:

Date: 15/06/2020

Acknowledgements

I would like to thank everyone who has helped, or in some way contributed to this thesis.

I would like to express my gratitude to my supervisors: Associate Professors Peter Larmer, Coral Ingle and Alain C. Vandal; and Professor Liz Smythe for their guidance and help throughout the DHSc journey.

I would also like to thank my friends and family my husband Damian Wilson, my mother Brenda Smith, and my four children Joshua, Jasper, Charlie, and Molly. Their support and love have been enduring and a source of inspiration. In loving memory of my father, Alan Smith, who passed away in March 2002, my father-in-law, Tony Wilson, who passed away in July 2017 and my mother-in-law, Mary Wilson, who passed away in January 2019.

Chapter 1 Introducing the practice project

1.1 Introduction

This is a practice-based research project. My aim as project leader was to design, implement, and explore the effectiveness of a recycling project within the healthcare setting of Counties Manukau (CM) Health. The objectives for the research project were designed to align with the organisation's objectives. The organisation's recycling project was a sub-set of the environmental sustainability programme. The research project involved the collection of three types of data sets spanning a 12-month period. The knowledge sought was context-specific which required a constant flowing back and forth between the theoretical and practical aspects of the project. I compared actual organisational waste data to the perceptions of end-users of the programme. The effectiveness of this project was measured in two ways: as a change in mindset and a behaviour change.

One of the two main aims of this research project was to deliver a recycling project as part of a wider environmental sustainability programme. A second aim was to share the results of this project with other health systems both locally and nationally. There is a lack of case study data available for healthcare employees in New Zealand (NZ) to draw on in their own practice, thereby representing a desirable practical output of this research-project; making a significant contribution to theory and practice.

This study is the first in NZ to explore the impact of recycling and environmental sustainability in the healthcare setting. This is an original piece of research since the study was wrapped around a large-scale organisational change programme. Uniquely, this study compares the outcomes of the recycling and environmental sustainability programme from a macro to a micro perspective over a 12-month period. This is significant because healthcare organisations more commonly tend to capture data on waste by type and weight in order to calculate transport and disposal costs. This study gathered and compared much more detailed data including the carbon emissions related to waste-related activities, which remains to this day a less commonly found approach taken in the NZ healthcare setting.

Originality was enhanced by including two different sites, one a large facility and largely inpatient and the other smaller, largely outpatient. In addition, programmes are often

designed without incorporating the viewpoints of the end-users of the programme. This study found that recycling matters to healthcare workers and suggestions were made with regards to the programme deliverables adding further significance to this project/research.

This study adds to the body of empirical knowledge of waste recycling and healthcare environmental sustainability. There is limited published empirical work in the field of healthcare recycling from NZ and the wider Australasian region. Additionally, the findings of this research-project make a more substantive contribution to the entire body of knowledge, indicating areas for further research, thereby fulfilling the wider academic aspirations in completing this doctoral thesis.

I undertook this research-project as an employee of Counties Manukau (CM) Health, charged with initiating and leading this project. My enrolment as a student within the Doctor of Health Science programme afforded me the opportunity to bring research rigour to the project and to offer a reflexive analysis. Jones (2018) describes the goal of professional doctorates as creating new knowledge in one's place of work. Rolfe and Davis (2012) are clear that the purpose of such a thesis is to draw knowledge from one's own practice setting and feed those insights back to directly impact local practice. This thesis, therefore, holds for me the tension of being both researcher and initiator/leader of the work-based project. Coughlan and Brannick (2010) refer to this as being the 'actor-director'. The value of such an approach is that it comes 'out of' and goes 'back to' real-world practice (Costley & Lester, 2012). I name my work a research project to signify that it is not 'research' as might be found in a traditional PhD study. Rather it is a disciplined initiation and reflective analysis of a work-based project.

In this chapter, I begin by introducing the term 'sustainability'. I then describe healthcare sustainability, with an emphasis on recycling. Preliminary details of the organisation (CM Health) are next provided thereby detailing the context of this study. The final section of the chapter reports on how the study was conducted, closing with an outline of the overall thesis structure.

1.2 Sustainability

Sustainability can be interpreted in different ways. Being sustainable or achieving sustainability is at the least considered appealing and, at best, described as being a necessity, given that many large organisations are required to deliver services in more constrained and mindful ways (Evans, Russell, Fielding & Hill, 2012; Wiesner, Chadee, & Best 2018). The way terms such as sustainability have been used and understood within this thesis are described in the glossary of terms (Appendix A).

There are measurable financial and environmental benefits to becoming more sustainable, in addition to less tangible social benefits (Jones, Jackson, Tudor & Bates, 2012; Lennox, Maher & Reed, 2018). Further, in the face of global warming and climate change there is growing emphasis on, and awareness of, the impact of non-sustainable practice regarding resource depletion (Kaplan, Sadler, Little, Franz & Horris, 2012). Seeking alternatives to fossil fuels - and limiting actions that result in polluting the atmosphere, land, or waterways - have become part of a suite of activities that are often housed within a sustainability programme (discussed in more detail in Section 2.4.2).

The hospitality industry (Chou, 2014; Haastert & Grosbois, 2010), tertiary sector (Posey & Webster, 2014; Pereira, Jabbour, de Oliveira & Teixeira, 2011), and commercial organisations (Teixeira, Jabbour, Oliveira, Battistelle & de Castro, 2011) have been adopting sustainability programmes in the hope of limiting the harm of their day-to-day operations whilst realising savings and raising their reputational status.

1.3 Healthcare Sustainability

Sustainability is becoming increasingly popular within the setting of health, as described by Karliner and Gunther (2011) and MacNeill, Lillywhite, & Brown (2017). There is a growing body of international work within sustainable healthcare practice (Godlee, 2012; Thiel, Woodes & Bilec, 2018). The healthcare sector represents an influential portion of public and private sector organisations. In some ways, sustainability practices are more philosophically aligned with the visions and values of healthcare organisations. This is, in part, because of a high level of expectation about the responsible allocation of resources within healthcare organisations. A constrained and mindful approach taken when expending scarce resources are welcomed, if not expected (Connor & Mortimer, 2010). It seems fitting that organisations that deliver their services sustainably provide

an opportunity to save the taxpayers' dollar in an environmentally and socially acceptable manner (Kaplan et al., 2012).

Within NZ, the healthcare sector is in the process of developing an environmental sustainability lens. This is being demonstrated by the appointment of sustainability project managers within District Health Boards (DHBs). Project managers guide senior management teams on being more sustainable; in effect, this is influencing the strategic direction of the healthcare sector. In doing so, environmental sustainability policies have been developed whilst implementation programmes that seek to achieve financial, environmental, and social outcomes are being compiled and sanctioned ("Scoop", 2013).

1.3.1 Recycling projects

Sustainability programmes are often initiated with recycling projects (Harris et al., 2009; Kaplan et al., 2012). There is a set of processes and practices that lead to reductions in waste to landfill, including recycling. By reducing the generation of waste in the first instance, waste minimisation activities support the objectives of a sustainable society. Recycling is the collection of used materials that would otherwise be waste to be broken down and remade into new materials and objects (Jones et al., 2012). Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution (from incineration), and water pollution (from landfilling) (Azmal, Kalhor, Dehcheshmeh, Goharinezhad, Heidari & Farzianpour, 2014).

For recycling to occur, there seems to be two main service delivery approaches adopted in New Zealand (Ministry for the Environment, 2015b). The first relies heavily on individuals sorting and separating their waste and placing it into the appropriate receptacle. Being expected to separate the waste at the point of waste generation is the most common approach taken by many organisations (Nichols & Manzi, 2014). This approach involves providing a range of recycling bins and the recycling streams are taken to a recycling facility where further separation is often required since contamination is common (Ministry for the Environment, 2015b). An alternative approach involves placing all recycling materials into one recycling receptacle with the separation occurring at a waste segregation facility. In this case, there is less emphasis on the behaviour of the individual and arguably a greater potential for disconnection between the person and the impact of their personal choices. Another area of concern with the second service delivery option relates to the problem of cross-contamination, best illustrated in the case

of glass and paper. When glass and paper all enter one recycling bin, glass fragments essentially end up contaminating the paper recycling. As a result, the function and value of the recycled paper as a commodity is lower.

Healthcare recycling programmes favour the segregation and recycling at the point of waste generation and there are multiple reasons for this. Healthcare service delivery results in the use of many disposable products, often involving teams of people, and as a result, waste is a very visible and tangible downstream effect of this care. Recycling projects which rely heavily on the active participation of individual employees are adopted early on in sustainability programmes and because they are relatively inexpensive to initiate, they result in financial and environmental benefits (Azmal et al., 2014; Karliner & Guenther, 2011). Successful implementation of recycling programmes in organisations also leads to a conducive and collaborative platform to influence and foster pro-environmental behaviours such as those pertaining to further waste reduction activities, energy and water conservation or procurement and travelling habits. Supported by leadership at the organisational level since recognising the importance of waste reduction activities such as recycling demonstrates a level of organisational commitment to supporting the change required.

The organisation demonstrates leadership by activating the initiation and sustaining the delivery of the recycling programme, by providing resources, in terms of the tools (for example local bins, posters), and staff training. In addition, by allowing for the development and provision of guidelines, and by tracking both the environmental and financial outcomes, results can (and need to) be shared with end-users of the programme. Result sharing has been shown to correlate with employee engagement and, therefore, other health systems are more likely to adopt similar practices – a further significant benefit of sharing the results (Kaplan et al., 2012, Yuriev, Boiral, Francoeur & Paille, 2018).

Programmes need to be evaluated, measured, and reported. Measuring the environmental outcomes of such programmes can be performed in different ways. Healthcare organisations in NZ tend to track waste weight and costs in isolation with little thought of the environmental impact. Greenhouse Gas (GHG) measurement expressed as a carbon footprint has been shown to be a reliable and scientific means of determining the environmental impact of day to day operations (Pandey, Agrawal & Pandey, 2011). In summary, organisational change is required for successful behavioural change results;

leadership is needed to ensure effective design and implementation of a change programme for recycling and sustainable waste management; and sustainability programmes require a strategic approach to avoid ad hoc uptake and ensure the programme is prioritised.

1.4 Counties Manukau Health

Counties Manukau Health (CM Health) provides care to the Counties Manukau (CM) multi-ethnic population of just over 545,700 (Counties Manukau Health Reports 2017-2020) equating to 11 percent of the total population for NZ (CM Health, n.d.). Sixty percent of the CM population are Māori, Pacific, or Asian (15%, 20%, and 25% respectively), with higher proportions of older adults and children compared to the NZ population. This is significant for this study since the most disadvantaged members of society are also at greater risk of experiencing the negative impacts of climate change.

The number of employees working across the DHB is in excess of 7,000. Two of the largest and busiest DHB sites are Middlemore Hospital and Maukau Health Park. Approximately 4,500 full time equivalent employees (FTEs) are based at Middlemore, which is a tertiary and teaching hospital. Middlemore has 800 beds, with an average length of stay of three days. Several departments covering all medical specialties are located at Middlemore including emergency care, critical care, inpatient wards, outpatient clinics, spinal and burns care, obstetrics and paediatrics, pharmacies, kitchens, and administrative offices.

A secondary site at Manukau (Manukau Health Park) has approximately 500 FTEs and provides mostly outpatient, with some inpatient, services. There are nine outpatient clinics offering a range of specialty services that see more than 300,000 patients per year. Inpatient services at the Manukau site are reserved for elective cases and care is provided on two ward areas and an operating suite.

The work context has implications for both theory and practice. In the absence of managerial and clinician support, the sustainable waste management project and broader environmental sustainability programme may not have been given approval to start and

would less likely be sustained. There needs to be alignment between organisational objectives which is to be discussed next.

1.4.1 Counties Manukau Health Sustainability

The DHB has been addressing the social and physical environments to make these more conducive to good health. When the decision was made to proceed down the path to sustainability, an alignment between the objectives of promoting health, practicing sustainable healthcare, and lessening the impacts of the social determinants of health was recognised by the senior executive team.

During 2012, Counties Manukau Health (CM Health) became the first DHB in Australasia to embark on a sustainability programme that measured and managed carbon emissions (“Connect” article, 2013). At that time, I was employed as a sustainability project manager and I co-designed with colleagues from the Environmental Advisory Group both the environmental sustainability programme and the recycling programme to reduce and manage the organisation’s carbon footprint. An approach was developed and taken to measure and track progress toward reaching sustainability goals whilst complying with the International Organisation for Standardisation (ISO) 14064 criteria. In addition, potential financial savings were set as targets, and the success of both the recycling project and the environmental sustainability programme from the DHB’s perspective heavily depended on achieving financial savings.

The two programmes were embraced by the DHB at the employee level, especially the recycling programme. This interest reflects a high social value, which signifies the potential for a considerable level of active participation and employee engagement. Being the project leader, a large component of my role has been spent building and fostering relationships with employees across all levels of the organisation to encourage high levels of engagement and foster support for the recycling project and environmental programme.

On becoming the sustainability project leader for CMDHB in 2012 my interest grew into the area of sustainable waste reduction. Before 2012 I worked in several different nursing roles, spanning over three decades. As a result, I possess a deep understanding of the health system and the issues and complexities faced when adopting environmental sustainability practices. From a personal, professional, and academic perspective, I was interested in the impact of recycling which led directly to this research-project. There

were and are, however, limitations on the amount of control I had over the project, working in a real-life situation as ‘actor-director’. My CMDHB role and responsibilities were initially more supportive in nature and perhaps considered ‘non-essential’ whereas other, more established roles were being more familiarly accepted. This meant I had little operational control over the recycling project post-implementation, with the day-to-day operationalisation of waste management services falling within the remit of the non-clinical support contract manager.

1.5 Research-Project Process

This thesis explores the leadership of a change initiative, specifically focussed on recycling behaviour. As indicated by the literature, for the programme to be effective, it was deemed important to measure the impact of this change initiative from the standpoint of the organisation and from the view of the end-users of the programme. In this way, an understanding of the actual and perceived outcomes of the programme could be realised.

1.5.1 Research-Project Purpose

The purpose of this research-project was for me to lead and then evaluate the effectiveness of a recycling project. In doing so, this understanding can also help other organisations considering introducing such a programme to plan their recycling/sustainable waste management/environmental sustainability initiative. Individuals within the organisation, by sharing their insights, will help provide a better understanding of the benefits, facilitators, and limitations of implementing strategies. In addition, other organisations could learn from understanding recycling practices in a specific healthcare context. Specifically aiming at recycling will raise awareness amongst the organisation’s individual employees. Raising awareness of recycling is thought likely to be an antecedent for and lead to behavioural change, impacting on day-to-day practice (Jones et al., 2012). The wider implications of this study are to influence and change practice for the better within the setting of health. The research-project questions are stated and discussed next.

1.5.2 Research-Project Questions

This recycling project was developed with expected favourable environmental, financial, and social outcomes identified, as indicated in the literature review findings. The primary research project question is:

- What are the outcomes of a recycling project and environmental sustainability programme on practice in a healthcare setting?

Sub research-project questions were developed to identify the specific elements of the study and are as follows:

1. What effects do recycling interventions have on sustainability outcomes in healthcare management?
2. What is the interplay between organisational support for such an intervention, a recycling project, and individual employee behaviours?

The research-project questions were developed to examine and understand the interplay between the three levels of analysis (as presented in **Error! Reference source not found.** below) and the change in behaviour required to sustain the recycling practices. Figure 1.1 provides my interpretation of the relevant layers and themes which were adapted from Langstaff and Brozowski (2017).

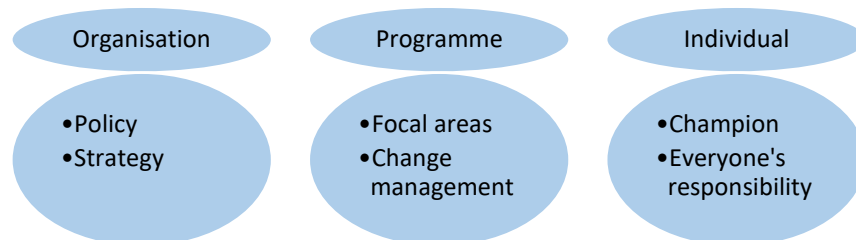


Figure 1.1. Healthcare sustainability and themes.

These themes will now be explained since they guided me to develop the research questions. Langstaff and Brozowski (2017) focus their attention on the strategies and outcomes of an environmental sustainability plan for one hospital. The first theme they described relates to the organisation where programme initiation and support requires a strategic and policy-driven approach. The second theme relates to the programme itself, and there are common areas of attention within sustainability programmes which always incorporate recycling (Langstaff & Brzozowski, 2017; McNeill, Lillywhite & Brown, 2017). By focussing on several key areas such as recycling, energy conservation, and

transportation, the literature suggests large organisations can achieve favourable outcomes by targeting and changing specific behaviour. The final theme refers to the individual employee, from the dedicated sustainability leader to all individuals in the organisation who follow the tenets of the sustainability programme. This is an important level of analysis from an organisational perspective since environmental performance of organisations largely depends on the voluntary participation of employees in sustainability activities. Employee engagement is likely to affect sustainability outcomes which is why it is important to have a high-level of employee engagement (Yuriev et al., 2018).

Therefore, the research focuses on each of these themes since each theme needs to be addressed to achieve sustainability programme success (Langstaff & Brozowski (2017)). A second set of questions was developed to uncover further understanding of the interconnected nature of organisational and individual employee factors:

3. Does organisational support for recycling impact positively on employees' recycling practices?
4. Do healthcare employees reflect more positive attitudes towards environmental sustainability after the intervention of a recycling project?

The research questions emphasise the contribution this study will make to research and practice. The questions frame this project by stating what I expect to find based on what the literature suggests. The questions also create the opportunity to explore the impact of the leadership and change management literature perspectives, which serve as a conceptual basis for this study; described in fuller detail in Chapter 3. The purpose of going into existing thinking, as reflected in the literature, is to gain knowledge and generate ideas from what has already been done. Learning can then take place, taking what is already known from current thinking which provides the supporting evidence for the approach taken to both structure and perform this study.

The following section provides an overview of the thesis structure, as the final part of this chapter.

1.6 Thesis Structure

Chapter 2 details the practical context and wider background of the thesis. This chapter provides an account of climate change, an overview of sustainability and sustainable waste management in healthcare.

Chapter 3 presents the constructs of leadership, with reference to complexity theory and change management and key elements of each are linked together to form the wider theoretical framework for this study.

Chapter 4 describes the CM Health recycling project and sustainability programme. This chapter provides an overview of my role as leader of the environmental programme and draws together the three constructs of sustainability, leadership, and change management (sustainable waste management).

Chapter 5 provides the more specific conceptual basis for the thesis by reviewing and critiquing relevant literature. The thesis integrates literature from disciplines of sustainability, management, and organisations from a healthcare perspective. The chapter reviews literature regarding waste management and recycling, the role of the organisation in managing waste, and sustainability programme development. Reviewed also is the sustainability programme implementation process and employee engagement. These sections thus draw together the roles of leadership and change management as it could apply in such programmes.

Chapter 6 describes the research project design and methodology adopted to address the research project question: a case study employing mixed methods of data collection and analysis. Data were collected before and after programme implementation. Waste data relating to weight, costs, and environmental impact were gathered. A survey tool was employed pre- and post-intervention to capture the perceptions of end-users of the recycling project and the wider environmental sustainability programme, using closed- and open-ended questions. A mix of quantitative and statistical data analysis techniques was required as the captured data sets provided disparate types of information.

Chapter 7 presents the empirical findings from each of the data sets, including the audit data relating to volume and types of waste generated pre- and post-programme intervention. Results of the Polychoric Correlation, Exploratory Factor Analysis (EFA)

and Mixed Model Regression relating to the programme of intervention were analysed along with the responses to open-ended questions.

Chapter 8 discusses the findings and common themes that emerged from the study, to make the case for change in the environmental sustainability management of healthcare services in favour of offering a recycling project and environmental sustainability programme. The study findings are compared with the literature review findings. The findings support the delivery of a recycling project and environmental sustainability programme with a dedicated resource to drive the change required. A discussion of the integrated findings is presented at the end of the chapter.

Chapter 9 concludes the thesis by summarising the main conclusions. Limitations of the research project are presented followed by implications for theory and practice and directions for further research.

Chapter 2 Sustainable Waste Management in Healthcare

2.1 Introduction

There are two overall purposes of this chapter. The first is to develop an understanding of the importance of sustainably managing healthcare waste and the second to show the necessity for this study. There are three parts to this chapter. The first part explains the wider context starting with an account of climate change and carbon footprint measurement. This is followed, in the second part, by a definition of sustainability and a model of sustainability. Covering the environmental impact of healthcare provision brings the sustainability discussion in the third and final part of the chapter to the context of healthcare with a focus on recycling as part of a sustainable waste management programme.

2.2 Climate Change and Healthcare

The effects of a warming planet and subsequent changing climate patterns are already evident, impacting on the economy, physical environment, and lifestyles (Karl & Trenberth, 2003). Human civilisation has flourished at the expense of the natural environment and as a result civilisation faces substantial health effects from the degradation of nature's resources (Whitmee et al. (2015). Countries are now required to rapidly decarbonise, and more so since 187 countries (including NZ) agreed to act on climate change by signing the Paris Agreement (COP 21) in April 2016 (Weimann & Patel, 2017). A comprehensive discussion paper published by the World Health Organisation (WHO, 2009) highlighted the essential role that the health sector needs to play in mitigating effects of climate change by taking steps to limit its own footprint through developing sustainability strategies and plans. The health service in NZ has largely been silent on this matter and has remained unresponsive to the growing concerns expressed by leading authorities on climate change, unlike their international counterparts (Karlner & Guenther, 2011; Malik, Lenzen, McAlister & McGain, 2018; Thiel et al., 2018).

Climate change action involves taking steps to both mitigate and adapt. Adaptation relates to the ability of the healthcare sector to continue delivering services despite the predicted increase in the demand for healthcare services as a result of the changing climate. Adaptation also relates to the state of the infrastructure of healthcare

establishments, for example, hospital buildings in low lying areas which may be at risk of flooding due to rising sea levels or may experience a disruption of essential services (electricity or water) as a result of an increase in storm surges (Malik, et al., 2018). As a result, healthcare facility managers are required to consider the change in climate conditions as these may pose threats to existing infrastructure disrupting service provision.

The NZ Public Health and Disability Act (2000) states that one of the 11 statutory objectives of DHBs is to demonstrate responsibility for the environment in their operations although it makes no specific mention of climate change. This officially stated objective demonstrates the need to further develop sustainability within the setting of healthcare. The NZ Health Strategy (2016) provides overarching strategic direction for the NZ health sector. Unlike international healthcare counterparts who are more commonly adopting lower carbon models of care (Charlesworth & Jamieson, 2017), sustainability has not been included within the remit of NZ statutory obligations (“OraTaiao”, n.d.).

There is however growing concern amongst healthcare professionals in NZ regarding the considerable negative effects on the environment of high-carbon and high-wastage healthcare practices. OraTaiao, the NZ Climate and Health Council, is part of a worldwide movement of growing consciousness comprising health professional authorities that are urgently focussing on the health challenges of climate change (“OraTaiao”, n.d.).

2.3 Carbon Footprint and Healthcare

With climate change high on the political agenda, the term ‘carbon footprint’ has been increasingly debated over the last few years (Godlee, 2012). The term ‘carbon footprint’ originates from the concept of ecological footprint, which is a measure of human demand on the earth’s ecosystems (Wiedmann & Minx, 2007, Malik, et al., 2018). It is a standardised measure of demand for natural capital that can be contrasted with the planet’s ecological capacity to regenerate.

There are growing efforts internationally to measure and mitigate healthcare environmental emissions, with special emphasis on carbon footprints. In 2009, the UK Sustainable Development Unit first reported National Health Service (NHS) GHG

emissions and now publishes updates every two to three years. By instituting a national-level measurement and reporting structure, NHS England has been able to demonstrate an 11 percent reduction in GHG emissions from health care activities between 2007 and 2015 despite increased utilization of health services during this time. (National Health Service Sustainable Development Unit, 2016).

An organisational carbon footprint refers to the direct and indirect carbon dioxide (CO₂) emissions generated within the range defined by the organisation's enterprises or projects (Gao, Liu & Wang, 2014). The results of CO₂ assessments tend to focus on an inventory of carbon emissions. Sources and information of GHG emissions are reported as a complete carbon inventory report and can serve two purposes. First, the inventory allows calculation of the footprint. Second, this information can be made public, reinforcing the organisation's values regarding transparency and credibility.

To standardise and make the results of carbon emissions accounting comparable, governments and international organisations such as the ISO, the World Resources Institute (WRI), the World Business Council for Sustainable Development (WBCSD) and the British Standards Institution (BSI) have introduced different kinds of carbon footprint assessment standards, mainly for organisations and products. These have been developed through many research studies carried out since the end of the last century (Gao et al., 2014).

Carbon footprinting allows organisations to measure and report on the outcomes of sustainability interventions (Malik, Lenzen, McAlister and McGain, 2018). By reporting on sustainability interventions and sharing the results with healthcare employees, individuals can make more informed decisions about several work-related pro-environmental behaviours (Charlesworth & Jamieson, 2017; Godlee, 2012; McNamara, 2010). Carbon footprints can be harnessed as strong tools for organisations to capture their progress in emissions reduction, for which benchmarking, and target setting is also useful (Malik et al., 2018; Murray et al., 2008). Footprinting methodological choices regarding planning and target setting require careful consideration, considering factors such as the size of the organisation and the nature and type of emissions generated (Pandey & Agrawal, 2011; Paulraj, 2011; Wiedmann & Minx, 2007).

Persistent human activities like driving cars, farming, burning coal, and cutting forestry produce GHGs. The main GHGs are CO₂, methane, and nitrous oxide ("The Guardian"

n.d.). Any organisation that adheres to the ISO 14064 assessment standard must capture details of the six main GHGs as designated by the Kyoto Protocol: CO₂, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride (Weidmann & Minx, 2007). Carbon dioxide is usually measured using CO₂e (carbon dioxide equivalent), a standard unit for measuring carbon footprints. The idea of the CO₂e measure is to express the impact of each different greenhouse gas in terms of the amount of CO₂ that would create the same amount of warming (Weidmann & Minx, 2007). The size of a carbon footprint corresponds to several organisational features, such as size, business type, geographical location, and the number of suppliers and deliveries. Given that the demand for healthcare continues to rise as funds for public services become more constrained, the next section presents further details about sustainability presented as a possible solution to address the environmental and financial burden of healthcare services.

2.4 Sustainability: A Growing Consciousness

Sustainability is a concept that originated in the early 1950s as attention shifted from an introspective view to a global consciousness and awareness of the need for improved stewardship of environmental resources and global ecology (McMillan, 2014). Environmentalism grew in the developed world following the Great Depression and World War II, coupled with the innovations in technology that were transforming society. Greater awareness of the increasing and unsustainable levels of consumption led to questioning the long-term ramifications of such behaviour (Friend, 2009). The term ‘sustainability’ suggests a need to live within set limits, preserving resources to meet the needs of future generations whilst acknowledging the interconnectedness between the economy, society, and the environment (Hopwood, Mellor & O’Brien, 2005).

The United Nations General Assembly established the Bruntland Commission in 1984. This was a global initiative, setting out to unite countries around the principles of sustainability as a means of addressing the global issues faced by civilisation. Principles of sustainability involve simultaneously addressing a range of environmental issues. These include conserving ecological services, reducing the levels of waste and pollution, and limiting consumption whilst investing in renewable resources since non-renewable resources are finite in supply. In 1987, the Bruntland Commission published the Bruntland Report (Goodman & East, 2014) that recognised that human resource

development in the form of poverty reduction, gender equity, and wealth redistribution was crucial to formulating strategies for environmental conservation. The report thereby linked in the social and health outcomes associated with the adoption of the principles of healthcare sustainable practice.

An insightful paper by Sustainable Aotearoa NZ Inc. (SANZ, 2009) compared two main sustainability definitions. The ‘Three Pillar’ framework otherwise referred to as the triple bottom line model underpins the discourse in the sustainability literature and asserts the requirement for a balance between environmental, economic, and social outcomes. The possibility of sustainability is represented by only a small intersection of the three circles, therefore being further defined as weak (see Figure 2.1 for my interpretation of the model described in SANZ (2009)).

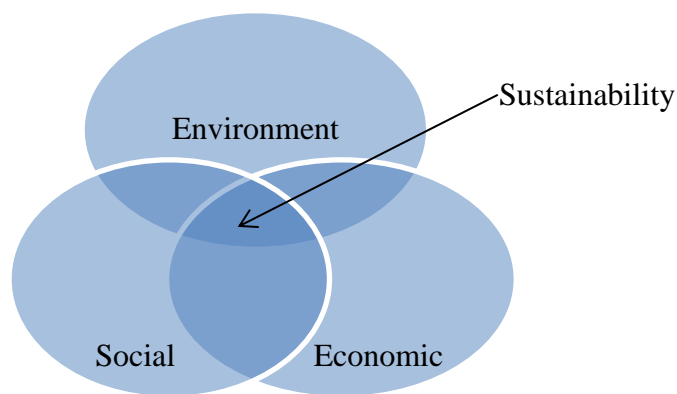


Figure 2.1. Weak Sustainability: Intersection between environmental, social and economic outcomes.

By comparison, and more favourably, strong sustainability shows that all life is contained within the biosphere or environment. Figure 2.2 represents my interpretation of the model presented in the SANZ (2009) paper.

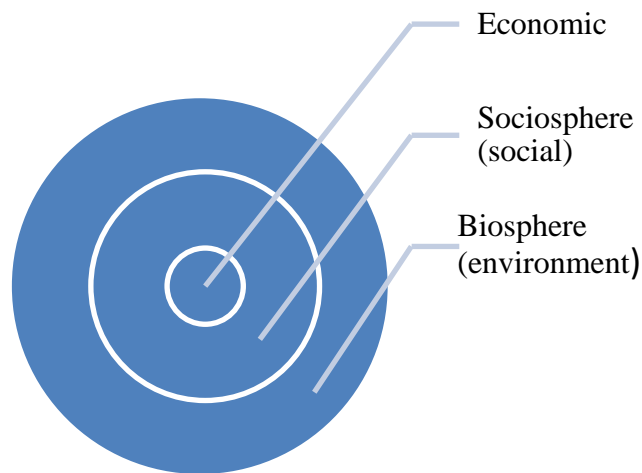


Figure 2.2. Strong Sustainability: all human activities contained within the environmental domain.

The sociosphere is next contained within the outer circle representing all human actions, or society at large. The economy is contained within the sociosphere, in the innermost circle, as a subset of human actions. Strong sustainability means the preservation of all ecosystems, where ethics, values, and world views directly support the concept because people know that they are integral to the biosphere. Therefore, people desire the integrity of all systems, linking to the attribute of social consciousness. To add further understanding to the concept of sustainability for this study a core model is presented next.

2.4.1 Model of Sustainability

The model described by McMillan (2014), presented in Table 2.1 suggests that sustainability has five attributes, as set out in Table 2.1. This model was chosen as a basis for this study because McMillan's account of sustainability described the different views of the term held by the disciplines of nursing and management. Nursing tends to view sustainability as an outcome, while the management discipline sees it more as a process. Viewing sustainability holistically, as presented in the model, as both a process and an outcome, facilitates critical discourse. By integrating both a management and health perspective on sustainability, the dynamics of working within an organisational context as well as the broader health sector highlights a more holistic commitment to health outcomes. Arguably, this enables a more collaborative and integrated approach to sustainable healthcare delivery.

The model provided insight into the development of the conceptual basis for this study and informed the research-project question. Further, attributes of this model indicate a suitable approach that could be taken by CM Health to deliver the CM Health environmental sustainability programme, for which fuller details are provided in section 4.1.

Table 2.1. Attributes of sustainability (Source: McMillan, 2014).

Change	Organisational change must occur prior to the creation of a sustainability initiative
Process	Staged implementation of sustainability interventions is required to prepare people for change
Outcome measure	Sustainability is described as an outcome of change initiatives
Stakeholder engagement	Achieving sustainability is dependent upon the strength of the relationships between stakeholders
Ethical-social consciousness	Sustainability is a social consciousness where organisations have an ethical responsibility to practice sustainably

In relation to the healthcare setting, the first of these attributes explains that sustainability, as a concept, depends upon the process of change. A context of change from unsustainable to sustainable practices must occur prior to the creation of sustainability. This involves a relative change in levels of sustainability (more/less) as a measure. Initiating a sustainability programme according to this model includes effecting pro-environmental behavioural change, from being less sustainable to becoming more sustainable. A simple example of pro-environmental recycling shows the importance of changing behaviour. One of the objectives of engaging in sustainability education through an awareness-raising programme might involve providing information on the impact of purchasing decisions. Influencing a person to select goods manufactured with materials that are readily recycled would enable more fruitful recycling activities. To inform behaviour change for this study, change management theories and frameworks based on Lewin's (1952) theory of change were explored within the sustainability literature (Buchanan & Fitzgerald, 2007b).

The second attribute of sustainability is referred to by McMillan as a process. Timing is of great significance to the process of sustainability in favour of exhibiting pro-

environmental behaviour, as enough time is required to prepare all stakeholders for a change in behaviour to occur. A staged implementation of sustainability initiatives is required, as is the need for a deliberate implementation process during all phases of transition, to maintain sustainability efforts. External and internal contexts of sustainability describe the ways in which both contexts work together to foster sustainable change, or it can decay. External contexts of sustainability refer to a wide range of influences including organisational, cultural (organisational and societal), political, and financial influences. These influences are especially pertinent for healthcare organisations that rely on central government funding models because healthcare organisations are empowered or restricted by political preferences and financial allocation (Carlson et al., 2010). Internal contexts include the individual, managerial staff and leadership initiatives within organisations. Additionally, within the health setting there are many competing programmes. As such, programmes that meet overt clinical issues are more often prioritised leaving other programmes on the margins (Wahlqvist, 2005) resulting in poor engagement in sustainability initiatives.

Third, sustainability is also an outcome measure, often referred to as programme evaluation. The ideal outcome of sustainability change initiatives is measured by achieving specific targets of the sustainability programme that can produce long-term benefits. Reporting on sustainability interventions also help communicate programme progress and resultant outcomes, thereby enabling employees to make informed choices about the products they use and whether the waste materials generated can be recycled or repurposed (Godlee, 2012; McNamara, 2010). Further, collecting data on sustainability outcomes adds to the growing body of evidence seeking to quantify the full range of achievable benefits. In doing so, healthcare organisations that are less inclined to participate in sustainability activities may be persuaded by the potential benefits to consider such activities.

Achieving sustainability outcome targets requires careful planning and consideration because of the risk of such a programme being set aside in favour of those addressing clinical issues or other priorities, as mentioned above. Targets serve as benchmarks, and benchmarking allows comparisons to be made between organisations (Kaplan et al., 2012; Murray et al., 2008). Competitive effects arise from organisations that develop environmental strategies, including greater efficiency and innovation with a positive correlation between environmental and financial performance (Kassinis & Soteriou, 2003). Smaller healthcare organisations are sometimes overlooked regarding measuring

the success of sustainability interventions. A need to include data from smaller healthcare organisations has been identified since many studies focus their attention on large in-patient hospital settings (Murray et al., 2008; Nichols et al., 2009; Wiesner et al., 2018). This point is relevant to this study because the recycling project was delivered across two sites, one of which is a considerably smaller outpatient setting.

A fourth attribute identifies sustainability as being highly dependent on the strengths of relationships between stakeholders, and their level of engagement in integrating social demands. Without high-level engagement and stakeholder collaboration, sustainability is threatened. Healthcare workers may become more engaged with sustainability programmes as they are directed towards protecting health and not just the environment. Direct threats to health are powerful motivators for action, and often more powerful than discussions about environmental threats.

A fifth attribute of sustainability described by McMillan (2014) refers to an ethical-social consciousness and suggests that sustainability also refers to a form of social consciousness. Fiscal and social responsibility raises questions over ownership and management of fiscal resources and whether resources are being used in a responsible and ethical way.

Sustainability is therefore regarded as a process, a desirable outcome which requires setting targets for a change process to occur, and an approach which requires stakeholder engagement. Sustainability cannot be done to someone – rather, for sustainability programmes to be successful, sustainability behaviours must be performed and coordinated by many. There is also an ethical responsibility for healthcare organisations to become more sustainable to limit the magnitude of anthropogenic climate change: that is climate change directly related to human actions (refer to the Glossary of Terms, Appendix A).

2.4.2 Healthcare Sustainability

Healthcare organisations are well situated to follow the path towards a more sustainably-oriented practice, as outlined above. A healthcare organisation that is oriented toward sustainability can be said to be a ‘green’ healthcare organisation (Bauermeister & Diefenbacher, 2015). The term ‘green’ is only used in this study to frame the survey administered to CM Health employees and is not used elsewhere within this thesis. The

decision was made to use this term in the survey alone as ‘green’ is widely accepted as a term that represents environmentally oriented activities. For academic pursuits, however, terms that are less specific and that can be interpreted in many ways have been avoided.

An organisation may decide whether to implement small sustainability changes or integrate sustainability into operations and strategy for making a positive social change, saving money, and reducing environmental impact (Swift, 2011). There is widespread evidence that healthcare managers and leaders are struggling to adapt to environmental challenges in the healthcare industry (Connor & Mortimer, 2010; Ebreo et al., 2001). This is because historically the primary aim of healthcare systems was to provide care with little regard for the number of resources required or to the outcome of highly consumptive and often wasteful practices (Tudor, Marsh, Butler, Van Horn & Jenkin, 2008).

Sustainability practices demonstrated by hospitals in the United States of America were summarised by Johnson (2010) who found limited documentation of the sustainability movement. Almost a decade ago Johnson discovered that despite the reported financial and environmental benefits of becoming more sustainable, healthcare organisations were not quite ready to make the changes required.

Sustainability has since been increasingly discussed in the healthcare literature; however, several authors have identified the lack of a clear conceptual understanding of what sustainability means (McMillan, 2014; Lennox et al., 2018). Sustainability is not just a concern for those who work in public health as it requires systemic political, social, economic, organisational, and personal change to address the health of individuals and populations at large (Goodman & East, 2014). Sustainable waste management projects are a significant component of healthcare sustainability programmes because of the environmental and financial implications of healthcare waste management, to be discussed next.

2.4.2.1 *Healthcare Sustainable Waste Management*

Sustainability programmes within the healthcare setting include recycling activities. Financial outcomes have most frequently dominated the more traditional approaches to measuring outcomes described in the previous section (2.4.1), with these measures representing ‘business as usual’. Applying the sustainability lens encourages the incorporation and inclusion of environmental outcomes in terms of reducing waste to

landfill weight and minimising the environmental impact of waste management activities.

Healthcare waste can incorporate many sub-sets, as noted by Thakur and Ramesh (2015) it is, therefore, beneficial for healthcare employees to possess knowledge about the nature of healthcare waste and the impact their waste management behaviour has on waste weights and costs as knowledge fosters the desired behaviour change. As a means of educating healthcare employees, the waste hierarchy in Figure 2.3 is useful as it describes levels of waste management, ranging from the least preferred options at the apex of the pyramidal diagram to the most preferred/effective methods for minimising waste, with recycling at the centre, highlighted in green (Radwan, Jones & Minoli, 2012).

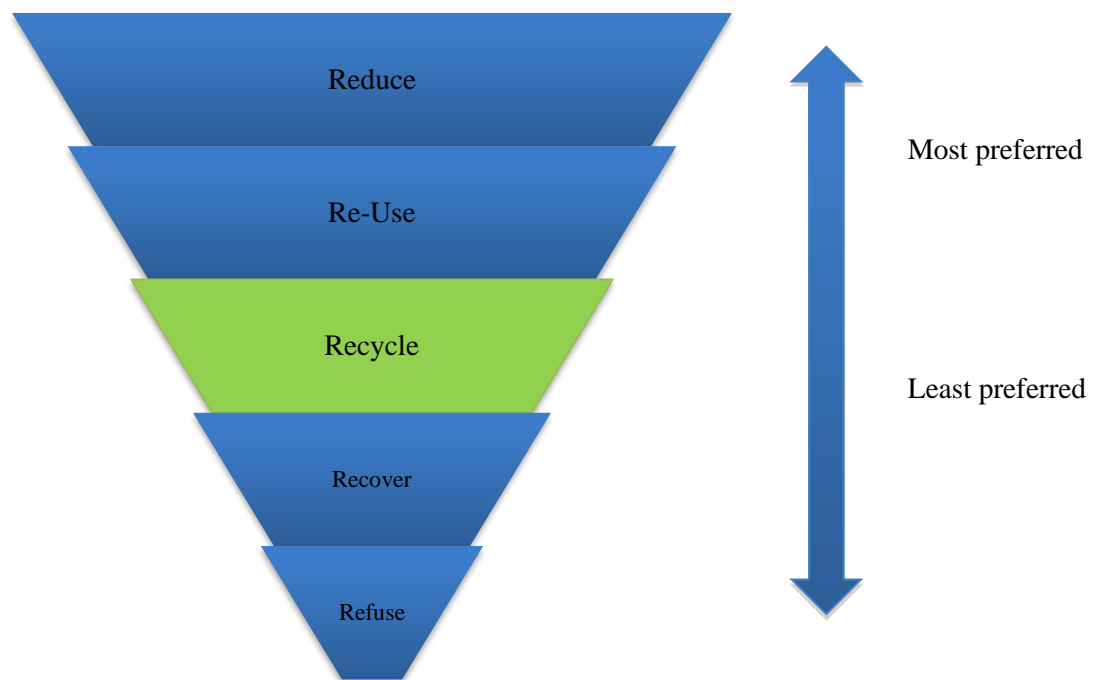


Figure 2.3. Model: Waste Management Hierarchy (adapted from EPA NSW, n.d.).

The waste management hierarchy is conceptually useful to organisations when developing a sustainable waste management strategy and evidence suggests the need to focus on the waste hierarchy, where practices can be adapted to contextual and situation factors influencing subsequent actions. Economic and social factors influence behavioural intentions, as do legislative pressures. Radwan et al. (2010) emphasised the importance of gaining the cooperation of employees. For organisations that generate substantial waste, staff training provides a means of disseminating knowledge and sharing the main aims of the waste management strategy.

By safely and lawfully reducing waste to landfill, the costs associated with its disposal could be significantly reduced, thereby releasing funds that could be diverted to direct patient care. There is a recognised need to reduce waste to landfill generated by healthcare services leading to cost savings and reduced carbon footprints (McMichael et al., 2008; Tomson, 2015). A full account of related NZ legislation is provided in Appendix B.

Before developing a waste management plan, a general knowledge of the waste composition and waste weights is required. This information is typically obtained by conducting waste audits or characterisation studies (Evans et al., 2012). By evaluating the components of each waste stream, a clear understanding of the effectiveness of current systems is gleaned, identifying areas for improvement.

For any large organisation the cost of solid waste management includes various factors related to the disposal and transportation of waste along with associated labour costs (Pirani & Arafat, 2014). More efficient waste management can lead to significant savings depending on the location of the organisation and the waste management regulations in that area. Benefits of sustainable waste management have been listed by Pirani and Arafat (2014) and include gaining an improved business image and reducing the carbon footprint. Carbon footprints are lower under effective waste management for two reasons: less waste results in reduced transport-related emissions; and diverting waste away from landfill decreases the amount of methane produced.

2.5 Summary

The first part of this chapter explained the wider context starting with an account of climate change and carbon footprint measurement. This was important as it is essential to connect all components of a sustainability programme to the wider environmental impact. Covering the environmental impact of healthcare provision then brought the sustainability discussion down to focus on recycling as an essential part of a sustainable waste management programme. Recycling was described within the Waste Management Hierarchy (see Figure 2.3) which is a useful education tool as it serves as a reminder that recycling is one of a few important waste management behaviours.

If it is accepted that organisations have an obligation towards meeting the challenge of sustainable waste management then clearly the organisation needs to demonstrate leadership and initiate change (Weaver, Blaski, Capon & McMichael, 2010). The next

chapter presents a discussion of leadership and change management including an overview of organisational change management theories and associated psychological theories.

Chapter 3 Leadership and Change Management in Healthcare

This chapter presents a discussion of leadership and change management revealing how the literature relating to these concepts provides insights for the development of a sustainability programme. For organisational change to take root in the activities of organisations, effective leadership is necessary. The chapter concludes with a summary which brings the three constructs of sustainability, change management and leadership together as a basis for the next chapter of the thesis which frames the study. The purpose of this chapter is to present insights drawn from the literature to frame this study. The next section brings the discussion to consideration of leadership and leadership styles.

3.1 Leadership and Healthcare

Leadership is defined by Northouse (2004) as a process by which an individual influences a group of individuals to achieve common goals. From Lewin's (1952) change management model, leadership plays a central role in facilitating organisational change. Acting as change agents, leaders 'unfreeze' the organisation and are instrumental in the implementation and 'refreezing' process. Cummings and Worley (2003) presented five crucial leadership activities involved in the change process. These activities are: motivating change (unfreezing), creating a vision, developing political support, managing the transition (implementing the change), and sustaining momentum (refreezing). The next section presents a discussion of leadership theories explaining why the theories reviewed are so relevant to the healthcare setting. I will then voice the insights I took with me from this literature into the research project of leading change.

3.1.1 Leadership Theory

There is a large amount of literature on definitions and theories of leadership and a number of these theories have attempted to identify the underpinnings of leadership success (Kumar & Khiljee, 2016). Early theories, such as the great man theory and trait theory, focused specifically on innate qualities that leaders were deemed to be born with. Within the next phase of leadership theory development, behavioural, situational, and contingency theories all demonstrated a shift in focus more toward what leaders do. More recent theories, including transactional and transformational theory and leader-member

exchange (LMX) theory, place more emphasis on the relationship between the leader and their followers (Kumar & Khiljee, 2016). Transformational leadership styles share a common feature with complexity leadership theory since both emphasise the connection between leaders and their followers. Complexity leadership theory however was chosen over any of the other leadership theories as the theoretical lens for this study because healthcare organisations can be conceptualised as complex adaptive systems. Complexity leadership theory conceptualizes leadership as a continuous process that stems from collaboration, complex systems thinking, and innovation.

The health system is turbulent which requires research designs and methods that foreground dynamic interactions and emergence to generate meaningful findings. As presented by Greenhalgh and Papoutsi (2018) researchers might benefit more from engaging pragmatically with the multiple uncertainties involved and offer a flexible and emergent approach to studying complex systems. There are blurred boundaries in complex systems; their interacting agents operate because of internal rules that cannot always be predicted; and they adapt, interact and co-evolve with other systems (Greenhalgh & Papoutsi, 2018). Leadership frameworks should shift from a predominantly human capital focus, such as the bias toward competency-based models, to a social capital emphasis, focusing on facilitating the movement of ideas across a system through collaborating. This kind of leadership is described in emerging work on complexity leadership theory (Uhl-Bien & Marion, 2009).

3.1.1.1 *Complexity Leadership Theory*

When looked at through the prism of complexity, the role of leadership moves away from providing answers or providing too much direction (for example, initiating structure) to creating the conditions in which followers' behaviours can produce structure and innovation (Hanson & Ford, 2010; Horvat & Filipovic, 2017).

Furthermore, when leaders promote the importance of followership this also ties in with the concept of collective leadership for healthcare. With collective leadership everybody takes responsibility for ensuring the success of an organisation, in contrast to placing the emphasis on a core group of leaders. Such an approach in healthcare is potentially more likely to yield an environment where problems can be solved and pro-environmental behaviours promoted (Hanson & Ford, 2010). With collective leadership, existing ways of tackling service level issues can be adopted such as was the case in this project.

Tackling the environmental project work as a quality project allows interested parties to work on different recycling projects. Members of the quality group can then oversee the development and evaluation of those projects. This is a form of collective leadership that already exists within the healthcare setting. If this approach is replicated across all clinical areas and services, the likelihood of achieving broader outcomes is increased. This approach was recognised as being of value by De Brun, Rogers, O'Shea and McAuliffe (2020) in their healthcare team evaluation protocol. De Brun et al. (2020) demonstrate there is accumulating evidence for the value of collective approaches to leadership, however there is a lack of understanding of the mechanisms that promote or inhibit the practice of collective leadership in healthcare teams. I saw this as a springboard to build an understanding of these mechanisms with project contributing to the development of this theory.

Complexity leadership theory proposes that adaptability occurs in the everyday interactions of individuals acting in response to pressures and opportunities in their local contexts, which enhances performance and innovation (Uhl-Bien & Marion, 2007). The central question addressed by complexity leadership theory is: How, in the context of bureaucratic organizing structures, can leaders enable the emergence of solutions and innovation needed to survive and thrive in today's complex world? Complexity leadership theory challenges us to reframe our human capital centric approach and embrace new practices that recognize and enable the value of social capital.

Complexity leadership theory provides an overarching framework that describes administrative leadership, adaptive leadership and enabling leadership; it provides for 'entanglement' among the three leadership roles and the organisation (Uhl-Bien & Marion, 2007). Administrative leadership refers to the actions of individuals in formal managerial roles who plan and coordinate organizational activities. Administrative leaders structure tasks, engage in planning, build vision, acquire resources to achieve goals and manage organisational strategy. Adaptive leadership is an emergent, interactive dynamic that produces adaptive outcomes in a social system. It is a collaborative change movement that emerges nonlinearly from interactive exchanges. Adaptive leadership is defined as emergent change behaviours under conditions of interaction, interdependence, asymmetrical information, complex network dynamics, and tension. Complexity leadership theory proposes that adaptability, which enhances performance and innovation, occurs in the everyday interactions of individuals acting in response to pressures and opportunities in their local contexts (Uhl-Bien & Marion, 2009).

The role of enabling leadership in the complexity leadership theory framework is to directly foster and manoeuvre the conditions and this form of leadership can be found anywhere across the levels of the organisation. A key role of enabling leadership is to effectively manage the entanglement between administrative and adaptive structures and behaviours in a manner that enhances the overall flexibility and effectiveness of the organization (Uhl-Bien & Marion, 2007).

Allowing teams within their services to work on environmental projects using their existing team structures helps innovation to flourish. These local actions then link up with one another to produce powerful emergent phenomena. Encouraging innovation and proactivity aids troubleshooting and helps foster positive behaviour where teams can find remedies for local issues, thereby deterring breakdown of the necessary pro-environmental behaviours. But the problem is that in many large and complex organisations these linkages are hard to make because organisational bureaucracy and silos can create obstacles to interconnectivity, hence the need to connect teams to one another and allow them to learn from each other.

The concept of leadership and a culture of leadership can be linked to the idea of a learning organisation, one which is open to change. Change is facilitated by empowering employees, encouraging collaboration, and by sharing information, thus creating opportunities for learning and promoting leadership development. Evidence from the literature suggests that health organisations improve their operational effectiveness and respond more efficiently to change when they function as learning organisations (Franco & Almeida, 2011).

These are insights I took from my understanding of complexity leadership theory. I believed by adopting a collaborative approach, one which fosters collective leadership, the outcomes of this project would be more favourable as a result. Clinicians, at least, are professionals who are well situated to this style of leadership. This is important to state because the literature is often broad and undifferentiating regarding the type of followers – this approach may not work at all well in a situation where predominantly unskilled staff rely on a directorial leadership style. For this reason, complexity leadership theory is especially suitable as a chosen lens for the study.

The challenge, however, for complexity leadership theory is that the level of analysis is different to other leadership thinking. One of the core propositions of complexity

leadership theory is that “much of leadership thinking has failed to recognize that leadership is not merely the influential act of an individual or individuals but rather is embedded in a complex interplay of numerous interacting forces” (Uhl-Bien et al. 2007). Arguably this level of complexity makes the study of this form of leadership particularly difficult, and poses challenges for the individual seeking to apply this thinking to their own leadership practice. To overcome this, the theory of collective leadership helped to frame this project at the service and individual group level whereas complexity leadership theory provided the broader frame from which to develop the programme. Collective leadership focuses on relational activities and offers a perspective of how to engage with complexity in practice. Complexity leadership theory provides a system-level critical theory lens where organisations are enabled to respond adaptively to challenges through network-based problem solving.

3.1.1.2 *Sustainability Leadership Theory*

Sustainability in a healthcare context involves not only environmental practices but also policy efforts to involve all members of the work community, develop organisational capacity, and encourage widespread adoption (Wang, Van & Lebrede, 2014). Sustainability leadership is the promotion of an array of practices, over time, by a broad range of actors including the leader of the programme, the employees, and others, to achieve the type of social change required. It is a shared responsibility, that does not unduly deplete human or financial resources, and that cares for and avoids exerting negative damage on the sector and environment. Sustainable leadership involves an activist engagement with the forces that affect it and builds an environment of organisational diversity that promotes cross-fertilization of good ideas and successful practices in communities of shared learning and development (Hargreaves & Fink, 2003).

Leadership across all levels is a powerful enabler when present. When considered through the lens of sustainability leadership, barriers that impede the success of achieving sustainability outcomes were described by Yuriev et al., (2018). Obstacles were largely associated with a lack of sustainability corporate culture and a lack of management commitment and support, making it more difficult for employees to perform sustainability behaviours. An engaged leadership team agrees to initiate and adopt a range of sustainability initiatives. Engaged leaders also allow for the provision of a person to undertake a dedicated environmental role (Langstaff, 2017). Leadership

support is crucial and sustainability initiatives may stagnate if not championed by a dedicated role.

There are advantages of having a dedicated sustainability officer appointed to lead this process. A fulltime sustainability officer can provide first-hand experience of hospital operations and is able to drive sustainability programmes from inside the organisation (Langstaff, 2017). This is the role I have been appointed to undertake, as reported on in this thesis. Of note, to my knowledge, there is a paucity of literature on the role of sustainability officers within the healthcare sector. As a result, literature from other sectors has not been included in this study because the healthcare sector is unique. Arguably, while there are similarities across sectors, no other sustainability officer working in other sectors must consider pressing clinical priorities, work within fierce economic constraints on healthcare provision, meet growing societal expectations of healthcare delivery whilst enabling lower carbon operations. In addition, and importantly, the sustainability officer in healthcare must carry out these functions whilst allaying extreme health and safety fears and complying with rigorous regulations.

Understanding the link between the type, style, and characteristics of leadership and the way in which to implement the sustainability role meant that I could design a project that was fit for purpose and would achieve the desired outcomes. I could also drive the project from within, remaining connected to the employees whilst at the same time being able to report up to the senior management team.

Depending on the nature and scale of organisational change, larger-scale change initiatives that tackle the system's level may need to be planned with actions taken to motivate employees. Theories of change describe and provide bases for testing the effectiveness of approaches by which organisations can modify their strategies, processes, and structures. From the change management literature, I uncovered insights that I used to frame the design and management approach for this project, as discussed next.

3.1.2 Change Management Theory

Change is crucial (and inevitable) for organisations in non-healthcare and healthcare environments alike (Hussain, Lei, Akram, Haider, Hussain & Ali, 2018). Organisational change explains the movement of an organisation from a known (current) state to an

unknown (desired future) state. From a review of theories and approaches to organisational change and change management Todnem (2005) and Hussain et al., (2018) argued that few frameworks explain how to implement and manage all types of organisational change. As a result, there is a high failure rate when implementing change programmes, especially so within the setting of healthcare (Hussain et al., 2018). In a broad sense, failed change efforts can destroy morale, waste resources, and increase staff turnover.

Change can be categorised in three ways: by the rate of occurrence; by how it comes about; and by scale (Senior, 2012). Earlier approaches and theories suggested that change should not be constant, as people need stable routines in order to be both productive and effective. Lewin (1952, cited in Todnem 2005) initiated 'the planned approach' to change and proposed that before any change and new behaviour can be successfully adopted, the previous behaviour must be discarded. This involves three steps: unfreezing the present; moving to; and then refreezing the new behaviour. This approach may be more effective for planned small-scale changes but for transformational and rapid changes it has been criticised for being too broad. This change model also assumes that organisations operate under constant conditions and that they can move in a planned manner from one state to another (Bamford & Forrester, 2003). Yet, the simplicity of this model appeals (Hussain et al., 2018) and when applied with a collaborative leadership style, individuals are arguably less resistant to change.

Favouring Lewin's Model over other models, such as Kotter's Model of Change which is commonly cited in healthcare literature, was due to the simplicity of Lewin's Model. Having fewer steps meant that conceptualising and managing many cycles of change which were being implemented concurrently across several different clinical areas in this way obviated the risk of privileging planning over implementation, thus helping to keep the focus on critical tasks in the process. I was able to respond and adapt and was less bound to a comparatively rigid and more detailed change management process. This is somewhat in tension with my earlier assertion of selecting the complexity leadership approach - an approach which is usually considered more emergent and negotiated, and less planned and structured than the clearly-delineated Lewin Model (noted here as being a planned approach). Planning is still required when it comes to managing change in a complex setting. Planning does not necessarily stifle innovation and adaptability; rather, effective planning when undertaken in a collaborative way gives rise to innovation and the emergence of new ideas.

To my knowledge, a collaborative leadership approach has not been combined with the ‘planned approach’ to sustainability change management programmes in the setting of healthcare. My adoption of this approach in designing and implementing my project provides an original contribution to these literatures.

The concept of social change further complicates the issue of sustainability since there is no clear understanding of the point at which the establishment becomes responsible for changing the ‘world’ and how social change is affected. McNamara (2010) found that becoming sustainable called for engagement with as many of the individuals as will be impacted by the change. A top-down initiative would not successfully manage social change as social learning is required. This type of learning is characterised by the mutual development and implementation of solutions, adopting a more collaborative approach to management, or a bottom-up initiative. This view aligns well with the notion of collective leadership and complexity leadership theory, thereby providing me with further support and guidance as to how to tackle this project.

More studies of the nature of change and how it is managed (Todnem, 2005) would help to identify critical success factors for more effective change management. In this regard, Millar, Hind and Magala (2012) identified a need to undertake more research into sustainability from an organisational perspective. Hussain et al. (2018) note several organisational change models in extant literature (Burke (2008); McNamara (2010), Wilkins & Dyer (1988)) that may be relevant to the implementation of sustainability initiatives. Hussain et al. (2018) noted however that many organisations tend to focus on reducing environmentally degrading behaviour rather than on encouraging the uptake of more pro-environmental behaviours. This suggests they are treating the symptoms rather than addressing the root causes.

Furthermore, general change models, while having broad applicability across sectors, may not be a close fit in the healthcare sector for several reasons. First, intentional change processes when applied to complex organisations such as hospitals may struggle due to the presence of multiple power and authority structures, as well as a unique collegiality culture with entrenched bureaucratic political systems and values. Second, whilst there are similarities among other large organisation such as tertiary institutions or other government-related institutions, the healthcare sector is in a uniquely favourable position to influence the norms of communities by adopting model policies and practices that promote environmental sustainability in the workplace. Given their unique position in

the healthcare system, the medical workforce can become stronger advocates for health, wellbeing, and the environment, hence revealing the impact of managing and sustaining pro-environmental changes.

Third, the idea of sustainability may be rejected by some members of the healthcare workforce because of fundamental differences between professions or for hierarchical reasons such as those reported between doctors, nurses and healthcare support workers (Topf, 2005). This may not be solely a feature of hospital hierarchies and culture as this situation can readily be identified in other bureaucratic/political organisational contexts, but either way, it is dysfunctional.

Finally, various psychological processes may also present potential barriers to the creation of sustainable practice (Topf, 2005; Harris et al. 2009). These range from denial and groupthink, to diffusion of responsibilities. While such processes also are not limited to healthcare organisations, these and factors such as ignorance among healthcare employees can be an obstacle to becoming sustainable because individuals may lack basic knowledge about sustainability and related issues, such as overconsumption of resources (Topf, 2005; McGain et al., 2012). Delivering sustainability education as a means of overcoming this barrier was described as a worthwhile approach by Topf (2005) who reviewed the literature on the role of the professional nurse. The nurse as a leader is especially well-placed to create environmentally friendly and holistic clinical practice and is ideally situated to educate fellow colleagues about sustainability. Change management and leadership theories do, nevertheless, offer practical solutions for dealing with such barriers.

Change management theory was important in guiding me from a foundation of knowledge on which to develop the research project. My approach to changing the behaviour of the workforce targeted the service and organisational level as much as behavioural and conceptual elements at the individual employee level. I saw my role as a sustainability change agent was to educate and thereby help staff participating in the project to collectively develop their own insights and clarity through identifying, resolving, and preventing sustainability problems. By adopting a complexity leadership approach and engaging them through collective leadership these employees were better placed to tackle the root causes of the sustainability problem as opposed to targeting the symptoms.

Linking together complexity leadership and change management theory affirmed the benefits of adopting a collaborative approach. This is important because I wanted to make the transition to sustainability which requires simultaneously changing the way the organisation interacts and affects its operations whilst changing the organisational culture. This means that the change is not dependent on one individual or group: there is a free-flowing of information in all directions where accountability is created by making the workplace environment conducive to learning and growth needed for developing pro-environmental behaviours. Given the potential impact of attitudes and norms on organisational behaviour, the next section provides an overview of relevant psychological theories.

3.1.2.1 *Associated Psychological Theories*

Social psychological theory suggests that attitudes, as well as subjective and descriptive norms, are important influences on behaviour (Rivis & Sheeran, 2003). An attitude reflects a person's positive or negative evaluation of a situation or object. In the context of sustainable waste management behaviours more positive attitudes to recycling should be associated with greater engagement with these actions (Evans, Russell, Fielding & Hill, 2012). Similarly, subjective norms, defined as perceived social pressure to engage in certain behaviours, can result in greater intentions to perform those behaviours.

Rivis and Sheeran (2003) performed a meta-analysis and found that descriptive norms are also predictive of behavioural intentions. Descriptive norms refer to an individual's perception of what other people 'typically' do. This is an important point because descriptive norms are said to motivate action by informing people about what is effective or adaptive and provide a decisional shortcut when an individual is choosing how to behave in a situation. However, descriptive norms are more likely to exert influence only in the specific context in which the behaviour occurs. The impact of social influence in the attitude-behaviour relationship helped me conceptualise my approach to this project, by indicating the need to measure changing attitudes to the recycling project and environmental programme as well as behaviours (self-reported and organisation-wide waste data results).

A review of two main types of social cognitive theories was undertaken by Perkins, et al. (2007) to understand clinicians' behaviour. These two theories were the theory of reasoned action (TRA) and the theory of planned behaviour (TPB) regarded by the authors as the most important for predicting behaviour. These perspectives were useful

in the context of the present study as they were found by Perkins et al. to be capable of predicting a moderate to a large amount of variance in intention and behaviour.

Godin et al. (2008) undertook a systematic review of studies based on social cognitive theories, from which they identified variables that could predict intention and behaviour focussing on environmental behaviours. Their study found that significant determinants of intention included beliefs about consequences, social influences, moral norms, role and identity, and characteristics of the healthcare professional. These determinants, as well as habit and past behaviour together with beliefs about capabilities, also influenced intention, all of which lead to behavioural change. Godin et al. argued that studies that explore the relationship between context-specific attitudes and behaviour are required – a call to which this project has responded.

Organisational culture impacts on employee perceptions in two ways. According to this literature an organisation that becomes more sustainable should see a move towards a more empowered and employee-centred culture. Moreover, a culture that is supportive of sustainability should lead to better outcomes for sustainable waste management and environmental impact which is why waste and carbon footprint outcomes were included in this study. The literature further suggests that tackling waste as part of a sustainability programme leads to employees who are more supportive of the sustainability movement. In this way sustainability can help an organisation to maintain superior competitive performance, implying that sustainability is a means for maintaining its competitiveness (Fok, Zee & Hartman, 2012). This literature shows that changing the culture of an organisation involves changing the way an organisation interacts within its internal environment, or essentially changing values and norms.

Furthermore, the literature shows that waste management strategies, including delivering sustainable waste management protocols, involves substantial organisational change and with formulating such protocols an understanding of psychological theory may help in developing approaches for shifting entrenched mindsets and established practices about resource management. Organisational readiness is said to be a prerequisite for such change (Franco & Almeida, 2011). For this change to occur, the organisation needs to enable employees to adopt the attitudes and values consistent with pro-environmental behaviours (norms) which leads to lasting change. As indicated in this literature, this is achieved when employees begin to value the sustainability programme, the natural environment, and broader social outcomes. In addition, being a learning organisation is

important, especially in knowledge-intensive industries such as the healthcare sector. This translates as organisational readiness to learn and change as demonstrated by the leadership team prioritising the programme, and in providing the necessary structure and systems to support the programme.

From these psychological theories I came to understand that connecting to and engaging employees in the sustainability programme is a crucial element of a change management process since more positive attitudes towards recycling are linked to a greater engagement to recycling and a major element in designing and implementing the project. The learning taken from the psychological theories also led me to realise that there is often a disconnect between intended and actual behaviour. As a result, this led to the inclusion of measures that accounted for both intended and actual recycling behaviour.

I have developed the following diagram to summarise the three main constructs presented which form the wider theoretical lens for this study.

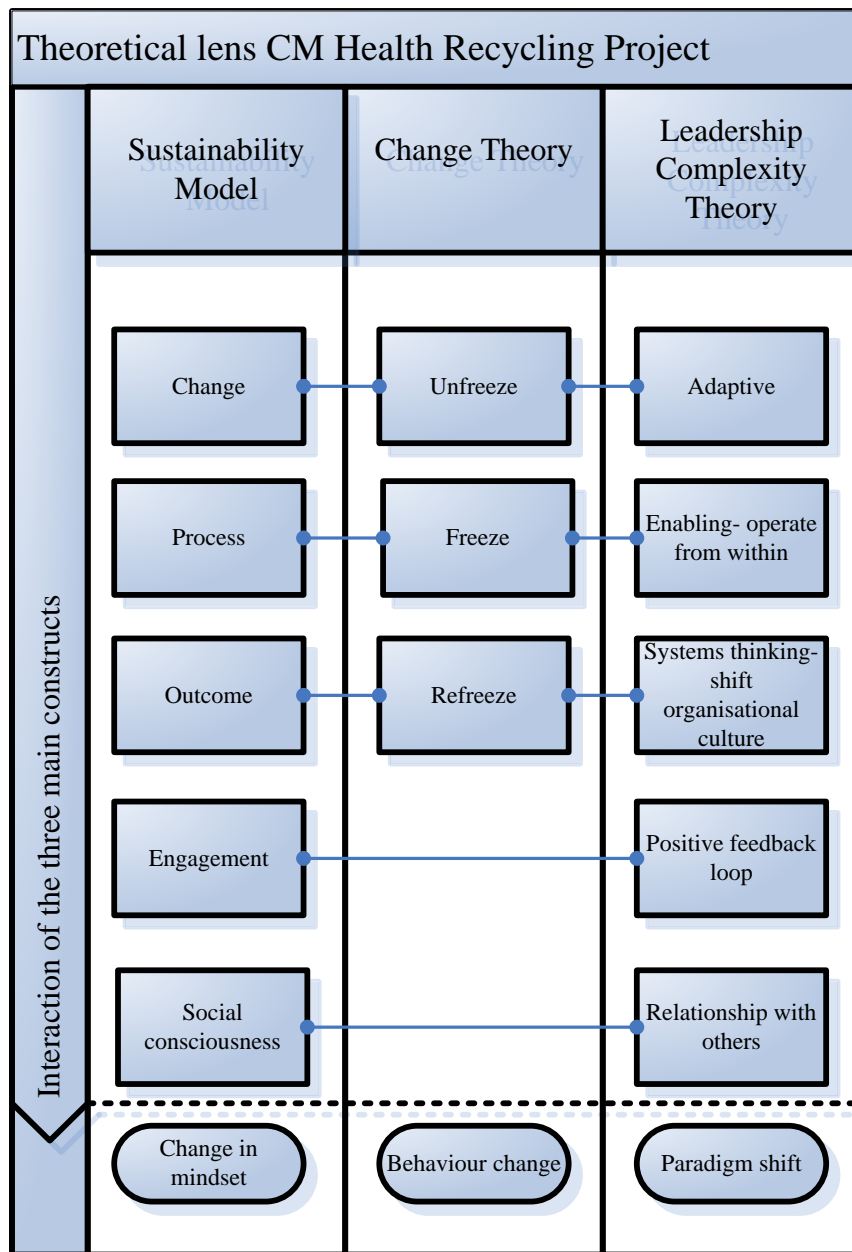


Figure 3.1. Theoretical constructs and interactions CM Health Recycling Project.

Given that the recycling project is situated within the complex setting of healthcare, this diagram shows the match between main attributes of sustainability (McMillan, 2014) and the phases of Lewin's theory of planned change. Basic features of leadership complexity theory have also been connected, identifying commonalities between the primary components of each construct. The next chapter provides an overview of how CM Health has responded to such requirements.

Chapter 4 Specifics of the CM Health Environmental Sustainability Programme and Recycling Project

Environmental sustainability management at CM Health will be described next before bringing the discussion to the specific considerations for this organisation. How CM Health manages sustainability is set out, including a description of my role as programme leader and the tensions of acting simultaneously as the researcher. Detailed also is the recycling project I initiated and developed as a component of the wider sustainability programme. The purpose of this chapter is to provide instructive steps on how to manage change in a dynamic setting. To add greater value, a reflective discussion on the issues of engaging in this setting is provided at the end of this chapter.

4.1 CM Health Sustainability Management

CM Health captures annually a carbon footprint measurement at Middlemore Hospital and Manukau Health Park. For the carbon footprint measurement at CM Health, as mentioned earlier, I gather the data required using the Certified Emissions and Measurement and Reduction Scheme (CEMARS). This programme is an internationally recognised carbon measurement and management programme (Enviro-Mark Solutions, n.d.) developed by Landcare Research. CEMARS requires businesses to measure emissions and reduce them against reduction targets that are at least 2.5 percent each year. Organisations must create a detailed reduction plan specifying the main initiatives and top management commitment that will be put in place, with five years to reach these targets. Enviro-Mark Solutions provides the tools, templates, and guidance needed for organisations to measure and reduce emissions in line with international best practice.

As programme leader I monitor, track, and report on the outcomes of the carbon footprint measurement and reduction programme to the CM Health executive leadership team, under the guidance of the CEMARS programme. Our results are also disclosed on the Enviro-Mark website which is accessible to the public. This programme has led to several projects at CM Health and recycling is situated within the wider CM Health sustainability programme which is depicted in the following diagram (see Figure 4.1). This diagram situates six focal areas within the broader sustainability programme for CM Health. Working on projects which target each focal area leads to lower emissions.

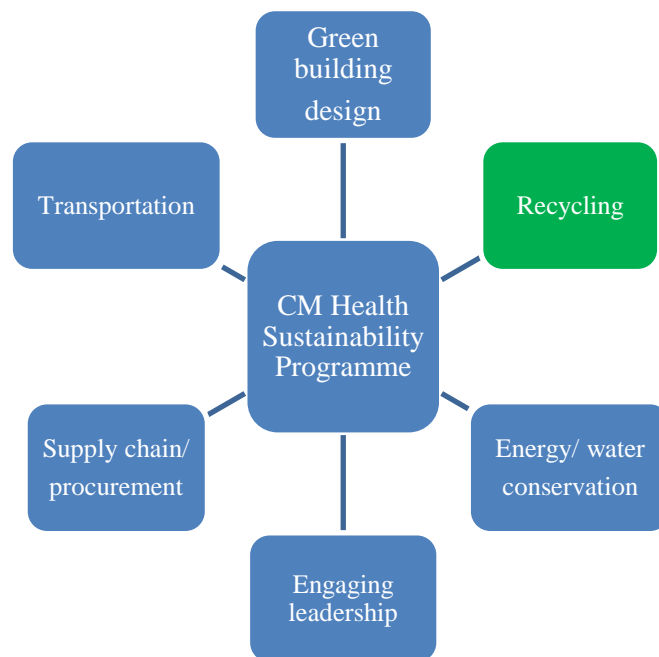


Figure 4.1. Main areas of focus within the CM Health sustainability programme.

Having provided a summary of CM Health sustainability management the next section draws the discussion specifically into the recycling programme as part of sustainable waste management at CM Health. For the purpose of this study, I do not go into the details of my involvement with the wider programme activities (as shown in the figure above) such as my influence on supply chain and procurement. I do get to influence the broader environmental impact of contract management, but the focus of this study is limited to recycling. My input into supply chain activity however can and does result in positive sustainable waste management outcomes, including less overall generated waste as a result, for example, of demanding that suppliers use more readily recyclable packaging.

4.1.1 Recycling at CM Health

The main intervention in this research project is recycling, recognised as being a significant component of sustainable waste management (Lui et al., 2014; Tudor et al., 2007b). While recycling is an effective means of lowering the amount of waste entering landfill, recycling is only one of many options and is not the panacea that addresses all waste management problems. After all, recycling a material might add to the carbon footprint since not all materials are readily recycled and recycling some materials

involves a greater consumption of energy than is warranted; this is especially so in Auckland and, in fact, in NZ.

The research project reported on in this thesis is wrapped around a large-scale organisational change programme. Recycling at CM Health on the scale and level described here is new and was initiated within the following strategic framework.

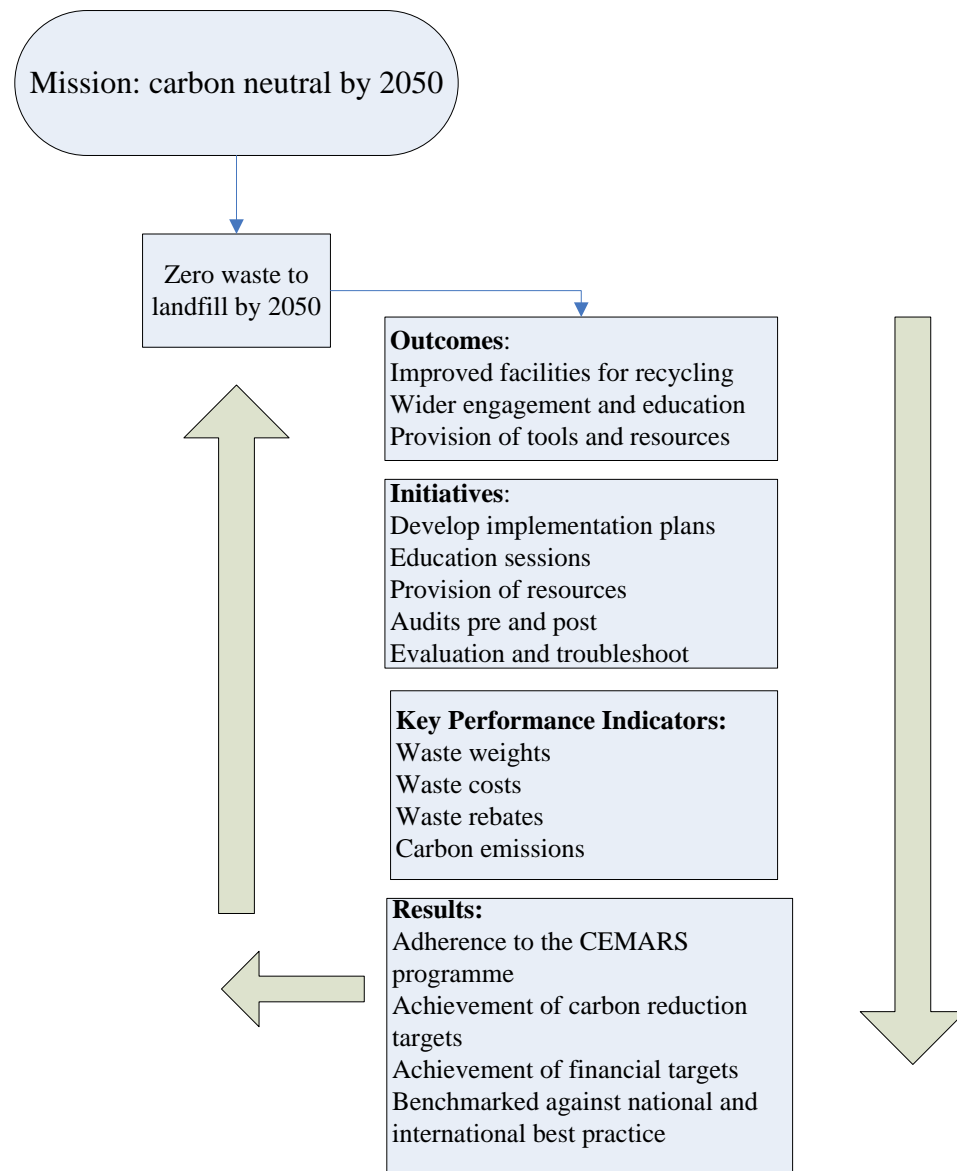


Figure 4.2. CM Health Sustainability Strategic Framework Recycling Programme.

The overall mission of becoming carbon neutral by 2050 superseded an initial target of 20% reduction by 2017. This research project feeds into the ultimate organisational goal of achieving zero waste to landfill by 2050. For more high-level details of the timeframe

and milestones of the complete sustainability programme including the development of the environmental sustainability policy, refer to Appendix M.

Details of how this goal and strategy were developed are presented next, followed by a summary of the outcomes of the programme. Key initiatives and performance indicators are described. Indicators feed into expected results of the project; and explaining the recycling project in this way allows for a detailed account of my role.

4.1.1.1 *Strategy and Goal*

On commencement as the sustainability leader, part of the project management aspect of this role involved setting up a sustainability advisory committee and ensuring that a governance structure existed for the carbon footprint measurement and reduction (sustainability) programme. Clinicians with a keen interest in developing sustainability within their departments and the wider organisation were recruited by invitation with representation from main services including surgery, radiology, critical care, quality, and obstetrics.

On collaboration with the sustainability advisory committee, I developed an environmental sustainability strategy and programme to reduce the carbon footprint, targeting several central focal areas (green building and design, transportation, supply chain, leadership, energy and water, recycling, as referred to in Figure 2.2) as advised by the literature. In knowing the importance of leadership, collaboration, change management and by applying the learning from the psychological theories an action plan was developed which involved two sets of tasks.

The first set of tasks concerned setting up the structure, covering the details of practical aspects of project delivery describing the various milestones, timeframes, measurements, deadlines with designated responsibilities (Harris et al., 2009; Hussain et al., 2018; McNamara, 2010). The second set of tasks involved managing the change management process which involved setting out how the organisation would modify the processes and structures to support the new sustainability strategy (Hanson & Ford, 2010; Langstaff, 2017). Day to day management of these tasks was part of my responsibility as the sustainability leader.

There was tension between strategic, operational, and academic aspects of this initiative, as explained next. The two figures (4.3 and 4.4) illustrate these tensions, showing the difference in the two sets of operational aspects of my role. The wider carbon footprint

programme is shown in Figure 4.3 and the more specific recycling programme is shown in Figure 4.4.

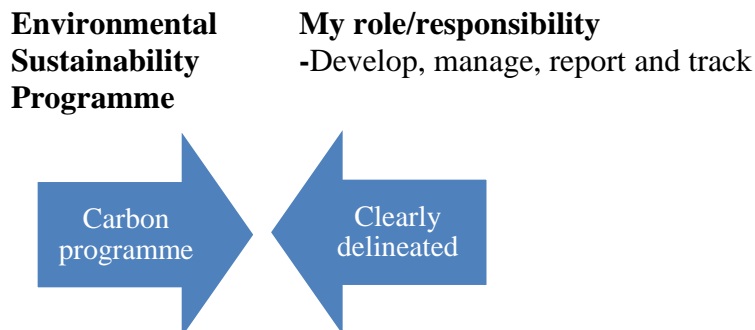


Figure 4.3. Model CM Health Sustainability Programme and relationship to researcher.

Working as the sustainability leader, I am solely responsible for reporting the outcomes of the carbon reduction programme (shown by the converging arrows in the diagram above). The operational management of parts of the programme, such as waste management, falls under the remit of different services. As the leader, I attempted to unite these by organising meetings and facilitating the adoption of common goals to bring about successful outcomes for the environmental sustainability programme and recycling project. Managers of the waste management services are less equipped to design and measure programmes from a sustainability approach as there is a lack of environmental awareness in healthcare organisations (Charlesworth et al., 2012; Harris et al., 2009), one which considers the environmental, social and economic impact of day to day operations.

As discussed in chapter 2, the non-clinical support services contract manager collects the waste reports from the waste service provider and this data is subsequently shared with me for two reasons. The first reason is that waste contributes significantly to the organisation's carbon footprint and, secondly, waste weights indicate relative success or failure of the various recycling activities. This next diagram reveals the tension between my operational and academic roles since, from a day-to-day management perspective, I was less involved with the recycling project.

My involvement with the recycling project is very front-loaded since the bulk of my time and energy is spent planning and providing education leading up to implementation, less so post-implementation. The project at that time is handed over to the non-clinical support services, as the new process becomes operationalised and integrated into

business as usual. There are benefits to this approach. The success of this project should always not be reliant on my being in all places. One of the objectives of my role is to make sure that I am not required post-implementation because when areas take ownership of a project this is an indicator of success.

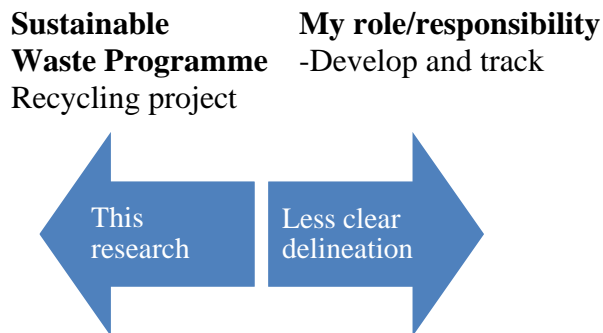


Figure 4.4. Model CM Health Recycling Project and relationship to researcher.

The divergent arrows represent the tension because of my supporting and advisory role in the organisation's waste management activities. For this reason, the measures of success for the project I designed and report on in this thesis are heavily reliant on variables which are outside the control of my organisational role. When I became the sustainability officer for CM Health in 2012, there were only two such roles across the NZ healthcare sector. As this was a new role for CM Health, promoting the environmental sustainability programme or, at times, just the recycling project, has not been an easy task. Fellow professionals and work colleagues were sceptical about the likelihood of success for the project, because of its newness and other failed projects in the past. Consequently, a slow early uptake by middle management required a concerted effort on my part to remain persistent and positive. In the absence of my role as dedicated sustainability officer, the environmental sustainability programme and the recycling project would have undoubtedly been less successful.

4.1.1.2 *Outcomes*

Increasing recycling provision took a complex process of negotiation with major budget holders and involved the production of several pieces of necessary organisational documentation. Part of my role also included organising waste counts and performing audits, not ordinarily and routinely undertaken by any other role in the organisation. Information gleaned from the audits provided information in support of funding to purchase the necessary tools and to justify the project. As part of my role I developed

business cases, implementation plans, and evaluation tools to secure funding and support. The reporting resulted in improved facilities for recycling, including the provision of tools and resources – bearing out the adage: “what gets measured gets managed” (attributed to Drucker (1954) in “The Practice of Management”). Working with clinical champions I organised trials which helped inform the implementation process. I needed to be sure that requests for capital expenditure were appropriate and fit for purpose, given the economic constraints of the public healthcare sector. Trialling equipment also allows for a trial of the process, where employees work in collaboration as is necessary for successful change management (Hussain et al., 2018).

Employees working across all areas within the inpatient and outpatient clinics required access to recycling bins to support waste segregation. The recycling bins also necessitate a servicing schedule. Because of this, detailed planning is required to inform budgets and feed into the reports. Wide engagement is needed, from the end-users of the recycling project to the orderlies and cleaners (non-clinical support services) who service the recycling bins. A full education programme supported the recycling intervention, to be discussed next.

4.1.1.3 *Key Initiatives*

As leader of the programmes I developed, designed, and managed the entire set of recycling activities in collaboration with stakeholders such as the operational managers, orderlies, and cleaners of the non-clinical support services. To undertake these activities, I developed, with clinical champions, specific implementation actions for areas including critical care, the operating and radiology departments, and outpatient clinics. Many clinical areas have distinctly different requirements. Their workflows differ, their layouts and team structures vary, and the volume and types of waste all require custom packages to help mitigate departmental waste associated risks. This is an important point since waste weight and types differ between the clinical areas. As a result, interventions need to be tailored to suit the requirements, thereby avoiding project issues and failure in achieving outcomes.

Drawing on the central findings from the literature review, I was able to identify viable waste reduction opportunities which could be planned, implemented, and evaluated in a relatively short space of time, as advised by Langstaff (2017). In line with Langstaff’s recommendations and to accomplish waste reduction targets, I developed, provided and

executed plans for the following tactics, all of which were derived from the literature discussed in full in the following chapter:

- waste audits: pre, during and post programme implementation,
- planning and evaluation meetings with stakeholders,
- comprehensive communication campaign tailored for each area,
- unit based in-service training,
- multi-stream waste receptacles in specific areas.

I organised for waste audits to be performed prior to any recycling intervention by examining the contents of waste receptacles and bringing waste auditing in-house - an approach supported by Langstaff (2017). Audits are a useful tool for gathering baseline data and aiding evaluation after a recycling intervention has been instigated. Any issues discovered such as identifying inappropriate waste segregation can be fed back directly to the teams for subsequent learning and adjustment/correction. To personalise the feedback, I took photos of the 'problem' and used these photos in email messages and posters. Displaying the posters near the recycling bins and in communal staff areas allows for information sharing. By adopting these methods, the messages about the recycling process could be spread, since healthcare workers often work across different shifts and are therefore not all present at one time for single message delivery. I designed and delivered different approaches to sharing information because of the nature of working patterns.

Based on the insights from the literature presented in the previous chapter I designed communication campaigns and planned education sessions which covered details of waste management in general before focusing on what could be improved. Delivering education is an important step in the process since it provides the platform for information sharing, building and working on relationships, inviting others to provide input and feedback on the programme, and fostering a shared approach demonstrating a collective leadership style.

This process followed the waste hierarchy principles detailed in section 2.4.2.1. I and the education sessions were repeated several times over the course of the planning and implementation phases of the recycling project. All members of the interdisciplinary

team were targeted since most, if not all, employees were expected to encounter the recycling system. Sessions were delivered within the different inpatient and outpatient settings by me using formal techniques and resources such as PowerPoint presentations in Appendix N, along with less formal approaches involving joining handovers and attending team meetings. I also gave demonstrations explaining the segregation required using examples of the different waste materials, specific to each area. My objective was to design a programme of education delivery that would enact ways to achieve engagement with employees. For this, I drew on the insights derived from the literature on complexity leadership, change management, and psychological theories that influence behaviour, as reviewed in the previous chapter and advocated for success.

4.1.1.4 *Performance Indicators*

As leader I identified a range of measures to capture the progress of the overall carbon footprint programme and the specific recycling project. In my role as designer and instigator of the recycling project I captured and recorded all types of waste weight by type and by site. Weight of recycling was not required for the purpose of carbon footprint reporting. I collected recycling weight on a monthly basis as a means of evaluating the success of this project and the complete waste data set was added to the pool of research data, all collected and used to inform the outcomes of this study. Costs and rebates were included in the data since the recycling project was initiated for two reasons: to minimise environmental impact and reduce costs.

As the leader of the programme, my role involved coordinating the capture of the carbon footprint data and managing the carbon reporting process. I did this for this research project, and it is part of my on-going role. I gather the data around the main emission sources of the organisation annually and input waste to landfill weight into the carbon reporting programme on an annual basis. I also gather data related to the number of employees required to deliver the healthcare services and the number of patient (inpatient and outpatient) presentations to add meaning and context to the overall carbon footprint. This is important since not all hospitals and clinics are similar in their size, function, capacity, and capability. Without this level of detail, it is difficult to compare and benchmark with other organisations.

4.1.1.5 *Results*

Results of the recycling project and sustainability programme feed into the annual CEMARS Certification process. Adherence to CEMARS is achieved only when

organisations develop and implement projects that measurably demonstrate a reduction in their carbon footprint. CM Health has achieved all expected carbon reduction targets which are reported on and audited annually. This recycling project helps reduce the organisation's waste to landfill weight, thereby lowering the environmental impact of waste-related activities.

Financial targets were also set at the time a project is initiated and savings are expected as a result of the recycling project based upon the comparative waste disposal scenarios. Savings are reported as waste avoidance costs and, in the case of CM Health, rebates for some of the recycling commodities help offset the total costs to recycle. Total waste management weight and costs are captured for cross-comparison purposes by the contract manager, shared with me for the project reporting purposes. This is an important practice within any organisation embarking on a sustainability journey. Not only does it impact my leadership authority: it is a concrete example of the type of organisational support which is essential to the success of a sustainability programme. As discussed in the previous chapter, the leadership literature emphasises this step as representing a sustainability-oriented corporate culture with management commitment and support (Wang et al., 2014). Without these seemingly routine and fundamental actions (such as the sharing of critical information being essential effective implementation in this role) the project would fail, and it would indicate a very dysfunctional organisational culture. As practiced in this project the open sharing of crucial information across intra-organisational boundaries represents a specific example of the kind of organisational support which, though expected, would doom the project if absent.

The literature further reveals that using a range of indicators for benchmarking purposes (Nichols and Manzi, 2014) helps organisations evaluate their success (or otherwise) with recycling activities. In some instances, calculations of the different waste weights are matched to the number of patient admissions or presentations. Alternatively, an indicator used as a proxy of healthcare activity matches waste weight to the number of full-time equivalent employees required to deliver the health services. Caution is required, however, when comparing results from other countries as the differences in policy and practice are wide and varied. There is, nevertheless, a case for developing and agreeing on a set of regional if not national indicators, as was incorporated into the project, thereby constituting a practical contribution from this study.

4.2 Reflective discussion

Managing the change process was difficult at times, in part because of the differences between the two sites. From my perspective the differences can be described as related to two functions: administrative and work culture. I will discuss each in turn. The administrative function relates to the way essential non-clinical support services were organised which impacted on programme planning and delivery. Orderlies and cleaners play a crucial role in moving all forms of waste from all areas across the hospital campus to the waste dock. Where there are no orderlies, this role falls on the cleaners, since cleaners and orderlies tend to share the task of delivering waste services. To illustrate with an example, there are no orderlies at the smaller site and whilst this may seem like a minor point of difference, this situation created a great deal of frustration. Delays were experienced whilst negotiations took place between the nursing staff in clinical areas and the non-clinical support services manager, often with me as the mediator. As a compromise, nurses and health care assistants took on the role of moving the recycling material within their departments to the central waste dock. At the larger site, and in an ideal situation, this task is assigned to the cleaners.

Making changes to the way waste services are managed has far reaching implications across hospital services and full consideration of these implications with careful planning is essential. The success of the programme relies on effective stakeholder engagement and making collaborative plans to achieve the desirable outcome of a sustained and meaningful change process. Despite the problem described above, the clinical staff were willing to continue with this arrangement because the only other option involved maintaining the status quo. Because of the high level of staff engagement with the recycling programme, maintaining the status quo (not recycling) was deemed by them to be the least desirable option.

Work culture is the second function which made a difference to the way in which the programme was planned and delivered. In one common framing (Schein, 1985) the shared aspects of organisational life—the culture—are categorised as three (obscured) layers. First, and most visible, are the physical artefacts and arrangements. These visible manifestations of culture are seen in how estate, equipment, and staff are configured and used, and in the range of behaviours seen as normal and acceptable. These include the embedded and accepted ways of working, clinical practices, and communication patterns. The second level is the shared ways of thinking that are used to justify the visible

manifestations. This includes the beliefs, values, and arguments used to sustain current work patterns. In this way, the local culture is expressed through what is done and by the way in which it is talked about and justified.

Deeper still, and much less overt, are the largely unspoken and often unconscious expectations and presuppositions that underpin both dialogue and practice, the shared assumptions. Such attitudes may be formed early, go deep, and be less amenable to modification (Schein, 1985). The difference in culture between the two sites manifested itself in several ways, which is interesting given a reasonable proportion of staff work across both sites.

First and foremost, employees at the smaller site displayed a greater sense of autonomy and independence. When confronted with the problem detailed in the section above which resulted in the delayed initiation of the recycling programme, rather than resigning themselves to waiting for the non-clinical support services to be able to provide the desired waste services support, they simply volunteered to take ownership of the problem. A solution was suggested by the employees which involved the nurses, health care assistants (and at times, the doctors) transporting recycling material between departments and to the waste dock. The downside of this created a tension since arguably trained and untrained health care workers have clear roles and responsibilities and waste management services tends to sit outside of those.

Another feature of the work culture relates to a commonly held expectation that smaller sites that deliver less acute services tend to expect to receive a lesser level of support by way of resources. There is a tendency in healthcare to prioritise acute care over elective and less acute services. This situation may stem from central government funding allocation which may have a trickledown effect. The prioritisation tendency described also correlates with the views held by clinicians on the frontline. Acute and more pressing healthcare needs must be met first since there is a higher mortality and morbidity associated with delayed care. Differences in the administrative function and work culture across sites therefore need to be considered to inform programme planning and delivery.

My role in helping to convince other DHBs to embark on this journey based on my experience in designing and implementing the project was significant. Many other DHBs were slower to start and wanted to see evidence of success (as in this project) before signing off their own environmental sustainability programmes of work. As a result of

the project's success, I am recognised as a national leader within the healthcare sector in NZ.

My responsibility as project lead was to suggest and set both achievable and instrumental targets drawn from the literature such as those described and from data shared within the NZ Sustainable Health Sector National Network (SHSNN). I needed to ensure that the results captured were useful to the DHB, this being a new programme of work and justification was required to support this direction. The national data collection process is underway, initiated because of more national DHBs signing up to the CEMARS programme since 2016.

4.3 Summary

In this chapter waste management within the context of sustainability and the setting of healthcare has been discussed. Sustainable waste management forms part of a suite of activities directed towards minimising environmental harm. This is especially pertinent for large healthcare organisations if they are to avoid the unfortunate consequence of healthcare being part of the problem instead of being part of the solution.

The next chapter provides a fuller discussion of healthcare sustainable waste management, presenting the findings from the relevant literature which provides the empirical grounding for the study.

Chapter 5 Theoretical Review of Healthcare Waste Management

5.1 Introduction

This chapter provides a systematic review of sustainable healthcare waste management literature from an international perspective. My conscious journey was informed by a variety of literature at different phases of the study. I present others' views/approaches and explain how I adopted and/or modified them as I progressed through the project. This chapter discloses details of the review undertaken to address the research-project question of this study, with two objectives in mind. The first was to discover what fellow researchers have examined and the second to identify what is known about recycling within the realm of sustainable healthcare waste management.

The chapter first outlines the process undertaken to perform the systematic review. The results of the review, which formed the conceptual and empirical basis for the study, are next presented, thereby providing the necessary empirical context and subsequent direction for the thesis.

5.2 Systematic Review

The objective of the review was to assess the breadth of evidence, including a range of research study designs and methodologies. From this, I identified the specific focus for the project, from which to contribute to furthering the body of knowledge. I sought information about how sustainability has been designed and implemented in other healthcare settings, including identifying suitable methodological approaches for data collection and analysis from the project.

A search of a comprehensive range of healthcare, business, environmental, economic, and education databases (EBSCO Health, Web of Science, Scopus, Cinahl, Medline and Green file) was undertaken under the guidance of an experienced librarian. Government websites, the WHO, DHBs, and university websites were also searched. The reference lists of identified literature were searched for any additional studies. A preliminary search targeting the date range of articles published between January 1990 and December 2000 revealed no studies on sustainable waste management within the healthcare setting. An additional search extending the publication date from January 2000 to March 2015

identified over 3,000 articles from the search terms described below, demonstrating a growing interest within this field.

After completing the preliminary search, a more detailed examination was undertaken by expanding the terms. To improve the specificity of this examination, papers published since 2000 were found using the following search terms:

sustain healthcare, sustainable health care, green practice, environmental practice, healthcare, health care, hospital, waste manage*, climate change, environment, carbon footprint, climate footprint.*

Newspaper and magazine articles were excluded. The following indicators were used as inclusion criteria: articles published in the English language; reports on the impact of climate change/sustainability/waste on organisations; the impact of climate change/sustainability/waste in relation to health and healthcare settings; climate change/sustainability/waste on outcomes and measures including interventions/policies/strategies; and any cost-benefit analysis of climate change/sustainability/waste interventions.

By applying the inclusion and exclusion rules stated above, 318 articles describing both quantitative and qualitative studies were identified (see Figure 5.1 below).

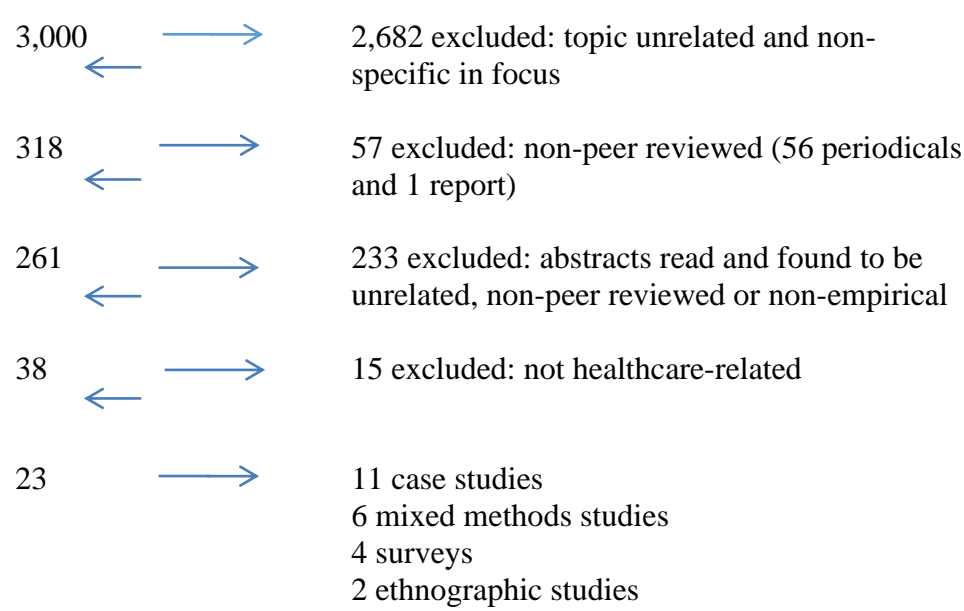


Figure 5.1. Schematic representation of the literature search.

The abstracts were reviewed and only 23 studies met the final inclusion criteria. Studies from a variety of organisations, including those from the healthcare sector, the tertiary education sector, as well as the hospitality and commercial sectors were initially included. After examining the sustainable waste management evidence and comparing the results found from the range of organisational types, the decision was made to include only articles from healthcare in the final literature review. Selecting only sector-relevant literature was considered critical since this research project study was set within the context of healthcare. The nature of healthcare establishments is unique as no other type of organisation can compare in terms of type and volume of waste generated, heterogeneity of workforce, nature, and type of work performed, and range as well as type of products and services used.

A summary of the literature is provided below. For each article the organisation was described with site and setting identified, along with sampling, study design, and data collection techniques used. Important elements have been conceptualised and construct labels assigned. This process was guided by the main themes presented in the literature. The annotated bibliography (Appendix C) further identifies whether the study examines sustainability in general (including waste/recycling) or, more specifically, whether the study solely focusses on waste/recycling; as such, the terms are in bold in the annotated bibliography. Theoretical underpinnings have been identified, notably those relating to leadership and change management. This theoretical lens provided the basis from which this research project was positioned.

The chapter then presents the literature review findings as a conceptual framework, providing a summary of the evidential base of this study in preparation for the methodological framework discussed in Chapter 6.

5.3 Results of the Systematic Review

A descriptive outline of each study is provided in the annotated bibliography in Appendix C. The following section summarises the main points of relevance to the present study. An organisation-wide study that incorporated the implementation and review of a waste reduction programme across two sites was not found, giving an early indication of the need for and potential impact of this study. The topic is a relatively poorly understood phenomenon and, as a result, the sample sizes ranged from 1 site to 2,500 survey

participants, depending on the specific research question and requirements of the chosen methodology.

5.3.1 Organisation/Setting/Sampling

The level of inquiry most commonly seen in the literature was the wider departmental or service level. When measuring the effectiveness of an organisation-wide change initiative, a generous assessment of indicators of success enables the capture of sufficiently appropriate data. Of the 23 healthcare-related studies, 13 researched the topic of waste/sustainability from a departmental or *service level* (Charlesworth et al., 2012; Hartman et al., 2011; Jamali et al., 2012; Kantabutra, 2011; Komilis et al., 2012; Miller et al., 2011; Nichols et al., 2012; Njagi et al., 2012; Patrick et al., 2011; Ruoyan et al., 2008; Srivastav et al., 2012; Tudor et al., 2008; Tudor et al., 2007b). Eight studies explored the topic at a *ward level* (Abor, 2013; Alam et al., 2008; Connor & Mortimer, 2010; Evans et al., 2012; Franco & Almeida, 2011; Goonan et al., 2014; Manga et al., 2011; Nichols & Manzi, 2014). Two further studies were more detailed and examined sustainability at an exact *case level*, reporting a specific case within the operating theatre (Kaplan et al., 2012; Lui et al., 2014).

Actions of individual employees within the workplace are to be supported by managerial and organisational change, which is an important finding (and is consistent with Charlesworth et al., 2012). It is not to say that only organisations which address each level effectively will find success; it does seem, however, that multi-level approaches do reap the most benefits that are sustained over time (Connor & Mortimer, 2010; Evans et al., 2012; Hartman et al., 2011; Jamali et al., 2010; Lui et al., 2014; Nichols et al., 2012; Njagi et al., 2012).

The healthcare settings within this review included both the public and private sectors, targeting a wide spectrum of areas including obstetric, renal, paediatric, general, medical wards, and theatre, neonatal, and community services. Importantly, differences were found between those areas in terms of patient throughput and activity. The studies showed a clear relationship between patient activity and waste; busier hospital areas see more patients, use more products and services, and therefore generate more waste. The review also revealed seasonal and temporal factors as impacting on waste generation rates, in addition to the contextual factors mentioned (Abor et al., 2013; Alam et al., 2008; Connor & Mortimer, 2010; Komilis et al., 2012; Ruoyan et al., 2008).

Evidence from economically less-developed countries, albeit limited, provided affirmation of the need for tighter regulation and identified a need for policy and guideline development (Abor, 2013; Alam et al., 2008; Manga et al., 2011; Srivastav et al., 2012). An overall lack of emphasis on training and education most commonly found in the economically less-developed healthcare communities resulted in poorer outcomes and often fewer desirable practices. As a result, waste segregation rates were lower, contamination rates were higher, and reported injury rates increased. This highlights the significance of providing effective training and specific education including the provision of standardised guidelines. A waste reduction programme ideally incorporates a range of education and training measures to mitigate the effects of poor training.

5.3.2 Design/Techniques of the Extant Literature

Eleven of the 23 studies were *case studies* (Abor, 2013 ; Alam et al., 2008 ; Jamali et al., 2010 ; Kantabutra, 2011 ; Kaplan et al., 2012 ; Komilis et al., 2012 ; Lui et al, 2014 ; Manga et al., 2011 ; Patrick et al., 2011 ; Srivastav et al., 2012 ; Tudor et al., 2008). Six studies use a *mixed methods* approach (Charlesworth et al., 2012 ; Evans et al., 2012 ; Franco & Almeida, 2011 ; Goonan et al., 2014 ; Ruoyan et al., 2008 ; Tudor et al., 2008). Four studies used *survey* design (Connor & Mortimer, 2010; Hartman et al., 2011; Miller et al., 2011; Njagi et al., 2012), and two were ethnographic (Nichols et al., 2012; Nichols & Manzi, 2014).

Five studies incorporated surveys as one of their data collection tools (Abor, 2013; Charlesworth et al., 2012; Evans et al., 2012; Franco & Almeida, 2011; Ruoyan et al., 2008). Only one study used pre- and post-test surveys (Evans et al., 2012), where the effectiveness of a ‘green’ programme was reviewed using the first survey as a baseline indicator of ‘green’ behaviour.

Among the 23 studies, five different data collection techniques were used (surveys, interviews, observation, document analysis, and waste audits). Sixteen studies used a combination of approaches (Abor, 2013; Alam et al., 2008; Charlesworth et al., 2012; Evans et al., 2012; Franco & Almeida, 2011; Goonan et al., 2014; Jamali et al., 2010; Kantabutra, 2011; Kaplan et al., 2012; Komilis et al., 2012; Manga et al., 2011; Nichols & Manzi, 2014; Ruoyan et al., 2008; Srivastav et al., 2012; Tudor & Marsh et al., 2008; Tudor et al., 2008). Four studies employed surveys only (Connor & Mortimer, 2010; Hartman et al., 2011; Miller et al., 2011; Njagi et al. 2012). Interviews were used by two of the studies (Nichols et al., 2012; Patrick et al., 2011) and one study was limited to

audit waste data as a means of measuring the impact of a waste management intervention (Lui et al., 2014).

Eighteen of the studies included in the review used more exploratory approaches. Sampling size varied and reflected the nature of inquiry. Mixed methods of data collection and data analysis were employed, and samples selected to meet the requirements of each approach. Less understood concepts lend themselves to exploratory designs, reflected by adopting, for example, the case study approach.

Various data collection techniques were used including the review of organisational documents, visiting and observing sites, undertaking waste audits, and, most commonly, undertaking surveys. Understanding how others explore this topic and capture data helped to inform the design of this study. Mixed methods approaches seemed to produce the most valuable results, especially when incorporating a survey tool. Since individual attitudes and beliefs around waste management require further attention, surveys are ideally placed to capture this type of data.

5.4 Interpretation of the Literature Reviewed

As this is an applied research project study there are practical and academic implications from the findings of the literature review. The following section presents a summary of the findings from Chapters 3 and 5, presented diagrammatically in Figure 5.2.

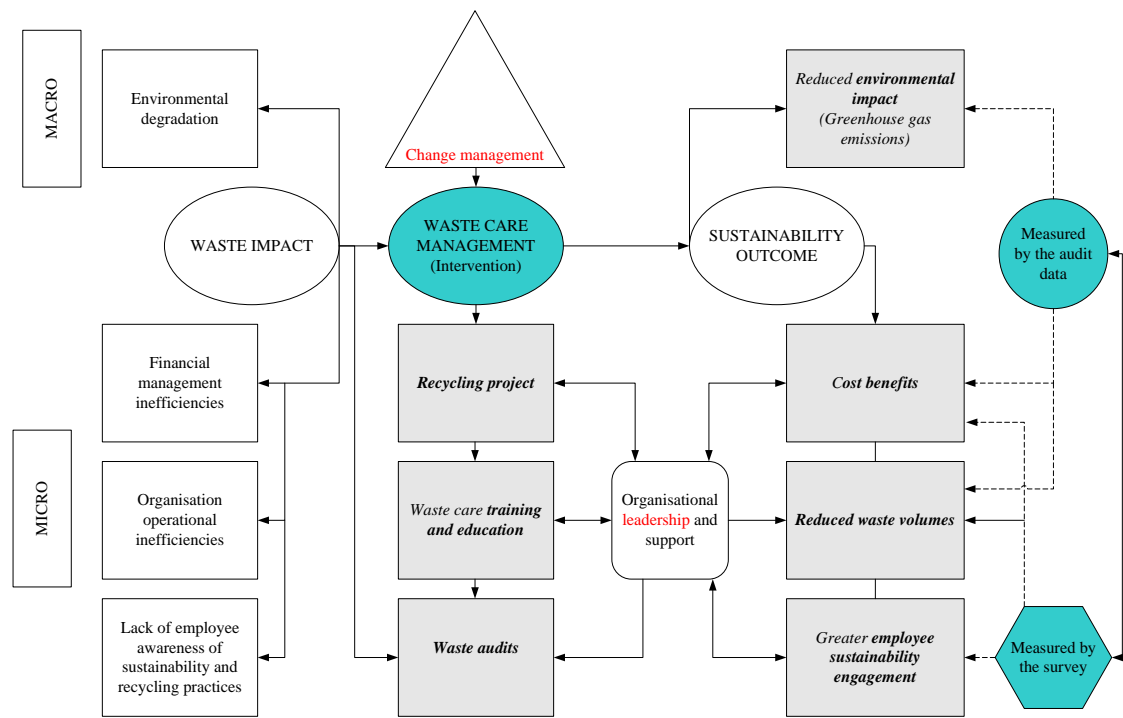


Figure 5.2. Conceptual framework: Recycling Project.

Each of the main elements is described as a construct and has been linked to outcomes, with associations depicted. Evidence for each of the three central constructs (waste impact, waste care management, and sustainability outcome) will be presented and discussed. The waste impact and sustainability outcome constructs are both conceptualised at the macro (external physical environment) and micro (organisation) levels. This research project sought to explore the impact of the intervention (recycling project) with the audit data informing the more tangible outcomes and the survey focussing on capturing the perceptions of the end-users of the programme including the less tangible social outcomes.

Waste impact is discussed in relation to the macro and micro levels. After discussing waste impact at the macro level of environmental degradation, findings in relation to financial management and operational efficiencies at the micro level are presented. Elaborating the connection between the organisation and individual employees in terms of waste impact will bring this section to a close.

5.4.1 Waste impact

There are many negative and long-lasting impacts of waste on the environment, especially in the case of healthcare waste (discussed in Section 2.4.2.1). This is a notable point since waste was identified by Kaplan et al. (2012) as one of a range of primary

target areas. By tackling waste, individuals are often made more aware of other significant actions they can take to make a positive impact on the environment, thereby further reducing environmental degradation.

As financial considerations play a significant role regarding environmental performance, organisations are required to focus on the most effective areas in which to invest to improve and sustain performance within this context. Results indicate that having expertise available is valuable, as this knowledge bridges the gap between strategy and operations, especially since settings within healthcare vary with respect to resource utilisation. When an organisation provides training and subsequent on-going support to sustain effective waste management practices, financial performance is enhanced as a result of this level of commitment. This is supported by the leadership/change management theory, as discussed in Chapter 3. Organisations that provide support and resources demonstrate engaged leadership and education, and training reinforces positive behaviour – a vital component of any change management programme.

Findings from the literature revealed insights into the complexities of healthcare waste management. In developing countries facing financial hardship, common challenges were described in this literature and included inefficient segregation, collection, and transportation, in the absence of training, poor legislation, and unsafe practice. It is reasonable to infer that all healthcare organisations are required to provide safe and effective waste management training to avoid unsafe practices irrespective of financial status (Alam et al., 2008; Manga et al., 2011) and to achieve operational efficiencies.

The effectiveness of sustainable recycling programmes relies on many programme features to tackle operational inefficiencies (Franco & Almeida, 2011). In the study conducted by Franco and Almeida (2011) several types of data were collected across 63 wards. They found that waste generation rates varied by service, site, and facility size. The variation across the 63 wards was minimal, yet differences were found between primary, secondary, and tertiary facilities. Franco and Almeida (2011) found that recycling programmes would benefit from being tailored to the site or service. External factors impact sustainable waste management practices. It seems from their findings that recycling techniques are more likely to succeed if the space and physical arrangement are conducive to segregating waste at source. I applied this finding where possible and made sure I sourced recycling bins that would fit into the areas at the point of waste generation. For clinical areas in newer buildings this was easier to apply but for areas in

older buildings, there tends to be less space and retrofitting created barriers that required innovative thinking in the project to resolve these challenges.

The working environment influences behaviour, as does the knowledge and practice in those involved in healthcare waste generation, management, and disposal. For example, in a study by Nichols and Manzi (2014) waste management and reduction techniques were evaluated using non-participant observation and interview methods in a neonatal unit. The unit was chosen as it had a relatively stable population of staff allowing for continuity of data collection. The authors found that waste segregation rates improved if organisations facilitated correct waste segregation processes. Space and physical arrangement of the environment were significant and influential factors.

Practices and segregation rates were found by Nichols and Manzi (2014) to have improved if the appropriate resources were provided. In addition, the authors found adequate information on how to segregate effectively helped to facilitate correct waste segregation. A commonly reported finding was that there is, in general, a lack of awareness of sustainability and recycling programmes. This finding directed me to the necessity for the development of the training and education programme as part of the project's sustainable waste management strategy.

Taking a different approach, Ruoyan et al. (2008) investigated how waste management practices varied across different levels of the organisation. Six sites were chosen as case study locations. Using a survey and interview techniques to capture data they found that training was urgently required as safety could be compromised as a result of poor education. This is an important finding from their study because issues of safety are paramount due to the increased chance of harming those who encounter the waste.

Drawing from this literature, recycling projects are therefore useful additions to sustainable waste management practices as they improve financial management and operational inefficiencies and rely on employee engagement, as was tested in this project. The next section further details the different components of waste care management programmes, which helped to shape the recycling project developed at CM Health.

5.4.2 Waste care management

The results of the literature review emphasise the importance of having effective healthcare waste care management which is a complex process because hospitals produce numerous toxins and pollutants in various forms. Hospital waste can lead to

environmental harm and this section discusses what makes an effective recycling project, in terms of the organisation and the individual. Discussed are measures required for training and education, and methods used to evaluate the success of such programmes.

Both Kaplan et al. (2012) and Lui et al. (2104) purport that recycling minimises waste going to landfill yet, as an intervention, recycling remains largely underutilised. In the study by Lui et al. (2014) it was shown that recycling programmes often originate from the operating theatres within hospitals. Operating rooms represent a major contributor to a hospital's footprint because they are often accountable for up to 30 percent of the total waste (Lui et al., 2014). There is likely to be a positive correlation between the clinicians' experience of waste generation and the volume of waste generated because I found there was a high level of interest for the recycling programme in the operating theatres and in the critical care complex. When working in these areas there is no escaping this very visual reminder of the volume of consumables used and of how much waste this leads to. For this reason, I targeted these two areas at the start of the process when recycling was introduced into the clinical areas. This approach was highly beneficial because I could ascertain from performing waste audits that both areas accounted for a large proportion of the overall total waste of the hospital.

Training programmes were found to be successful in improving behaviour (Tudor et al., 2008). Tudor et al.'s (2008) study, across 72 sites, aimed to assess the levels of diversion of recyclables from the domestic waste stream as well as non-clinical waste from the clinical waste stream. During their trial's significant reductions in clinical and domestic waste were achieved due to effective training and the provision of adequate resources. Their training was tailored to each area and included providing instructions and making posters available. Resources such as bins and stickers were strategically placed, and recycling outcomes were positive as a result of these combined measures. From this finding, I developed a range of methods for delivering the education sessions during this project. I also decided to include the delivery of education using web-based platforms, which is often underutilised (Miller et al., 2011). By providing an online option, clinicians that were unavailable and subsequently unable to attend the scheduled sessions in person because of, for example, working unsociable hours, could pick up the same information online at their convenience. Based on the success of this approach in the project, making the information available in a variety of ways is thus an important feature of a successful sustainable waste management programme.

When considering the drivers of a recycling project, Charlesworth et al. (2012) found that concerns over the effects of climate change were the primary driving forces that underpin the motivation for a sustainability strategy. Their intervention consisted of the delivery of an educational programme to more than 200 public health registrars. The aim was to train participants to be more environmentally sustainable by delivering a workshop on climate change, explaining the implications of sustainability on health and healthcare within the National Health Service in the UK. In this study, awareness, advocacy, and actions were surrogate measures of knowledge, attitudes, and practice. The authors found that staff engagement, as indicated from a wide range of their sustainability measures, increased as a result of exposure to this education. They measured engagement using a survey; subsequent actions were assessed qualitatively over the telephone three months after the intervention. However, the Charlesworth study found that despite the success of their programme, many health professionals had yet to engage with sustainability in the workplace. This was an important finding which led me to devise a project which captured survey and audit data over a 12-month timeframe. According to the change management literature, sustaining the change over time is often difficult to achieve, and having a sustainability programme with a dedicated sustainability lead are both essential as these actions keep the momentum of change going.

Charlesworth et al. (2012) suggested that one way of demonstrating a strong support system is to provide adequate training and education. They argued that because education plays such a pivotal role within the healthcare setting, it represents a crucial component of professional development. Professional education enhances the quality of practice and forms part of compliance to regulatory health and safety standards. Further, education helps to raise awareness, and exposing healthcare practitioners to education about sustainability programmes has been shown to increase the level of engagement. From this literature I realised that the content and delivery of the education needed to be tailored to suit the audience. From my professional experience I also understood that the needs of the work environment could change on a moment to moment basis. I recognised that my delivery methods needed to be flexible, proactive, both planned and impromptu. As the project manager, I understood that in some instances I needed to be able to deliver the salient points of a presentation in just a few minutes when clinical pressures were too pressing for clinicians to spend time in the sessions, whereas at other times, I could take more time and deliver more detailed coverage of the material. Being flexible therefore

matters, as does understanding the clinical pressures. This approach aligns well with the collective leadership approach because the emphasis is on relationships and understanding contexts, as opposed to project outcomes. This is not to say that project outcomes are not important, it is more about the outcomes are achieved, through considered project design and implementation.

For the content, the literature supports providing education set in the context of healthcare by way of explaining the links between health and the environment. In the example of recycling, explanations are required about the impact of making errors, about the improvements to practice that can be easily made, and about the financial, environmental, and social value of sustainably managing healthcare waste.

Six of the studies determined the value of using campaigns designed to foster pro-environmental behaviours (Cole & Fieselman, 2013; Kaplan et al, 2012; Lui et al., 2014; Njagi et al., 2012; Ruoyan et al., 2008; Tudor et al., 2008). All organisations in these studies provided training in the form of educational materials and resources such as recycling bins. In addition, ‘green teams’ were established as a means of facilitating sustained change (Tudor et al., 2008). This was another important insight that helped shape the way I designed the operational aspect of the recycling programme. In this literature, green teams (as they were termed) successfully helped to drive the motivation for more environmentally minded practice by sharing information, identifying projects, and helping engage with the entire workforce within any one given clinical area. Suggesting that the clinical areas establish green teams seemed like a workable strategy because establishing project teams is already seen to work well within the health setting. As discussed in the literature this approach is commonplace and was taken up by many in the different clinical areas. In the healthcare sector, project teams are routinely established to help focus on areas of interest such as pressure area prevention, health and safety work, quality and patient centred care; and so on. In knowing this, I considered that encouraging the establishment of green teams was a workable approach, with the sole purpose of applying a sustainability lens to the teams’ everyday healthcare delivery and practice.

Many health professionals are trained in, and involved with, the delivery of health promotion, there are multiple co-benefits for the promotion of health and the protection of the environment through adopting a range of initiatives centred on sustainability (Patrick et al., 2011). The competencies inherent in health promotion that are useful for

health and sustainability practice include targeting behaviour change at the individual and societal levels, as well as the strategic and organisational level. According to Patrick et al. (2011), positive outcomes are achievable despite employees being faced with multiple barriers including lack of funding and directionless policy. The authors found there was a crossover with health promotion competencies and sustainability, and they encouraged targeting individual behaviour. The organisation could affect social change by encouraging collaboration and interdisciplinary communication, further supporting the collective and collaborative approach taken for this project.

Finding alternative and effective ways of delivering the knowledge required, such as using web-based methods, could assist in increasing the range of communication tools available. Using web-based approaches to deliver healthcare training packages is becoming more popular (Miller et al., 2011). A web-based tool was regarded as a useful means of delivering healthcare-related messages and information (Miller et al., 2011).

Such a programme was developed by Evans et al. (2012) incorporating the use of a range of communication tools including posters, stickers, and internal web-based methods. Their study reported on benefits which included improved recycling rates, as determined by undertaking waste audits. Benefits were achieved as a result of providing sustainability education. Nevertheless, they found that a range of different interventions were required, depending on whether the targeted behaviours had an individual or collective responsibility. For instance, participants who shared office spaces were less likely to demonstrate pro-environmental behaviours because of there being a diffuse responsibility. Participants were more likely to comply with environmental programmes where a sense of personal ownership and responsibility was found. Accordingly, I used a range of communication tools and, whenever possible, emphasis was placed on the importance of every individual being part of this programme of work. However, I modified the approach by using motivational and inspirational messaging, personalising communication, and offering positive feedback to all those who made attempts to comply with the programme. Based on this experience I found that it is important to stay positive as this encourages confidence among the team and belief in the value of the project. A relational approach to sustainability helps since the strength of the sustainability programme hinges on sound relationships (Mc Millan, 2014).

The education component of a recycling project is seen in the literature as an important aspect, as is the nature of the approach taken to deliver the project. Five authors identified

a wide variability of approaches among organisations to the management of healthcare waste such as minimising only municipal waste or offering only one or two recycling options (Hartman et al., 2011; Komilis et al., 2012; Manga et al., 2011; Nichols et al., 2012; Srivastav et al., 2012). Two studies (Lui et al., 2014; Ruoyan et al., 2008) targeted the types and weight of waste generated. Data collection methods used by the studies were similar; sites were visited, waste types and weight were analysed, and subjects were interviewed. Recycling was the specific focus for one study (Lui et al., 2014) whereas in the other study (Ruoyan et al., 2008) recycling figures were captured in addition to information about overall waste generation rates. I found that it is important to understand the complete picture of healthcare waste, breaking each waste stream down and being able to measure the comparative and proportional weights, impacts, and costs of each. This data can then be reported to the organisation as a means of validating the benefits and highlighting any issues of the programme. Information can also be shared with individuals who often ask for feedback. Communicating outcomes of the programme is a useful way of helping support the continuation of current methods or provide evidence in support of making necessary modifications.

The literature emphasises the value of auditing waste. Audits provide detailed accounts on the progress of all waste-related activities including recycling. The review shows that they are a useful way of evaluating how an individual employee interacts with the recycling programme. Since audits were regarded as useful to include, I decided to employ these in both the pre- and post-recycling intervention phases as a means of revealing compliance to segregation. Higher level measures include measuring overall weight of waste diverted from landfill and providing a general indication of the level of employee engagement. Different methods can be used to complete the audits and audits are performed routinely by many large organisations intent on reducing the volume of waste entering landfill. The next section presents a summary of the findings with specific reference to sustainability outcomes. This is an important section since the outcomes reported in the literature not only helped shape the research project design of this study, the findings, more importantly, also helped to shape the delivery and evaluation of the actual organisation-wide sustainability programme and recycling project.

5.4.3 Sustainability outcome

The evidence suggests that, as a result of implementing a recycling project, positive outcomes are achievable within the environmental, financial, and social realms (Nichols

et al., 2012). This section considers outcomes from the macro and the micro perspective. The macro outcome is presented as an environmental impact (greenhouse gas emissions), uncommonly reported by healthcare organisations in NZ. The micro impacts represent the more likely organisational waste management behaviour relating to financial reporting and waste volume tracking. The final and lengthier segment of this section discusses the positive impact a recycling project and sustainability programme has on employee engagement.

As discussed in Chapter 2 there is an increasing awareness of the environmental impact of healthcare practice. Expectations of more deliberate waste reduction activities that include recycling projects are being increasingly reported. Reputational aspects also come into force where companies want to avoid being linked with practices leading to environmental degradation. On reviewing the literature, information on how NZ healthcare organisations measure and report on the environmental impact of their day to day operations was scant. There is no evidence to suggest healthcare organisations in NZ are actively measuring their greenhouse gas emissions, an approach undertaken at CM Health. This is an important finding because organisations which employ large numbers of staff often have a range of recruitment and retention schemes. Being perceived as being supportive of sustainability and contributing to a more sustainable society and being supportive are two different matters. An organisation that merely complies with environmental programmes may be less likely to leverage this in terms of being able to recruit and retain staff (Charlesworth & Jamieson 2017).

Recycling projects are an important component of sustainability programmes since waste contributes significantly to greenhouse gas emissions. One study by Kaplan et al. (2012) suggested using standardised metrics across a range of sites, finding considerable financial savings were possible. Benefits are identified by the literature (Kaplan et al., 2012; Lui et al., 2014) regarding financial savings, improved organisational performance, increased employee satisfaction, and improved morale. Waste reduction practices and recycling schemes were recognised as being the most successful target areas for sustainability programmes (Tudor et al., 2008b).

The literature review has shown a correlation between waste generation and type of service as well as size of site. For example, as previously discussed by Connor and Mortimer (2010), renal services tend to be high use areas of consumables. The research findings indicate that most types of healthcare organisations can benefit from safe and

effective sustainable waste management/recycling projects (Komilis et al., 2012). Few attempts have been made by researchers to report on savings from sustainable waste reduction practices when applied to outpatient settings when compared to inpatient services (Connor & Mortimer, 2010). With the large number of patients seen and many procedures undertaken in outpatient settings, if there is a likelihood of increased financial and environmental savings from effective waste management practices, research is required to explore this. Therefore, the CM Health programme evaluated and reported on in this thesis incorporates two different sites to determine if there is any evidence to support or refute the findings related to applying standardised metrics across sites.

In the literature review, five studies shared a common programme goal each focussing on recycling activities. A study set in India provided a non-Western view to hospital waste management (Srivastav et al., 2012), whereas the remaining four studies provided insight into healthcare waste management in the UK (Nichols et al., 2012; Nichols & Manzi, 2014; Tudor et al., 2007a; Tudor et al., 2008). Findings from these studies support the value of recycling as a focus of sustainable waste reduction practices. Therefore, I focussed so much on setting up and evaluating the recycling service because I wanted to demonstrate how environmental and financial benefits can be achieved.

Health professionals are often regarded as leaders and therefore have a significant role to play in modelling and initiating environmental sustainability behaviours (Hartman et al., 2011). Nine studies focussed their attention on the individual employee regarding how much importance health professionals direct towards environmental sustainability (Charlesworth et al., 2012; Evans et al., 2012; Goonan et al., 2014; Hartman et al., 2011; Jamali et al., 2010; Nichols et al., 2012; Nichols & Manzi, 2014; Patrick et al., 2011; Tudor et al., 2008).

The two main points from these nine studies which are especially pertinent to the present study are discussed next. In the study by Nichols et al. (2012), attitudes, beliefs, and knowledge were deemed to be important attributes to gauge in this context. Twenty participants were interviewed and underlying cognitive processes that underpin individual and organisational behaviour with reference to the 'reduce, reuse and recycle' philosophy were explored. The personal values of individuals were elicited and clearly showed that topics such as knowledge, finance, and legislation impacted on attitudes and behaviour regarding healthcare waste management. Participants were clear that it was

desirable to reduce, reuse, and recycle waste in healthcare from financial and environmental perspectives.

Previous research also indicates a need for an understanding of the mind-set of individuals and organisations focussing on the values, attitudes, norms, and behaviours as a means of seeing a positive change response (Nichols et al. 2014). A greater understanding of the attitudes, beliefs, and knowledge that underpin individual and organisational behaviour can be expected to lead to a deeper appreciation of the factors that enhance or inhibit pro-environmental waste-related behaviours. Self-reported behaviour may not always translate into actual behaviour when the actual behaviour is measured through waste weight alone. The volume and type of waste generated is a result of a few factors. From this finding I came to realise whether a person chooses to place the correct waste into the correct bin is one part of the process, but if the bins are not situated in close proximity to where the waste is generated then a poor contamination rate in this instance may be a result of an entirely different reason than personal choice. Furthermore, evidence suggests that individual employees may prefer to recycle but can only recycle when it is convenient and straightforward (Tudor et al. 2008). I made a concerted effort to place recycling bins in locations that were convenient, however, this was not always entirely possible given some of the older building locations had space constraints. To overcome this problem, I purchased stackable recycling bins that could easily fit into tight locations. I did this because I wanted to make sure that resources were readily available to make it easier for people to do the right thing.

5.4.4 Hypotheses

The literature review findings led to the development of the following hypotheses to address the overarching research-project question and sub-questions (detailed in Chapter 1). In relation to the first question and based on the findings from the literature I expected to see positive financial and environmental effects of the recycling project:

Question 1 What effects do recycling interventions have on sustainability outcomes in healthcare practice?

H1.1 Recycling has a positive financial effect in healthcare waste management.

H1.2 Recycling has a positive environmental effect in healthcare waste management.

H1.3 There is a difference between and within sites (Hospital versus Clinic setting)

Findings from the audit data would be able to confirm or refute the first set of hypotheses whereas the survey responses would hold the answers to the following set of hypotheses:

Question 2 What is the interplay between organisational support for such an intervention, a recycling project and individual employee behaviours?

H2 Leadership support is necessary to improve sustainability outcomes.

Question 3 Does organisational support for recycling impact positively on employees' recycling practices?

H3 Interventions regarding recycling bring about positive employee responses.

Question 4 Do healthcare employees reflect more positive attitudes towards environmental sustainability after the intervention of a recycling project?

H4 Differences in study outcomes arise as a result of demographic variables.

The discussion in the previous section of the findings of the literature review focussed on the broader constructs of waste impact, waste care management, and sustainability outcome. The next section provides a summary of the impact of leadership and change management. The themes presented in the conceptual framework are greatly affected by the presence or absence of organisational support and leadership especially in a complex setting such as a large multi-site healthcare organisation. The CM Health sustainability programme and recycling project required a change management process. I was the dedicated resource who delivered, measured, and drove the change required to achieve the programme outcomes.

5.4.5 Theoretical lens

There is a clear relationship between leadership and change management since changing behaviour from an undesirable state to another more desirable state requires leadership. Engaged leadership is widely recognised as being an essential component of ensuring effective sustainable waste management (Patrick et al. 2011). Hartman et al. (2011) found that when organisations were more aligned with the sustainability movement, they were more likely to have higher perceived outcomes; this was much more the case for

healthcare organisations. The underpinning theories of leadership and change management are discussed next, further supporting the theoretical lens presented in Chapter 4, showing the way the theory shaped this project.

5.4.5.1 *Leadership*

Strong demonstration of leadership is required for the successful adoption of sustainability. This was shown in the literature review with 12 studies demonstrating the importance of organisational leadership (Abor, 2013; Alam et al., 2003; Franco & Almeida, 2011; Goonan et al., 2014; Hartman et al., 2011; Jamali et al., 2010; Kantabutra 2011; Komilis et al., 2012; Manga et al., 2011; Patrick et al., 2011; Srivastav et al., 2012; Tudor et al., 2008). This illustrates the connection between an engaged and committed organisation, the leadership of individual employees, and the successful adoption of sustainable waste management programmes. This is the reason I included details of how the leadership team fully supported this programme in all messages that went out to employees.

Two studies expounded on the importance of having a strong leadership focus regarding sustainability (Franco & Almeida, 2011; Kantabutra, 2011). One study described the importance of seeing sustainability as part of organisational culture (Franco & Almeida, 2011). The organisation was found to play a central role in terms of learning and leadership in relation to performance. Leadership amongst managers was found to play an important role in interpreting environmental issues and developing pro-environmental programmes, thereby shaping corporate behaviour. Their survey focussed on measuring the components of learning and leadership styles. This finding led to the inclusion of a survey question directly asking for evidence of departmental leadership support since I learnt from the literature that leadership across all levels of the organisation needs to be demonstrated. Additionally, and in some ways, more importantly, I sought approval from and the support of departmental, service, and general managers prior to approaching any area about initiating sustainability-oriented practice.

I knew from my professional nursing experience that it is beneficial to respectfully follow often ingrained and not always useful hierarchical processes. This shines a spotlight on the differences between healthcare and non-healthcare organisations since practices such as these stem from a western medical model approach, less aligned with the collective leadership style and representative of an autocratic leadership style.

Using Avery's (2005) Sustainable Leadership Grid, Kantabutra et al. (2011) attempted to assess embedded sustainable leadership practices because organisations need to do more than merely comply with environmental programmes. Organisations that are committed to environmental management display values that are aligned with high quality, high performing organisations. As such, this type of organisational culture positively influences individual employee behaviour. Once again, this resonates with complexity leadership theory which conceptualizes leadership as a continuous process stemming from collaboration, complex systems thinking, and innovation (Chapter 3).

From the literature I understood how an individual's characteristics ultimately influences behaviour, yet interplay exists between both. I could see that by incorporating sustainability, organisations can also attain performance improvement targets. From my experience as a sustainability officer I noticed that improved financial outcomes are the main objectives of a sustainable waste programme. Sustainability objectives are less commonly set as targets, yet they are more readily achieved especially when fully integrated and embedded into every aspect of organisational performance.

Organisational commitment is expressed in terms of policy and policy is said to drive and sustain behaviour change in terms of developing a strategic and integrated approach to sustainable management (Franco & Almeida, 2011). Within that approach, one study identified the importance of setting strategic sustainability targets (Patrick et al., 2011). Kantabutra (2011) described the need for legislation, in addition to developing a clear and comprehensive waste management policy, based on the findings of a study seeking evidence of corporate sustainability in a Thai healthcare service provider. Manga et al. (2011) set out to critically analyse existing national waste policy. Findings uncovered insights into the complexities of healthcare waste management in developing countries. Inefficient segregation, collection, and transportation in the absence of training, poor legislation, unsafe practice, and illegal dumping were described as common challenges in this context. In knowing the complexity of healthcare waste management, I deemed it was important to set out and communicate a clear plan to help prevent, or at least lessen the likelihood of issues arising and therefore impact of the challenges occurring (listed above). The details of the plan were shared with relevant parties at both the service and operational level and at the managerial and leadership level. Thereby serving two purposes, the first was to raise awareness of the programme and the second was to positively influence attitudes and beliefs.

As previously discussed, corporate success in adopting sustainability practices depends on corporate attitudes towards environmental issues (external factors) in addition to the personal beliefs and everyday actions of employees (internal factors). Having organisational and senior management level support helps drive policy that has a mediating effect on individual employees, resulting in more voluntary adoption of environmental practices. Strategic benefits may result from an improved institutional image, an increase in productivity, enhanced personnel commitment, and better relationships with external agencies.

Improved governance practices in the area of sustainability often correlate with positive organisational performance (Jamali et al. 2010). Institutional support is one of the crucial factors to success in achieving progress towards sustainability goals. This further supported the development of a clear sustainability plan to help provide a measurement and feedback process to assess goal completion. From the literature I realised the presence of leadership support was significant in terms of enabling the onset and ongoing delivery of the sustainability and recycling programmes in addition to equipping the personnel with the necessary resources required to deliver the programmes. Resources include the materials and the human resource, such as the sustainability manager. The literature suggests employees recognise how organisations value issues of sustainability measured by the presence or absence of sustainability programmes and resources. Furthermore, a growing culture of sustainability helps to raise awareness and understanding; helps identify the benefits of practising more sustainably, where changes are more readily adopted (Komilis et al. 2012). This emphasised to me the importance of ‘managing’ the change management process in the most effective way, but also on the way the change management process is ‘managed’. This brings the discussion on to change management where these points are further discussed.

5.4.5.2 *Change management*

For organisation-wide programmes where employees were required to consider altering their behaviour, an understanding and application of the theoretical principles of change management was deemed to be crucial in 11 studies (Charlesworth et al., 2012; Connor & Mortimer, 2010; Evans et al., 2012, Kaplan et al., 2012; Lui et al., 2014; Miller et al., 2011; Nichols et al., 2012; Nichols & Manzi, 2014; Njagi et al., 2012; Ruoyan et al., 2008; Tudor et al., 2008).

A well-managed change process leading to sustained change involves a range of strategies and leadership characteristics. Literature indicates that achieving positive and desirable behaviour change might provide a valuable means of achieving effective outcomes in healthcare waste management (Kaplan et al. 2012; Lui et al. 2014; Nichols et al. 2012). Suggestions for ways of changing behaviour within an organisation include employee training as well as increasing the level of communication about recycling and environmental issues (Charlesworth et al. 2010; Evans et al. 2012).

Campaigns that incorporate a range of different education techniques have been designed and discussed as they target behaviour change (Evans et al. 2012). Education overall was found to be lacking as there is very little evidence on effective methods for teaching healthcare workers about sustainability and recycling programmes. This is an important point since the success of the CM Health programme hinges on the ability to sustain the desired behaviour over time. Therefore, I adopted a flexible approach and offered a range of educational resources and delivered the information in many formats. The options provided to clinicians included, for example, written forms of information such as posters, fact sheets, frequently asked questions, or more formal in-person formats including delivering slideshows, attending meetings, huddles to organising and running workshops. Web-based platforms were also available, as previously mentioned. Managing the programme over the years has involved engaging in many opportunities to provide education, raising awareness to support and sustain the programme over time.

Behaviour change in relation to waste in the setting of healthcare responds favourably to several components of a campaign as described by Evans et al. (2012). Eliciting behaviour change is one aspect of sustainable healthcare waste management; however, maintaining the desired behaviour overtime is another matter. Using a campaign was found to help normalise pro-environmental behaviours. Targeted behaviours were found to be successful, using prompts, posters, and feedback. In addition, having a sustainability programme and policy helps maintain the momentum required to sustain the desired behaviour change (Manga et al. 2011).

Behaviour change techniques were identified as important features of successful sustainability programmes since attitudes and practices of individual employees related to waste generation and disposal were deemed important indicators of behavioural outcomes (Goonan et al., 2014). Eleven studies recognised effective change management as having enabled successful sustainability outcomes (Charlesworth et al., 2012; Connor

& Mortimer, 2010; Evans et al., 2012; Franco & Almeida, 2011; Hartman et al., 2011; Kaplan et al., 2012; Lui et al., 2014; Miller et al., 2011; Nichols et al., 2014; Njagi et al., 2012; Ruoyan et al., 2008). Components of effective change management are summarised as preparing for, managing, and reinforcing the change.

Guided by the literature, preparation for this project included defining the change management strategy, preparing the stakeholders, and developing the plan. The actual change management process involves delivering and implementing the plan. Further, the final step involves reinforcing the change where feedback is collected and analysed (like Lewin's Theory of Planned Change, discussed in Chapter 3). With this, I could identify data gaps and implement corrective actions. I made sure certain successes were celebrated to reinforce the change, all of which culminates in a well-managed change management process. The findings of the study by Franco and Almeida (2011) attested to the importance of a well-managed change management process when delivering sustainability programmes.

Positive behaviour change was more likely to be seen in the presence of a well-managed change process. Several organisational change models are relevant to the implementation of sustainability change initiatives. As noted earlier in Section 3.1.2, change management models may not be the best fit for the healthcare sector because these are loosely coupled organisations with unique cultures, differing social systems with multiple power and authority structures creating an ambiguous leadership structure. These characteristics make intentional changes more difficult to make and sustain, however, a way forward has been formed and proposed for this study using the lens of complexity leadership theory and Lewin's unfreeze, freeze and refreeze framework.

5.5 Summary

From the literature review the research-project questions and hypotheses were developed (see Sections 5.4.4 and 6.2) and a range of data collection methods were chosen to gain a more comprehensive understanding of the topic. For this study, organisational waste data, the carbon footprint associated with waste activities, and end-user (individual employees) attitudes and perceptions, were gathered and drawn together as a means of measuring the effect of the recycling project from a macro to a micro perspective.

The literature review highlighted the absence of literature on recycling (as a component of sustainable healthcare waste management practice) from a NZ perspective and this study set about to measure the environmental and financial outcomes of the recycling project, as discussed in Section 4.1.1. This is a practice-led case study and the case study approach was the most commonly adopted among the studies reviewed, being well-suited to healthcare-related research project studies (refer to Section 3.3.1).

This chapter reported on a range of studies in a wide-ranging discussion that had a variety of things to say about a sustainability programme. This study sought to explore the link between the organisation and the programme, since evidence suggests that a successful and comprehensive programme of intervention would not exist in the presence of a disengaged leadership or in the absence of having a dedicated sustainability lead (see Section 3.1.1.2).

The literature review showed that there is a need for further research into the nature of the organisation and how it interrelates with individual employee perceptions and behaviour regarding waste management change programmes (as was described in Section 5.4.1). Further investigation is therefore required to determine whether there is a complex interaction between individual employee perceptions and organisational behaviour.

Different methods used to train and educate staff about waste management also warrant further exploration. The extant studies indicate a link between the effects of education, training, and increased engagement in such change programmes (Charlesworth et al., 2012). Learning how the change process continues over time would help to gauge whether and how the change is sustained in the longer term (Nichols & Manzi, 2014).

The literature review has revealed that sharing the results of a sustainability programme in relation to financial and environmental outcomes is considered important from an employee perspective (Hartman et al., 2011). Individual employees are often very interested in knowing these results as feedback around progress is motivating and encouraging.

Figure 5.2. Conceptual framework: Recycling Project summarises a conceptual framework derived from the literature review findings and provides an indication of the data capture methods employed during this research-project. The intervention reportedly leads to the outcomes listed, which in turn makes the programme more effective. The

primary constructs are incorporated within this framework and, while the nature of the interplay among the outcomes conceptually is unclear, the literature findings suggest that there is a positive compound effect (Tudor et al., 2008a).

The next chapter describes the research-project design for the study, discussing the research paradigm and the approach used. The methods chosen to gather and analyse the data are discussed regarding addressing the research-project questions based on the framework (shown in Figure 5.2).

Chapter 6 Research-project Design and Methods

6.1 Introduction

This practice-led case study uses mixed methods of data collection and analysis with a time series design. After stating the research-project question and purpose, a description of methodological procedures is presented. A description of the steps taken to fulfil the ethical requirements of this study precedes a summary of sampling steps taken. The three data sources: audit, quantitative (closed survey questions) and qualitative open-ended survey questions) are described separately, in terms of data collection through to data analysis. The respective data sources provide different views of the outcomes of the recycling project and environmental sustainability programme, from across all levels of the organisation, and are presented next.

6.2 Research-Project Question

The research project questions introduced in Chapter 1 and detailed below set out to determine if recycling (used as a proxy for waste reduction outcomes) improves as a result of the sustainability interventions:

The overarching research-project question is:

- What are the outcomes of a recycling project and environmental sustainability programme on practice in a healthcare setting?

Sub-questions are as follows:

1. What effects do recycling interventions have on sustainability outcomes in healthcare management?
2. What is the interplay between organisational support for such an intervention, a recycling project, and individual employee behaviours?

Interplay exists between the organisation, the programme, and the individual employee (Nichols et al. 2014). In support of this agenda, the provision of an effective recycling project by the organisation and the subsequent adoption of that project by individual

employees can be expected to result in behavioural change, as indicated by the research reviewed in Chapter 5.

A second set of questions was therefore developed to uncover further understanding of the interconnected nature of organisational and individual employee factors:

3. Does organisational support for recycling impact positively on employees' recycling practices?

4. Do healthcare employees reflect more positive attitudes towards environmental sustainability after the intervention of a recycling project?

I expected that leadership support, as shown by the provision of the project and a dedicated sustainability resource along with a commitment to integrating approaches to recycling, would improve sustainability outcomes. Furthermore, I expected that employee attitudes and beliefs towards the sustainability interventions would change over time, and interventions regarding recycling would bring about financial and environmental benefits.

The audit data were gathered to provide the evidence for or against the claim of the environmental and financial benefits of a sustainability programme. A survey was developed with closed questions to measure the attitudes and beliefs, behaviour change, knowledge, and level of exposure to the sustainability interventions. Demographic details of individual employees were gathered as it was anticipated that these could make a difference to behavioural outcomes. Different occupational groups could also exhibit behavioural differences and there could be a difference between sites (hospital versus clinic), as supported by the findings of the literature review. Further, data on both measures were included in the survey instrument.

The survey questions were framed to add context and glean an understanding of the end-users as a means of generating an appreciation of the programme processes as opposed to the outcomes. This is an important point since the literature review indicated that previous studies have focused largely on outcomes alone. Including open-ended questions with the survey tool allowed respondents the opportunity to provide feedback and add comments about the recycling project and environmental sustainability programme. By using mixed methods of data collection, this study evaluated project

outcomes and reveal how individuals regard the processes of the programme, thereby enriching the findings.

Healthcare is based on the plurality of data and interpretations where practical reasoning requires interpretation and context (Denscombe, 2012). Since this study was set in the context of healthcare practice, the adoption of case study research using multiple sources of data gathering assisted in providing a holistic in-depth investigation (Charles & Mettler, 2007; Patton, 2002; Robson, 2011; Teddlie & Tashakkori, 2009). The rationale for taking this approach is discussed next.

6.3 Case Study Research

Costley and Lester (2012) describe four types of doctoral projects. One of the four types describe development or change projects pursued as part of (or an extension of) the candidates' work, from the insiders' (emic) perspective, taken forward in an intellectually rigorous and critically reflective way. This type of doctoral research project employs research principles and produces insights and impacts beyond what would normally be thought of as the practice context and they can be described as practice-as-research.

To address the research project question, a practice-led case study design was developed. As the project (and programme) continues to evolve, the research-project approach was designed to meet both the expectations of the DHB, and to answer the research project question, thereby meeting both the requirements of the doctoral programme and aligning with my personal beliefs and worldview. The process of building theory from case study research began in the 1960s with Glaser and Strauss and, more recently, with Yin (1981, 1984) and Eisenhardt (1989). Yin (1984) described the design of case study research and noted three main categories (explanatory, exploratory, and descriptive). This study falls into the explanatory category, seeking to generate theory and increase understanding.

Recycling in the context of large-scale organisational change management is a complex phenomenon where close examination is required to build understanding of an emerging area in research. Case studies provide the opportunity to explore in-depth relationships of social behaviour, such as that pertaining to the CMDHB recycling project and environmental sustainability programme. Case studies cope with technically difficult situations (De Massis & Kotlar, 2014; Sato, 2015), rely on multiple sources of evidence

and allow for the investigation of a phenomenon within its real-life context (Zainal, 2007). This is an important point in the case of this study where the boundaries between the phenomenon and context are not so clear (Yin, 1984) with the chosen methodology being both justifiable and appropriate.

Case study research fits well with real-world research approaches. The variables of interest for this study could not be so tightly controlled. Budgets had to be approved, business cases signed off, areas and departments had to be amenable to the proposed changes and clinical demands conducive and able to adapt their waste management behaviour. Using a case study approach meant I could be practical in the way the programme was implemented because this approach afforded me a reasonable level of flexibility. Additionally, as was discussed in section 5.3.2, the case study approach is commonly applied by many other healthcare organisations when studying sustainable waste management practices. Eleven of the 23 studies were *case studies* and sixteen studies used a combination of approaches, further validating the approach taken to address the research questions posed in this study.

The next section presents an overview of four interlinking elements, my epistemological perspective, the applied theoretical perspective, chosen methodology, and methods. As a pragmatist and as a long-standing healthcare worker, the case study approach was fitting. Pragmatists decide what they want to study based on what is important within personal value systems and what fits in well with both the work context (Crotty, 1998; Kadlec, 2006; Robson, 2011; Teddlie & Tashakkori, 2009) and practice-led research, reflecting my ontological belief regarding my understanding of what is this reality. The following diagram provides a summary of the processes adopted for this study using Crotty's framework.

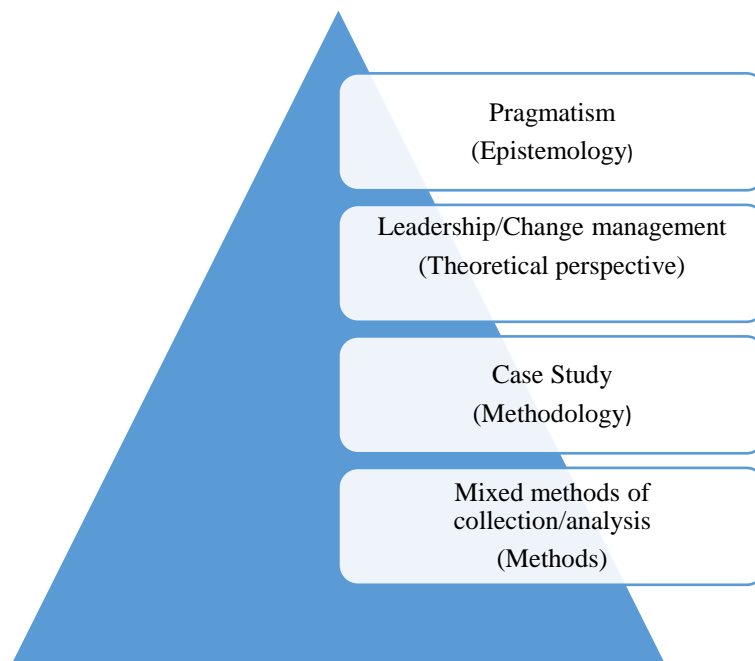


Figure 6.1. Research process (Crotty's framework) adapted from Crotty, 1998, p. 4.

Case studies are particularly relevant to organisational and healthcare studies because they allow for multiple facets of the research phenomenon to be revealed using a variety of lenses, whilst navigating multiple levels of analysis (De Massis & Kotlar, 2014). The adoption of mixed methods using multiple sources of data gathering helps to overcome the limitations of using a single approach (Charles & Mettler, 2007; Patton, 2002; Teddlie & Tashakkori, 2009).

This study sought to test a conceptual framework developed from the findings of the literature review that linked together multiple interconnected dimensions (organisation, programme, and individual employee) using expansion to add breadth and depth to the inquiry. Expansion, an approach described by Rocco et al. (2003), is used as a means of validating a study's findings. The audit data and closed-ended questions assess the outcomes, while the open-ended questions assess the processes. This is important since using multiple methods of data collection techniques provides the opportunity to explore a topic from both wider and deeper views (Rocco et al., 2003), as well as providing an opportunity to triangulate the findings (Yin, 2009). The phases of the research-project are next explained.

6.4 Phases of the Research Project

The research design included a sequential pre-test- post-test approach (Teddle & Tashakkori, 2009); capturing audit data and utilising a survey tool and comprising the first two phases of a five-phase process (see Figure 6.2 below). The survey was designed, guided by the literature (discussed in detail in Section 6.6.2.2). The purpose of this case study design is to correlate audit data (actual) with the surveys scores (stated) as well as to measure the interrelationship of the open-ended questions to the outcome measures of stated and actual behaviour. A sequential approach ensured that the data retrieved during Phase 1 could orientate the focus of Phase 2. This ensured cohesion between the first and second phases of the research project.

Phases	Case Study Research	Start	Finish	Duration	2014				2015				2016	
					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
1	Baseline data: gather audit data	02/12/2013	13/12/2013	10d										
2	Phase 1: gather audit data and distribute survey 1	21/02/2014	01/04/2014	28d										
3	Deliver project activities	17/02/2014	20/02/2015	265d										
4	Phase 2: gather audit data and redistribute the survey	20/02/2015	31/03/2015	28d										
5	Phase 3: Integration of findings	29/09/2015	29/06/2016	197d										

Figure 6.2. Research project design.

There was a 12-month period between the first two phases with a concerted effort made to implement the recycling activities in many areas of the organisation. The survey provides the opportunity to capture data that could be analysed in different ways.

This study is primarily quantitative; the qualitative component was embedded within the survey instrument. Respondents completed the survey and no interviews were required because a wealth of data was generated by including two open-ended questions within the survey tool. Figure 6.2 provides the details of timeframes showing how the bulk of recycling activities were employed in-between data gathering. The project did not start and end to suit the research, rather the research project was built around the organisation-wide project. Collecting organisation-wide waste and carbon footprint data provides the high-level overview of the project and programme outcomes. These data are useful to collect as they allow for year-to-year comparisons. Gathering data by employing a survey tool adds greater detail, addressing the research project question in keeping with the conceptual framework. Comparing and contrasting the results provides a further dimension to this research project, adding understanding whilst enriching the results.

The research project design features sought to strengthen the findings, add credibility, and enhance the likelihood of project replication despite living and ‘doing’ research in the context of the ‘real world’. One of the greatest strengths of case study practice-based research is conversely its greatest weakness, since each ‘case’ is unique, making replication and generalisation problematic (Tudor et al., 2008b). However, one of the purposes of case study research is to generalise to a theory, not necessarily to a population (De Massis & Kotlar, 2014).

The first part of this chapter has focused on the theoretical aspects of the research project. The next section of this chapter explains the operational process and presents the steps taken to ‘do’ the research project. These steps are described in chronological order, collectively entitled ‘Procedures’.

6.5 Procedures

To undertake an effective research project the steps that researchers are required to follow are generic (Teddlie, & Tashakkori, 2009), this study being similarly ordered. After submitting a research project proposal one of the next steps involved gaining ethical approval.

6.5.1 Ethics

The ethics of undertaking practice-led research do not differ from the ethics of the more traditional approaches (Robson, 2011). The following steps were put in place to mitigate the effects of the two major types of bias: selection and information bias. The surveys were administered by a third party to maximise the potential for open and honest responses to avoid selection bias. The surveys were intended to provide the participants with an opportunity to express their perceptions in relation to the topic. The questions were neutrally worded to avoid information bias and posed limited risk or discomfort resulting from financial, cultural, or social pressures. This is because CMDHB employees who worked at the Middlemore Hospital (MMH) and Manukau sites were invited to take part in the research project and did so voluntarily. The design of the data collection procedure attempted to neither favour nor disfavour collecting data from certain individuals or in certain conditions. To reduce sampling bias, the target population was properly defined to ensure the sample frame matched it as closely as

possible. I had implemented the recycling project across these sites and these employees were likely to be already aware of the environmental sustainability programme.

Ethical approval for this study was sought from CMDHB (the case organisation) as well as from the Auckland University of Technology Ethics Committee (CMDHB reference number 1435, AUTECH reference number 13/213, in Appendix E). The need for two sets of approvals is because this is a practice-led study, developed as partial completion of the Doctor of Health Science (DHSc) programme requiring approval of both the case organisation and the doctoral programme provider. Formal steps were taken to gain ethical approval as follows: application documents were assembled, later signed off by the Head of School (AUT) and the CMDHB research committee. A risk assessment was undertaken by the AUT/CMDHB ethics review body followed by notification of approval. Once all ethical criteria were met, as set by the University and the CMDHB research office, the project could begin.

6.5.2 Sampling

Approval was obtained from CMDHB's research office to access the organisational database which listed all current employees. The sampling frame consisted of 6,525 employees at CMDHB in February 2014, along with organisational information enabling accurate divisional and occupational stratification.

For this study sampling for the qualitative aspect involved purposefully selecting responses from the participants being explored. The sample used to provide the quantitative data represented maximal variation. All participants who completed the qualitative component were included in the qualitative analysis.

The same survey was distributed to each respondent for the pre- and post-programme intervention, thereby resulting in the generation of three different respondent statuses: those who answered the first survey only; those who answered the second survey only; and those who answered both surveys. Only respondents who worked more than 20 hours per week were included. This was deemed appropriate as staff working less than half time would likely be less exposed to new changes and potentially less familiar with organisational goals.

To allow for effective sampling, and to subsequently assist the methods used to analyse the data, descriptive headings were assigned and categorised fewer than two main headings: clinician and non-clinician. Health practitioners were categorised as clinicians

– staff that were the most likely to segregate and handle all waste types- general, recyclable, medical, and food waste. Non-clinicians were staff that mainly held administrative roles and would handle all types of waste apart from medical. This category label also included individuals who worked as cleaners and orderlies as well as any other role that did not fall into the clinician category. This group of staff handle all types of waste, with less emphasis on medical waste at the point of segregation, and more emphasis on the transportation of all waste away from the sites. This categorisation of the two groups was intended to develop an understanding of the waste programme as experienced by staff in each category, since the level of exposure to the different waste types may impact differently on behavioural outcomes. Stratified sampling involved these two groups. This next section presents a summary of the steps undertaken to distribute the survey, focusing on data collection.

6.5.3 Survey administration

An email invitation to take part in the survey was sent to the staff and included an information sheet (Appendix F). Two prize vouchers each one amounting to \$300 were used as a recruitment mechanism and participants were informed in the introduction to the survey. The AUTECH suggested the inclusion of a prize to boost response rates. Respondents were able to indicate if they wanted to enter the draw for the vouchers. The draw for each voucher was being used to thank respondents for their valuable contribution and time. Response rates to surveys are notoriously low and so it is therefore considered useful to both acknowledge and encourage participants by offering a small gift or incentive to take part in the surveys (Church, 1993).

Employees from both sites (MMH and Manukau) were invited to participate in the surveys. Both sites were chosen because they allowed comparisons to be made between the two sites since MMH provides mainly inpatient services, whereas Manukau provides mainly outpatient services. The systematic review in Chapter 5 identified no empirical studies that had explored and compared the outputs from inpatients' and outpatients' facilities.

6.6 Data Collection

The three types of data collected are presented next, starting with the numeric data, referred to here as audit data. This section is followed by a summary of the survey data and an overview of the pilot study.

6.6.1 Audit Data

The numeric or descriptive data accessed from CM Health and used in this study comprises costs and weight of landfilled waste and waste diverted from landfill including waste activity-related carbon emissions. To allow for further exploration of the waste data, indicators of activity are also gathered. Data were captured of the number of employees required to deliver the healthcare services and the number of inpatient and outpatient presentations to inform the annual carbon footprint calculation. These data were captured as baseline information showing the type and quantity of waste and resultant carbon impact before implementing any change intervention. Data were collected pre-implementation and compared to the same data collected post-implementation. Organisational data of this kind are routinely collected by CM Health and are available to me as the primary researcher the organisational project leader. Pre- and post-comparisons were intended to indicate numerically the relative success or failure of the programme.

Numeric data, referred to as material sampling (Teddlie & Tashakkori, 2009), collected pre- and post-implementation, included:

- Waste to landfill amounts expressed in tonnes
- Costs of waste disposal and transportation
- Amount of recycled waste, sorted by type and weight
- Revenue/rebate earned from recycling
- Waste activity-related carbon footprint data
- Number of Full Time Equivalent (FTE) employees
- Number of inpatient and outpatient presentations

Audit data were collected pre- and post-programme to validate and augment the reported and perceived behavioural changes. Calculations of carbon impact were provided as part of our membership of the CEMARS programme (as discussed in Chapter 4). The survey captured self-reported accounts, discussed next.

6.6.2 Survey Data

A questionnaire employing an attitude scale was developed containing closed- and open-ended questions derived from the literature. Many issues may arise as a result of developing and using a novel and untested tool (Teddlie & Tashakkori, 2009). As this research-project has unique features not previously studied in the literature, a search for a pre-tested and validated tool used in a similar context was unfruitful. Practical experience and the literature informed the development of the survey under the guidance of a biostatistician. Piloting the survey prior to full implementation enabled preliminary review, evaluation, and revision.

6.6.2.1 *Pilot Study*

The pilot study took place during October 2013 and the pilot survey was distributed via an email. Additionally, four academics from Auckland University of Technology (AUT) provided expert critique of the survey instrument. Sixteen clinicians and administrators from MMH formed the remaining pilot sample, providing an opportunity to test the survey on site. The pilot sample was excluded from the final sampling frame.

An evaluation form was sent out with the pilot study asking respondents to rate the qualities of the survey instrument such as the appearance, format, length, language, and clarity (Appendix G). Seventeen of the 20 pilot participants responded within the given timeframe; 14 responded on the day of survey distribution with the remainder responding after their second and final reminder.

The feedback in the evaluation forms resulted in a range of alterations and improvements to the format of the survey. Further modifications were made following the attendance of a statistics clinic held at AUT, August 2013. The instrument used for the pilot survey initially used a bipolar response format. Changing this to a unipolar scale meant that responses were ranked from 'Not at all' to 'Very', with the mid-point being no longer neutral but equating instead to being in the mid-range between the two end-points. The difficulty with assigning a score to a neutral response was therefore removed (Teddlie & Tashakkori, 2009).

6.6.2.2 *The Survey Tool*

The survey contained 48 questions including sub-questions (see Appendix H). All the variables of interest in the closed survey questions were measured by a Likert scale response. Table 6.1 provides an explanation by category for each question. The

constructs within the survey relate to knowledge, perceptions/facts, attitudes/beliefs, exposure/engagement, and segregating behaviour.

The purpose of the open-ended questions within the survey was to gain an understanding of the change process from the participants' perspective and the factors likely to be related to their change efforts. The first open-ended question asked for suggestions from respondents regarding how the waste programme might be improved. The second open-ended question focussed on how the sustainability ('green') programme might be improved.

Thirty-five questions were opinion-based, requiring either a dichotomous Yes/No answer or Likert scale response. These scales measured response either as "Not at all- Slightly- Moderately- Very- Extremely" or "Never- Rarely-Sometimes- Mostly- Always".

Table 6.1. Questions and their categories.

Question Number	Category	Number of Questions
1,39,40	Consent	3
2-7	Demographic	6
8-11, 19, 33	Knowledge	6
32-36, 36.1-36.7	Perception/fact	10
12-15	Self-reported behaviour	4
16-18, 21, 22, 24, 26, 28, 30, 37	Attitude/belief	10
23, 25, 27, 29, 31	Engagement/exposure	5
20,38	Open	2

6.6.2.3 *Survey Distribution*

'Survey Monkey' was used to administer the surveys. Electronic data collection methods have the advantage of leading to a more transparent data trail and easy data transfer for data analysis (Teddlie & Tashakkori, 2009). The first survey was distributed in February 2014 and achieved a response rate of 31percent. The total sample size was 977, with 321 responders and 656 non-responders. The invitation to take part in the second survey was distributed in April 2015 to 945 employees, using the same sampling pool, targeting the same respondents who took part in the first survey. A small number of people had left the organisation within the study timeframe, accounting for the lower sample size for the second survey. A total of 285 surveys were completed achieving a response rate of 30.2 percent. Organisational data were simultaneously collected on general waste, medical

waste, and all recycling streams. Waste weights and costs were recorded from data relating to the previous calendar year, from January to December 2013.

6.7 Data Analysis

The results accrued from using multiple data collection techniques required different types of analysis. The audit data merited a summary of findings whereas the survey generated numeric and narrative data. The research project design, therefore, involved both sequential and parallel data analysis. Phase 1 captured the baseline data, Phase 2 provided the follow-up data, and Phase 3 involved an integration phase. Table 6.2 summarises the different data analysis requirements and analysis schedule.

Table 6.2. Data analysis overview.

Data Type	Analysis	Analysis Schedule
Audit data	Summarising results	Following data collection Phases 1,2
Survey- closed questions	Exploratory Factor Analysis (EFA)	Following data collection Phases 1,2
Survey- open questions	NVivo coding	Following data collection Phases 1,2
Data integration	Integration of all results	Phase 3

Sequential integration of data collection methods and analysis provides multiple lenses through which to view the phenomenon in question and to enable triangulation. The audit data provides objective information, the survey data provides pre-set closed questions, and the open-ended questions enable the collection of further information not considered in the closed questions. A summary of the data analysis methods for each data set is presented next.

6.7.1 Audit Data Analysis

The waste and carbon footprint data were summarised as a means of identifying patterns (Teddlie & Tashakkori, 2009). Comparisons were intended to be made between sites and based on the different key performance indicators (KPIs) in relation to the research project question. The indicators chosen related to staff numbers (full time equivalent employees) and patient activity (inpatient and outpatient).

6.7.2 Quantitative Data Analysis

To answer the research-project question and assist with analysing the wealth of quantitative data generated, Exploratory Factor Analysis (EFA) was chosen. This method is suitable for complex organisational data such as in the case of this research project. EFA leads to the generation of patterns in a set of variables and uses mathematical procedures for the simplification of interrelated measures. EFA attempts to uncover complex patterns by exploring large datasets and testing predictions. This approach was deemed suitable given the unexplored nature of this research project question and the sample size (Yong and Pearce, 2013). EFA was chosen over Principal Component Analysis (PCA) because this study intended to discover the factors that accounted for common variance in the data. EFA describes the factor structure of data, underlying latent and unique factors. On the other hand, PCA accounts for a maximal amount of variance of observed variables and creates principal component scores, thereby rendering this approach less suitable, given the explanatory nature of this inquiry. A correlation matrix and a regression analysis were components of this factor analysis (Yong and Pearce, 2013).

Multigroup structural equation modelling (SEM) was initially deemed able to provide the means of analysing the quantitative survey data. A theoretical model was developed based upon the proposed SEM but the SEM proved too problematic to adopt which led to the more favourable use of EFA followed by mixed regression modelling, where the qualifier ‘mixed’ refers to the simultaneous fitting of fixed and random effects. The data generated favoured this type of analysis, primarily because when there are many potential correlations EFA helps point to the main factors or clusters of factors that have higher interconnectedness (Robson, 2011). Further, mixed regression modelling is a natural way to carry out analysis of the multivariate outcomes identified.

The analyses were carried out primarily using SAS 9.4 (SAS Institute, Cary NC) on the data generated from the closed survey questions. The quantitative analysis proceeded in three stages. The first stage consisted of the estimation of the polychoric correlation matrix of both survey questionnaires. The second stage comprised an EFA of the polychoric correlations to identify groupings of items or factors (realisations of emergent constructs) for further analysis. The third stage comprised a multivariate (mixed) linear regression analysis of the identified item groupings to estimate the changes effected on the constructs in the intervening year between pre- and post-intervention, as well as any

effect of main variables on these changes. The first two stages resulted in some items being removed; these removals were to be expected since this is part of the EFA process. Factors were identified from the loadings derived from the EFA; this was informed by the conceptual model derived from the literature review.

6.7.3 Qualitative Data Analysis

Open questions were included in the survey to provide a more meaningful account of the recycling project and the environmental sustainability programme from the end-user perspective. In doing so, further understanding is gained since relying only on numeric data may limit the expanse of this exploration. Offering respondents the opportunity to disclose their views using an open field helps to minimise this limitation, serving as an advantage in using a range of data collection methods, in fitting with the pragmatic approach to collection and analysis chosen.

All responses to both questions were read in their entirety to allow for a general appreciation of the qualitative findings as a first step. Fragments of text were next selected and assigned to categories or sub-categories, regarded as instances as general concepts. Emergent themes (or dominant features) of the research project topic were sought from the analysis of the answers to the open-ended survey questions. Themes based on the findings of the literature review and the findings of the quantitative study are incorporated. This enables a categorical analysis using a constant comparative method which involved comparing the results of the data analysis of the different data sets (De Massis & Kotlar, 2014; Saldana, 2016) to assist in addressing reliability. Categories and sub-categories were developed by applying the theoretical lens, guided by the literature review findings and the theoretical base (described previously in Chapters 3 and 5).

The qualitative data were coded, and the text divided into smaller units as a means of identifying the emergent themes. NVivo10 software was used as the coding tool, which generated a range of reports (fuller details can be found in Appendix I). A label was assigned to each unit allowing the unit to be grouped under codes and themes (Burnard, Gill, Stewart, Treasure & Chadwick, 2008; Creswell & Clark, 2011). Thematic coding is used to identify patterns and variations in the data for comparison. For example, healthcare workers' support for the idea of recycling could be contradicted by audit data showing that the amount of recycled waste is considerably less than expected and waste

is inappropriately placed. In vivo methods were used to analyse the data, extracting the exact words and phrases used by the subjects.

6.7.4 Integration of the Results with the Theory and Practice

Interpreting a range of data collection and analysis methods involved looking across all the results and assessing how all the information addressed the research project question. Inferences were made from the separate strands of data as well as from the consolidated data set (Creswell & Clark, 2011). The results from each strand were assessed to determine if they were congruent or divergent to each other, to the theory and to the practice (the project). To guide the reflective process, I used a model developed by Moon (1999) to explore and explain events, not just describe them, thereby identifying errors and weaknesses, as well as strengths and successes of the project. I chose this model because of my familiarity with it, having found it a useful tool because it embeds reflection into the learning process (Mann, Gordon & MacLeod, 2007). I selected the most significant parts of the project to reflect on, reflecting back on the past, how the research project was designed; the way the project was delivered and compared expected to actual outcomes as well as reflected forward to the future to consider what I might have done differently as a result of the process of reflecting.

This section brings the chapter to a close, and a chapter summary follows.

6.8 Summary

This chapter has presented the research project design and methodology of this study, focussing on the primary research project question and sub-questions. Philosophical underpinnings have been presented and methodological choices explained in the first part of this chapter, followed by an explanation of the research-project procedures, including sampling, data collection and analysis. The ensuing chapter presents the research project findings and results.

Chapter 7 Results

7.1 Introduction

The results of this study are presented in accordance with the order followed in the previous chapter. The audit is described as well as the results used to display the outcomes of the recycling project and environmental sustainability programme (intervention). Audit data captured both before and after the ‘intervention’ summarises the weight of each waste stream from the two sites of interest (MMH and Manukau) as well as the carbon impact of the waste-related activity. These data address sub-question 1 and are tested for H1.1 and H1.2 and H1.3. They provide a high-level overview of waste weight and associated environmental impact.

The findings from the quantitative aspect of the survey are presented next regarding whether and to what extent the audit data reflects the expected outcomes of the programme, and the level of interconnectedness of organisational and individual employee factors. These specifically address the second and third research project sub-questions, H2 and H3. Differences in study outcomes as a result of demographic variables (H4) are also presented. The findings from analysis of the open questions follow where participants were able to elaborate on, and evaluate, the effectiveness of the recycling project and the environmental sustainability programme. The final section of this chapter presents the integrated results from all three components of this research project.

7.2 Audit Results

A range of data is presented next revealing the broader outcomes of the recycling project and the environmental sustainability programme.

7.2.1 Waste Weight

A baseline measurement of all the weights of waste was recorded at the end of 2013, which preceded the introduction of recycling into the wider hospital context. General waste (GW) and medical waste (MW) weights have been tracked and are shown in Figure 7.1 (p. 93).

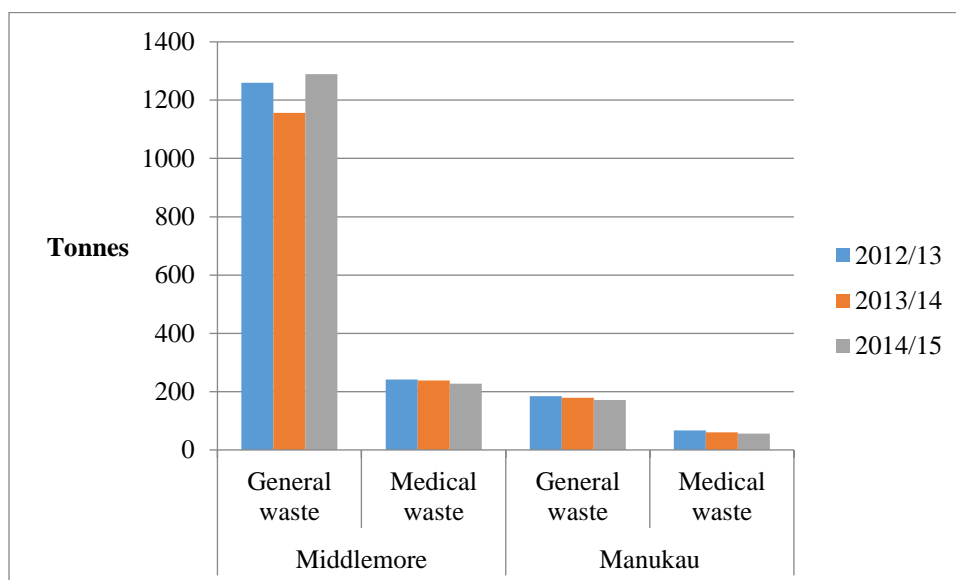


Figure 7.1. General and medical waste measured in tonnes at Middlemore and Manukau for the three reporting periods.

The weight of GW generated at Manukau shows a steady decrease over the study period with an average annual reduction of 4.6 tonnes. The weight of GW at Middlemore shows variation. Contextual factors explain this result, further discussed in Chapter 8.

The type and weight of recycling material are recorded by the operational team (contract manager). This provides a means of understanding waste by type whilst providing me with an opportunity to test the effectiveness of the recycling project. Figure 7.2 shows weight of paper, comingled (a term used for the combination of glass, plastic, and aluminium), cardboard, and total weight of all recycling at both sites across the three reporting periods, measured in tonnes.

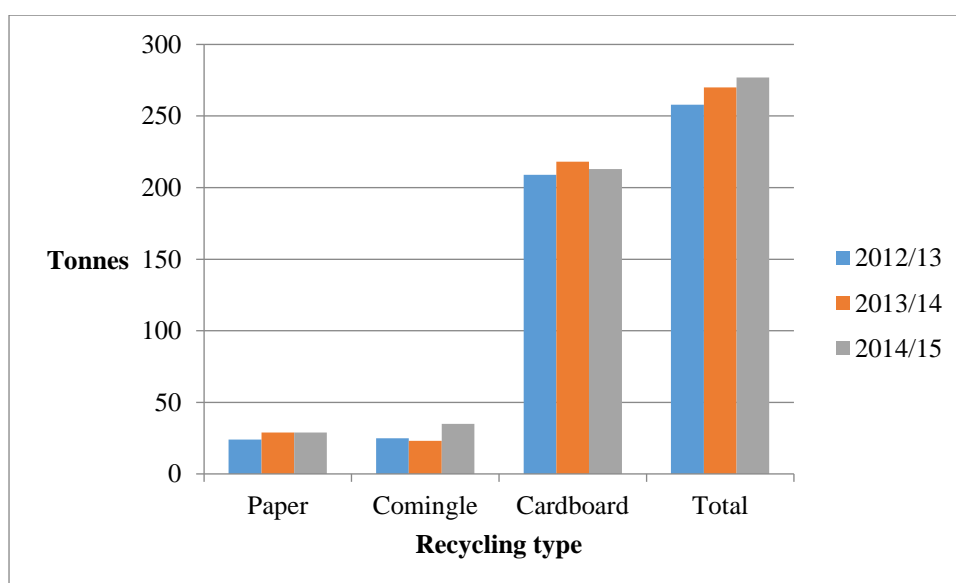


Figure 7.2. Tonnes of paper, comingled, cardboard and total (combined) recycling of both sites for the three reporting periods.

The total recycling weights show an average annual increase of 6.3 tonnes, with comingled showing the largest annual average increase (3.3 tonnes).

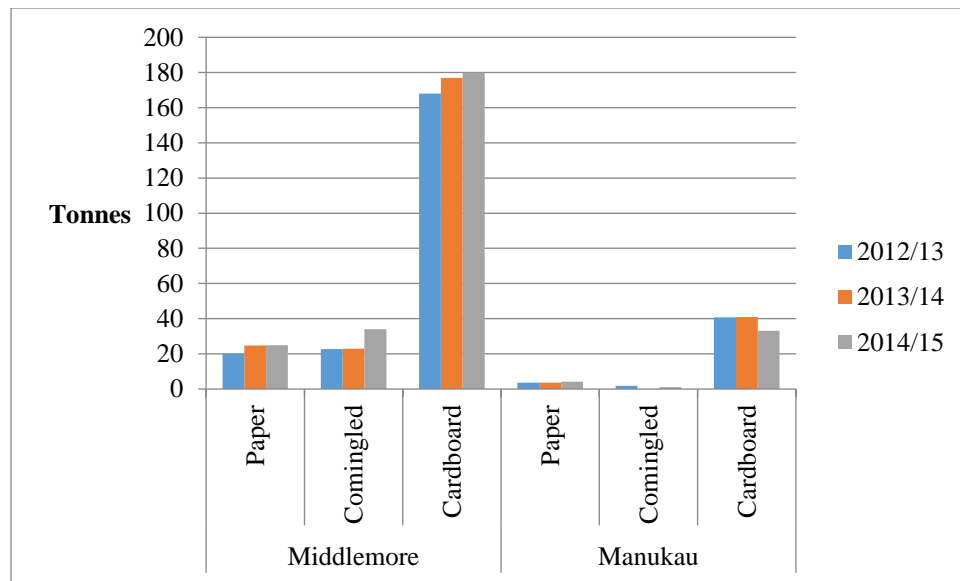


Figure 7.3. Paper, comingled and cardboard recycling per site, measured in tonnes for the three reporting periods.

Figure 7.3 shows recycling differentiated by type and site per year, measured in tonnes. Splitting the data this way reveals differences between sites. The Middlemore data reveal a steady average annual increase of 8.6 tonnes (5% increase) of recycling, whereas the cardboard weight dropped by 7.0 tonnes (20% decrease) at the Manukau site when comparing the endpoint data sets. There is only a slight variation found in the data collected on the weight of comingled and paper recycling.

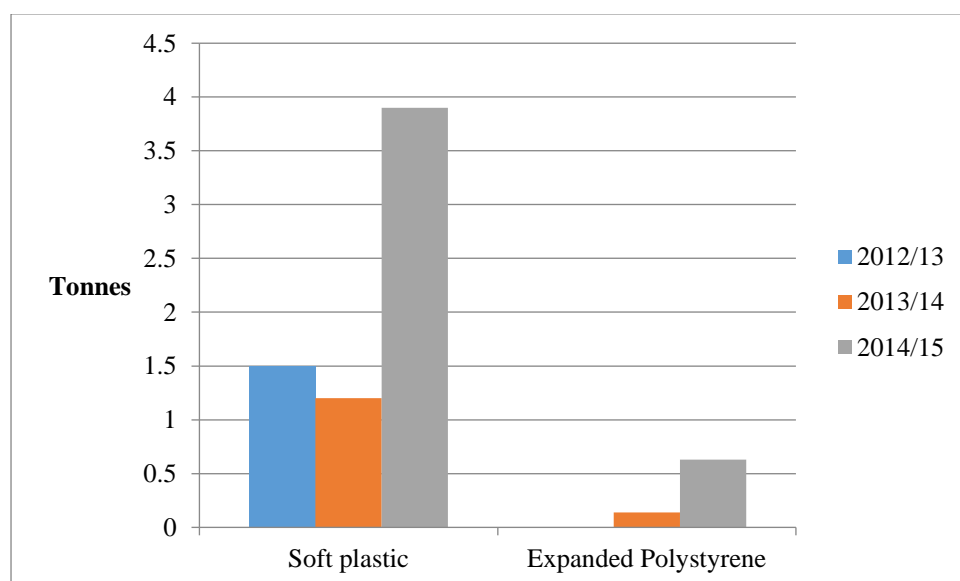


Figure 7.4. Soft plastic and expanded polystyrene recycling measured in tonnes for MMH for the three reporting periods.

Figure 7.4 presents information on other materials being recycled: namely soft plastic and expanded polystyrene. Expanded polystyrene was not recycled in the first year (2012/13). The weight of soft plastic and expanded polystyrene is four times greater at the end of the measurement period when compared to the baseline measurement.

As discussed in Section 5.4.3 (reduced waste costs), the waste management and sustainability literature suggest the use of indicators such as FTE to track the effectiveness of waste reduction programmes. This indicator is used in the following figures.

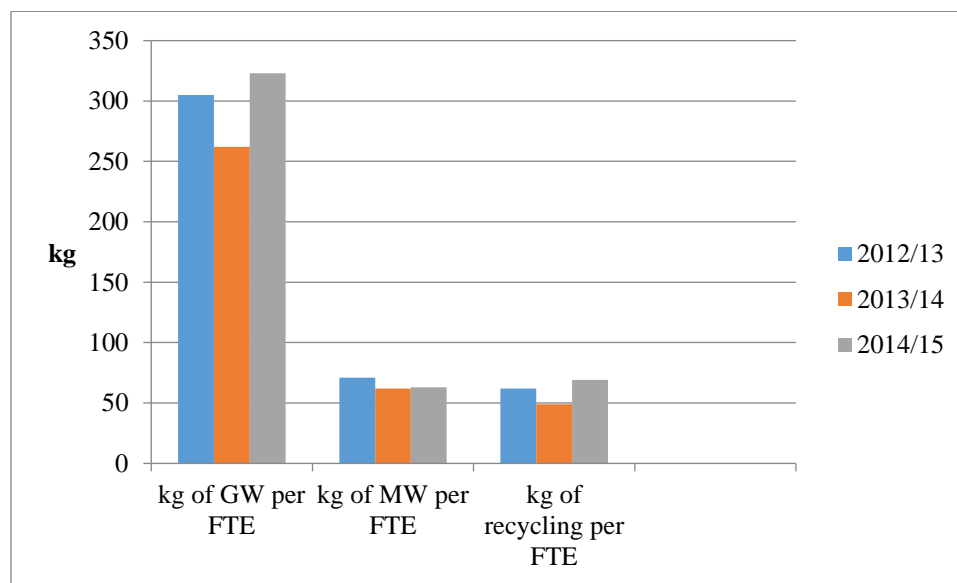


Figure 7.5. Kilograms of General Waste, Medical Waste, and overall kilograms of recycling at MMH and Manukau combined per Full Time Equivalent for the three reporting periods.

Since the data are recorded as a per person volume, the waste weight has been reduced to kilograms. Figure 7.5 details the kilogram (kg) weight of GW, MW, and overall recycling waste for three reporting periods per FTE, across both sites. In showing this level of detail, differences caused by factors such as staffing are revealed with implications for interpreting the results.

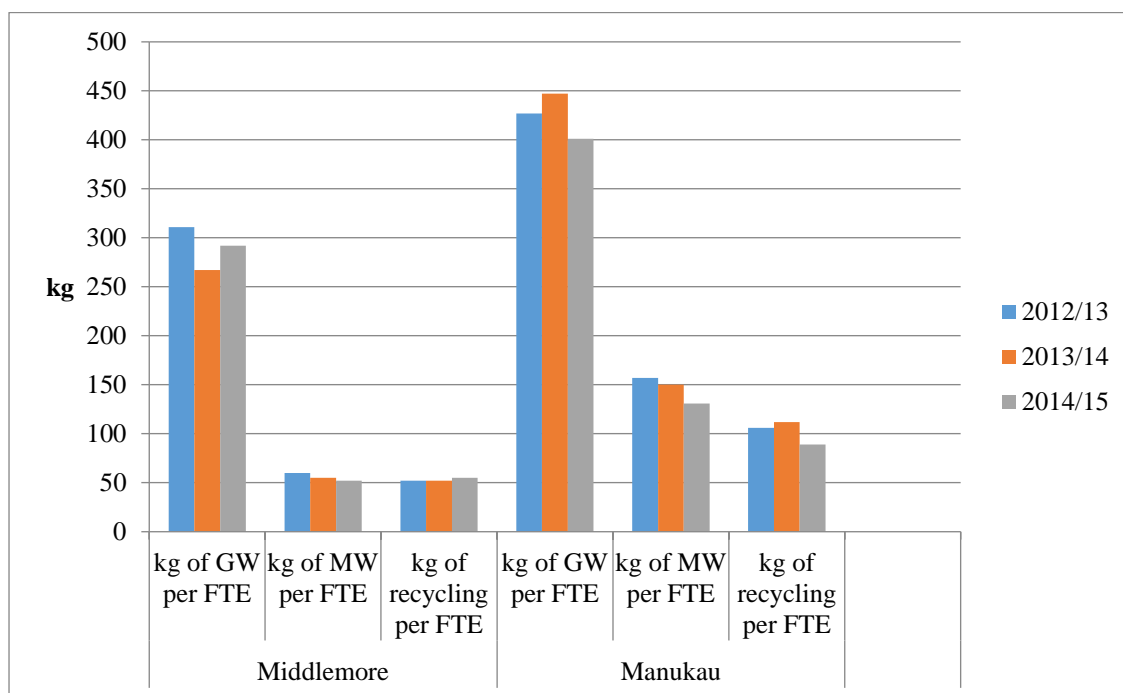


Figure 7.6. Weight of General Waste, Medical Waste and recycling (kg) per Full Time Equivalent, per year for Middlemore and Manukau.

Waste amounts per FTE for each site are measured in kilograms for each of the reporting periods (see Figure 7.6). General waste amounts (8% decrease at Middlemore, 6% decrease at Manukau) and medical waste per FTE (12% decrease at Middlemore and 18% decrease at Manukau) across both sites generally trended downwards. Recycling weight per employee at Middlemore shows a very slight increase (6% increase); however, the data for Manukau reveal the opposite (17% decrease). By comparison, the number of employees at the smaller Manukau site is far lower and, in this case, a patient activity indicator may be more representational.

To evaluate waste generation rates a measure of patient activity (PA) was used. This indicator combines the number of inpatient admissions and outpatient presentations and is a significant factor in seeking to understand waste generation in this context. Figure 7.7 shows the kilograms of GW, MW, and total recycling waste for three reporting periods per PA for both sites combined.

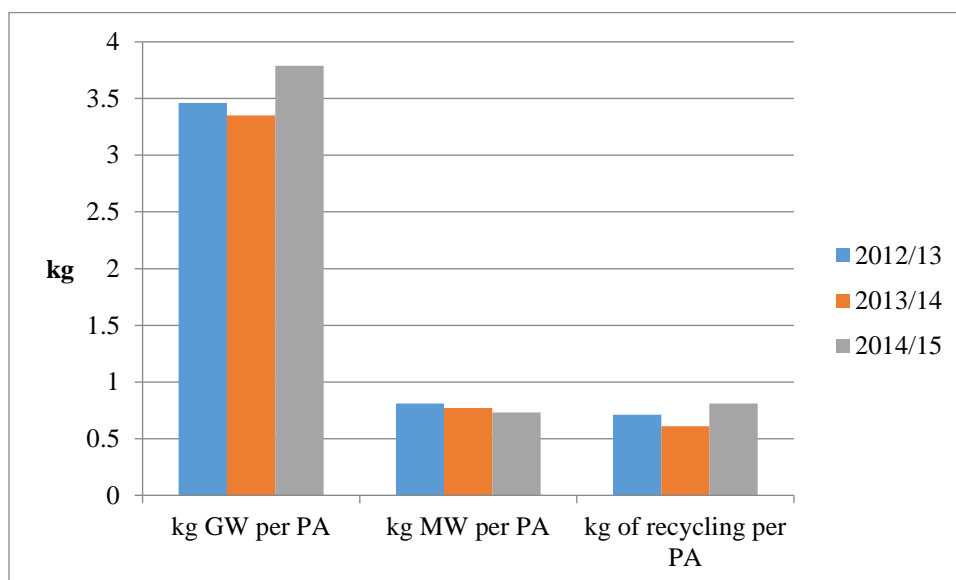


Figure 7.7. Kilograms of General Waste, Medical Waste, and overall kilograms of recycling for both sites per Patient Activity for the three reporting periods.

Grouping the data is useful when reporting high-level results but any differences between sites are lost. The following chart presents the same data comparing the two sites (see Figure 7.8). Of interest, the weights of waste generated per PA at the Manukau site were lower than the weight for Middlemore which had a much greater throughput of patients.

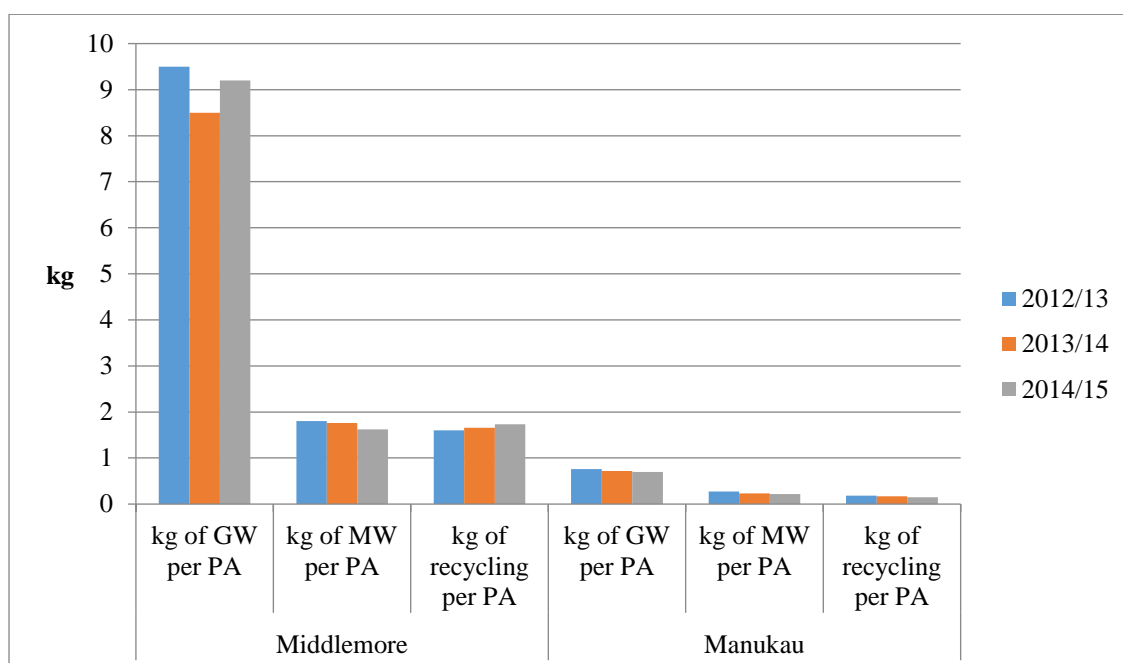


Figure 7.8. Kilograms of General Waste, Medical Waste, and overall kilograms of recycling comparing both sites per Patient Activity per year.

7.2.2 Fiscal and Environmental Outcomes

The fiscal and environmental outcomes of the recycling project and the environmental sustainability programme are presented next.

7.2.2.1 *Fiscal Outcomes*

Avoided costs amount to \$100,000 and rebated revenues total \$21,000 over the course of the study timeframe, as a direct result of the recycling project. The financial outcomes are directly attributed to the recycling project since no other project attempts to divert waste away from landfill. Overall, the waste to landfill charges arising from general and medical waste steadily decreased each year. This is despite the increase in GW weight between the last two reporting periods, simply because MW weight was tracking down with the charges for MW being significantly higher. The avoided waste to landfill costs has been calculated over the three reporting periods based on current charges. The charge for GW transportation and disposal is \$160 per tonne¹ MW disposal and transportation costs amount to \$800 per tonne;² MW is weighed with exact weight known.

Recycling waste has a cost in some instances. For the paper and comingled recycling, payments are requested for recycling bin rental and servicing costs. These costs equate to \$66 per tonne.³ The remaining recycling commodities have no charges while cardboard and soft plastic for recycling receive a rebate. Rebates are relatively small, amounting on average to \$7,000 per annum. This result confirms H1.1 in that recycling has a positive financial effect on healthcare waste management.

7.2.2.2 *Environmental Outcomes*

The carbon footprint associated with waste to landfill weight has been tracked as part of the overall carbon footprint profile, seen in Table 7.1.

Table 7.1. Carbon impact of waste to landfill activities measured in tCO₂e or kgCO₂e per site, per FTE and PA for each year.

Year/Site /KPI	tCO ₂ e	MMH		tCO ₂ e	Manukau	
		kgCO ₂ e /FTE	kgCO ₂ e /PA		kgCO ₂ e /FTE	kgCO ₂ e /PA
2012/13	486	112	3.7	81	203	0.3
2013/14	486	110	3.5	82	205	0.3
2014/15	531	123	3.8	78	184	0.3

¹Cost as of September 2017

² Cost as of September 2017

³ Cost as of September 2017

Carbon in total is measured in tonnes of CO₂e. There is an upward trend for Middlemore (8% increase) and overall a downward trend for Manukau (10% decrease). Addressing H1.2, recycling has a positive environmental effect on healthcare waste management. Carbon emissions associated with waste to landfill weight show differences between the two sites for each reporting period, considering the previously reported KPIs (FTE and PA). For these indicators carbon emissions are measured as kilograms per staff member or per patient presentation. Kilograms of CO₂e per employee are significantly higher at Middlemore (10% higher) while kilograms of CO₂e per employee are significantly lower at Manukau (10% lower) confirming that there were differences between and within sites (H1.3).

In summary, the essential findings from this data set relate to three main areas: costs, the environment, and benchmarking. As a result of the recycling project financial savings were realised, due to avoided costs. The environmental impact reduced after the introduction of my project (as shown by the data presented above). Indicators are helpful when setting benchmarks because of the differences between sites and services. The findings of the quantitative data set are now presented.

7.3 Survey- Quantitative Data

As discussed in Section 6.4 the quantitative analysis proceeded in three stages. The results of the quantitative analysis are now presented following an overview of the sampling results.

7.3.1 Sampling Results

All results are presented in an Excel workbook in Appendix J. Of the 298 responses in 2014, 147 were clinicians and 151 were non-clinicians. For the 2015 survey, there are 271 responses in total, of which 137 were clinicians and 134 were non-clinicians. Of these, 184 were common to both years (84 clinicians, 100 non-clinicians). The weights applied are 44.80 for clinicians and 13.28 for non-clinicians, denoting the number of staff represented by each.

The sampling frame represents 3,718 clinicians and 1,301 non-clinicians. The response rate achieved might have induced bias in the originally-planned structural equations model (SEM). The actual analysis plan of mixed model regression was retained and not

subject to bias under the mild assumption that attrition did not interact with covariates or with the sustainability intervention in explaining the emergent constructs (Carter, Imlach-Gunasekara, McKenzie & Blakely, 2012).

This alternative analysis consisted of controlling the power to detect a given difference in the average response to any 5-level item in the questionnaire between 2014 and 2015, within each location and each group. A power of a minimum of 80% was sought to detect a difference of 0.5 between the responses in each year. A standard deviation of 1.4 was assumed corresponding to the extreme case of uniformly distributed responses amongst the item levels. An approximately normal distribution for the item and a small correlation of 0.2 between the two years was also assumed. A response rate of 75% was expected.

The data captured from the two surveys were merged using the participants' email addresses. Once the data sets were merged, there were 70 variables (2014 and 2015 opinion questions). Thirteen people were excluded since they did not provide consent, and 23 people answered none of the survey questions and so were also excluded. Three people answered the first survey twice, so their first response was kept and the second one deleted.

Data were weighted according to clinician and non-clinician strata to reflect the different sampling fractions achieved in both groups. The weighting was based upon the number of distinct individuals on the CMDHB 2014 staff database and the number of individuals who responded to both surveys. Each of the three stages of the quantitative data analysis is now presented. The first two stages are preparatory steps with the third stage reporting the actual results.

7.3.2 Stage 1: Polychoric Correlation

A polychoric correlation matrix of the data was obtained from the full data set. The polychoric correlation coefficient (Olsson, 1979) is a measure of association for ordinal variables and is a useful technique applied for such data sets. The polychoric correlation matrix was computed. Some items had to be removed at this stage as they were incompatible with the assumption of latent Gaussian random variables and prevented estimation of the correlation matrix: Questions 15, 16, and 17 (Appendix H) were excluded. Polychoric correlations failed to be computed unless Question 15 was removed. Additionally, there was a large proportion of missing values for Questions 16

and 17 (59.4% for each question in 2014; 60.9% and 61.2% respectively in 2015) presenting a further compelling reason for excluding these questions.

7.3.3 Stage 2: The Exploratory Factor Analysis (EFA) Results

The EFA was carried out on the polychoric correlation matrix of the weighted data. An oblimin rotation scheme was used (Yong & Pearce, 2013). The EFA was carried out on a matrix that accounted for item correlations within (subjects who completed the two surveys) and between (subjects who completed a single survey) years. Any EFA-factor single items that were unrelated in the conceptual model to the main items of the EFA-factor were removed from the analysis.

The EFA-derived factors were used to identify groups of items that were conceptually and empirically related. These item groupings were analysed for change between 2014 and 2015 as multivariate dependent variables. A mixed model with a least squares approach was used, with the respondent being treated as a normally distributed random effect. The combination of year and item type was treated as the index of a repeated measure, and each item was allowed its own variance and its own covariance between years as equality of these quantities across items could not be assumed. The data used in the regression were weighted as in the EFA. All results were adjusted for gender, location, and clinician versus non-clinician strata.

The items involved were either 5-level Likert type items (ordinal) or dichotomous (yes/no answers). A least-squares approach was used for all items despite this since binomial and multinomial mixed models failed to converge. In addition, an unconstrained least-squares approach with identity link provides unbiased estimates under non-normality (Judkins & Porter, 2016). The standard errors were also reliable since the variance was modelled flexibly. The approach allowed the analysis of paired (both surveys) and unpaired (single survey) data in the same regression model.

The changes were considered significant if the global F-test for the year was significant (displayed under the “Contrasts” section, with the “Effect of Year” label. See Appendix J). In such cases, the item-specific changes were explored to determine their significance. Unadjusted p-values for these items are reported in Section 7.3.4, along with the False Discovery Rate (FDR) control threshold. Under FDR control for multiple testing, an alternative sub-hypothesis was declared accepted if the corresponding p-value was smaller than the threshold. Finally, the 2015 question asking whether the respondent

recycled in 2015 than in 2014 was analysed using point estimates and confidence intervals for each response category.

Factors were identified and loadings were assigned through EFA. The loading range was between -1 and 1. Under normal circumstances, a sufficient factor loading is 0.45 with a sample of 200, and 0.40 for 300 observations. With 298 observations a loading threshold of under 0.40 meant, in principle that the variable did not contribute to the factor (Yong & Pearce, 2013).

In some cases, an item was included with a loading smaller than 0.4 in an identified grouping to match the original constructs more closely or to keep the groupings similar across years. Similarly, items were removed with a loading larger than 0.4 if they were egregious regarding the original conceptual model. These are documented below under “Exclusions”.

The EFA yielded eight factors based on the weighted proportions of variance explained. The following table summarises the eight factors presented in order of magnitude of factor loading.

Table 7.2. EFA derived factors.

Number	Factor
1	Change Value 2014
2	Receptivity 2014
3	Change Value 2015
4	Work Context 2014
5	Core Values 2014
6	Awareness 2015
7	Segregation Behaviour
8	Awareness 2014

Adding a ninth factor left the structure of the first eight unchanged and their weighted contribution to the variance roughly unchanged, while the ninth factor contributed only 1.2, less than a third of the smallest factor amongst the first eight. Further, the eight factors accounted for all the retained items, and the weighted contribution of the eighth factor to the overall variance was larger than that of the seventh. For these reasons, and because the ultimate purpose in carrying out the EFA was to identify appropriate

multivariate groupings of items on which to carry out the change analyses, a smaller number of factors was not selected.

The EFA demonstrated no clear factor membership for items Need_Training_2014, Need_Training_2015, Recycle_Takes_More_Time_2014, and Recycle_Takes_More_Time_2015. These were excluded from the final analysis (see worksheet in Appendix J EFA-Exclusions).

Table 7.3. Constructs elicited from the EFA.

EFA identified Construct	Abbreviation
Awareness	A
Work Context	WC
Segregation Behaviour	SB
Core Values	CV
Receptivity	R
Transformational Values	TV

The eight factors covered six identifiable constructs (see Table 7.3). Two of the constructs (Transformation Values and Awareness) were identified by separate factors across the years. The other four (Core Values, Receptivity, Work Context and Segregation Behaviour) were identified as single factors across the years.

7.3.4 Stage 3: Mixed Model Regression Results

Statistically significant results are presented next and non-statistically significant results are detailed in Appendix J.

7.3.4.1 Awareness

Changes involved in Awareness were negative but small for all items, representing a maximum variation of 0.15, while standard deviations ranged for these items between 0.80 and 1.05 (and all ranges were equal to 4). All the Awareness items displayed a decrease in 2015 compared to 2014, to be discussed in the next chapter. Indicators included within this construct are detailed in Table 7.5. The adjustments proved significant, driven by a marked tendency for females to score higher (meaning they were more aware of the need to recycle) than males on these items. (See Tables 7.4 and 7.5).

Table 7.4. Contrasts for awareness.

Contrast (all items simultaneously)	p value
Year	0.007
Professional group, Sex and Location as confounders	0.01
Professional group	0.83
Gender	*0.004
Location	0.06

* p = < 0.005

Table 7.5. Changes in awareness 2014-2015.

<u>Change from 2014 to 2015</u> <u>in item:</u>	Estimate	95% Confidence bounds		p value	FDR p threshold
		Lower	Upper		
Green Good Example	-0.14	-0.23	-0.05	*0.002	0.013
Reduce Pollution	-0.14	-0.25	-0.02	0.022	0.017
Hospital Save Money	-0.02	-0.16	0.12	0.78	0.050
Reduce Chronic Disease	-0.08	-0.18	0.02	0.10	0.025

* p = < 0.005

Awareness questions targeted the knowledge and beliefs of participants in relation to the wider impacts of climate change (Questions 32-35 in the survey, Appendix H). Perceptions of the linkage between the environment and health outcomes were gauged and the results may be interpreted in several ways. This finding suggests that the success of the programme was driven by an emotional or moral imperative as opposed to an intellectual or theoretical driver and it is discussed further in the next chapter.

7.3.4.2 *Work Context*

Work Context items displayed progression in exposure to the various communication platforms. The probabilities of exposure in 2014 ranged from 27.2% (for the Webpage) to 66.7% (discussed at staff meetings) while the improvements in 2015 ranged from 2.6 percentage points (having spoken to colleagues about sustainability) to 7.2 percentage points (having seen the Webpage). Adjustments associated with gender, professional group and location were not significant for Work Context (see Tables 7.6 and 7.7). Discussing the programme at staff meetings was ranked the most favourable approach to use as a means of sharing the details of the programme. Interfacing with a Webpage was regarded as the next most useful approach to sharing knowledge within the healthcare work context. Communicating with peers was ranked the least meaningful approach by the respondents in this study yet discussing the details of the programme between

colleagues could still add value when considered as being part of a suite of communication methods.

Table 7.6. Contrasts for work context.

Contrast (all items simultaneously)	p value
Year	*0.001
Professional group, Sex and Location as confounders	0.43
Professional group	0.42
Gender	0.46
Location	0.32

* $p < 0.005$

Table 7.7. Change in work context 2014-2015.

<u>Change from 2014 to 2015</u> <u>in item:</u>	Estimate	95% Confidence bounds		p value	FDR p threshold
		Lower	Upper		
Seen Posters	0.03	-0.03	0.09	0.39	0.05
Seen Webpage	0.15	0.01	0.29	0.04	0.03
Seen Notices	0.11	0.03	0.19	*0.00	0.01
Manager Recycles**	0.12	0.06	0.18	*0.00	0.01
Spoken to Colleagues	0.06	0.001	0.12	0.02	0.02
Discuss at Staff Meetings	0.10	0.04	0.16	*0.00	0.01

* $p < 0.005$

** Note: The estimate for “Manager Recycles” is an additive change on a Likert-type scale ranging from 1 to 5. The other estimates can be interpreted as additive changes to the probability of the event described in the left-hand column

7.3.4.3 Segregation Behaviour

A change in Segregation Behaviour was significant and displayed a marked improvement in the case of comingled waste (Plastics-Glass-Aluminium) (increase of 0.52, 95% Confidence Interval [CI] [0.36, 0.68]) and, to a lesser extent, Paper (increase of 0.21, 95% [CI 0.05, 0.36]), but not Food Waste. Participants of this study perceived an increased ability to recycle, especially in the case of comingled waste. They were less able to recycle paper and not able to recycle food waste. This perceptual finding was interesting given that the audit results reflected a dissimilar trend in that the paper recycling weight was comparable to the comingled recycling weight (see Figure 7.5).

Adjustments for Segregation Behaviour were significant, with increased scores for Recycling Plastics-Glass-Aluminium and decreased scores for recycling Paper at MMH

as compared to the Manukau site, with decreased scores for recycling Paper amongst clinicians as compared to non-clinicians (See Tables 7.8 and 7.9). These results were divergent from the audit results. According to the audit results recycling weight increased at both sites and comingled weight decreased, more so at the Manukau site. Due to the complexity of healthcare and the nature of healthcare waste, a food waste separation and collection service was not initiated during the study.

Table 7.8. Contrasts for segregation behaviour.

Contrast (all items simultaneously)	p-value
Year	*<0.0001
Professional group, Sex and Location as confounders	*<0.0001
Professional group	0.001
Gender	0.12
Location	*<0.0001

* p = < 0.005

Table 7.9. Change in segregation behaviour 2014-2015.

<u>Change from 2014 to 2015</u> <u>in item:</u>	Estimate	95% Confidence bounds		p Value	FDR p threshold
		Lower	Upper		
Food Waste	0.11	-0.05	0.27	0.17	0.05
Plastics-Glass-Aluminium	0.52	0.38	0.68	*<0.0001	0.02
Paper	0.21	0.05	0.37	0.01	0.03

* p = < 0.005

7.3.4.4 Self-Reported Change in Recycling Behaviour

The self-reported change in Recycling behaviour in 2015 as compared to 2014 reported higher for Yes which means respondents believed they could recycle more in 2015. The results are shown below (Table 7.10) stating the Confidence Interval of each.

Table 7.10. Self-reported change in recycling behaviour comparing 2015 to 2014.

Likert scale	F	%	CI range
Don't know	26	9.6	96.4% - 13.7%
No	19	7.0	4.3% - 10.7%
No change	80	29.5	24.2% - 35.3%
Yes	132	48.7	42.6% - 54.8%
No answer	14	5.2	2.9% - 8.5%

* N=271, Confidence Interval (CI) = 95%

Just under half of the respondents reported being more able to recycle in 2015 compared to 2014, with only 7% of respondents being less able to recycle and 30% reporting no change in their ability to recycle.

In summary, the quantitative results show the extent to which the waste generation rates differ between the hospital and clinic settings. Self-reported segregation behaviour shows an improved ability to recycle over the duration of the study. The recycling project and the environmental sustainability programme are regarded positively and described as being of value. The next section presents the findings of the qualitative component of this study to add further meaning and context.

7.4 Qualitative Findings

A total of 121 respondents answered the open-ended questions in the first survey, 72 answered these questions only in the second survey, and 187 respondents answered both questions in both surveys. Results of the qualitative data analysis are presented according to pre-identified themes. The literature review findings helped guide the assignment of category headings, as described in section 5.4. This data set did not seek to identify changes in behaviour over time, whereas the audit data and quantitative survey data sets were designed specifically to explore this important feature of this study.

Extracts quoted directly from participants' responses are used on occasion during this summary to add context and meaning, aiding with finding validation (De Massis & Kotlar, 2014). Respondents were stratified by occupational categories rather than which survey the extract came from.

The total number of comments exceeds the number of individuals because respondents made multiple responses. The findings are presented first (summarised in the following coding frameworks). More specific details follow, with participant extracts used to illustrate the level of specificity. Features of the qualitative sample in relation to gender, occupational category, and site are shown in the table below.

Table 7.11. Respondents differentiated by gender, professional category and site to each survey's open-ended questions.

		2014	2015
Gender	Females	171	142
	Males	42	23

Professional Category	Admin	91	66
	Clinician	122	100
Site	MMH	174	142
	Manukau	39	24

The data were coded into frameworks, as suggested by Burnard et al. (2008). The initial high-level framework, examples of which are presented in Table 7.12, identified several sub-categories which were found and assigned within each category label. Refer to section 6.7.3 for a fuller description of how these frameworks were developed.

Table 7.12. Examples taken from the initial framework (Recycling and Environmental Sustainability).

	Recycling Project	Respondent Extract	ES Programme	Respondent Extract
Category	Sub category			
Organisation	Leadership	‘We should stop using paper cups, plastic cutlery in the cafeteria’	Leadership	‘Leadership from the top will make a difference’
	Procurement and supply chain	‘It would be great to see the elimination of poly cups’	Prioritise the programme	‘We were told it would cost us more, but we felt it was worth it and that it was our responsibility’
Programme	Education	‘Educate employees about proper waste disposal’	Education and awareness	‘Educate staff about green practices’
	Waste streams identified	‘Have a food waste bin on each patient’s meals kitchen trolley’		
Individual employee	Being mindful and considerate	‘Staff to be more mindful when recycling’	Green champions	‘We need green champions at each workplace’

A total of 161 comments were captured from both surveys in response to the open-ended question referring to the recycling project. These are categorised and described under the three main category headings of organisation, programme, and individual employee. The final category appears light in text because all the main points were covered under the first two headings.

7.4.1.1 **Organisation**

The term recycling features frequently throughout the survey responses as can be seen by the wordle, with the term ‘bins’ most frequently used. However other aspects of the waste programme also feature in the responses. Respondents identify that large healthcare organisations procure many goods and services. Those who make procurement decisions can show *corporate leadership* given that the day-to-day operations rely on many *supply chain* and *procurement* activities. Respondents believe that it is important to avoid selecting single-use items in favour of using more durable options. This action may cost more but this increased cost is considered worthwhile, as identified by the clinician in the following extract:

We were told it would cost us more, but we felt it was worth it and that it was our responsibility... (Participant ID3090379893: Clinician)

The responses also identify the way upstream activities such as rationalising packaging are very important. By reducing waste at the outset, time spent segregating, sorting, and recycling is saved, and resultant waste weight is lower.

The next extract identifies the existing overuse of single-use kitchenware items. The organisation supplies, and therefore encourages, the use of many single-use and generally non-recyclable kitchenware items. The waste generated as a result can only be disposed of into landfill. Using durable alternatives avoids this type of waste: (19 out of 161 references made)

Stop using paper cups, plastic cutlery in the cafeteria and in work areas. (Participant ID 3118157386: Admin)

Respondents believe that, in the case of kitchenware items, it is more advantageous to encourage the use of reusable items, where possible. In some cases, respondents mention

that adopting a life cycle approach to cost evaluations would help evaluate the full costs and benefits. Using environmentally friendly materials enables more positive disposal options, as was suggested in 35 (out of 161) instances. Food and beverage areas are deemed useful focal areas for their ability to reduce downstream waste.

Another attribute of the qualitative findings that became apparent reflects the role of the organisation in having decision makers as influencers, since purchasing choices and product selection impacts selection of supplies. It is also recognised that supplies are delivered to work areas swathed in many layers of packaging. Reducing this packaging would also reduce the downstream impact on waste production. Respondents believe suppliers should be asked to reduce their packaging at the early stage of contract negotiations as this would save a lot of time and effort in recycling activities.

Reducing paper consumption was also regarded by respondents as a target area for the organisation. Using technology to move towards paperless systems or at least reduce paper consumption was recognised as an important adjunct of the sustainable waste programme.

Methods of conveying information requiring less printing need to be implemented. (Participant ID 3166462113: Admin)

Avoiding the use of plastic was another major focal waste reduction activity recognised by respondents. Foam cups are regarded as being harmful for the environment. The comments made by respondents suggest that the organisation has an ethical role to play in taking ownership of the waste generated. Foam cups are very visible, and their elimination signals strong organisational support for environmentally preferable procurement practices. As such, their elimination would be welcomed by many respondents, as reflected by the following extract:

It would be great to see the elimination of poly cups. (Participant ID 3171389429: Admin)

In summary, the results show that employees understand the impact supply chain and procurement activities have on waste disposal. The organisation clearly has a meaningful role to play when setting up contracts and making procurement decisions that have far-

reaching downstream impacts. Having presented the main findings in this section, the focus now shifts onto the waste programme level.

7.4.1.2 *Programme*

Recycling is described by respondents as an essential *part* of a system-wide approach, a primary component of a sustainable waste reduction programme. All visitors and staff should have access to recycling bins because everyone should be playing their part by contributing to waste reduction activities.

Many suggestions are made by respondents in relation to *systems and processes*, programme provision and delivery. Various products and *resources* were regarded by these staff as being essential to ensure successful waste segregation and recycling, including being provided with bins and containers (52 out of 161 references). Proximity and location of the bins was an essential consideration for respondents, as was being given clear instructions. Respondents stated that recycling does take more effort, so it is important to have bins and suitable information at hand, making recycling behaviour easier to adopt. The following extract explains that taking the extra time to recycle is important because of long-term planetary gains:

Sometimes the added time/cost/effort appears (to) outweigh the benefit but we must realise that an extra minute or two to separate food, paper, glass plastic etc. is nothing in the long-term benefits to the planet being habitable.
(Participant ID 3166462113: Admin)

Organisational recycling projects within healthcare settings are uniquely different to other sectors for two main reasons, as highlighted by respondents. The first reason is that healthcare workers prioritise patient care. The second reason is the nature of the waste generated, as it may be infectious, or at least aesthetically displeasing. *Safety and compliance* issues are consequently highly relevant. Respondents believe that by having specific waste areas where a range of bins could be found, and by making sure the waste areas are secure, safety concerns are mitigated.

The current mechanism of cardboard recycling was regarded as problematic since the approach was described by some respondents as being ad hoc and inconsistent. Respondents also considered that by providing adequate signage and clear instructions, confusion can be prevented. Responses indicate that the bins were not so clearly labelled.

In addition to having specific waste areas, appropriate bins and receptacles, and clear signage (all near where the waste is generated), providing *education* and raising awareness were also described as other factors for success. Education about waste practices was said to be required (21 responses out of 161 responses), with the focus on all waste categories, not just recyclable waste. Different approaches to the delivery of the education were described. Respondents recognised that people need to understand what to do and how well they are doing. During the education sessions, awareness was raised regarding sharing the benefits of recycling, further assisting in achieving successful outcomes, as demonstrated by the following statement:

Educate employees about proper waste disposal like what items to throw in yellow bag and which ones shouldn't. (Participant ID 312746943: Clinician)

Auditing was described by respondents as a useful *evaluation* tool. Providing feedback and encouragement was said to assist in reinforcing behaviour, as do incentives. Promoting the programme regularly in other ways was also regarded by respondents as serving to sustain the desired behaviour, and as worth celebrating.

There are many types of waste and respondents described the *waste streams* that are central to recycling projects: food waste worm farms, comingled (PGA), paper, cardboard, and printer waste. Food waste was a popular suggestion (17 instances).

Have a food waste bin on each patient's meals kitchen trolley so staff has (have) somewhere to send their apple cores to. (Participant ID 3148615348: Clinician)

Yet respondents also recognise that regular servicing is required for all waste containers. When bins reach their full capacity, no more waste can be added. In addition, waste bins become unpleasant and foul-smelling if they are not adequately serviced. Protecting vulnerable patients from airborne pathogens requires careful consideration of all waste programmes within the setting of health. Keeping track of progress is required as this also ensures correct procedures are followed.

Employees are committed to recycling and, despite having competing priorities, they show a high level of engagement with the recycling project. Engagement is affected if

the systems and processes are not in place, which have been identified. The significant feature in relation to the individual employee is now presented.

7.4.1.3 Individual Employee

Being mindful, connected and considerate of others is the single most important feature of this section. Respondents suggest that everyone in the organisation needs to take the time to consider the impact of their waste reduction behaviour. They believe that individuals can make a difference and empower action, influencing others. Recycling was described as everyone's responsibility.

Staff to be more mindful when recycling. (Participant ID 3179898993: Admin)

This concludes the summary of the qualitative findings pertaining to the waste programme. The next section presents the findings in answer to the question regarding the environmental sustainability programme.

7.4.2 Environmental Sustainability Programme

The second open-ended question was:

‘What else would you like to see or make a comment
about regarding a green programme?’

The wordle diagram in Figure 7.10 (p. 16) summarises from NVivo the most frequently encountered terms used by respondents in answer to the open-ended question relating to the green programme.

Adopting a *system-wide and integrated* approach to the environmental sustainability programme is regarded as being beneficial. In doing so the aims of the environmental sustainability programme would come to fruition, that is to be discussed next.

7.4.2.2 *Programme*

Changing behaviour is regarded as difficult to facilitate and sustain. A *change of behaviour* is recognised as a requirement when delivering an environmental sustainability programme. Respondents suggest reminders are useful with knowledge gaps identified. Adopting a range of education methods and means of delivering the relevant messages are described as being beneficial.

Educate staff about green practices including posters on hospital hallways and units. (Participant ID 3127469431: Clinician)

Respondents acknowledged the difficulty of reaching all members of staff, especially if messages are heavily reliant on electronic communication. The following diagram (Figure 7.11, p. 109) summarises the preferred means of educating staff as identified by participants in both surveys with a combination of methods regarded as being most useful.

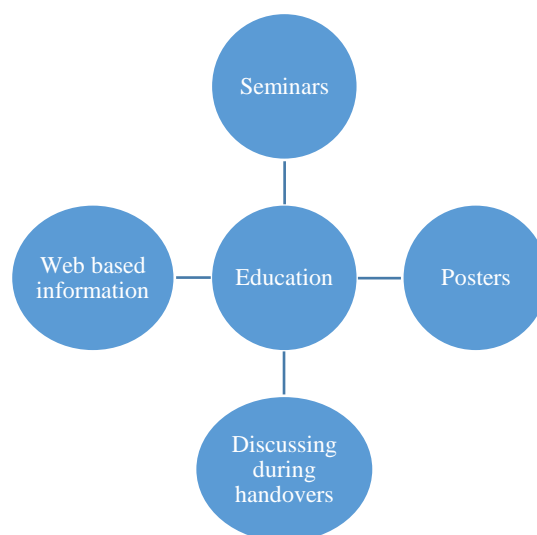


Figure 7.11. Suggestions made by respondents on preferred ways of information sharing.

Aside from respondents suggesting more favourable ways of delivering important messages, several programme *target areas* were also identified in both surveys and have

been summarised in Figure 7.11, page 109 (69 references made from 94). This shows a good level of knowledge about what should be included in a green programme. Similarities can be drawn between the contents of this figure and Figure 4.1, page 33. Similar categories are found except for two categories: chemical exposure and organic food and improved nutrition.

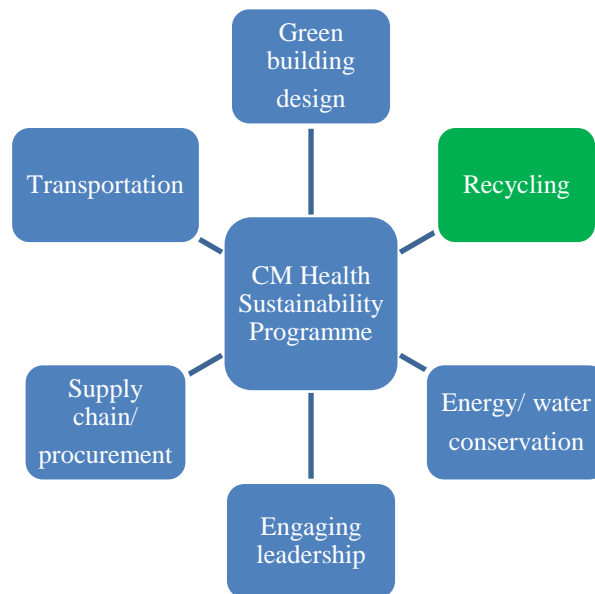


Figure 7.12. CM Health Environmental Sustainability Programme - target areas as identified by the respondents across the two surveys.

The findings at the individual employee level are presented next.

7.4.2.3 *Individual Employee*

Individual employee efforts are central to the success of the programme and *green champions* are identified by respondents as being vital. A green champion is an employee who steps up as a recognised environmental leader within a service area or department, necessary to drive the day-to-day operational aspects of the programme. Respondents believe green champions within different service areas help drive the essential messages of the recycling project and the wider environmental sustainability programme.

We need green champions at each workplace. (Participant ID 3100900912: Clinician)

Individual employees are more likely to comply if the programme of work is fully supported by managers. This point refers to the requirement of leadership across all levels of the organisation (Goonan et al., 2014; Hartman et al., 2011; Jamali et al., 2010;

Kantabutra 2011; Komilis et al., 2012; Manga et al., 2011; Patrick et al., 2011; Srivastav et al., 2012; Tudor et al., 2008).

The final framework is presented in Figure 7.13, page 111 where significant findings of the qualitative data are summarised.

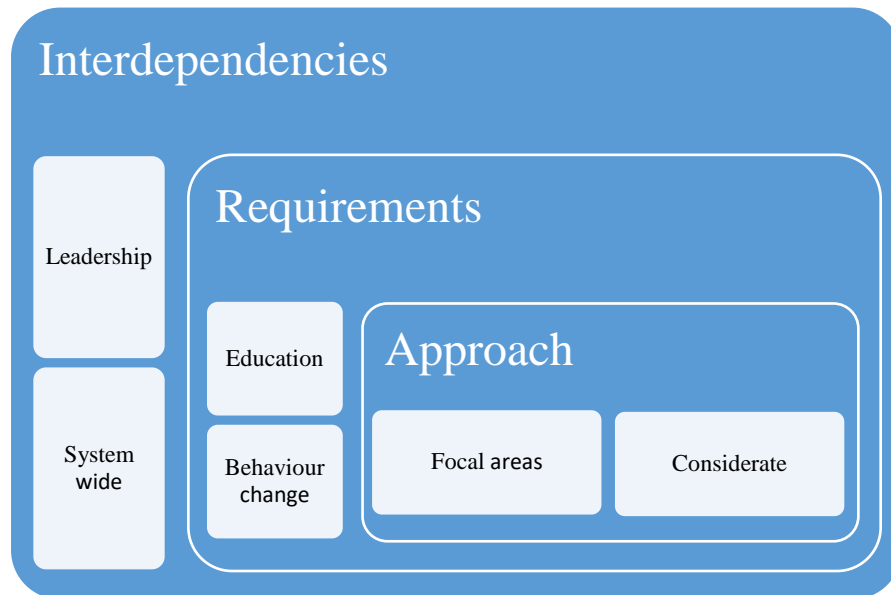


Figure 7.13. Final framework: Interdependencies, Requirements and Approach of the Recycling Project and ES Programme.

The results of the qualitative findings focus on programme processes. The findings show leadership as being integral to the success of the recycling project and environmental sustainability programme. Leadership and system-wide integration are depicted as interdependencies since the qualitative findings of this study suggest that their interaction leads to improved outcomes, recycling being part of the wider environmental sustainability piece. Requirements of a successful intervention are simply stated as education and behaviour change with process improvements suggested by respondents (labelling, more recycling options) and preferences declared regarding communication processes (leaders promoting, discuss at team meetings and delivering notices personally). The desired approach needs to tackle specific focal areas in a considerate and mindful way, referring to being conscious, connecting behaviour to outcomes. This part of the research-project set out to find out what matters to people and employees express an increase in satisfaction as a result of the recycling project and environmental sustainability programme.

The next section presents the integrated findings which will be elaborated on further in the next chapter when the discussion on integrated findings will bring together not only the outcomes of this study, but the outcomes as compared to the theory and practice.

7.5 Integrated Findings

This study compares the difference in waste generation rates between two different sites, one being where mostly inpatient services are provided (MMH) and the other being mostly outpatients (Manukau), over a 12-month period. Since this thesis incorporates exploring the intervention across two separate sites, differences in outcomes as a result of site variation have been revealed (as suggested in Section 5.4.3).

The audit data findings show improved outcomes as a result of the recycling project. Outcomes are measured in terms of waste to landfill weight, recycled weight (waste diverted from landfill), costs avoided, and the environmental (carbon) impact. The conceptual framework developed in Figure 5.2, page 49, indicated that financial benefits and environmental benefits in terms of a reduced environmental impact were achievable as a result of delivering a recycling project within the setting of healthcare. To test the associated hypotheses (H1.1 and H1.2), the audit data were analysed. Recycling has a positive financial and environmental effect in healthcare waste management and there was a difference between sites (H1.3).

When the audit data is considered alongside the quantitative findings, further meaning and understanding is gained. There is progression in exposure to the various communication platforms. Respondents' survey scores were higher in 2015 when compared to 2014 indicating positive changes in attitudes and recycling behaviour towards the project and programme over the study timeframe (H2 and H3). The changes in segregation behaviour for glass, plastic, and aluminium are significant. There were differences in scores for females, professional categories, and across sites. This level of detail could not be extracted from the audit data demonstrating the value of adding this further method of survey data collection and analysis.

In addition, the comments made by respondents presented in the qualitative data set uncovered the perceptions of end-users of the recycling interventions. The recycling project is situated by the respondents within the context of a wider environmental

sustainability programme. Features of the recycling project were described. Emphasis was placed on the requirement of resources needed to deal with waste and the recycling measures. These resources included having the appropriately situated number of waste receptacles and information at hand to guide the users of the waste receptacles. Leadership was identified by the respondents as a major feature of the sustainability interventions: as indicated in the literature (Goonan et al., 2014; Hartman et al., 2011) if leadership is lacking at the organisational senior management level, individual employees are less likely to engage.

Indicators of the success of the recycling project from different levels of analysis were compared. Perceptions at the organisation and programme level in terms of waste and carbon footprint data were compared with the individual employee level (see Section 5.4). To capture a more detailed understanding, individual employees expanded on their views about the recycling project and environmental sustainability. The main point from this comparison revealed advantages of taking a multi-level approach to measuring the impact of a recycling intervention. A brief summary of this chapter follows.

7.6 Summary

During this chapter the findings of the study were presented and the extent to which they supported the hypothesised outcomes were highlighted. The data collection and analysis methods employed examined the different layers of the organisation from the programme level to that of the individual employee. Additional richness was added to the findings of the quantitative analysis from commentary provided by survey participants. The next chapter discusses the findings in relation to the role of recycling and environmental sustainability within the healthcare setting. The common themes found during analysis are compared to the findings of the review in Chapter 3, making a case for change.

Chapter 8 Sustainable Healthcare Waste Management: The Case for Change

8.1 Introduction

This chapter discusses the findings of the study and compares these findings with those of the literature review. First, the audit data are discussed prior to the quantitative findings relating to the three constructs of Awareness, Work Context, and Segregation Behaviour. Significant qualitative findings are then considered, under the broader headings of the recycling project and environmental sustainability programme.

A discussion of the integrated findings follows at the end of this chapter. Adopting a reflective approach, the discussion starts with signalling the importance of locating the recycling project within the context of a wider environmental sustainability programme. The next section of this chapter concerns the role of leadership, from organisational leadership to the dedicated sustainability lead to the role of the individual employee in achieving and sustaining the required change in organisational behaviour regarding recycling, as a major requirement in a successful programme - as demonstrated by this study. Using the theoretical lens this section presents an overview of the change management process of delivering the sustainability project adopting the overarching lens of complexity leadership theory, related to the theoretical constructs identified in Chapter 4 which underpinned this study.

8.2 Audit Data

Essential elements of the audit data findings are now presented which consider the waste weight, costs, and environmental impact. The use of KPIs and issues associated with benchmarking are also discussed to identify the salient points regarding how these data are measured.

8.2.1 Waste Types and Weight

Raw waste data are open to misinterpretation until these data are understood in a contextual and meaningful way. There are differences in the way in which GW, MW, and recycling waste is collected, transported, and disposed of by CM Health. To

differentiate between the associated costs and risks, the next section discusses the salient differences between these aspects relevant to this study.

Weights of waste, associated costs, and, in some instances, value of rebate, are routinely collected by CM Health. Materials are collected separately, and their weights are measured in different ways. Each type of waste is discussed in turn to highlight the range of methods used and the impact of the operational differences on the findings of the audit data gathered.

8.2.1.1 *General Waste*

GW at both sites is collected at each area (hospital and clinic) and placed at source into white or black bags, according to the NZ Waste Standard 4304:2002. The bags are taken to the waste dock at the respective sites and emptied into large on-site compactors. The waste company routinely removes and transports the compactors to the nearest authorised lined landfill, which under the current contract is in rural Whitford, South Auckland. Once there, the weight of the waste is measured and payment for disposal and transportation is then requested based upon the weight and volume of the waste.

GW generated at MMH increased between the reporting periods which can be accounted for by several factors. MMH opened a new clinical service building and as a result, a large department moved into the new area including the theatre and operating department, neonatal unit, non-clinical support, and transcription services. Moving from one area to another generated more waste since individuals were forced to clear out desks, empty filing cabinets, throw away unwanted and often broken office equipment, and clear out storerooms. At the same time, cardboard was mistakenly thrown into the GW stream following the introduction of a new means of collecting and transporting GW (new bins). In addition, a new meal delivery system was put in place in mid-2015. Weight of food packaging and food waste increased, generating a spike in GW weight around that time.

The GW weight at Manukau, however, has steadily decreased. Over the duration of the study there were no major building developments at the Manukau site. The food delivery process that affected MMH was not implemented elsewhere and the means of capturing the cardboard recycling remained the same.

From these findings, two insights are gained. The first relates to the employee level of engagement. To help reduce the impact of future departmental moves, it would be useful

to run frequent campaigns to remind employees to use less paper, to gather fewer consumables, and to be conscious of the type and volume of office materials being kept on a day to day basis. The second insight relates to the supply chain in terms of contract negotiations. The increase in general waste as a result of food packaging and food waste could have been lessened by smarter contract negotiations.

8.2.1.2 *Medical Waste*

MW is collected in yellow bags, as per the Waste Standard. Because of the nature of this waste, and the risks associated with handling this potentially contaminated and bio-hazardous waste, associated costs for transportation, removal, and treatment are substantially higher. MW cannot be compacted since the bags are likely to contain bodily fluids. Compacting and expressing the containers would cause contents to escape, thereby contaminating the area and placing waste handlers at risk of cross-contamination. Findings from the literature review support the adoption of safe handling when it comes to healthcare waste (Njagi et al., 2012; Srivastav et al., 2012). Hazardous material could also contaminate the environment and encounter surrounding waterways, posing further risks of cross-contamination. Yellow bags are collected and placed into larger yellow bins and labelled accordingly where they are safely transported to an authorised and tightly regulated waste treatment centre.

In the Auckland region, MW is weighed and then autoclaved at a waste treatment centre and subjected to temperatures reaching 140° C. The sterilisation process takes 40 minutes and the material is then macerated and taken to a lined landfill where final containment is mapped. By mapping the landfill location of healthcare MW, future allocation of the land for further developments is restricted as a means of protecting future generations. For example, the land would not be used in the future for playground development or for building a school.

MW weights at both sites, across the three reporting periods, have steadily decreased as a result of this project since no other project targets organisational waste management. Accordingly, costs have been avoided and are discussed further in Section 8.2.3. This is an important finding because economic benefits are welcomed by healthcare organisations. I was also able to emphasise and quantify the environmental benefits of this project, further, supporting the benefits of having a dedicated lead for this programme.

8.2.1.3 *Recycling*

The addition of recycling increases complexity in the process of waste handling. Recycling involves adding more bins, a different set of instructions, and it has implications for health and safety (Lui et al., 2014). Arguably, in the context of healthcare, health and safety implications are far greater since hospitals and healthcare facilities generate waste that is either perceived as being, or is, infectious. When introducing recycling into healthcare facilities, it is, therefore, essential to ensure that the risks associated with improper segregation are emphasised (Lui et al., 2014). Clear systems and processes with accompanying instructions help direct individuals and explain what waste should go where and why (Evans et al., 2012).

Materials recycled during the project in this study have been limited by several factors. Limitations can be described in terms of availability and accessibility of services and the relative cost of recycling. Waste removal services are tendered, and suppliers are chosen following strict commercial criteria. Contracts are drawn and services are provided accordingly. Recycling services are no different to any other service in that regional and national variations do exist. If the infrastructure and services are available, the cost to implement serves as another barrier. This cost applies only to the financial element, less so to the wider and more significant social and environmental costs (Deprez et al., 2000). Fortunately, recycling systems are cheaper to instigate in terms of transportation and disposal costs, when compared to GW and MW. However, since recycling sometimes requires further segregation, workstreams are affected, therein presenting another limitation.

Different commodities are recycled; many have been introduced as part of the project in this study directly as a result of my leadership. Details regarding each commodity can be found in Appendix K. When the combined recycling weight of the different commodities are compared over the three years (the audit period), there is an upward trend. The amount of paper recycled increased for both sites. There was an increase for comingled waste at MMH, however, there was a withdrawal of comingled bins at the Manukau site at the midpoint of the intervention (see Section 7.2.1). This was due to a fruit fly infestation. Fruit flies were found to be breeding in the comingled recycling bins. The bins were temporarily removed from the site pending an investigation and the subsequent development of an improvement plan.

Cardboard recycling also declined in the last reporting period for MMH, which may be attributable to the alteration in the segregation process. Amounts of soft plastic and expanded polystyrene recycling continued to rise; these services were only provided at MMH during the time of the study. There is an increased cost associated with recycling expanded polystyrene. Despite this cost increase, it was not considered to be a barrier to initiating the recycling service. The amount of expanded polystyrene waste generated at Manukau is negligible and thus the service was not extended to this site. Moreover, deliveries to the smaller satellite sites are mostly centralised at MMH where all items are unpacked and then decanted by internal organisational means.

8.2.2 Benchmarking

Absolute waste weight provides useful information for future benchmarking. This enables better organisational tracking and understanding of waste segregation behaviour and ensures that charges and rebates are based on actual weight, whilst providing more accurate accounting of the carbon footprint. To be able to evaluate the impact of the recycling project more effectively, best practice suggests the use of more discreet KPIs. Since waste generation relates to levels of acuity (sudden onset of illness) and type and size of service provision (Connor & Mortimer, 2010; Komilis et al., 2012), indicators used need to include the number of people employed to provide the required healthcare services expressed as FTE as well as other indicators that reflect patient activity.

When analysing the audit results of this study, by comparing the waste weight in a more exact way there are clear differences between the two sites as revealed by each site and selected indicator. The literature discussed in Section 5.4.2 (operational efficiencies and costs) indicates that inpatient and outpatient facilities vary in terms of their waste weight and that an increased turnover of patients tends to lead to higher waste generation rates. The findings of this study support these results from other studies, especially when comparing the amounts of waste generated per patient activity, as discussed in Section 7.2.2. Using a patient activity indicator as opposed to one that represents staffing seems to best capture waste activities in the setting of healthcare.

When waste generation rates are considered in relation to patient activity, a few factors will affect the meaningfulness and representativeness of the data. The evidence is divided and suggests using either the number of patient bed days or the number of admissions and discharges. Using the former fails to capture the number of patients admitted into the same bed over a given time period or number of outpatient appointments since the

calculation involves counting (usually at midnight) the number of patients who occupy a bed. The latter captures the total number of admissions and discharges during a given timeframe, but once again does not capture the number of outpatient appointments. Due to the shortfalls described, Komilis et al. (2012) proposed a means of overcoming this by simply using the total number of beds a facility has on the basis that this type of information is more readily available.

From the results of this study, I recommend using the PA indicator which is also informed by my experience as a nurse and as the sustainability leader. As discussed in Section 7.2.1 PA refers to a combination of inpatient (number of patients admitted for greater than three hours) and outpatient activity (number of outpatient appointments). For full details of the exclusion and inclusion criteria used, refer to Appendix L.

Both MMH and Manukau sites provide inpatient and outpatient services, as previously described in Chapter 4. The MMH site is larger and provides the bulk of inpatient services; whereas the Manukau site is smaller yet accounts for a high volume of outpatient activity. The findings of this study indicate that the preferential adoption of a patient activity indicator, specifically one that captures both inpatient and outpatient activity. Whichever KPI is chosen, disclosing underlying assumptions and explaining inclusions and exclusions assists other organisations to make more accurate comparisons between the differing waste generation rates. This being the first NZ study will allow other organisations to be able to compare whilst taking into account operational and logistic differences as a result of organisational features and geographical location, described previously in section 2.4.2.1.

8.2.3 Fiscal Outcomes

Sustainability interventions have a positive effect on fiscal outcomes, confirming H1a. Waste disposal transportation and treatment incurs costs, whether the waste is taken to landfill, or it is recycled. Costs associated with waste management are routinely tracked by many large organisations and are part of the day-to-day operational costs. Diverting waste away from landfill is desirable, however, success depends on many factors, as discussed in Section 5.4.3 (waste care management). Cost savings are often reported as a compelling and useful indicator of the success of recycling activities.

Kaplan et al. (2012) encouraged healthcare establishments to quantify the financial benefits of adopting green practices with respect to waste and several other sustainability

practices. Fiscal benefits as a result of implementing the recycling project reported in this study are calculated to be in the region of \$121,000 since the project began. This calculation considers the comparative cost of waste transportation and disposal of the different types of healthcare waste reported in Section 7.2.2. This saving is substantial, given the current economic climate in NZ, with rising healthcare costs and the increasing economic burden associated with a rising population.

8.2.4 Environmental Outcomes

This study reported on the environmental impact of waste disposal by calculating the associated carbon footprint using the software tool accessible to CM Health as members of the CEMARS programme. This result confirms H1.2 in that recycling has a positive effect in healthcare waste management. Healthcare has the potential to cause environmental harm (Patrick et al., 2011). Measuring a carbon footprint has proven to be a useful means of measuring the impact of environmental harm (as discussed in Section 2.3). As found by Charlesworth et al. (2012), concerns over climate change were the primary driving force of clinicians' active participation in environmental sustainability programmes, supporting the need to report on the environmental impact of such programmes of intervention.

The carbon footprint for Middlemore showed a small but steady increase, whereas the emissions for the Manukau site tracked downwards over the duration of this study. There is a direct association between the carbon footprint and waste to landfill activities which explains this finding. The higher weight of GW associated with the activity at Middlemore accounts for the increase in carbon footprint. For healthcare establishments that are unable to count and track their footprints this finding is useful. In knowing this, other healthcare organisations will be able to expect the associated environmental outcomes by adopting recycling projects.

Despite there being a growing interest within the field of sustainability and the healthcare sector, no other literature within the review undertaken (in Chapter 5) reported on the carbon impact of their recycling projects. Exploring the more recent literature (published since that reviewed in the chapter) supports this claim. According to a publication from a workshop I attended (by invitation only) on environmental sustainability in clinical care held at Yale University during April 2018, a comprehensive approach to healthcare emissions research is needed to better evaluate clinical materials and processes (Sherman et al., 2020). Hospital/clinic level sustainability benchmarking thus is a strategic research

area. The findings of this study indicate the need to focus on wider outcomes. Focussing solely on fiscal outcomes devalues the benefits of adopting a more complete approach. Collecting data of this nature adds to a growing body of knowledge by seeking to quantify the full range of benefits (Garriga & Mele, 2004). Tracking carbon footprints, as in this case, serves as another useful benchmark, and an important contribution of the present study (Sherman et al., 2020).

Healthcare establishments routinely send many tonnes of waste to landfill. Much of this waste causes damage to the environment (Kaplan, et al., 2012; Langstaff, 2017; Lui, et al., 2014; Tudor et al., 2008) by polluting the land and waterways and entering the food chain by way of creatures ingesting particles of damaging materials including plastic. Activities aimed at diverting waste away from landfill offer benefits beyond fiscal and environmental contexts.

8.3 Quantitative Findings

Significant results are discussed in this section; focussing on awareness, work context, and segregation behaviour.

8.3.1 Awareness

Awareness scores were negative but small for all items, showing a decrease in awareness in 2015 when compared to 2014. This finding is interesting in that participants regarded the factors within this category as being not so important. This finding leads to questioning the depth of knowledge regarding sustainability that exists among healthcare employees. Sustainability is not generally included in much detail within the various educational curricular programmes, thereby leading to a knowledge deficit, as supported by Charlesworth et al. (2012).

Understanding the implications of unsustainable practice requires an in-depth and systematic application of knowledge from across the disciplines of climate science, environmental science, and human science. Education and research agendas are being designed (Charlesworth et al., 2012) to fill this obvious gap and the results of this study support the need to develop such programmes in NZ and elsewhere. Another point of interest relates to the lack of negative impact this factor has had on the other factors (Work Context and Segregation Behaviour). One could assume that without complete

knowledge and appreciation of the impact of unsustainable practice, individuals would be less likely to comply with programmes aimed at reducing pollution, saving money, and reducing the impact of chronic disease (all described in the literature as being connected to unsustainable practice).

The findings of this study suggest that actions relating to recycling are regarded as being part of the norm, more driven by emotive and ethical imperatives than by normative expectations. This is an important point because it reflects an element of emotional connectedness. The desired behaviour change is more likely to be sustained when people are emotionally connected to the behaviour. There was also a marked tendency for females to score higher on these items, demonstrating the potential impact of traits associated with gender such as ethical behaviour with recycling considered by females as being innate (recycling is good, necessary, useful, and sensitive). This is of interest since the workforce within the healthcare sector is predominantly female (Harris et al., 2009). Further exploration is required to evaluate the impact of gender on sustainable behaviour.

8.3.2 Work Context

There was a progression in exposure to the communication platforms. The most significant of those being: seeing the notices, discussing sustainability aspects at staff meetings, and the support given by the area manager in facilitating the discussion. Of less significance were the posters, webpage, and talking between peers. This finding is helpful since the means of delivering key organisational messages often rely on electronic and passive methods (websites, posters). Healthcare facility workers may have little down-time, and few opportunities to access emails or look through websites.

Respondents suggested the usefulness of delivering notices directly to the services during staff forums as this helps to socialise the programme. In addition, if managers are present, they indicate their support adding to the impact and contributing to the success of the programme. Using staff meetings to disseminate messages creates the opportunity for discussion and generates higher levels of interest. This finding is of interest given the link identified in Figure 4.5 (Chapter 4) between engagement and establishing a positive feedback loop as being a crucial component of the CM Health Recycling project. Delivering education sessions personally also allows for the relationship to be developed with others, this being an important element of behaviour change.

8.3.3 Segregation Behaviour

Marked improvements were displayed with comingle (Plastics-Glass-Aluminium) and paper scores, but not for food waste recycling. Raised awareness meant that employees are more conscious of the need to manage waste more effectively and therefore noticed it (waste) more than before. The recycling project was intentionally rolled out initially within the non-clinical areas. In such areas, there is little to no chance of finding waste that has been in contact with patients. Targeting such areas at first allows programmes to be developed in a less challenging environment. Introducing recycling into clinical areas increases the likelihood of finding contamination, adding to the associated risks posed to waste handlers (Lui et al., 2014).

Findings suggest that non-clinicians can recycle more paper than clinicians. The programme did however target more non-clinical than clinical areas. Anecdotal and professional experience supports the notion that non-clinicians generate higher levels of paper waste than clinicians, another reason that could explain this finding.

The findings of this aspect of the study demonstrate a difference between sites; the recycling project was more successfully rolled out at MMH. Issues pertaining to resource allocation impacted on the speed at which the interventions could be put into action, which was especially the case with the Manukau site. Consequently, issues beyond the control of the recycling project served as a barrier. The way in which budgets and resources are allocated within the setting of healthcare can hinder system-wide recycling projects and environmental sustainability programmes. Unless waste budgets allow for the provision of recycling in the first instance, making alterations post-budget allocation becomes problematic. A matter of greater significance can be noted here as to how the change was negotiated and resources navigated across the two sites. This is relevant to the very core of what was being investigated in this study and supports the adoption of the Complexity Leadership Theory approach. Organisations are dynamic, the programme has to adapt and flex as contextual factors present themselves. Building in adaptability and flexibility is therefore an essential feature of a large-scale organisational change management programme as otherwise such programmes would fail to take hold.

Food waste recycling is not offered to any of the sites under consideration. Smaller sites within the CMDHB have used worm farms and have since been successfully using these systems. Much work has been undertaken to find a suitable food waste recycling process for the study sites. This is a complex and time-consuming process that requires wide

stakeholder engagement, undertaking full market appraisals, and seeking approval from executive and corporate leadership committees.

The self-reported change in recycling behaviour was markedly positive. Just under half of the respondents reported being able to recycle more in 2015 than in 2014. This is a significant finding. Self-reported behaviour alone is most often used when studying the effect of waste reduction programmes (Evans et al., 2012). This study measures both actual and perceived data and the findings correlate.

Three constructs failed to reveal any statistically significant changes between the two years. The first of these was labelled 'core values' and the questions in the survey targeted how respondents scored their responses in relation to reducing their waste and recycling. The second construct, termed 'receptivity', aimed to capture changes regarding the level of engagement with the various communication platforms. The final construct which was assigned the label 'transformational values' relates to the wider sustainability programme. It is important to state that the timeframe of this study was limited with respect to duration and, potentially, alterations of perception towards these constructs may take longer than twelve months.

Discussion of the qualitative findings follows, prior to considering the integrated findings in the final section of this chapter.

8.4 Qualitative Findings

This discussion of the qualitative findings focuses first on the recycling project and then on the environmental sustainability programme. The qualitative findings add depth of information to the survey data set.

8.4.1 Recycling project

Each level is discussed, starting with the organisation, then the programme, and finally the individual employee.

8.4.1.1 Organisation

The need to use business power in a responsible way is described by respondents as being a corporate responsibility. Organisations that do so are regarded as leaders within the area of environmental sustainability. Many measures are required to reduce waste,

including up-front measures (Kaplan, et al., 2012). Respondents in this study described how procurement and the supply chain presented opportunities to influence the downstream impact of waste. Respondents suggested undertaking an analysis of costs and associated benefits as this activity might assist decision makers in making the right choices. In doing so the downstream impacts of waste production could be more favourable.

Selecting materials that are more readily recycled make an important difference to the type of waste generated at the outset. Lui et al. (2014) urged for a better quality of interaction between suppliers of medical equipment and consumables and end-users/clinicians. In doing so, products and materials can be developed that can be disposed of at the end of their intended use.

To further reduce the generated waste, using fewer single-use items or, indeed, using single items more than once was another useful suggestion by respondents. This suggestion is not made with reference to the many single-use items that are intended for clinical use but, rather, non-essential kitchenware items. Respondents recognised that many single-use items are still required and cannot be avoided, yet practical suggestions were given relating to impact and reduction.

8.4.1.2 *Programme*

Recycling is described as part of a range of waste reduction solutions (as described by Figure 2.3). All organisational members are required to adhere to a recycling project, supporting the need to take a multi-level approach (Kantabutra, 2011; Nichols et al., 2012). Respondents described various systems and processes as being needed to facilitate successful waste segregation and recycling. This response supports the notion of systems thinking as a means of shifting organisational culture (Figure 4.5).

Space and physical arrangement of the environment were described by respondents as being significant and influential factors, which were also previously identified by Nichols and Manzi (2014). Respondents stated that clear instructions are also required, as are adequate signage and posters (Evans et al., 2012; Tudor et al., 2008).

Safety features were considered of paramount importance by respondents since healthcare waste is more likely to pose a risk to all involved in the waste handling process as supported by Alam et al. (2013); Manga et al., (2011); Njagi et al., (2012); Ruoyan et al., (2008). The qualitative findings of this study attested to the importance of providing

safe and effective recycling services (see Section 7.4.1.2). Having an integrated approach to recycling reflects effective and strong leadership. Leadership support improves sustainability outcomes (H2.1) since when an organisation prioritises a project and/or programme of work, efforts are made to ensure processes are safe and effective.

Having the correct number of bins and containers is seen as being a pivotal factor by the respondents of this study, contributing towards successful outcomes; yet there is no mention of the size of the receptacles, as found by Tudor et al. (2007b). Recycling was regarded by respondents as being a valid component of a sustainable waste management programme, yet issues were identified in relation to the current mechanism in place to segregate and recycle cardboard. Results from the audit mirror this finding, as described in Section 7.2.1.

Respondents identified the importance of receiving feedback and being given prompts, supporting the findings by Evans et al. (2012). Providing information on progress and outcomes of the programme assists in achieving the desired outcomes and fostering lasting behavioural change (Kaplan et al., 2012; Miller et al., 2011; Njagi et al., 2012). The results of this study indicate a need to target waste streams that are important to the individuals who participate in the programme and is a new finding. All too often, activities aimed at reducing waste are, instead, designed from the perspective of programme coordinators or waste disposal service providers. This collective and collaborative approach aligns well with the complexity leadership theory, completing the integrated framework presented in Figure 2.5. This brings the discussion onto the final theme of individual employee.

8.4.1.3 *Individual Employee*

This study found that recycling matters to employees. Understanding what matters to people who use the recycling systems and follow the processes allows the project leader to shape the way the project is delivered. A careful balance is therefore required, taking into consideration what materials can be readily segregated, what materials can be easily recycled, what matters to the participants, and what specific projects can be adapted within the financial constraints. As described by McMillan (2014), a lack of high-level engagement and stakeholder collaboration threatens sustainability interventions (see Section 2.4.1). From the comments made by many respondents, the currently targeted waste streams are of value and the project generally meets expectations, aside from the issues identified with cardboard recycling and the lack of a food waste collection service.

This finding is especially important for me as the project leader because I often feel isolated working as the sustainability officer in the setting of healthcare. This feeling of isolation comes about for a few reasons. First, the position falls outside of the usual organisational structure within healthcare, making it difficult to find a sense of belonging to any one team or service division. Second, because the position is relatively new for the healthcare sector in NZ, local policy and organisational guidelines did not pre-exist and these needed to be developed at the start of this project. Third, the aims and objectives of the recycling project and wider environmental sustainability programme are dissimilar to existing projects and programmes within the organisation, otherwise regarded as being business as usual. Knowing that employees really value this project by showing their true interest and passion goes partway towards offsetting the strain created by feelings of isolation in the position.

Healthcare sector purchasing decisions and practices come under the spotlight when an environmental sustainability lens is applied. One obvious example found at CM Health (and many other DHBs in NZ) is the reliance and heavy use of the Styrofoam (foam) cup. The qualitative findings showed that many respondents agreed with the view that these cups should not be used because of their damaging environmental impact. Consequently, they urged for the discontinuation of foam cups within the organisation. Adopting less sound and less sustainable procurement practices impacts on waste generation. In addition, the expectations of employees about what the organisation should be purchasing play a part in perceived business ethics. Sustainability is described as a social consciousness, which means that the organisation has a social responsibility to engage in sustainable supply chain and procurement practices (McMillan, 2014).

Being mindful when recycling, and being considerate to others and the environment, displays a higher level of integrated thinking about pro-environmental behaviours. This finding contrasts with McMillan (2014) who stated that healthcare professionals or those working within the health setting tend to be less focussed on the longer term and the wider impacts of their behaviour. Recommendations were made by respondents to offer the recycling project to all people that access CMDHB sites. At this stage, there is little access to recycling bins for non-employees. This point highlights another area of improvement.

As discussed in Section 7.4.1.2, in many instances' respondents expressed the importance of targeting food waste. It is notable that the findings from the literature

review provide no insight as to how to address this waste stream within the healthcare context. This finding represents an area of mismatching priorities. The organisation did not prioritise food waste within the recycling programme, yet the respondents emphasised a need to do so. The qualitative findings of the wider environmental sustainability programme are discussed next.

8.4.2 Environmental Sustainability Programme

The following section presents the discussion under the themes of ‘organisation’, ‘programme’ and ‘individual employee’

8.4.2.1 *Organisation*

The concept of leadership was discussed previously (section 3.1.1). Study respondents emphasised that the organisation has a responsibility to behave in accordance with sustainability principles, thereby showing leadership in the sustainable healthcare sector. Leadership is described in terms of the organisation and the individual with every person favourably taking responsibility for their own actions (Goonan et al., 2014; Hartman et al., 2011; Lui et al., 2014; Patrick et al., 2011). Positive outcomes in relation to retention and recruitment are more readily seen when organisations demonstrate improved sustainability practices.

Recycling was described by respondents as being a crucial component of an overall environmental sustainability programme. Suggestions were made for making the programme mandatory to improve compliance, indicating that the environmental sustainability programme aligns well with the values held by the respondents of the study.

Hartman et al. (2011) and Jamali et al. (2010) both found that when healthcare organisations embrace the environmental sustainability movement, employees react quickly and positively, and this is supported by this study. Integrating organisational and individual factors in this way has been worthy of investigation since no research into the environmental behaviour of healthcare organisation has been undertaken in NZ. The only study found was by Goonan et al. (2014) who focussed on food waste generation within hospital kitchen departments. Goonan was more interested in exploring ways the kitchen departments could reduce food waste by minimising food preparation waste and appropriate portion size rationalisation. This study focussed on the wider spectrum of healthcare waste across multiple departments and two sites.

8.4.2.2 *Programme*

Respondents recognised that managing the recycling process of change requires attention because it doesn't just happen without focused effort. The requirement for managing and sustaining the desired behaviour change over time presents another important finding, as reflected in the literature (Connor & Mortimer, 2010; Evans et al., 2012; Franco & Almeida, 2011; Kaplan et al., 2012; Miller et al., 2011; Nichols et al., 2014; Ruoyan et al., 2008). Various steps were considered helpful in keeping the momentum going, such as: issuing friendly reminders, having champions to drive the central messages, and, in general, increasing the level of communication about recycling and wider environmental issues.

Education assists with communication and several objectives of sustainability education programmes identified in the literature (Charlesworth et al., 2012; Connor & Mortimer, 2010). In addition to being able to deliver messages and assist with reaching compliance, generally, regarding health and safety regulations, increasing awareness is also identified as being a primary objective. Socialising the existence and application of the environmental sustainability programme aids successful employee engagement (Njagi et al., 2012).

The literature suggests several focal areas that fit within a wider environmental sustainability programme (Connor & Mortimer, 2010; Kantabutra, 2011; Patrick et al., 2011). The focal areas brought forward by the respondents of this study correlate well with those identified in the literature. Respondents suggested adopting initiatives directed towards energy conservation since these bring substantial financial benefits, and these initiatives are like those described by Kaplan et al. (2012). In addition, applying sustainability criteria to procurement practices present to influence all stages of the supply chain. If all goods and services required by large organisations are selected because of a set of sustainability criteria, improved and wider-reaching social and environmental outcomes could be expected (Kaplan et al., 2012).

The respondents situated recycling within the context of a wider environmental sustainability programme. The importance of tackling waste early on in an environmental sustainability programme was recognised as important by respondents. Employees start by tackling recycling and become more inclined to continue with other sustainability activities that sit within the wider programme. Healthcare employees are used to tackling issues using a system-wide approach, as many health issues require a multifaceted

approach to diagnosis and treatment. The same approach can arguably be taken when tackling global warming and climate change. Successful environmental sustainability performance could be limited if only directed towards one focal area since taking a system-wide approach to global issues such as these further enables success. This brings the discussion to the individual employee level.

8.4.2.3 *Individual Employee*

Respondents believed that champions are well equipped to assist with programme delivery. Consistent with Evans et al. (2012), individual employees were, according to respondents, more likely to comply with the requirements of an environmental sustainability programme if there was support from their managers thereby demonstrating the advantage of having leadership support. This finding also aligns with the requirement of having a dedicated resource, such as a sustainability officer, as noted in the qualitative responses. Many DHBs in NZ are struggling to get approval for a dedicated sustainability position. This situation exists because the sustainability role is relatively new for the healthcare sector and considered by many as non-essential, despite there being a strong link between health and environmental outcomes.

The importance of having leadership support cannot be overstated. Leadership demonstrated across all levels of the organisation underpins the success of the programme by signalling support, translating support into action by providing a dedicated resource; in doing so inspiring pro-environmental change from the management layer down to the individual employee level.

The findings of this study have been presented as two single data streams. The integrated findings are now presented, further revealing the main insights from the findings as well as highlighting the uniqueness and value of this study.

8.5 Integrated Findings

The final section of this chapter summarises my reflective learning and integrates three components of this project, as shown in the following figure.

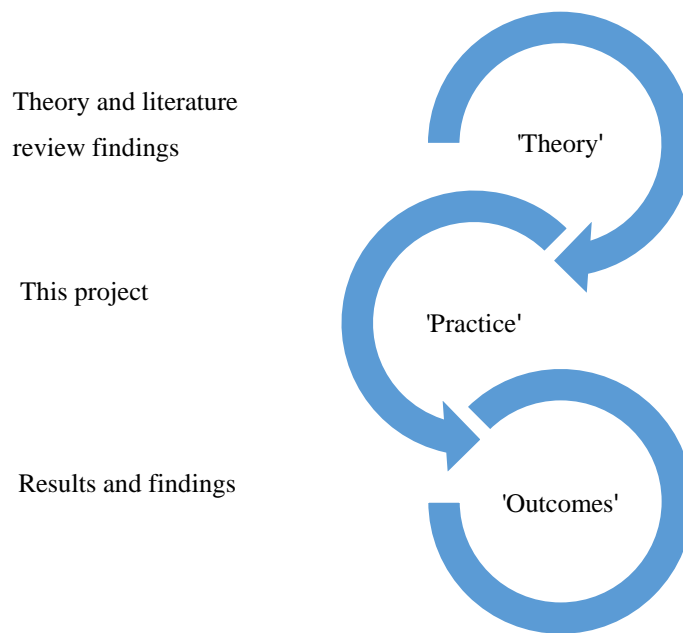


Figure 8.1. Integrated findings connecting the ‘theory’ to the ‘practice’ and the ‘outcomes’.

The term integration in this sense refers to the integration of the theory and literature, the practice (this project) and the outcomes of this research using a reflective approach. The following figure has been developed to connect the literature review and theoretical lens which provided the basis for the conceptual framework (Figure 5.2). From the findings of this study this initial framework has been refined, as shown in the diagram below which highlights the main findings.

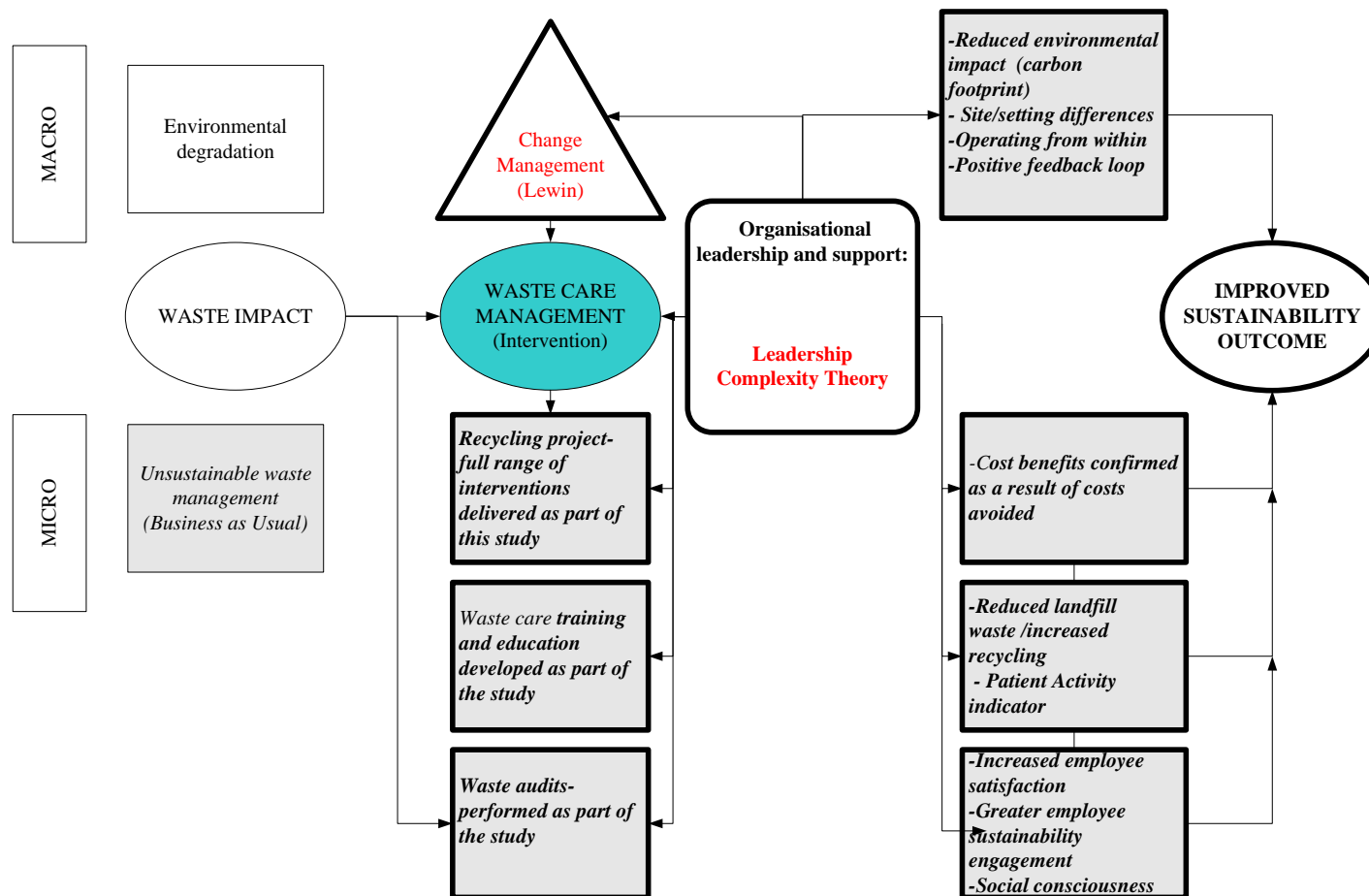


Figure 8.2. Recycling Project Conceptual framework depicting main research-project findings.

The thicker lines around the boxes in the diagram (Figure 8.2) draw attention to the main findings of and insights gained from this study. Theories of significance presented in 0 have been highlighted in red. Arrows represent the direction of influence between the constructs presented and show linkages and connectivity. The results reveal three essential and interlinking components of a recycling project relating to the roles of the organisation, the programme, and individual employees.

Recycling is demonstrated to be a highly significant component of an overall environmental sustainability programme. The first two left hand boxes have been decoupled since the waste impact financial has reduced as a result of the intervention. Leadership, displayed across each component (or layer) of the recycling project, helps drive successful outcomes and achieve sustained organisational change in recycling behaviour.

Leadership and its role in achieving and sustaining the required behavioural change (through change management strategies) are recognised as a necessary requirement for a successful programme. Leadership is demonstrated by the organisation in terms of providing the dedicated resource, the recycling service, and by equipping areas with the required resources. Individuals are also recognised as leaders in successful change management, whether they are already in a recognised and designated formal leadership role or they choose to take on the role of clinical champion. Operating from within the organisation helps to keep the momentum of the project and programme going and adds to the level of employee engagement by furthering the development of a social consciousness. The level of importance ascribed to the recycling project by employees was unexpected, as was the place of their underlying ethical and moral motives for supporting the project.

Using the theoretical lens and reflective approach this next section presents an overview of the change management process of delivering the recycling and sustainability programme couched within the overarching lens of complexity leadership theory. Complex systems incorporate myriad interacting elements. The interactions between these elements are nonlinear and minor changes can cascade into large-scale consequences. Such systems are dynamic, with a whole greater than the sum of its parts. It is not possible to impose solutions or order upon them; rather, such novel forms arise from the circumstances within them.

When people in an organisation interact, they change due to the influence of relationships, interdependent behaviours, and the emergence of subsets of networks that engage one another interdependently. These interactive behaviours and outcomes ultimately create feedback loops with each other. This leads to effects becoming causes and influence arising from extensive chains of effect, as previously indicated in Section 3.1.2.1 (page 34) on the discussion of social norms associated with psychological theories.

Complexity does not refer to static events. Rather, it concerns a dynamic process that consistently changes as new behaviours emerge. While there is global stability and resilience within complex systems and complex behaviour, they are fundamentally defined by change and adapt.

Managing change is an on-going process that takes time, expertise, dedication, and efforts to not only implement the change but to sustain the desired changes in behaviour. To be effective, leaders learn to cultivate interdependencies in this case through the management and development of networks, or green teams, within – and external to – their organisation. This involved forging new connections or enriching existing connections. The development of these networks provides contacts, but more importantly, they form the structure from which innovation can emerge as supported by Brown (2011).

In addition to creating and maintaining networks, I created the supportive environment in which new networks could emerge by simply not interfering in network construction. Work environments can effectively support interaction, creating a culture of interaction and networking. Complex leaders can also catalyse network development by avoiding solving problems, insisting, rather, that they work out their own issues collaboratively. An approach I simply had to take because of my workload. Having a dedicated resource is one thing but having a team of sustainability champions working together and pushing forward on the sustainability agenda achieves far more.

The discussion thus far correlates with the first stage of the process of change (unfreezing), according to Lewin's method, referring to the preparation for the change. This means that at this step, all levels, from individual to organisation, must be prepared for the change and for the fact that change is required. Networks can assist with this preparation phase thereby avoiding resistance to change and realising the importance of

breaking the status quo. At this early stage, explanations were offered to people about why existing waste management behaviour needed to change and how the proposed changes would bring about improvements. Since this project incorporated the wider environmental sustainability programme this step also involved steering the teams to re-examine the basis of all organisational operations through a sustainability lens.

It is important to have a leadership 'tag' or flag around which all parties rally, reflecting the binding philosophy that brings people together. Leaders catalyse network development by becoming a tag. This does not mean that they control people with respect to a certain philosophy, but rather that they represent the essence of that philosophy or concept. For example, I became the tag for the environmental sustainability and recycling programme. Such leaders rally people around the ideals of the organisation, promoting sustainability with a positive attitude.

Complex leaders drop seeds of emergence by identifying, encouraging, empowering, and fostering the connection of sustainability knowledge within an organisation. Rather than trying to closely control, champions were encouraged to try new approaches, and pilot the application of novel ideas, then challenge them to evaluate and adjust their experiments. The purpose here is to create a space where dynamic activity flourishes, emergent behaviour, and creative 'hot spots' of activity at multiple locations throughout the system. This where the real transition or change takes place which may take time as people usually require time to embrace new happenings, developments, and changes. At this stage, good leadership and reassurance are important because these aspects not only lead to steer forward in the right direction but also make the process easier for individuals who are involved in the process. Effective communication and having enough time are thus the keys for unlocking success at this stage.

For organisations without dedicated sustainability leads, this is where progress falters because the sustainability lead is essentially the 'glue' that keeps all the parts of the work programme together. Without the 'glue' each part works independently, in a less cohesive fashion where small gains may be achieved but in the longer term, this approach is less effective.

Now that the change has been accepted, embraced, and implemented by people, the organisation begins to become stable again. This stage is referred by Lewin as refreeze and is the time when the staff and processes start going back to their normal pace and

routine. Now with a sense of stability, employees get comfortable and confident of the acquired changes. I invested both time and energy in fostering collaboration by connecting disciplines, teams, and services. On the downside, this takes time in the early stages of network construction, but I believe this pays off in the longer term as networks continue to expand their work programmes and spheres of influence.

This study captures organisational data through self-reported measures and qualitative responses to uncover valuable insights into sustainable healthcare management, with a focus on recycling. Drawing all the findings together, this study shows that recycling leads to positive financial and environmental outcomes for the organisation. Differences were found within and between sites, as shown in the audit findings and the results of the survey. From the combined results, recycling is deemed to be a valuable component of a wider environmental sustainability programme and success is more likely if the programme is supported by the organisation with appropriate resourcing and leadership. Organisational support is demonstrated by engaged leadership, by the provision of a dedicated position resource and the delivery of a programme. The findings show that when individual employees are provided with the requisite resources, they are also more likely to engage.

The qualitative findings augment the quantitative findings, adding further depth specifically in relation to the value of the recycling and environmental sustainability programmes. Finding out what matters to employees is an important learning for informing the recycling project and the wider environmental sustainability programme. The reported increase in employee satisfaction as a result of the intervention is thus likely due to a better alignment between organisational and individual employee beliefs. This level of detail would have been missed because ordinarily, organisations capture the high level 'audit' data to inform project and programme outcomes. By employing the survey, more detailed information was gathered and a deeper level of understanding of the recycling project was generated. Developing an understanding and appreciation of the outcomes and processes of a project and programme builds knowledge and confidence in the value of the initiative and creates the capacity to make the case for positive change.

8.6 Summary

This chapter discussed the results of this study considering the findings of the literature review and the extent to which the hypotheses were supported by the findings in relation to the research-project question. I have reflected on the role of complexity leadership theory and attempted to integrate the theoretical component of this project with the delivery of the project and the research findings. Favourable financial and environmental outcomes occur as a result of a recycling project and recycling is an essential component of a wider environmental sustainability programme. Employees reported an increase in work satisfaction as a result of the intervention and doing what matters to people is important. This is especially so in the case in the public sector where employees' performance is driven less by an organisational profit orientation.

The audit data were considered regarding waste weight, costs, and environmental impact. The use of KPIs and issues associated with benchmarking were also evaluated. Quantitative findings relating to the three constructs of Awareness, Work Context, and Segregation Behaviour allowed further exploration of employee behaviour. Similarly, qualitative findings were discussed under the broader headings of the recycling project and environmental sustainability programme. Based on these findings, the conceptual model has been refined to reflect the major points discussed above and their contribution from the study. The next chapter draws together the final conclusions, the limitations of this study, and the implications of this research project for theory and practice. Directions for further research are then offered in the final section of this thesis.

Chapter 9 Conclusions

9.1 Introduction

This final chapter summarises the main conclusions and considers the limitations of this study. Implications of this research-project for theory and practice are presented next concluding with a section offering directions for further research.

9.2 Main Conclusions

When reporting healthcare waste-related activity, costs, weight, and environmental impact should form the basis of the report. Success of a recycling project is demonstrated by reporting reducing waste to landfill diversion rates and the increasing weight (and range) of materials recycled. Using the Patient Activity indicator is a useful means of understanding waste-related activity (waste amounts and associated emissions) as it considers the frequency and volume of inpatient and outpatient activity.

Differences were found between and within sites: where patient acuity levels are higher and when mixtures of different types of services are delivered, waste activity will be higher. It would be useful to be able to tag the amount of waste per type from every specific ward or department. The information would be advantageous as it would track the progress of department-level recycling interventions as well as being able to provide valuable feedback to end-users. Such feedback allows for the correction of unfavourable behaviour and encouragement of positive pro-environmental behaviours.

End-users benefit from being involved along the way as this encourages ownership of the programme, increases success, and facilitates the desired behaviour change. Having a dedicated sustainability lead is essential as this person helps to connect employees to all components of the programme and ensures alignment of programme objectives.

A dedicated sustainability lead to devise, deliver, drive, and evaluate the environmental sustainability programme is essential and contributes to achieving successful sustainable healthcare programme outcomes. Recycling is one sustainable waste management activity which sits within the wider environmental sustainability programme. The organisation demonstrates leadership and executive-level buy-in when resources are

provided, from the dedicated resource, to the range of required equipment, and to making it possible for employees to attend training.

Emotive forces drive employees' pro-environmental behaviour which has implications for research, education, and practice. Future programme developers would benefit from connecting with employees on an emotional level when designing the messages for recycling projects and environmental sustainability programmes.

When planning recycling activities, programme developers would benefit from building in opportunities to deliver relevant organisational messages using face-to-face interactions as this leads to higher engagement.

Systemic thinking is central to complexity leadership. It challenges leaders to continually be aware of the interactive dynamics at multiple levels of engagement. This is not easy to accomplish, but it is deemed vital to consistently see the broader pattern of events and understand how networks can create positive change and improved outcomes. The limitations of this study are presented next.

9.3 Limitations of this study

This study focussed on a healthcare setting in a single country. The results, therefore, are specific to this context and may not apply - or apply in the same way - to another sector and country setting. The study could, therefore, be extended to test the findings in other healthcare settings, and more widely in other sectors or countries. Repeating the study at other healthcare establishments (such as private hospitals, residential retirement or care facilities, or medical practices and laboratories) may deepen the understanding of complexity in healthcare waste management. This study explored the differences between two sites that delivered inpatient and outpatient services. This case study did not capture in-depth interview material, which could be regarded as a further limitation. Collecting in-depth material from hospital and community-based primary healthcare establishments may reveal new findings because site and setting variability impacts waste generation rates, as highlighted by this study and indicated in the literature.

This case study applied both quantitative and qualitative approaches to data collection and analysis. These approaches are often distinguished and defined based on the type of data used, the logic employed regarding data collection, the type of investigation, the

method of analysis, the approach to explanation and, in part, based on the underlying paradigm (which reflected a post-positivist stance in this study). For this research project, the main issues were methodological and related to validity and reliability.

For this study, a new survey tool was guided by and developed from the literature (Connor & Mortimer, 2010; Tudor et al., 2007a; Tudor et al., 2008a). Pre-tested and pre-validated survey tools are deemed more reliable than new survey tools (Teddlie & Tashakkori, 2009, see Section 6.6.2). Existing tools were explored, and none were found that could be adapted to answer the research project questions for this study. Several steps were taken to ensure internal validity with the new tool. The survey instrument was piloted and following a clear research project protocol helped to overcome the limitations associated with internal validity regarding the survey instrument.

External validity refers to generalisation (De Massis & Kotlar, 2014; Yin, 2009) and this study was set at two sites. Since the sites under consideration vary in many ways, comparisons between the two could be problematic. Nevertheless, examining the data within the context of the setting of this study also presents one of the strong advantages of the case study research project, as this encourages replication logic. Many settings in health are either based at a single hospital or a clinic. The rationale for including both sites in this study was thus logical, defensible, and useful in terms of future practical and research project applications.

A clear case study research project protocol was developed primarily to minimise errors and bias (Yin, 2009) due to sampling issues. Regarding the longevity of the study which captured data over a 12-month period to compare matched responses, initial oversampling ensured that the final sample size was adequate to meet the requirements of the quantitative dataset.

In addition, reliability was enhanced by keeping a case study database. This entailed organising the raw data (audit data, survey findings) chronologically along with details of the programme as a means of confirming through triangulation that the findings were indeed accurate and reliable. The speed at which the organisation-wide sustainable waste management programme could be implemented relied on several external factors, some of which were outside the control of the project manager/researcher. To account for this uncertainty and to increase the reliability of the findings, a time series design was used.

Exploratory Factor Analysis (EFA) used in analysing the quantitative data has two main limitations, as discussed in Chapter 4. In some instances, lower factor loadings were included because the desire to retain features of the initial statistical model was greater than the desire to follow stringent and inflexible analytical steps. Consequently, reported associations may be less significant, presenting another limitation. Most features of the model were retained and reporting on the lower factor loadings and was an important step in the process. By repeating the study in a different context results might differ; hence an attempt made during analysis to retain as many of the original features as practically possible.

A further limitation in EFA relates to the way in which one of the constructs was analysed. The ‘Work Context’ construct included two types of data: Likert Scale and dichotomous responses. Different analytical methods are normally used for each scale type set, but for this analysis the same approach was used for both types. A consistent approach was taken to avoid adding too much complexity. The means by which the data were analysed to mitigate the impact of this limitation have been fully described in the supporting documents in the appendices.

Furthermore, the findings of this study were advanced through the application of pattern matching, which was achieved in this study by comparing the patterns observed with the patterns described in literature regarding previous studies in different contexts. These decisions would need to be considered in any future replications of this study where EFA was used.

9.4 Implications for Theory

The theory that has been extended relates to sustainability programmes and outcomes in the healthcare sector. This study shows that organisational support, leadership, educating staff, and having a well-thought-out strategy for recycling/environmental sustainability are together necessary components of a successful sustainability approach in an organisation. This requires a deliberate formal strategic approach by the organisation, as part of a sustainability philosophy, this being a useful confirmatory finding.

Education on recycling and sustainability is required for undergraduates of healthcare programmes. All too often, the topic of sustainability is omitted from the curricula or

included as an optional extra. From my experience (as a nurse and sustainability practitioner) healthcare organisations also fail to deliver a meaningful level of sustainability-related education. Prior to the introduction of the recycling project and environmental sustainability programme at CM Health, no information was given to employees about waste management, recycling, or environmental sustainability, and consequently little was done to draw attention to the need for sustainable practices. Recycling was the focus of this thesis and the education strategy which formed part of the project has accordingly emphasised recycling. For the organisation to fully support the wider environmental sustainability programme, time needs to be allocated to every employee to facilitate the development of their sustainability knowledge. This has yet to be executed across the sector in NZ; this study contributes to this discussion.

Couching the change management literature within the lens of complexity leadership theory could form the basis for further theoretical development within the context of sustainable healthcare literature. Complex adaptive systems such as healthcare organisations require approaches that tackle all levels of an organisation and warrant further investigation since there has been insufficient longitudinal research to date (that I am aware of) in which leaders intentionally applied complexity leadership theory to their organisations in relation to building and managing their sustainability strategy and overall organisational sustainability performance.

Using a longitudinal approach, this study has extended existing theory in the collective realms of sustainability, leadership, and change management. Unpicking the way in which a large complex healthcare organisation adopted and translated a sustainability strategy could lead to further practical applications and subsequent theoretical development. Understanding how sustainability messages are communicated and exploring the many different methods of engaging with multiple employees across different sites also merits further investigation.

The way sustainability is conceptualised adds to the theoretical discourse. Sustainability is a crucial approach, a philosophy that underpins all decisions, an outcome, a continual two-way learning process, a means of connecting people with nature, and with each other whilst being described as a moral imperative. Thereby the thinking is extended further into the meaning of the concept of sustainability.

Teasing out the essential strands of a sustainability strategy and recycling programme whilst identifying indicators for success adds to existing knowledge in support of the alignment between top-down (policy levers), bottom-up (individual), and the ‘in-between’ (societal levers). However, of note, the socio-political context is very different in New Zealand when compared to other countries. There are unique opportunities available for sustainability practitioners in the healthcare sector in New Zealand which may not be so readily available at other geographical locations. Nevertheless, this study highlights ways in which these dimensions can be elaborated, both regarding constraints and freedoms to develop and innovate sustainability approaches in the healthcare sector elsewhere.

The opportunities being referred to here are linked to a combination of factors. New Zealand, by comparison, is a small country, globally recognised for being proactive and standing ‘for nature’ and agile enough to respond to evolving issues, such as climate change. There is also strong government support for environmentalism in addition to growing societal demands for change. Further exploration of such differences might add insight into what makes a sustainability programme at a healthcare organisational level succeed or fail, adding to the theory around sustainable healthcare practice.

In addition, and importantly, this study contributes to the New Zealand and more widely, the Australasian empirical database as there are very few published context-specific studies. Despite the opportunities described, one-third of DHBs in New Zealand have yet to initiate a sustainability programme. This leads me to question the differences between organisations because some organisations value this approach whereas it appears that others do not. Describing the way this case study organisation facilitated the project could help others have confidence to follow suit or could direct further research regarding such differences and their impact. Further investigation would be useful in determining whether other organisations were helped by adopting this conceptual roadmap.

Healthcare organisations found in the literature report on waste weights by type, per site, per service and this study confirms the value of doing so. Where this study differs is the way in which it reports on waste-related carbon emissions. This practice is less commonly described, and no other studies were found which performed this step. The literature supports the need to measure environmental impacts (carbon footprints) yet

there are few models available which provide the theoretical details or practical guidance, and this study adds to this growing field.

9.5 Implications for Sustainable Healthcare Practice

Organisations rarely track emissions, as found in the literature review (Chapter 3). This study found a direct correlation between waste to landfill and carbon emissions. Delivering a recycling project lowers the environmental impact of waste-related activities and provides assurance to organisations less able to track their carbon footprints. Undertaking this research-project as the dedicated sustainability lead has enabled me to develop the project and provide the basis for the development of the environmental sustainability programme. Furthermore, I have been able to manage the effect of this project from ‘within’ whilst concurrently developing a high level of expertise in the field of healthcare sustainability management and sustainable waste management.

The audit data reveals differences between sites and between waste streams with reference to general and medical waste and recycling. The study revealed the value of using relevant indicators to provide context and meaning. Using audit data is useful when measuring the progress of recycling activities, especially when the weight of each of the different waste streams is known. Understanding the proportions of waste diverted from landfill relative to the total waste generated allows for a more comprehensive appreciation of the impact of recycling.

Providing additional contextual information such as bed numbers, levels of acuity, nature of specialties, levels of staff-to-patient ratios, and number of clinical versus non-clinical staff might help to overcome the potential issues faced by the professional, policy and site differences discussed. Using the PA indicator takes into consideration inpatient and outpatient activity and seems to best reflect the healthcare sector. As a practical suggestion for programme managers, adding in the ability to routinely tag waste to specific areas would be beneficial as this would facilitate deeper understanding and appreciation of service level outcomes. This activity was not possible during the timeframe of this study because the waste contractor at that time did not offer this level of service. This would provide the level of detail needed to provide feedback to all services, to give employees within specific areas feedback on their performance. Pre- and

post-intervention waste audits were performed during this project, a step supported by the literature. While auditing serves a purpose, audits only allow you to test over a prescribed and short timeframe and they are time consuming to undertake because they require detailed organisation and planning. During contract negotiations for waste services, managers of healthcare waste contracts could suggest including this activity within their supply and service contracts.

The programme audit data reported fiscal benefits calculated as costs avoided and included rebates earned. These amounted to \$120,000 over the course of the programme. This is a relatively large saving which adds value and provides a rationale for other healthcare organisations to initiate recycling projects.

The survey reveals a further difference between sites. Middlemore employees reported that they recycled less paper than employees based at the Manukau site, whereas previous literature findings indicate no differences as a result of inpatient to outpatient services. This finding implies there are contextual differences as a result of site and setting suggesting the need for further research to explore the causative factors of these differences.

The quantitative survey results reveal a change in awareness scores, a progression in exposure to the various communication platforms, and a positive change in waste segregation behaviour. This is an important finding since it signifies a paradigm shift, behaviour change, and change in mindset. Ways of socialising the programme were identified, face-to-face discussions being the most successful, thereby supporting the development of a social consciousness and building relationships from within the organisation. This can be linked with successful complexity leadership and is an important element in achieving/managing effective organisational/behaviour change. Being available, flexible, and visible helped to facilitate this relational aspect of the change strategy in this study.

The study emphasises that programme leaders need to understand the differences between areas, from the way the teams operate, the services the teams deliver, the space arrangements, the patient flows, existing communication channels, and the team structures. Once the functioning of an area becomes familiar to the programme leader-manager solutions can be identified collectively by the teams, thereby facilitating the journey to becoming more sustainable. This is an organisational learning process where

people within the areas learn how to change their behaviour. As the sustainability manager, learning how employees adapt as a team is also crucial. This allows you to offer tailored solutions which are more likely to work. For example, there is little point in offering every area the same set and style of recycling bins when all areas differ, from the priorities held dear in each area, to the waste they generate. In some areas, interest in recycling may be limited at the initiation of a programme so it is important to start slowly and gently build on the implementation of the change programme. Taking a one-size-fits-all approach could lead to higher failure rates and a lack of engagement.

In this study participants were more able to recycle when asked in 2015 compared with when the programme began. This is a significant finding because the study aimed to determine if individual employees were more able and more likely to recycle over the duration of the research. As discussed in Chapter 5 previous researchers rarely reported longitudinal data, further revealing the potential value of the findings of this study.

Food waste was recognised by many as being a priority area in terms of a recycling project and many respondents urged the organisation to stop purchasing and using foam cups. Targeting foam cups would be regarded as an easy and measurable win for the future. The collection of food waste was not initiated during the timeframe of this study because the cost to do so was prohibitive. This is an area for improvement, especially since the environmental impact of food waste entering landfill is much higher than that of non-organic matter (Auckland Council, 2012). Another important consideration relates to the priority assigned by many participants in this study to divert waste from landfill.

The environmental sustainability programme was regarded as being of value by employees with positive perceptions of the programme expressed. Finding out what matters to employees is important to gain buy-in for such a programme and organisations that display pro-environmental behaviours are described favourably, adding further value in terms of social benefits. Based on these findings developing the programme with input from employees was shown to really help garner support, feed into positive feedback loops, build relationships with others, and gave rise to the opportunity to shift the organisational culture. Successful behaviour change reflects a change in the mindset of people which leads to a paradigm shift, which surely must be the goal of any sustainability programme. To simply desire a change in one set of behaviours could lead to superficial and shorter-term gains. Undertaking longitudinal research helps evaluate

behaviour change over a longer timeframe, presenting the opportunity to dig a little deeper, searching for signs of the changing paradigm.

Overall, the study gave weight to the general view that there is a compelling argument for implementing a recycling project and environmental sustainability programme to bring about and embed behavioural change regarding recycling behaviour in healthcare organisations. The findings from this study underscore the view that it is comparatively cheaper to recycle. The results indicate that to ensure appropriate resources are allocated for waste management contracting and services, recycling needs to be incorporated into budget planning. Furthermore, the value of having a dedicated role to champion and manage the recycling project and environmental sustainability programme is crucial to success. Essentially, success does not happen just because a board or management decides that it is a good idea, it takes appropriate insightful leadership and a strategic approach to the behavioural change required to make it work.

Using the sustainability, leadership, and change management literature to guide programme development provided a solid base from which to deliver this programme. Without this foundation, the implementation would have been ad hoc, and I suspect the outcomes would have been different and less successful. Using the lens of complexity leadership theory combined with a deep understanding of the pitfalls of large-scale organisation change management, the results of this study support both the adoption of such a programme and the delivery of the programme according to the chosen research design and implementation strategies.

I am sharing the main outcomes of this study locally, regionally, and nationally as part of my role as sustainability manager. This is an important point because this project is a living project which has real implications for leadership and management of sustainability in the healthcare sector in NZ. Information from the study is being shared across the different levels of the sector including the individual employee at meetings and forums, at different sites and settings, and to the wider macro level, targeting policy makers, leaders, and decision makers. The outcomes of this study are being disseminated using a range of informal and formal written and spoken approaches, as required.

To date as much as half of the DHBs have yet to have a dedicated sustainability lead to help drive this agenda despite years of lobbying by senior clinicians. Publication of this study will further support the argument in favour of this step.

9.6 Directions for Future Research

This study contributes much needed empirical data to the debate regarding recycling and sustainability, both in healthcare generally and in the public hospital context. However, further research into recycling within different settings is required. The wealth of evidence presented in Chapter 1 on the environmental impact of climate change and non-sustainable practice formed the basis of the conceptual model for this study. The research project question was developed to explore the impact of the recycling project. Audit data were captured, and different approaches used throughout the duration of the study aimed at raising awareness about the programme.

Further research within this area would help determine best practice for hospital governance systems. The healthcare sector is ideally situated to make improvements regarding recycling activities given the reported financial and environmental benefits. Further research into the on-going impact of such interventions in CMDHB, and in other hospitals would be beneficial.

The literature revealed a lack of consistency in measuring the impact of sustainability interventions. Not every organisation is able to measure carbon emissions. The literature highlighted this area as being generally under-researched and further empirical research is required to more comprehensively delineate the societal costs of sustainability specific interventions in healthcare. Further research to explore the merits of employing the various indicators would help to determine if the PA indicator is the most suited in healthcare establishments other than CM Health.

This study focused attention on recycling and set out to measure the existence of a sustainability culture. Specific organisational actions and employee perceptions were explored, and these could be repeated in different settings besides that of health. Extending the research into sustainability issues and practices in different types of organisations, and addressing different sustainability aspects, environments and workforces might capture new results that bring novel insights and contribute further to theory and practice. In the context of this study, a disconnection was found between healthcare and non-healthcare that merits further investigation, as was also noted by Hartman et al. (2011).

The findings attested to the value of delivering relevant messages to employees using face-to-face communication. Presenting in-person at team meetings and staff forums was

identified as a beneficial way of providing education and raising awareness. Further research is required into the nature, extent, and type of education that best supports organisational behaviour change programmes within other healthcare and non-healthcare organisations and settings.

Finally, and notably, the need to explore the role of complexity leadership theory within the context of sustainable healthcare practice and large-scale organisation change management merits further investigation. As presented in Chapter 4, three theoretical constructs were drawn together and their interactions proposed (Figure 4.5, page 49). Further research into the connection between the specific theories presented here (sustainability model, change theory, and complexity leadership theory) could test the strength of their relationship and usefulness as a perspective in this context. Research into whether applying different change or leadership theories could uncover further indicators of success for a range of different projects and a multi-theoretic approach is appropriate given the need to build further the body of knowledge in the field of sustainability management. In addition, further research could explore whether being able to work as a change agent from within the organisation, as opposed to employing an outsider in a consultative capacity, for example, makes a positive difference to behaviour change, as proposed by this study.

9.7 Summary

The components of sustainable healthcare practice can be described as having three themes or layers of influence. At the organisational layer the change required relies on a strategic approach which supports the delivery of such projects and programmes. The programme layer relates to the programme itself, and there are common areas of attention within sustainability programmes, with recycling being one area of impact. The individual employee layer relates to the dedicated sustainability lead and the interface role of every person within the programme. As argued by Harris et al. (2009) and emphasised from this study, each layer needs to be addressed as part of an organisational sustainability system to achieve success regarding delivering successful sustainability programmes.

Recycling projects need to be evaluated, measured, and reported for performance measurement, benchmarking, and evidence of value creation. Measuring the outcomes

of such projects can be performed in different ways. This thesis adds to the body of existing knowledge, by clearly demonstrating the value of instigating measures to better manage waste, as well as the benefits of practising more sustainably. Having a dedicated resource in possession of the necessary skills and competence who can design and deliver a project and programme is crucial to success. With previous healthcare experience and a deep understanding of the healthcare system a person working in this role can create the most appropriate approach.

Steps taken to research this topic have been described, methodological limitations have been discussed regarding how the limitations are addressed, and directions for further research have been suggested. There is very little research into recycling practices within the setting of health in NZ. This study is original as it adds new insights into the understanding of how such practices can be developed by committed leadership and by embedding it into the culture and behaviour in the organisation. At the onset, the intention of the research and the programme itself was to specifically influence change within the NZ healthcare context. Disseminating the results and sharing the learning from the programme's development and implementation process in wider forums within and beyond NZ has already delivered on that intention.

Extended research is needed, however, from which to establish benchmarks for tracking sustainability performance, to refine measures for sustainability indices and individual organisational reporting on sustainability to stakeholders, to applying the lens of complexity leadership theory, and to develop practical steps for workplace training and education in sustainability management. There remains much to do in raising conscious awareness and making substantive progress in improving human impacts on the environment. The programmes initiated and reported on in this study have indicated that recycling can have a substantially beneficial impact, thereby contributing to better sustainability outcomes. The study also indicates that much more can be done, linking to broader benefits for other organisations and the wider environment.

9.8 Epilogue

Managing change in a large complex organisation whilst fulfilling the objectives of a Doctoral programme was far from easy. This epilogue has two sections and serves two purposes. To further enrich the findings of the study I initially describe the way in which

I personally managed the project. The second section summarises the personal approach taken to plan, deliver and evaluate the project, to serve as a practical guide to others in this field of work.

From a personal management perspective, having a strong support network was the single most important work feature. From the start, the environmental programme was framed as a team effort. Each member of our close knit environmental advisory group recognised the value of supporting each other. We proactively sought each other out on an almost daily basis. This was beneficial because it was stressful at times, especially in the early days, when the environmental sustainability programme was not regarded as being an essential part of the business. The benefits of having this level of support at work cannot be over-emphasised.

Having a nursing background also helped. Nursing tends to build emotional resilience and working in the setting for many years meant I had a broad network of existing connections and relationships. When meeting teams for the first time, mentioning my nursing background during the first encounter tended to help build trust since we shared a common understanding of the work environment.

Another positive and salient feature worth noting was the strong connection between my job and my research which is why I pursued the clinical Doctorate programme over and above the more traditional doctoral alternative. The style, approach and purpose of the clinical Doctorate programme was well suited to my learning needs and, more importantly, the intended output was both highly desirable to me and immanently practical.

Working full time and studying part time whilst being a parent with a large school-age family meant there was little time for reflection, which was a downside. Having time to reflect in action, amid 'being' and 'doing' is an essential component of any scholarly programme. Reflection allows consideration of how the theory relates to practice, which parts of the theory are more or less applicable to the specific situation than others, and what the findings mean for theory development as they are uncovered. Taking time out to go for a walk or run helped me to create the time and space to think. Keeping active and taking regular exercise are also crucial to staying healthy throughout the exceptional demands of work and study in such a doctoral programme.

Having a positive work life balance is therefore of high importance, as is having a supportive family. Frequent exercise, rest and good nutrition all add to a suite of generally healthful life skills. Knowing when to stop work and making a deliberate effort to unwind and enjoy family life helped to recharge my energy and refuel the very necessary optimism, energy and enthusiasm essential for this undertaking, which required optimism and being able to communicate effectively, energetically and empathically for a more positive workplace response.

This next section provides a simple overview of the approach taken, which is offered as guide to others working in the field. I have shared this advice over the years with many colleagues:

- Take time at the outset to get to know the different areas and teams. Any change management programme fundamentally relies on sound and meaningful interactions with people. Connecting with others at a human level seems to tap into their emotions, the resultant feelings then triggering an intellectual response which results in an openness to change.
- Do not rush the engagement process, spend time setting up the plan together, be authentic, flexible and adaptable, be responsive and proactive, provide feedback and keep the communication channels open. Provide training and support, be prepared to troubleshoot and offer advice, think on your feet and expect issues. There will be issues because each team works together differently, each area has their own unique set of circumstances so you should never assume all areas are the same. Of course, there will be commonalities and you will be able to achieve a level of standardisation but be prepared to tweak the programme.
- Share the story with other teams, connect the teams to one another, encourage autonomy and interdependence. By doing this, you are making it clear that you serve a facilitative role by shifting the ownership of the programme to the teams which helps sustain the desired behaviour change.

Seeing the programme adopted across the organisation and beyond and realising the impact this has on a whole range of pro environmental behaviours is very rewarding. Recognising that you are the glue that connects the teams together, connects the clinicians to the managers, connects waste behaviour to supply chain decisions, connects environmental problems we face to individual behaviour. Being a sustainability manager in a large complex organisation is a very challenging yet powerful and meaningful role.

The role transcends organisational silos, requires systems thinking and an optimistic outlook to provide vision and direction.

My role has changed as a result of undertaking and completing this project. I am currently working as a Principal Advisor, Sustainability at the Ministry of Health for the Health Infrastructure Unit. I attribute this career success directly attributed to my achievements through undertaking and executing the waste management and recycling programme while at CMDHB.

9.9 Presentations and Publications

The following details presentations delivered over the last 6 months.

1. Climate Change Mitigation at DHBs July 2020. Part #1 Leadership, carbon, energy & buildings, Sustainable Healthcare and Climate Health, 2020 webinar series (international webinar series).
2. Green Healthcare Infrastructure. Transalpine Environmental Sustainability Governance Group Meeting, July 2020 (national level).
3. Sustainable Healthcare Practice. Health Policy Presentation, August 2020 (local level).
4. Healthy People, Healthy Hospitals, Healthy Planet. The Ministry of Health: A leader or late adopter? August 2020 (internal).
5. Sustainable Healthcare Practice Going green is good for your bottom line. ANZICS Sustainability Conference, September 2020 (international).
6. Sustainable Healthcare Practice -Employee Engagement. Presentation to AUT Undergraduates, October 2020 (local level).

By invitation only, I attended a Workshop on Environmental Sustainability in Clinical Care held at Yale University April 4-6 in 2018, co-hosted with New York University (as referred to in Chapter 8). The Workshop brought together international experts in engineering, sustainability science, clinical care, and health systems management to explore issues of resource consumption and environmental emissions associated with healthcare services. As a result, I co-authored the Green Print publication.

Sherman, J.D., Thiel, C., MacNeill, A., Eckelman, M.J., Dubrow, R., Hopf, H., & Bilec, M.M. (2020). The Green Print: Advancement of Environmental Sustainability in

Healthcare. Resources, Conservation & Recycling. 161, doi:
10.1016/j.resconrec.2020.104882.

References

- Abor, P. A. (2013). Managing healthcare waste in Ghana: A comparative study of public and private hospitals. *International Journal Health Care Quality Assurance*, 26(4), 375-386.
- Alam, M. M., Sujauddin, M., Mohammed, G., Iqbal, A., & Huda, S.M.S. (2008). Report: Healthcare waste characterization in Chittagong Medical College Hospital, Bangladesh. *Waste Management Research*, 26(3), 291-296.
- Alase, A. O. (2017). The Task of Reviewing and Finding the Right Organisational Change Theory. *International Journal of Educational Leadership and Management*. 5(2), 198-215.
- Alliance, S. I. (2014, May 1). *Sustainable DHBs good for health too*. South Island Alliance. Scoop Health News. Retrieved January 18, 2017, from <https://www.sialliance.health.nz>.
- Anaker, A., & Elf, M. (2014). Sustainability in nursing: A concept analysis. *Scandinavian Journal of Caring Sciences*, 28, 381-389.
- Anand, S., & Sen, A. (2000). Human development and economic sustainability. *World Development*, 28(12), 2029-2049.
- Association of Surgeons in Great Britain & Royal College of Surgeons in Ireland. (2012). *Consensus statement on cost effective and sustainable surgery*. Retrieved from www.asgbi.org.uk.
- Auckland Council. (2012). *Auckland waste management and minimisation plan*. Retrieved February 11, 2015, from <http://www.aucklandcouncil.govt.nz>.
- Auckland Council. (2016). *Waste minimisation*. Retrieved June 24, 2016, from <http://www.aucklandcouncil.govt.nz>.
- Azmal, M., Kalhor, R., Dehcheshmeh, N.F., Goharinezhad, S., Heidari, Z.A., & Farzianpour, F. (2014). Going toward green hospital by sustainable healthcare waste management: Segregation, treatment and safe disposal. *Health*, 6, 2632-2640.

- Baldo, L. G. Marino, M., Montani, M., & Ryding, S. (2009). The carbon footprint measurement toolkit for the EU ecolabel. *International Journal Life Cycle Assessment*, 14(7), 591-596.
- Bamford, D. R., & Forrester, P. L. (2003). Managing planned and emergent change within an operations management environment. *International Journal of Operations & Production Management*, 23(5), 546.
- Barbier, E. (1987). The concept of sustainable economic development. *Environmental Conservation*, 14(2), 101-110.
- Bauermeister, M. L., & Diefenbacher, L. H. (2015). Beyond recycling: Guiding pre-service teachers to understand and incorporate the deeper principles of sustainability. *Childhood Education*, 91(5), 325.
- Baum, F., & Fisher, M. (2010). Health equity and sustainability: Extending the work of the commission on the social determinants of health. *Critical Public Health*, 20(3), 311-322.
- Bazeley, P. (2004). Issues in mixing qualitative and quantitative approaches to research. In R. Buber, J. Gadner, & L. Richards (Eds.), *Applying qualitative methods to marketing management research* (pp. 141-156). London, UK: Palgrave Macmillan.
- Bebbington, J., & Barter, N. (2011). Strategic responses to global climate change: A UK analysis. *Chartered Institute of Chartered Accountants*, 7(11), 1-8.
- Blashki, G., McMichael, T. & Karoly, D. J. (2007). Climate change and primary healthcare. *Australian Family Physician*, 36, 986-989.
- Braemer, H. (n.d.). *Braemar hospital: A green hospital*. Retrieved November 10, 2014, from <http://braemarhospital.co.nz/patient-or-visitor/i-would-like-to-know-more-about-braemar/state-of-the-art-facilities/a-green-hospital/>.
- Brown, B.C. (2011) Complexity Leadership: An Overview and Key Limitations. Integral Leadership Reviews. Learner Papers.
- Brown, C. (2005). *The sustainable enterprise: Profiting from best practice*. London, UK: Kogan Page.

- Brown, J. (2009). Letter to the editor. *Health Environments Research and Design Journal*, 3(1), 106-110.
- Bryman, A. (2008). Of methods and methodology. *Qualitative Research in Organisations and Management: An International Journal*, 3(2), 159-168.
- Buchanan, D., & Fitzgerald, L. (2007). The sustainability and spread story: Theoretical developments. In D. Buchanan, L. Fitzgerald & D. Ketley (Eds.), *Sustainability and spread of organisational change* (pp. 227-248). New York, NY: Routledge.
- Buchanan, D., Fitzgerald, L., Ketley, D., Gollop, R., Jones, J. L. & Whitby, E. (2005). No going back: a review of the literature on sustaining organisational change. *International Journal of Management Reviews*, 7(3), 158-173.
- Burnard, P., Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Analysing and presenting qualitative data. *British Dental Journal*, 204(8), 429-432.
- Campbell, J. L. (2007). Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility. *The Academy of Management Review*, 32(3), 946-967.
- Carlson, G., Greeley, H., & Atchison, T. (2010). Is the relationship between your hospital and your medical staff sustainable? *Journal of Healthcare Management*, 55(3), 158-173.
- Carter, K. N., Imlach-Gunasekara, F., McKenzie, S. K., & Blakely, T. (2012). Differential loss of participants does not necessarily cause selection bias. *Australian and New Zealand Journal of Public Health*, 36(3), 218-222.
- Ceasar, N., & Stubbings, A. (2012). Sustainability forever? Embedding sustainability into your brand and culture. *Directions*, 1-4.
- Centre for Maximum Potential Building Systems and Practice Greenhealth. (2012). *Green guide for healthcare*. Retrieved May 4, 2013 from <https://noharm-global.org/documents/green-guide-health-care-imagine-brochure>.
- Chan, M. (2007). *Climate change and health: Preparing for unprecedented challenges*. The Global Health Lecture. Bethesda Maryland, USA.

- Charles, C. M., & Mertler, C. A. (2002). *Introduction to educational research*. Boston, MA: Allyn & Bacon.
- Charlesworth, K. E., Sumantra, R., Head, F., & Pencheon, D. (2012). Developing an environmentally sustainable NHS: Outcomes of implementing an educational intervention on sustainable health care with UK public health registrars. *Public Health Bulletin*, 23(1), 21.
- Charlesworth, K. E. & Jamieson, M. (2017). New sources of value for health and care in a carbon-constrained world. *Journal of Public Health*. 39(4), 691-697.
- Chou, C. J. (2014). Hotels' environmental policies and employee personal environmental beliefs: Interactions and outcomes. *Tourism Management*, 56(6), 889-905.
- Church, A. H. (1993). Estimating the effect of incentives on mail survey response rates: A meta-analysis. *Public Opinion Quarterly*, 57, 62-79.
- Counties Manukau Health. (2008). *CMDHB health needs assessment*. Retrieved November 10, 2014, from <http://www.CMDHB.org.nz>.
- Counties Manukau Health. (n.d.). *About us*. Retrieved March 30, 2017, from <http://countiesmanukau.health.nz/about-us/our-region/>.
- Counties Manukau Health (n.d.). *Statement of Intent*. Retrieved November 10, 2014, from <https://www.countiesmanukau.health.nz/assets/About-CMH/Reports-and-planning/Annual-reports-and-plans/2017-2020.CM-Health-Statement-of-Intent.pdf>.
- Cole, E. J., & Fieselman, L. (2013). A community-based social marketing, recycling, paper reduction, and preferable purchasing. *International Journal of Sustainability on Higher Education*, 14(2), 176-195.
- Connect Article. (2013). *About CMH*. Retrieved February 11, 2013, from <http://www.countiesmanukau.health.nz>.
- Connor, A., & Mortimer, F. (2010). The green nephrology survey of sustainability in renal units in England, Scotland and Wales. *Journal of Renal Care*, 36(3), 153.

- Costello, A., et al. (2009). Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *The Lancet*, 373(9676), 1693-1733.
- Costley, C., & Lester, S. (2012). Work-based doctorates: professional extension at the highest levels. *Studies in Higher Education*, 37:3, 257-269.
- Coughlan, D., & Brannick, T. (2010). *Doing action spiral in your own organisation*. London, UK: SAGE Publications.
- Creswell, J. W., & Clark, V. L. P. (2011). *Designing and conducting mixed methods research*. Los Angeles, CA: Sage Publications.
- Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research Process*. Los Angeles, CA: Sage Publications.
- Davies, A. R. (2009). Clean and green? A governance analysis of waste management in New Zealand. *Journal of Environmental Planning and Management*, 52(2), 157-176.
- De Brun, A., Rogers, L., O'Shea., M., & McAuliffe, E., (2020). Understanding the impact of a collective leadership intervention on team working and safety culture in healthcare teams: a realist evaluation protocol. *HRB Open Research*, 2-5. doi:10.12688/hrbopenres.12860.2
- De Massis, A., & Kotlar, J. (2014). The case study method in family business research: Guidelines for qualitative scholarship. *Journal of Family Business Strategy*, 5(1), 15-29.
- Décieux, J. P., Mergener, A., Neufang, K. M. & Sischka, P. (2015). Implementation of the forced answering option within online surveys: Do higher item response rates come at the expense of participation and answer quality? *Psihologija*, 48(4), 311-326.
- Denscombe, M. (2008). Communities of practice: A research paradigm for the mixed methods approach. *Journal of Mixed Methods Research*, 2, 270-283.

- Deprez, P. H., Horsmans, Y., Van Hassel, M., Hoang, P., Piessevaux, H., & Geubel, A. (2000). Disposable versus reusable biopsy forceps: A prospective cost evaluation. *Gastrointestinal Endoscopy*, 51(3), 262-265.
- DiPietro, R. B. (2013). Green practices in upscale foodservice operations: Customer perceptions and purchase intentions. *International Journal of Contemporary Hospitality Management*, 25(5), 779-796.
- Drucker, P.F. (1954) "The Practice of Management." New York: Harper & Row.
- Dunphy, J. L. (2013). Enhancing the Australian healthcare sector's responsiveness to environmental sustainability issues: Suggestions from Australian healthcare professionals. *Australian Health Review*, 37(2), 158-165.
- Dunphy, J. L. (2014). Healthcare professionals' perspectives on environmental sustainability. *Nursing Ethics*, 21(4), 414-425.
- Dwyer, J. (2009). How to connect bioethics and environmental ethics: Health, sustainability, and justice. *Bioethics*, 23(9), 497-502.
- Ebreo, A., & Vining, J. (2001). How similar are recycling and waste reduction? Future orientation and reasons for reducing waste as predictors of self-reported behaviour. *Environment and Behaviour*, 33(3), 424-448.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532-550.
- Energy Efficiency and Conservation Authority. (2005). *Summary of nine sawmill energy audits*. Retrieved September 18, 2006, from <http://www.eeca.co.nz>.
- Enviro-Mark Solutions. (n.d.). *Carbon programmes and certification*. Retrieved November 7, 2016, from <https://www.enviro-mark.com>.
- Environmental Protection Agency New South Wales. (n.d.). *The waste hierarchy*. Retrieved March 30, 2017, from epa.nsw.gov.au.
- Evans, A., Russell, S. V., Fielding, K., & Hill, C. (2012). Turn it off: Encouraging environmentally-friendly behaviours in the workplace. *Asia Pacific Work in Progress Research Papers Series*, (8), 1-9.

- Faculty of Public Health, United Kingdom. (2009). *Sustaining a healthy future, Taking action on climate change*. Retrieved May 4, 2015, from http://www.fph.org.uk/uploads/r_sustaining_a_healthy_future.pdf
- Fallow, B. (2011). UN finds NZ credibility gap on emissions. *New Zealand Herald*. Auckland, New Zealand.
- Farquhar, J. D. (2012). *Case study research for business*. London, UK: SAGE Publications.
- Ferreira, V., & Teixeira, M. R. (2010). Healthcare waste management practices and risk perceptions: Findings from hospitals in the Algarve region, Portugal. *Waste Management, 30*(12), 2657-2663.
- Fok, L. Y., Zee, S. M. & Hartman, S. J. (2012). Relationships among individual's green orientation, employee perceptions of organisational commitment to the green movement, and organisational culture: A comparative study of Jamaica and the United States. *Journal of Organisational Culture, Communications and Conflict, 16*(2), 115-134.
- Frackiewicz-Wronka, A., & Szymaniec, K. (2012). Resource based view and resource dependence theory in decision making process of public organisation - research findings. *Management, 16*(2), 16-29.
- Franco, M., & Almeida, J. (2011). Organisational learning and leadership styles in healthcare organisations: An exploratory case study. *Leadership and Organisation Development Journal, 32*(8), 782-806.
- Friend, G. (2009). *The truth about green business*. Upper Saddle River, New Jersey: Natural Logic.
- Fulop, L. (2012). Leadership, clinician managers and a thing called "hybridity". *Journal of Health Organisation and Management, 26*(5), 578-604.
- Fulop, L., & Mark, A. (2013). Leading in healthcare- foregrounding context: The theory and practice of context- Introduction to the special issue. *Leadership, 9*(2), 151-161.

- Gadner, J., Palgrave, C., Buber, R., & Richards, L. (2004). *Organising knowledge: Methods and case studies*. Houndmills, Hampshire: Palgrave Macmillan.
- Gao, T., Liu, Q., & Wang, J. (2014). A comparative study of carbon footprint and assessment standards. *International Journal of Low-Carbon Technologies*, 9(3), 237-243.
- Garriga, E., & Melé, D. (2004). Corporate social responsibility theories: Mapping the territory. *Journal of Business Ethics*, 53(1/2), 51-71.
- Giltinane, C. L. (2013). Leadership styles and theories. *Nursing Standard*, 27(41), 35-39.
- Glaxo Smith Kline. (2011). *Climate change. Global public policy issues*. Glaxo Smith Kline Environmental Sustainability Centre of Excellence. Retrieved March 21, 2014, from <http://www.gsk.com/policies/GSK-on-climate-change.pdf>.
- Godin, G., Belanger-Gravel, A., Eccles, M., & Grimshaw, J. (2008). Health professionals' intentions and behaviours: A systematic review of studies based on social cognitive theories. *Implementation Science*, 3(1), 1748-5908.
- Godlee, F. (2012). Save carbon and money. *British Medical Journal*, 344, doi: 10.1136/bmj.e488.
- Goodman, B. (2011). The need for a 'sustainability curriculum' in nurse education. *Nurse Education Today*, 31, 733-737.
- Goodman, B., & East, L. (2014). The 'sustainability lens': A framework for nurse education that is 'fit for the future'. *Nurse Education Today*, 34, 100-103.
- Goonan, S., Miroas, M., & Spence, H. (2014). Getting a taste for food waste: A mixed methods ethnographic study into hospital food waste before patient consumption conducted at three New Zealand foodservice facilities. *Journal of the Academy of Nutrition and Dietetics*, 114(1), 63-71.
- Gordon, R. (2004). The global reporting initiative- meeting reporter's needs. *Chartered Accountants Journal*, 83(7), 12-15.

- Greenhalgh, T., & Papoutis, C., (2018). Studying complexity in health services research: desperately seeking an overdue paradigm shift. *BMC Medicine*, 16-95, doi: 10.1186/s12916-018-1089-4.
- Griggs, C., Fernandez, A. & Callanan, M. (2017). Nursing and the barriers to sustainable health care: a literature review. *British Journal of Nursing*, 26(22), 1230-1237.
- Haastert, M. V., & Grosbois, D. D. (2010). Environmental initiatives in bed and breakfast establishments in Canada: Scope and major challenges with implementation. *Tourism and Hospitality Planning*, 7(2), 179-193.
- Hall, A. G. (2008). Greening healthcare: 21st century and beyond. *Frontiers of Health Services Management, American College of Healthcare Executives*, 25, 37-43.
- Hamoda, H. M., El-Tomi, H. N. & Bahman, Q. Y. (2005). Variations in hospital waste quantities and generation rates. *Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering*, 40(2), 467-476.
- Hanson, W. R. & Ford, R. (2010). Complexity leadership in healthcare: Leader network awareness. *Procedia Social and Behavioural Sciences*, 2, 6587-6596.
- Hargreaves, A & Fink, D., (2003). The seven principles of sustainability leadership. Retrieved October 12, 2020 from, http://site.iugaza.edu.ps/magha/files/2014/05/seven_principles1.pdf.
- Harris, N., Pisa, L. Talioaga, S. & Veseau, T. (2009). Hospitals going green, a holistic view of the issue and the critical role of the nurse leader. *Holistic Nursing Practice*, 44(45), 101-111.
- Hartman, S. J., Fok, L. Y. & Zee, S. M. (2011). Employee perceptions of individual and organisational commitment to the green movement and their perceived impacts in healthcare vs. non-healthcare organisations. *Academy of Healthcare Management Journal*, 7(2), 15-32.
- Herbst, S., & Fitzgerald, J. (2000). Reaping the benefits of waste recycling. *Pollution Engineering*, 32(4), 46-49.

- Hopwood, B., Mellor, M. & O'Brien, G. (2005). Sustainable development: Mapping different approaches. *Sustainable Development*, 13, 38-52.
- Whitmee, S., Haines, A., Beyrer, C. Boltz, F., Capon, A.G., de Souza Dias, B.F., ... & Yach, D. (2015). Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *The Lancet*, 386, 1973–2028,
- Horvat, A. & Filipovic, J. (2017). Service quality and maturity of health care organisations through the lens of Complexity Leadership Theory. *Journal of Evaluation in Clinical Practice*. 24:301-307.
- Hussain, S.T., Lei, S., Akram, T., Haider, M. J., Hussain, S.H. & Ali, M. (2018) Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organisational change. *Journal of Innovation & Knowledge*. 3, 123-127.
- Ingham-Broomfield, R. (2016). A nurses' guide to mixed methods research. *Australian Journal of Advanced Nursing*, 33(4), 46-52.
- Institute of Health Improvement. (n.d.) *Going green*. Retrieved March 15, 2014, from <http://www.ihl.org/resources/Pages/AudioandVideo/WIHIEmbeddingEnvironmentalHealth.aspx>.
- Jamali, D., Hallal, M., & Abdallah, H. (2010). Corporate governance and corporate social responsibility: evidence from the healthcare sector. *Corporate Governance*, 10(5), 590-602.
- Johnson, S. W. (2010). Summarising green practices in US hospitals. *Hospital Topics*, 88(3), 75-81.
- Jones, M. (2018). Contemporary trends in professional doctorates, *Studies in Higher Education*, 43:5, 814-825.
- Jones, J., Jackson, J., Tudor, T., & Bates, M. (2012). Strategies to enhance waste minimisation and energy conservation within organisations: A case study from the UK construction sector. *Waste Management and Research*, 30(9), 981-990.

- Jones, R., Bennett, H., Keating, G., & Blaiklock, A. (2014). Climate change and the right to health for Māori in Aotearoa/New Zealand. *Health and Human Rights Journal*, 16, 54-68.
- Judkins, D. R., & Porter, K. E. (2016). Robustness of ordinary least squares in randomised control trials. *Statistics in Medicine*, 35, 1763-1773.
- Kadlec A (2006). Reconstructing Dewey: The Philosophy of Critical Pragmatism, *Polity* 38(4).
- Kantabutra, S. (2011). Sustainable leadership in a Thai healthcare services provider. *International Journal Health Care Quality Assurance*, 24(1), 67-80.
- Kaplan, S., Sadler, B., Little, K., Franz, C. & Orris, P. (2012). Can sustainable hospitals help bend the health care cost curve? *Commonwealth Fund Publication*, 29, 1-14.
- Karl, T., & Trenberth, K. (2003). Modern global climate change. *Science*, 302, 1719-1723.
- Karliner, J., & Guenther, R. (2011). A comprehensive environmental health agenda for hospitals and health systems around the world. *Health Care without Harm*, 1-41. Retrieved May 4, 2013, from <https://noharm.org/>.
- Kash, B. A., Spaulding, A., Gamm, L. D., & Johnson, C. E. (2014). Healthcare strategic management and the resource-based view. *Journal of Strategy and Management*. 7(3), 251-264.
- Kassinis, G. I., & Soteriou, A. C. (2003). Greening the service profit chain: The impact of environmental management practices. *Production and Operations Management Society*, 12(3), 386-403.
- Khajuria, A., & Kumar, A. (2007). Assessment of healthcare waste generated by government hospital in Agra City, India. *Our Nature*, 5, 25-30.
- Kinney, L. M. (2010). Case study: Oldham. *The Journal for Quality and Participation*, 33(2), 23-24.

- Komilis, D., Fouki, A., & Papadopolous, D. (2012). Hazardous medical waste generation rates of different categories of health-care facilities. *Waste Management*, 32(7), 1434-1441.
- Kumar, R. D. C. & Khiljee, N. (2015). Leadership in healthcare. *Anaesthesia and Intensive Care Medicine*. 17:1, 63-65.
- Kurland, N. B. (2011). Evolution of a campus sustainability network: a case study in organisational change. *International Journal of Sustainability on Higher Education*, 12(4), 395-429.
- Langstaff, K. & Brzozowski, V. (2017) Managing environmental sustainability in a healthcare setting. *Healthcare Management Forum*. 30(2) 84-88.
- Lennox, L., Maher, L. & Reed, J. (2018) Navigating the sustainability landscape: a systematic review of sustainability approaches in healthcare. *Implementation Science*. 13:27.
- Lighter, D. E. (2011). *Advanced performance improvement in healthcare principles and methods*. Sudbury, Country: Jones & Bartlett Publishers.
- Lim, V., Stubbs, J. W., Nahar, N., Amarasena, N., Chaudry, Z. U. & Gilmore, I. (2009). Politicians must heed health effects of climate change. *Lancet*, 374(9694), 647.
- Lindsay, G., Woodward, A., & Macmillan, A. (2008). *Effects on health and the environment of increasing the proportion of short urban trips made by bicycle instead of motor vehicle*. Discussion paper prepared for the Board of the New Zealand Transport Agency. Auckland, New Zealand: School of Population Health, University of Auckland.
- Lui, J. T., Rudmik, L., & Randall, D. R. (2014). Reducing the preoperative ecological footprint in otolaryngology. *Otolaryngology-Head and Neck Surgery*, 151(5), 805-810.
- MacNeill, A., Lillywhite, R. & Brown, C.J. (2017). The impact of surgery on global climate: a carbon footprinting study of operating theatres in three health systems. *Lancet Planet Health*.1: e381-88.

- Malik, A., Lenzen, M., McAlister, S. & McGain, F. (2018). The carbon footprint of Australian health care. *Lancet Planet Health*, 2: e27-35.
- Manga, V. E., Forton, O. T., Mofor, L. A. & Woodard, R. (2011). Health care waste management in Cameroon: A case study from the South-western Region. *Resources, Conservation & Recycling*, 57, 108-116.
- Mann, K., Gordon, J. & MacLeod, A. (2007) Reflection and reflective practice in health professions education: a systematic review. *Advances in Health Science Education*, 14, 595-621.
- Mayoh, J., Bond, C. S. & Todres, L. (2012). An innovative mixed methods approach to studying the online health information seeking experiences of adults with chronic health conditions. *Journal of Mixed Methods Research*, 6(1), 21.
- McCartney, G., & Hanlon, P. (2010). Oil, health and healthcare. *British Medical Journal*, 341, 5796.
- McGain, F., Cox, N. R., Cecchin, S. S., McAllister, S., & Barach, P. R. (2010). Sustainable cardiac services- From the catheterization laboratory to the operating room and beyond. *Progress in Paediatric Cardiology*, 33, 82-84.
- McMichael, A. J., Friel, S., Nyong, A., & Corvalan, C. (2008). Global environmental climate change and health: Impacts, inequalities and the health sector. *British Medical Journal*, 336, 191-194.
- McMillan, K. (2013). Sustainability: an evolutionary concept analysis. Exploring Nursing's role within the sustainability movement. *Journal of Advanced Nursing*, 70(4), 756-767.
- Mcnamara, K. H. (2010). Fostering sustainability in higher education: A mixed methods study of transformative leadership and change strategies. *Environmental Practice*, 12(1), 48-58.
- Metcalf, S., Woodward, A., Macmillan, A., Baker, M., Howden-Chapman, P., & Kane, P. (2009). New Zealand climate and health. Why New Zealand must rapidly halve its greenhouse gas emissions. *New Zealand Medical Journal*, 122(1304), 72-95.

- Millar, C., Hind, P., & Magala, S. (2012). Sustainability and the need for change: organisational change and transformational vision. *Journal of Organisational Change Management*, 25, 489.
- Ministry for the Environment. (2005). *Case study: Waitakere Hospital*. Wellington, New Zealand: www.mfe.govt.nz.
- Ministry for the Environment. (2011). *Environmental stewardship for a prosperous New Zealand*. Wellington, New Zealand: www.mfe.govt.nz.
- Ministry for the Environment. (2015a). *About the waste disposal levy*. Retrieved August 14, 2015, from <http://www.mfe.govt.nz/waste/waste-disposal-levy/about-levy>.
- Ministry for the Environment. (2015b). *Waste*. Retrieved August 15, 2015, from <https://www.mfe.govt.nz/waste>.
- Ministry for the Environment. (2016). *About climate change*. Retrieved August 15, 2015, from <http://www.mfe.govt.nz/node/16597>.
- Ministry of Health. (2009). *The environmental health indicators for New Zealand*. Wellington, New Zealand: Publisher.
- Ministry of Health. (2016). *The New Zealand health strategy*. Retrieved from <http://www.health.govt.nz>.
- Montgomery, H. (2009). Climate change: the health consequences of inactivity. *New Zealand Medical Journal*, 122(1304), 6-8.
- Moon, J. (1999) *Reflection in Learning and Professional Development: theory and practice*. London: Kogan Page.
- Moynihan, R. (2012). The greening of medicine. *British Medical Journal*, 16(344: d8360), 21-23.
- Murray, J., Pahl, O., & Burek, S. (2007). Evaluating the scope for energy-efficiency improvements in the public sector: Benchmarking NHS Scotland's smaller health buildings. *Energy Policy*, 36, 1236-1242.

- New South Wales Environment Protection Authority. (2015). *Waste hierarchy*. Retrieved from June 5, 2015, from <http://www.epa.nsw.gov.au/>.
- New Zealand Government. (1991). *Resource Management Act*. Retrieved October 15, 2105, from <http://www.mfe.govt.nz/rma>.
- New Zealand Government. (2000). New Zealand Public Health and Disability Act. Retrieved October 15, 2015, from <http://www.legislation.govt.nz>.
- New Zealand Government (2002). *Local Government Act*. Retrieved October 15, 2015, from <http://www.legislation.govt.nz/act/public/2002/0084/latest/DLM170873.html>.
- New Zealand Government. (2002). *The New Zealand waste strategy*. Retrieved October 15, 2015, from <https://www.mfe.govt.nz>.
- New Zealand Government. (2010). The New Zealand waste strategy. Retrieved October 15, 2015, from <https://www.mfe.govt.nz>.
- New Zealand Government. (2008). *Waste Minimisation Act*. Retrieved October 15, 2015, from <http://www.legislation.govt.nz>.
- New Zealand Standards. (2002). *Management of healthcare waste*. Retrieved from <https://shop.standards.govt.nz>. 4304.
- NHS Sustainable Development Unit. (2009). *NHS England carbon emissions carbon foot printing report*. Retrieved April 21, 2015, from http://www.sdu.nhs.uk/documents/publications/1232983829_VbmQ_nhs_england_carbon_emissions_carbon_footprint_mode.pdf.
- NHS Sustainable Development Unit. (2012). *NHS England carbon footprint NHS SDU*. Retrieved April 21, 2015, www.sdu.nhs.uk/documents/publications/Health_Check_Carbon_Footprint_2012.pdf.
- Nichols, A., & Allum, P. (2015). Emergency medical services (EMS) and waste: A review of the literature on sustainable EMS waste management. *Journal of Paramedic Practice*, 7(11), 568-571.

- Nichols, A., Grose, J. & Mukonoweshuro, R. (2016). Achieving cost and carbon savings in neonatal practice: A review of the literature on sustainable waste management. *Journal of Neonatal Nursing*, 22, 81-87.
- Nichols, A., Grose, J., Bennallick, M., & Richardson, J. (2013). Sustainable healthcare waste management: A qualitative investigation of its feasibility within a county in the south west of England. *Journal of Infection Control*, 14, 60-64.
- Nichols, A., & Manzi, S. (2014). Physical space and its impact on waste management in the neonatal care setting. *Journal of Infection Control*, 15, 134-138.
- Nichols, A., Maynard, V., Goodman, B., & Richardson, J. (2009). Health, climate change and sustainability: A systematic review and thematic analysis of the literature. *Environmental Health Insights*, 3, 63-88.
- Nkonge, N. A., Mayabi, O. A., Kithinji, J., & Magambo, K. J. (2012). Knowledge, attitude and practice of health-care waste management and associated health risks in the two teaching and referral hospitals in Kenya. *Journal of Community Health*, 37(6), 1172-1177.
- Olsson, U. (1979) Maximum likelihood estimation of the polychoric correlation coefficient. *Psychometrika*, 44(4), 443-460.
- OraTaiao (n.d.). *New Zealand Climate & Health Council*. Retrieved October 25, 2015, from <http://www.orataiao.org.nz/>.
- Oreskes, N. (2004). The scientific consensus on climate change. *Science*, 306(5702), 1686.
- Padgett, P., Steinemann, A. C., Clarke, J. H., & Vandenberg, M. P. (2007). A comparison of carbon calculators. *Environmental Impact Assessment Review*, 28, 106-115.
- Pandey, D., Agrawal, M., & Pandey, J. S. (2011). Carbon footprint: current methods of estimation. *Environment Monitoring Assessment*, 178, 135-160.
- Patrick, R., Capetola, T., Townsend, M. & Hanna, L. (2011). Incorporating sustainability into community-based healthcare practice. *EcoHealth*, 8(3), 277-289.

- Patton, M. Q. (2002). *Qualitative research and evaluation methods*. City, CA: Sage Publications.
- Paurlaj, A. (2011). Understanding the relationships between internal resources and capabilities sustainable supply management and organisational sustainability. *Journal of Supply Chain Management*, 47(1), 19-37.
- Payne, J., & Leiter, J. (2013). Structuring agency: Examining healthcare management in the USA and Australia using organisational theory. *Journal of Health Organisation and Management*, 27(1), 106-126.
- Pereira, G. S. M., Jabbour, C., Oliveira, S. V. W. B. & Teixeira, A. A. (2013). Greening the campus of a Brazilian university: Cultural challenges. *International Journal of Sustainability on Higher Education*, 15(1), 34-47.
- Perkins, M. B., Jensen, P. S., Jaccard, J., Gollwitzer, P., Oettingen, G., & Hoagwood, K. E. (2007). Applying theory-driven approaches to understanding and modifying clinicians' behaviour: What do we know? *Psychiatric Services*, 58(3), 342-348.
- Pharmac (2012). *Operating policies and procedures, What's in? What's out?* Wellington, New Zealand: New Zealand Government.
- Phipps, R., Randerson, R., & Blashki, G. (2011). The climate change challenge for general practice in New Zealand. *New Zealand Medical Journal*, 124, 47-54.
- Pirani, S. I., & Arafat, H. A. (2014). Review: Solid waste management in the hospitality industry: A review. *Journal of Environmental Management*, 146, 320-336.
- Plowman, D. A., & Duchon, D. (2008). Dispelling the myths about leadership: From cybernetics to emergence. In M. Uhl-Bien & R. Marion (Eds.), *Complexity leadership, Part 1: Conceptual foundations* (pp. 129-154). Charlotte, NC: IAP – Information Age Publishing Inc.
- Posey, M. J., & Webster, A. H. (2014). Environmental sustainability practices in publically supported two-year colleges in the southern United States. *Community College Journal of Research and Practice*, 37(10), 800-803.

- Radwan, H. R. I., Jones, E., & Minoli, D. (2012). Solid waste management in small hotels: a comparison of green and non-green small hotels in Wales. *Journal of Sustainable Tourism*, 20(4), 533.
- Randerson, R., & Phipps, R. (2010). *Greening your practice toolkit*. Retrieved March 17, 2012, from <http://archive.orataiao.org.nz/Greening%E2%80%85Your%E2%80%85Practice%E2%80%85toolkit.pdf>.
- Reed, B. (2007). "Shifting from 'sustainability to regeneration'." *Building Research & Information*, 35(6), 674-680.
- Rivis, A., & Sheeran, P. (2003). Descriptive norms as an additional predictor in the theory of planned behaviour: A meta-analysis. *Current Psychology: Developmental, Learning, Personality, Social*, 22(3), 218-233.
- Robinson, J., & Cole, R. J. (2015). Theoretical underpinnings of regenerative sustainability. *Building Research & Information*, 43(2), 133-143.
- Robson, C. (2011). *Real world research*. City, UK: Wiley and Sons Limited.
- Rocco, T. S., Bliss, L. A., Gallagher, S. & Perez-Prado, A. (2003). "Taking the next step: Mixed Methods Research in Organisational Systems." *Information Technology, Learning, and Performance Journal*, 21(1), 19-29.
- Ruoyan, G. X., Lingzhong, L., Huijuan, Z., Chengchao, H., Jiangjiang, S., & Chushi, Wei K. (2010). Investigation of health care waste management in Binzhou District, China. *Waste Management*, 30, 246-250.
- Sadatsafavi, H., & Walewski, J. (2013). Corporate sustainability: The environmental design and human resource management interface in healthcare settings. *Health Environments Research and Design Journal*, 6(2), 98-118.
- Saldini, J. (2016). *The coding manual for qualitative researchers*. Los Angeles, CA: Sage.
- Sato, H. (2016). Generalization is everything, or is it? Effectiveness of case study research for theory construction. *Annals of Business Administrative Science*, 15(1), 49-58.

- Schein, E. (1985). *Organizational culture and leadership*. Jossey Bass.
- Sherman, J.D., Thiel, C., MacNeill, A., Eckelman, M.J., Dubrow, R., Hopf, H., Bilec, M.M. (2020). The Green Print: Advancement of Environmental Sustainability in Healthcare. *Resources, Conservation & Recycling*, 161, doi: 10.1016/j.resconrec.2020.104882.
- Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, 15(2), 105-121.
- Scott, P., & Briggs, J. S. (2009). A pragmatist argument for mixed methodology in medical informatics. *Journal of Mixed Methods Research*, 3, 223-241.
- Senior, B. (2002). *Organisational change*. London, UK: Prentice Hall.
- Setó-Pamies, D., & Papaoikonomou, E. (2016). A multi-level perspective for the integration of ethics, corporate social responsibility and sustainability (ECSRS) in management education. *Journal of Business Ethics*, 136(3), 523-538.
- Simpson, D., & Samson, D. (2010). Environmental strategy and low waste operations: exploring complementarities. *Business Strategy and the Environment*, 19(2), 104-118.
- Smith, P. A. C. (2011). The importance of organisational learning for organisational sustainability. *The Learning Organisation*, 19(1), 4-10.
- Sobrio, A., & Keller, M. (2007). Integration through sustainable value creation. *Journal of Medical Marketing*, 7(2), 102-113.
- Solutions, E.-M. (n.d.). *Carbon management*. Retrieved March 20, 2017, from <https://www.enviro-mark.com/what-we-offer/carbon-management>.
- Srivastav, S., Mahajan, H., & Mathur, B. P. (2012). Evaluation of bio-medical waste management practices in a government medical college and hospital. *National Journal of Community Medicine*, 3(1), 80.
- Stafford, E. R. (2003). Energy efficiency and the new green market. *Environment*, 45(3), 32-47.

- Sustainability, Otago University (n.d.). *Otago University Sustainability Policy*. Retrieved March 20, 2017, from <http://www.otago.ac.nz/sustainability/policies/index.html>.
- Suter, E., Deutschlander, S., & Lait, J. (2011). Using a complex systems perspective to achieve sustainable healthcare practice changes. *Journal of Research in Interprofessional Practice and Education*, 2(1), 83-99.
- Swift, J. M. (2011). *Persistence the key to promoting and implementing sustainability*. City, State: Publisher.
- Tang, C. S., & Zhou, S. (2012). Research advances in environmentally and socially sustainable operations. *European Journal of Operational Research*, 223(3), 585-594.
- Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research. Integrating qualitative and quantitative approaches in the social and behavioural sciences*. City, CA: Sage Publications.
- Teherani, A., Nishimura, H., Apatira, L., Newman, T. & Ryan, S. (2017). Identification of core objectives for teaching sustainable healthcare education. *Medical Education Online*. 22, 1386042.
- Teixeira, A. A., Jabbour, C. J. C., Oliveira, J. H. C., Gomes, R. A., Battistelle, R. A. G., & de Castro, R. (2011). Environmental practices and motivational elements: A study of leading Brazilian companies. *Environmental Quality Management*, 21(1), 39-51.
- Thakur, V. & Ramesh, A. (2015). Healthcare waste management research: A structured analysis and review (2005–2014). *Waste Management & Research*. 33(10), 855-870.
- The Guardian. (n.d.). What are the main man-made greenhouse gases? Retrieved March 30, 2017, from <https://www.theguardian.com/environment/2011/feb/04/man-made-greenhouse-gases>.

- Thiel, C. L., Woodes, N. C. & Bilec, M. M. (2018). Strategies to Reduce Greenhouse Gas Emissions from Laparoscopic Surgery. *AJPH Research*, 108(52), 5158-5164.
- Thorne, D. M., & Venable, B. T. (2008). Governance theory and practice for non-profit organisations. *International Journal of Governance and Ethics*, 4(2), 148-168.
- Todnem, R. (2005). Organisational change management: A critical review. *Journal of Change Management*, 5(4), 369-380.
- Tomson, C. (2015). Reducing the carbon footprint of hospital-based care. *Future Hospital Journal, Royal College of Physicians*, 2(1), 57-62.
- Topf, M. (2005). Psychological explanations and interventions for indifference to greening hospitals. *Healthcare Management Review*, 323(30), 2-8.
- Torraco, R. J. (2005). Writing integrative literature reviews: guidelines and examples. *Human Resource Development Review*, 4(3), 356-367.
- Townend, W. K. (2005). Guidelines for the evaluation and assessment of the sustainable use of resources and of waste management at healthcare facilities. *Waste Management & Research*, 23(5), 398-408.
- Tudor, T., Barr, S. W., & Gilg, A. W. (2008a). A novel conceptual framework for examining environmental behaviour in large organisations. A case study of the Cornwall National Health Service (NHS) in the United Kingdom. *Environment and Behaviour*, 40(3), 426-450.
- Tudor, T. L., Barr, S. W. & Gilg, A. W. (2007a). Linking intended behaviour and actions: A case study of healthcare waste management in the Cornwall NHS. *Resources, Conservation & Recycling*, 51, 1-23.
- Tudor, T. L., Barr, S. W., & Gilg, A. W. (2007b). Strategies for improving recycling behaviour within the Cornwall National Health Service (NHS) in the UK. *Waste Management & Research: The Journal of the International Solid Wastes & Public Cleansing Association, ISWA*, 25(6), 510.
- Tudor, T. L., Marsh, C. L., Butler, S., Van Horn, J. A. & Jenkin, L. E.T. (2008b). Realising resource efficiency in the management of healthcare waste from the

- Cornwall National Health Service (NHS) in the UK. *Waste Management*, 28, 1209-1218.
- Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the Industrial age to the knowledge era. *The Leadership Quarterly*. 18(4), 298-318.
- Uhl-Bien, M., & Marion, (2009). Complexity leadership in bureaucratic forms of organising: A meso model. *The Leadership Quarterly*. 20 (4), 631-650.
- UNFCCC. (2011). *Report of the in-depth review of the fifth national communication of New Zealand, United Nations Framework Convention on Climate Change*. Retrieved June 24, 2016, from <http://sdg.iisd.org/news/unfccc-publishes-new-zealands-fifth-national-communication-review-report/>.
- United Nations. (1987). *World commission on environmental and development: Our common future*. Oxford, UK: Oxford University Press.
- Vernon, W. N. (2009). "Helping hands": Leaders in the healthcare sustainability movement. *Journal of Healthcare Management*, 54(4), 227-231.
- Wang, X., Van. W., Lebrede, N. (2014) Sustainability Leadership in a Local Government Context. *Public Performance & Management Review*. 37 (3), 339-364.
- Wahlqvist, M. L. (2005). The new nutrition science: sustainability and development. *Public Health Nutrition*, 8(6), 766-772.
- Watts, N., Adger, W. N., Agnolucci, P., Blackstock, J., Byass, P., & Costello, A. (2015). Health and climate change: Policy responses to protect public health. *The Lancet*, 386(10006), 1861-1914.
- Weaver, H. J., Blaski, G. A., Capon, A. G., & McMichael, A. J. (2010). Climate change and Australia's healthcare system- risks, research and responses. *Australian Health Review*, 34, 441-444.
- Weimann, E. & Patel, B. (2017). Tackling the climate targets set by the Paris Agreement (COP 21): Green leadership empowers public hospitals to overcome

- obstacles and challenges in a resource constrained environment. *SAMJ*. 107(1), 34-38.
- Weiner, B. J. (2009). A theory of organisational readiness for change. *Implementing Science*, 4:67, doi:10.1186/1748-5908-4-67.
- Whittmore, R. (2005). Combining evidence in nursing research. *Nursing Research*, 54(1), 56-62.
- Wiesner, R. Chadee, D. & Best. P. (2018) Managing Change Toward Environmental Sustainability: A Conceptual Model in Small and Medium Enterprises. *Organisation & Environment*. 31(2), 152-177.
- World Health Organisation. (2009). Healthy hospitals, healthy planet, healthy people: Addressing climate change in healthcare settings. Retrieved March 20, 2015 from <http://www.who.int/globalchange/publications/climatefootprintreport.pdf>.
- Wiedmann, T., Barrett, J., & Lenzen, M. (2007). *Companies on the scale: Comparing and benchmarking the footprints of businesses*. International Ecological Footprint Conference, Stepping up the Pace: New Developments in Ecological Footprint Methodology, Policy and Practice. Cardiff, Wales
- Wiedmann, T., & Minx, J. (2007). *A definition of 'carbon footprint'*. ISA UK Research Report. London, UK: Publisher.
- Wilson, D. K. L., & Ingley, C. (2012). *Such a waste: Literature review on sustainable healthcare practice*. Adelaide, Australia: ANZICS.
- Woods, M. (2003). The global reporting initiative. *The CPA Journal*, 73(6), 60-65.
- Worrell, R., & Appleby, M. (2000). Stewardship of natural resources: Definition, ethical and practical aspect. *Journal Agricultural Environ Ethics*, 12(3), 263-277.
- Yin, R. K. (2009). *Case study research: Design and methods*. City, CA: Sage.
- Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in Quantitative Methods for Psychology*, 9(2), 79-94.

- Yung, E., Gagner, M., Pomp, A., Dakin, G., Milone, L. & Strain, G. (2010). Cost comparison of reusable and single-use ultrasonic shears for laparoscopic bariatric surgery. *ObesSurg*, 20(4), 512-518.
- Yuriev, A., Boiral, O., Francoeur, V. & Paille, P. (2018). Overcoming the barriers to pro-environmental behaviors in the workplace: A systematic review. *Journal of Cleaner Production*. 182, 379-394.
- Zainal, Z. (2007). Case study as a research method. *JurnalKemanusiaan*, 9, 1-6.
- Zattoni, A., Douglas, T., & Judge, W. (2013). Developing corporate governance theory through qualitative research. *Corporate Governance: An International Review*, 21(3), 119-122.
- Zhang, J. J., Joglekar, N., Heineke, J., & Verma, R. (2014). Eco-efficiency of service co-production: Connecting eco-certifications and resource efficiency in U.S hotels (Electronic version). *Cornell Hospitality Quarterly*, 55(1), 1-13.

Appendices

Appendix A: Glossary of terms

Anthropogenic climate change: The scientific study of the origin and development of humans and the impact human activity is having on the global climate (Oreskes, 2004).

Carbon footprint: A definition now widely recognised in the discipline of economics. The carbon footprint is a measure of the total amount of carbon dioxide emissions directly and indirectly caused by an activity or accumulated over the life stages of a product (Wiedmann and Minx, 2007).

Climate change: this effect is likely to bring about more extreme weather events in the form of floods, storms, cyclones, droughts and landslides rather than an increase in temperature alone (Godlee, 2012).

Green hospital: A ‘green hospital’ or healthcare system continuously focusses on upgrading public health by reducing environmental impacts and eventually by eliminating hospitals’ role in bearing the disease burden (Azmal et al., 2014).

Greenhouse Gases (GHGs): These gases gather in the atmosphere, wrap around the earth and trap the sun's heat. The more GHGs emitted, the faster the climate heats up; a process more commonly referred to as ‘global warming’ (Gao et al., 2014).

Sustainability: A well-referenced definition of sustainability emerged as ‘the ability to meet present needs without compromising the ability of future generations to meet their needs’ (United Nations, 1987).

Appendix B: New Zealand Waste Legislation

1. Resource Management Act (RMA) 1991

The Resource Management Act (RMA) 1991 is the main piece of legislation. It is a statutory law that states the roles and responsibilities of local authorities in relation to waste management and resource allocation. The purpose of the RMA is to promote regional sustainable management of natural and physical resources in a way that meets the current and future needs of the population and communities by providing national environmental standards (<http://www.mfe.govt.nz/rma>). The RMA outlines guidelines for the New Zealand public and business organisations when undertaking any project that may have adverse effects on the physical environment. The RMA is enforced through a range of statutory bodies including The Ministry for the Environment and local councils.

Central government has administrative responsibilities under the RMA in providing national direction and responding to national environmental issues. Local government, under territorial authorities and regional councils, is also charged with management of land, water, and air quality using district and regional plans and resource consents. Consents are required for new disposal facilities, recycling plants and clean fills.

2. The Local Government Act 2002

The Local Government Act 2002 promotes the wellbeing of communities and empowers councils to enable local decision-making and action by, and on behalf of, communities. This Act states the purpose of local government and provides a framework for local authorities to decide which activities to undertake. Promotion of the accountability of local authorities to their communities ensures that local authorities play a role in meeting current needs (www.legislation.govt.nz/act/public/2002) and that long-term council plans are formulated. In performing its role, a local authority must pay regard to the contribution that core services make to its communities, i.e. network infrastructure, public transport services, solid waste collection and disposal, and the avoidance or mitigation of natural hazards. As a result of this Act, local authorities have been permitted to pass bylaws to protect the public, specifically in relation to waste.

3. Waste Minimisation Act 2008

The purpose of this Act is to encourage waste minimisation and a decrease in waste disposal to protect the environment from harm and provide environmental, social, economic, and cultural benefits. The Act defines the primary roles and responsibilities of stakeholders such as consumers, producers, local government organisations, and landfill operators, in solid waste reduction.

The Waste Minimisation Act provided plans and introduced a levy on waste disposed of at disposal facilities, effective from 1 July 2009. The levy has two purposes set out in the Act: to raise revenue for promoting and achieving waste reduction, and to increase the cost of waste disposal to recognise that disposal imposes costs on the environment, society, and the economy. The levy is currently set at a rate of \$10 (plus GST) per tonne which is low when compared to other countries

(<http://www.mfe.govt.nz/waste/waste-disposal-levy/about-levy>).

The levy encourages New Zealanders to begin taking responsibility for the waste they produce, and to find more effective and efficient ways to reduce, reuse, recycle, or reprocess waste; whilst also creating funding opportunities for waste reduction initiatives. A proportion of the funds generated from the levy are directed towards the Waste Minimisation Fund. The Waste Minimisation Fund provides funding for projects that promote or achieve waste reduction. By supporting these projects, the fund increases resource efficiency, reuse, recovery, and recycling, and decreases waste sent to landfill. The fund was introduced by the Act as a means of supporting local initiatives aimed at minimising and reducing waste, thereby engaging members of the community.

Another key endorsement of the Act relates to product stewardship. Product stewardship is the responsible management of the environmental impact of a product and aims to reduce the impact of manufactured products at stages of the product life cycle. Under a product stewardship scheme, any party involved in the life of a product may accept responsibility for reducing the product's environmental impacts. In a product stewardship scheme some, or all, of the environmental costs from a product are included in the product's price. Without product stewardship, society and the environment carry the cost of a product's environmental impact, rather than the consumer or producer.

4. New Zealand Waste Management Strategy 2002

This strategy provided a comprehensive plan for all waste from generation to disposal and included provisional targets and standards, supporting information and communication, with an indication of full cost accounting. This strategy filled a gap in the legislative framework for managing and minimising waste. The strategy set an ambitious target to move New Zealand towards ‘zero waste’ and a range of activities and regulatory changes have ensued resulting in some progress towards these targets. However, many of the targets outlined in this waste strategy were unable to be measured, which led to a revision of the strategy in 2010.

5. New Zealand Waste Management Strategy 2010

The revised strategy aimed to reduce the harmful effects of waste in addition to improving the efficiency of resource use. The Waste Strategy provides direction to central and local government, businesses (including the waste industry), and communities for where to focus their efforts to manage waste.

When planning waste management and reduction activities, local government, businesses, and communities need to assess the risk of harm to the environment and human health from waste to identify and act on those wastes of greatest concern, thereby reducing their harmful effects. In doing so, such entities improve the efficiency of resource use to reduce the impact on the environment and human health and capitalise on potential economic benefits. Examples of resource efficiency in consumption include choosing products that are reusable, durable, and able to be repaired rather than being discarded, or choosing products with less, and recyclable, packaging.

6. NZS4304:2002 Management of Healthcare Waste

The purpose of this standard is to minimise potentially acute, long-term, or accumulative environmental or human health impacts. This standard provides guidelines for the disposal of human and animal healthcare waste, including generators, waste transporters and waste disposal facilities. This is to guarantee the safe management of healthcare waste and ensure the protection of community and environmental health (NZS4304:2002:9) and applies to all medical practitioners. Healthcare waste in this standard refers to all waste generated by any healthcare facility and classified as either ‘Non-Hazardous’, ‘Controlled’ or ‘Hazardous’ waste.

Non-Hazardous waste represents the bulk of waste generated by healthcare organisations and is a greater public risk issue than household waste. Hazardous or controlled types of waste refer to healthcare waste which may present a real or perceived health or environmental risk. The safe management of healthcare waste is intended to ensure that community and environmental health are protected irrespective of the technological treatment and disposal methodology applied.

The Standard outlines procedures for the classification, segregation, packaging, containment, labelling, storage, transport and disposal of healthcare waste. It also provides guidance on best practice over and above legislative requirements to prevent or minimise potentially acute, long-term or cumulative environmental and human health impacts.

A fundamental principle of any waste management strategy is minimising waste generation. The appropriate classification and segregation of waste at generation enables healthcare organisations to minimise weight of waste sent to landfill, thereby reducing the associated costs and potential environmental impacts. Additionally, longer term strategies of waste reduction require a review of healthcare practices and purchasing policies, thereby minimising waste generation up stream.

Accordingly, segregation and identification of healthcare waste are important steps which relate directly to a range of recommended disposal options and processes. Non-hazardous waste may be compacted (to reduce volume) and most of this waste is transported into a landfill or sanitary landfill. A sanitary landfill accepts hazardous waste and controlled waste and has specific disposal arrangements to meet the objectives of this Standard (NZS4304:2002:32). The hazardous or controlled waste needs to be covered immediately with a suitable material to ensure complete burial. When non-hazardous waste is recognisable as healthcare waste, shredding is recommended prior to burial.

If the services are available, and the waste is not contaminated with food or other material, it may be recycled. The material also must be recognised as being recyclable: for example, paper, cardboard, glass, most forms of plastic, and aluminium, are deemed suitable and can be readily recycled in most instances.

Hazardous waste (sharps, infectious, cytotoxic, radioactive) is non-recyclable, cannot be compacted, and must be disposed of under strict conditions. In New Zealand,

incineration is prohibited yet cytotoxic waste needs to be incinerated. As a result, all cytotoxic waste in New Zealand is transported to Australia where it is incinerated under special conditions before being buried in a sanitary lined landfill. The remaining hazardous waste material undergoes a steam sterilisation process at a local Auckland plant, using an Autoclave. After 40 minutes at 140°C the waste is then ground prior to disposal in an approved local authority sanitary landfill.

Controlled waste can be compacted only if any expressible liquid is fully contained, but it should be sterilised, ground or macerated prior to going to a sanitary landfill.

Anecdotally, most healthcare practitioners are not aware of this controlled waste classification and many DHBs do not adhere to this part of the Standard. This is problematic for regulatory and compliance reasons.

7. Auckland Council Waste Management and Minimisation Plan 2012

Auckland sent 1.174 million tonnes of waste to landfill in 2010, representing approximately 0.8 tonnes of waste for every person in the region. This waste includes a significant quantity of material that, if separated, could be recycled and put to beneficial use. For example, around 65 per cent of kerbside refuse collected from households could be recycled or composted (or processed in some other way) instead of being sent to landfill.

The Plan aims to enable Auckland to become the most liveable city in the world regarding waste management. The Plan has the long-term, aspirational goal of Zero Waste by 2040, turning its waste into usable resources. Zero waste, according to the Plan, means changing mind sets about waste, treating it as a resource rather than a disposal problem.

However, this plan focuses only on the approximately 17 per cent of the waste stream that the Council currently influences (over 80 per cent is largely controlled by the waste industry, with limited council influence). The Plan outlines specific actions that the Council proposes to achieve consistent, streamlined, efficient waste services across the Auckland region. Although the Council does not control the services provided by the private sector, it will work collaboratively with the sector to achieve an overall reduction in waste sent to landfill under the legislative requirement to promote effective and efficient waste management and reduction within its district

(www.aucklandcouncil.govt.nz).

Appendix C: Annotated Bibliography

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
Abor (2013)	<ul style="list-style-type: none"> • Healthcare • Four hospital settings in Ghana, different wards/2 public and 2 private • Case study/document analysis, interviews, questionnaire and observation. 	<ul style="list-style-type: none"> • Organisation (public versus private) • Leadership • There is room for improvement in health care waste management in public and private settings in Ghana. Public hospitals generate more waste, in relation to higher number of cases treated. 	<ul style="list-style-type: none"> • Very few empirical studies exist regarding HCW management in Africa, multiple case study approach comparing public to private hospitals. • Waste management practices in Africa vary widely with those of more developed countries and no mention of analysis methods applied.
Alam et al. (2008)	<ul style="list-style-type: none"> • Healthcare • 1 hospital in Bangladesh/n=12 wards • Case study/interviews, measurement of waste and observation. 	<ul style="list-style-type: none"> • Organisation • Leadership • Periodic waste stream assessments are required to provide a complete picture of HCW. 	<ul style="list-style-type: none"> • Very little research undertaken regarding HWM in Bangladesh, very comprehensive assessment and description and classification undertaken of waste per type. • No information given as to methods of qualitative data analysis used and less generalisable due to study setting.
Charlesworth et al. (2012)	<ul style="list-style-type: none"> • Healthcare • Evaluation of a climate change workshop delivered to public health registrars in the UK/n= 238 • Mixed methods/questionnaires, telephone interview. 	<ul style="list-style-type: none"> • Individuals • Change management • Some pockets of good practice, many health professionals are yet to engage with sustainability in the workplace. 	<ul style="list-style-type: none"> • There is very little evidence on how to teach health professionals about sustainability and the study captured levels of awareness and attempted to capture subsequent behavioural changes. Offered explanations as to why levels of engagement of health professionals may be low. • Only broad information shared about the research tools used.

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
Connor & Mortimer (2010)	<ul style="list-style-type: none"> • Healthcare • 78 adult and paediatric units in UK, 63 of those units provided a contact for survey completion/n=63 • Survey /Surveys. 	<ul style="list-style-type: none"> • Programme/Individuals • Change management • A baseline for sustainability in kidney care was measured to allow for future iterations of the survey to measure the magnitude and direction of any change resulting from the interventions of a green nephrology programme. 	<ul style="list-style-type: none"> • Improvements in the way renal care is delivered would help reduce carbon footprint of healthcare and limit the unprecedented demands. Clear explanation of background and survey items. • Not all data that were needed were collected. Units who were less inclined to practice sustainably did not respond, representing a potential bias.
Evans et al. (2012)	<ul style="list-style-type: none"> • Healthcare • Australian setting/n=816 • Mixed methods/energy audits and survey. 	<ul style="list-style-type: none"> • Programme/Individuals • Change management • Different sustainability intervention strategies are required depending on targeted behaviours having collective or individual responsibility. Prompts were found to be useful for targeting individual responsibilities. 	<ul style="list-style-type: none"> • Pre- and post-test intervention design measuring the effectiveness of an intervention in the workplace, over time. Tested the application of prompts in the workplace setting. Used self-reported measures as an indicator of behaviour. Addressing the lack of research conducted in workplace settings. • The pre-test post-test design was described as a limitation as an ABAB design is said to be more conclusive, although not easily applied in a workplace setting when the intervention is part of the direction an organisation is taking. No control group was used, once again, not possible to apply the intervention to some employees and not others.
Franco & Almeida (2011)	<ul style="list-style-type: none"> • Healthcare • 1 European health organisation, 2 wards/n=63 • Mixed methods/surveys, document analysis and interviews. 	<ul style="list-style-type: none"> • Organisation • Leadership • The findings attested to the central role of organisational learning and leadership in organisational performance/effectiveness within healthcare sustainability. 	<ul style="list-style-type: none"> • Very clear processes and details of research protocol provided. Link made between an organisation's learning capacity to their ability to change. • Limitations include the fact that the study is restricted to just one case/organisation, implying the findings are less generalisable. The sample size was small for a survey.
Goonan et al. (2014)	<ul style="list-style-type: none"> • Healthcare • Hospital food services in New Zealand/n=3 sites • Mixed methods/document analysis, observations, focus groups and one-on-one interviews. 	<ul style="list-style-type: none"> • Individual • Leadership • Most food waste occurs as a result of over production. Exploring attitudes and practices of food service personnel allowed for an understanding of reasons behind hospital food waste and ways in which it could be minimised. 	<ul style="list-style-type: none"> • Set in hospitals in New Zealand. Really clear and methodical approach taken to explaining the research. • Caution should be taken to generalise the findings to other types of hospitals or different food service settings such as those in schools.

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
Hartman et al. (2011)	<ul style="list-style-type: none"> • Healthcare and commercial • 83 managers from healthcare and 124 from non-healthcare organisations in the US/n=323 • Survey/Surveys. 	<ul style="list-style-type: none"> • Organisation/Individual • Leadership • The research found that employees who believe that their organisations are aligned with the green movement/are sustainable are more likely to have higher outcome perceptions, although not consistent when comparing respondents from non-healthcare to healthcare organisations. Non-healthcare organisations were seen to be performing better in a green sense. When healthcare organisations embrace the green movement, employees recognise their concerns and react positively. 	<ul style="list-style-type: none"> • Compared employees' perceptions of being green from healthcare and non-healthcare organisations. Link made between organisational performances and being green. Clear and methodical research approach taken. • No mention of response rate achieved. Focussed on perceptions as opposed to actual organisational behaviour.
Jamali et al. (2010)	<ul style="list-style-type: none"> • Healthcare • Lebanese hospitals/n= 35 hospitals • Case study/in-depth qualitative interviews based on a semi structured questionnaire. 	<ul style="list-style-type: none"> • Organisation (profit versus not for profit organisations) • Leadership • Expected differences found between not for profit and for profit organisations, such as, for profit organisations score lower with respect to disclosing information and communicating to various stakeholders. Yet in terms of corporate social responsibility, sustainability and governance, the result indicate Lebanese hospitals have some way to go to promote or enact a governance system based on sound governance principles. Not for profit establishments were however more aligned with the governance principles. 	<ul style="list-style-type: none"> • Compared profit to not for profit healthcare organisations. Healthcare governance has received very little empirical attention in the healthcare literature, particularly in the context of developing countries. • Firms with better governance practices might be more willing than others to respond to the survey and agree to be interviewed. No mention of the methods used for the qualitative data analysis.
Kantabutra (2011)	<ul style="list-style-type: none"> • Healthcare • Thailand/n=32 participants • Case study/non participant observation, document analysis, semi structured interviews. 	<ul style="list-style-type: none"> • Organisation • Leadership • Compared leadership practices in a less economically developed setting. The Avery framework provides a useful tool for evaluating corporate sustainability in the Thai enterprise. 	<ul style="list-style-type: none"> • Multiple data collection to explore the research proposition. Promotes the development of social policies and organisations sharing a social vision, adding value to society. Puts forward a useful framework that would help organisations to sustain success when striving towards achieving sustainable leadership practices. • Difficult to extrapolate findings across other healthcare organisations as this was based on a single case study.

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
Kaplan et al. (2012)	<ul style="list-style-type: none"> • Healthcare • USA/n=7 hospitals • Case study/existing institutional data was standardised. 	<ul style="list-style-type: none"> • Organisation/Programme • Change management • After standardising metric across hospitals and generalising the results nationwide, the analysis found savings achievable through these interventions could exceed \$5.4 billion over 5 years. Agencies and organisations that regulate and advise on health care systems would do well to increase their educational efforts regarding sustainability interventions for both their institutional and societal cost saving consequences. There is a need for increased standardisation of data collection and further evaluation of the costs and benefits of sustainability interventions in healthcare. 	<ul style="list-style-type: none"> • Seminal piece of research trying to quantify the fiscal benefits of adopting green practices with respect to energy, waste and procurement practices. Deals with the misconception that going green costs money. • A small number of interventions were selected, limited number of hospitals studied, data availability was compromised, complexities of measuring the staff education costs and difficulty in selecting typical hospitals for extrapolation. Sample is not representative, and the estimations are conservative.
Komilis et al. (2012)	<ul style="list-style-type: none"> • Healthcare • Greece/n=132 hospitals • Case study/existing institutional data was standardised. 	<ul style="list-style-type: none"> • Organisation (in private versus public setting) • Leadership • Differences were found between public and private hospitals, private birth and general hospitals generated more waste. Although, there was a large variability found within the data from healthcare facilities within the same category. 	<ul style="list-style-type: none"> • Attempted to find similarities between different healthcare establishments as a means of predicting waste generation rates. Identified the link between bed occupancy and waste generation rates. One of very few studies of this type in Greece. • Focussed solely on medical waste therefore less relevant as the non-hazardous medical waste category were not included. Did not look at the different local policies and procedures or individuals' perceptions and behaviours.
Lui et al. (2014)	<ul style="list-style-type: none"> • Healthcare • Canada/n=3 sites • Prospective study evaluating 97 operative procedures/waste audits. 	<ul style="list-style-type: none"> • Programme/Individual • Change management/Leadership • Recycling is largely underutilised and there remain concerns about waste handling safety. Demonstrates the preoperative period provides a great opportunity for recycling without affecting patient or staff safety. 	<ul style="list-style-type: none"> • Some of the differences may have been overstated as subspecialty assignment is difficult as there are overlaps between specialities. Many procedures were not included, and the waste generated may not reflect the amount of waste produced in other centres counties. True generalisability across all centres may be unachievable as it is difficult to define an operating room environment and workflow processes that can be universally applied.
Manga et al. (2011)	<ul style="list-style-type: none"> • Healthcare • Cameroon/n=5 facilities • Case study/interviews and structured questionnaires, site visits, and a waste characterisation survey. 	<ul style="list-style-type: none"> • Organisation/Programme • Leadership • Little attention is given to medical waste management. There is a need for an integrated approach to policy making and 	<ul style="list-style-type: none"> • Comprehensive overview of HCWM procedures in a developing country. Provides an interesting account of waste generated by different services. Uncover the challenges found in developing countries and confirms findings of other research studies: inefficient segregation, collection, transportation, absence of training, poor legislation, unsafe practice and illegal dumping.

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
		develop sustainable waste management legislation.	<ul style="list-style-type: none"> • No clear explanation given around methods employed for data collection and analysis. The results of the study are less generalisable as the sites chosen are in Cameroon, a developing country.
Miller et al. (2011)	<ul style="list-style-type: none"> • Healthcare • UK/n= 188 • Survey/Surveys. 	<ul style="list-style-type: none"> • Organisation/Programme • Change management • The website was an enabler. Making available easily accessible information about nappies had the potential to nudge people to make decisions that those who designed the survey, feel they are in the best interest of society. Websites were seen as being new tools that empower individuals around sustainability. Empowerment was described as an outcome and an enabling process. 	<ul style="list-style-type: none"> • The study highlights how a website can more provide information and preliminary information evidence suggests that people's beliefs can be nudged, and the internet has the potential to change health behaviours. For a relatively low cost, web-based platforms can target lower social, economic and rural groups. • The main criticism relates to the lack of information provided on how the data was analysed. The study was limited to people who were computer literate.
Nichols et al. (2012)	<ul style="list-style-type: none"> • Healthcare • UK/n=20 participants • Ethnography/semi structured interviews. 	<ul style="list-style-type: none"> • Programme/Individual • Change management • Attempts to implement sustainable healthcare waste management philosophy are desirable both financially and environmentally. 	<ul style="list-style-type: none"> • Very clear explanation of steps taken to address rigour. Affirms the need to explore attitudes, belief and knowledge that underpin individual and organisational behaviour. • The context in which people work and the confidentiality agreement established for the study was described as a limitation.
Nichols & Manzi (2014)	<ul style="list-style-type: none"> • Healthcare • UK/n=1 hospital • Ethnography/8 observational visits and 3 further visits to conduct 20 interviews. 	<ul style="list-style-type: none"> • Programme/Individual • Change management • Space and physical arrangement of the environment are significant and influential factors in clinical practice. Sustainable waste management practices are more likely to succeed in an environment that facilitates correct waste segregation. 	<ul style="list-style-type: none"> • The working environment was found to have a significant impact on practice within the NNU. Lack of space was described as a prohibitive factor. This is disappointing because evidence from an infection control perspective indicates that overcrowding leads to raised infection rates. Further supports that much healthcare waste is incorrectly and expensively disposed of as a result of poor segregation. • It may be unreasonable to attempt to generalise when the results are based upon the evidence from one area. This area may be an atypical example.
Njagi et al. (2012)	<ul style="list-style-type: none"> • Healthcare • Kenya 2 sites/n=599/261 • Survey/Surveys. 	<ul style="list-style-type: none"> • Programme/Individual • Change management • Training not often included in curricula, yet it is necessary for health and safety reasons. Most of the information acquired by healthcare workers was through on the job 	<ul style="list-style-type: none"> • The training improved the worker's compliance to hepatitis B vaccinations and the use of PPEs when handling HCW. • The self-evaluation process used was subjective and may have resulted in biased responses. Waste management practices in Kenya vary widely with those of more developed countries, making findings less generalisable to third world setting.

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
		<p>training and informally through organised training at work places. Continuing education on health and safety in healthcare waste management is required, as is training in induction curricula training programmes.</p>	
Patrick et al. (2011)	<ul style="list-style-type: none"> • Healthcare • Australia/n=5 sites • Case study/interviews. 	<ul style="list-style-type: none"> • Programme/Individual • Leadership • Health promotion competencies and sustainability include individual behaviour, organisation and social change, partnership developments and community engagement. Despite multiple barriers, including lack of funding and policy direction, health promotion principles and practices can enable action on sustainability. The study revealed a range of barriers and facilitators to incorporating sustainability into community-based healthcare practice. Key factors were discussed using a model (micro-macro level). 	<ul style="list-style-type: none"> • Recognises how healthcare has the potential to cause environmental harm, promote good health, and prevent environmental degradation, as well as preventing further climate change by implementing strategies aimed at adaptation and mitigation. There has been limited research and public documentation on the role of health promotion and on the barriers and facilitators that healthcare practitioners are experiencing in developing sustainable practice, thereby addressing the gaps in knowledge. One of the strengths of the study was the use of data from varied healthcare contexts supplemented by key stakeholder interviews. • The use of only one case study per inclusion criteria and the variable duration of and number of interviews might have compromised the ability to identify all factors influencing practice. The findings are therefore limited to a broad overview of factors that constrain or facilitate practice and are not directly transferable to other settings.
Ruoyan et al. (2008)	<ul style="list-style-type: none"> • Healthcare • China, site visits/n=169 interviews • Mixed methods/questionnaire and interviews. 	<ul style="list-style-type: none"> • Programme/Individual • Change management • Waste generation depends on patient population and primary health care centres were found to be less compliant with the national standards, because of the increased financial investment required. Training and safety measures are urgently required. 	<ul style="list-style-type: none"> • The formula used for calculating waste generated per bed did not take the number of admissions and discharges into account, just the total number of beds available. Cleaning personnel were short-term workers with a low level of education giving rise to the validity of the findings as on the sections within the studies' results were based upon their perceptions. HCWM practices are very different and programmes/ policies available in New Zealand are not so comparable.
Srivastav et al. (2012)	<ul style="list-style-type: none"> • Healthcare • n=1 hospital/India • Case study/observation, questionnaire and interviews. 	<ul style="list-style-type: none"> • Organisation/Programme • Leadership • There should be strict implementation of a waste management policy to help set up organisational training as HCWM practices were found to be unsafe and inadequate. 	<ul style="list-style-type: none"> • Very few references (6). Limited information provided around analysis methods employed. Lacked generalisability as HCWM practices are very different in more developed countries.

Author and Date	<ul style="list-style-type: none"> • Organisation • Setting/sampling(n=) • Design/ Data collection techniques 	<ul style="list-style-type: none"> • Key level • Theoretical link • Essential finding 	<ul style="list-style-type: none"> • Key critique
Tudor, Marsh et al. (2008)	<ul style="list-style-type: none"> • Healthcare • UK/n=1 hospital • Case study /audits: waste, recycling weight, repeated visits and a discussion session. 	<ul style="list-style-type: none"> • Programme/Individual • Change management • The study showed through a combination of reduced clinical bin sizes, increased recycling bins, in conjunction with improved awareness, communication and training significant opportunities for improved sustainable waste management can be realised within the setting of health. The trials were able to achieve significant waste reductions in clinical and domestic waste. Containment, logistics and social factors were identified as factors for success. 	<ul style="list-style-type: none"> • The findings confirm the results of previous studies. Also, this study has shown the importance of social factors such as awareness and attitudes if success is to be achieved. • The research was single case study based, implying limited generalisability.
Tudor et al. (2008)	<ul style="list-style-type: none"> • Healthcare • UK/n=72 sites • Mixed methods/ data collection via a range of ethnographic techniques: waste bin analysis, interviews, questionnaire and ethnographic study. 8 unstructured interviews. 	<ul style="list-style-type: none"> • Programme/Individual • Leadership • The findings confirm the holistic and interrelated nature of these factors in their influence on the general and environmental behaviour of individual employees. They also demonstrate the close interaction between the cognitive and organisational variables. Main factors and their links were identified- the focus and structure of the NHS, the org culture, attitudes of staff, waste management behaviour at home and an intention-behaviour gap. 	<ul style="list-style-type: none"> • Several key factors that serve as antecedents to individual EM behaviours, including both organisational and cognitive/individual factors. There has been limited research thus far into the environmental behaviour in UK organisations, particularly studies that have sought to integrate both organisational and individual factors. • Discrepancies between stated and actual behaviour were noted during the interviews, statements were found to be rhetoric rather than fact; with a few actual examples demonstrating behaviour were provided.

Appendix D: The Programme

Once the initial data sets were obtained waste reduction interventions were instigated. The intervention is not part of the study; yet the study measured the effectiveness of the sustainable waste management interventions. Education sessions were delivered as a means of providing information and general communication about the changes to waste management because of the programme. Workshops were held periodically for the duration of the research (12 months). The workshops explained waste reduction as part of a wider sustainability programme and provided a rationale for the various interventions.

Workshops were supplemented by on-going communications, including progress reports and educational posters. Posters were distributed and displayed on staff notice boards, uploaded on the hospital intranet and information about this initiative presented at staff forums. The project leader ran the workshops and part of the survey ascertained if education about the programme was deemed necessary. An overview of each intervention was recorded, and details are provided below.

Log of interventions for waste programme- between the two survey collection dates

- Theatre department (MMH) established a green team during February 2014.
- Theatre department recycling rolled out at MMH during February 2014. The recycling programme consisted of introducing and trialling a new waste segregating and classification process/system capturing the following new waste streams: paper/fine card, comingle, and soft plastic. Each theatre and set up room were provided with a collection of purposely designed bins set in a trolley with wheels. The theatre team requested mobile bins, making it easier to move the bins across to where the waste was generated, making it easier for them to recycle.
- Desk top cube (DTC) package launched at the Staff Centre at MMH in March 2014. The DTC package involves replacing personal waste paper bins with small desk top cubes. Recycling bins for paper/fine card and comingle are provided at the same time.
- DTC package launched in building 26, MMH in March 2014.
- Green team established in the Critical Care Complex, MMH during March 2014.

- DTC package and worm farm provided to the Homehealth team on the Western campus, MMH, July 2014.
- Milk bottle recycling implemented within Critical Care and the theatre department (MMH) June 2014.
- Trial of reusable mugs in the free issue area of the staff canteen at the MSC August 2014.
- DTC package initiated in Building 2 (admin area) MMH August 2014.
- E waste (electronic waste) recycling and battery recycling initiated at MMH in Sept 2014.

Resources were required, including the different bins. Allowing time to undertake audits and having the expertise at hand in terms of being able to safely and effectively perform waste audits pre- and post-programme intervention was an essential part of the waste reduction programme.

Recycling- bins, audits

- LoveNZ bins ordered for 6 public/staff eating areas.
- Annual organisational waste audit, September 2014.
- Bins and resources provided to all areas mentioned above.
- Pre- and post-waste counts undertaken at each area where new processes were initiated.

Education- workshops, forums

- Critical Care Complex (MMH) planning day- presentation, March 2014.
- Radiology (MMH) presentation, April 2014.
- Theatre team at MSC April 2014.
- Staff forum with CEO April 2014.
- Module 9/10 MSC April 2014.
- Composting course MMH & MSC May and June 2014.
- Presentation to Homehealth July 2014.
- Worm farm at Western Campus July 2014.
- Green Expo July 2014 both sites.
- August 2014- hand drier trial at MSC.
- September- Asia Pacific conference (APAC) presentation and posters.

- KeepCup promotion Sept-Oct 2014.
- 20 cents off a coffee for employees using reusable coffee cups established- October 2014.
- Population Health Congress presentation and workshop, October 2014.
- Presented to EC at their senior management team meeting, October 2014.

Communication- posters, intranet, newsletter

- e-Update monthly- Environmental Sustainability electronic internal newsletter.
 - Daily Dose message regarding recycling delivered in March 2014.
 - Daily Dose message regarding the e-Update, each month.
 - Team Counties Blog- 'Waste' October 2014.
 - All areas provided with posters, fact sheets and emails prior to, during and after each intervention.
 - Feedback provided to each area after any audit.
 - Regular attendance of green team meetings for each department.
-

Appendix E: CMDHB and ATEC Ethics Approval



10 October 2013

Dear Debbie Wilson

Thank you for the information you supplied to the Ko Awatea Research Office regarding your research proposal:

Research Registration Number: 1435

Ethics Reference Number: 13/213

Research Project Title: Sustainable healthcare practice: Examining waste and energy reduction strategies- a mixed methods study

I am pleased to inform you that the CMDHB Research Committee and Director of Hospital Services have approved this research with you as the CMDHB Co-ordinating Investigator.

Your study is approved until 16 September 2013.

Amendments:

- All amendments to your study must be submitted to the Research Office for review.
- Any substantial amendment (as defined in the *Standard Operating Procedures for HDECs*, May 2012) must also be submitted to the Ethics Committee for approval.

All external reporting requirements must be adhered to.

Please note that failure to submit amendments and external reports may result in the withdrawal of Ethical and CMDHB Organisational approval.

We wish you well in your project. Please inform the Research Office when you have completed your study (including when a study is terminated early) and provide us with a brief final report (1-2 pages) which we will disseminate locally.

Yours sincerely



Dr Samantha Everitt
Manager Research Office
Counties Manukau District Health Board
Under delegated authority from CMDHB Research Committee and Director of Hospital Services

17 September 2013

Peter Larmer
Faculty of Health and Environmental Sciences

Dear Peter

Re Ethics Application: 13/213 Sustainable healthcare practice: Examining waste reduction strategies - a mixed methods study.

Thank you for providing evidence as requested, which satisfies the points raised by the AUT University Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 16 September 2016.

Please include within the questionnaires introduction that the qualification is being undertaken at AUT University.

As part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 16 September 2016;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>. This report is to be submitted either when the approval expires on 16 September 2016 or on completion of the project.

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this. If your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply there.

To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,



Kate O'Connor
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: debbie.wilson@middlemore.co.nz

Appendix F: Email invitation

Dear

My name is Debbie Wilson and I am undertaking this study as part of my Doctor of Health Science qualification.

You have been selected to take part in a study, which will involve completing two surveys, one within the next few weeks and one in 12-months' time. Please indicate at the end of the survey if you would consider being contacted for an interview. If chosen for an interview, these will take place after the second survey and will take 60-90 minutes.

Your input is voluntary, and you may opt out at any point without question. For fuller information about the study an information sheet is available upon request.

When you complete a survey, you will automatically be entered a prize draw for a \$200 Westfield voucher. Winners will be notified soon after each survey closes.

Click on the following link to start the survey:

https://www.surveymonkey.com/s.aspx?sm=oHcVDcxPpLBg7z557NH4qg_3d_3d

This link is uniquely tied to this survey and your email address. Please do not forward this message.

Best of luck with the draws!

Debbie Wilson Sustainability Officer
Business & Corporate Services

T: +64 9 276 0044 I Ext: 8917 I M: 021 830 235 Debbie.wilson@middlemore.co.nz Building
25 I Middlemore Hospital, 100 Hospital Road, Otahuhu, Auckland 1640
countiesmanukau.health.nz

Please note: If you do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.

https://www.surveymonkey.com/optout.aspx?sm=oHcVDcxPpLBg7z557NH4qg_3d_3d

Participant Information Sheet

Date Information Sheet Produced: 14 July 2013

Participant Information Sheet



Project Title

Sustainable healthcare practice: Examining waste reduction strategies- a mixed methods study.

An Invitation

My name is Debbie Wilson and I would like to invite you to take part in my research project. This research will help me complete my Doctor of Health Science qualification. I work as the Sustainability Officer and lead the environmental programme at Counties Manukau DHB. Your input is most appreciated, yet your participation is voluntary, and you can opt out at any point during the research without question. As I work at Middlemore hospital you may know me and if this makes it uncomfortable for you to participate then please feel able to decline the invitation.

What is the purpose of this research?

This research aims to examine the effectiveness of interventions that reduce waste at Middlemore Hospital and Manukau Health Park. Data will be collected using surveys and interviews that will then be compared to waste weight. I shall be publishing the results of this thesis in an academic journal and aim to present the findings at medical conferences.

How was I identified and why am I being invited to participate in this research?

You have been chosen because you work at either Middlemore hospital or Manukau Health Park. As an employee here at Counties and after been given ethical approval I have gained access to your contact details and you have been randomly selected from a larger list of contacts. All employees who work at any other site within Counties Manukau DHB have been excluded. People who already have a relationship with me will be excluded from the interview process. Employees whose English language is less than conversational will also be excluded.

What will happen in this research?

The project involves two surveys with 12 months in between. After the survey data has been analysed nine participants will be invited to take part in interviews. The data will be collected to see how effective waste reduction strategies have been over the course of a 12-month period. This will help to inform further interventions across other sites at Counties and possibly other hospitals in the region.

What are the benefits?

This research will inform colleagues about the effectiveness of waste reduction in large healthcare organisations. By taking part you will also be helping me to achieve my Doctor of Health Science qualification.

What are the discomforts and risks?

There are few, if any risks associated with this research and the process will mean you are free from discomfort. A third party, Dr Peter Larmer, can be contacted if you have any questions, comments or concerns about this research. Dr Peter Larmer is not an employee of Counties Manukau DHB this means contacting Dr Larmer will be treated with the upmost confidence and respect whilst maintaining your privacy and confidentiality.

How will these discomforts and risks be alleviated?

Your confidentiality and privacy will be maintained throughout. Pseudonyms will be used when discussing results and any identifying data will be un-personalised.

How will my privacy be protected?

The data you provide will be treated confidentially and anonymity protected where the surveys are concerned.

What are the costs of participating in this research?

You may need to allow 15 minutes to complete the surveys and about 60-90 minutes for the interview.

What opportunity do I have to consider this invitation?

You will be invited to take part and given 4 weeks before the survey closes to consider the invitation. If you are invited for interview purposes at the later date you will be given a couple of weeks to think about whether you want to take part or not.

How do I agree to participate in this research?

By completing the survey, you are indicating consent. If you agree to take part in the second survey you will indicate this towards the end of the first survey. If you agree to being contacted again for the interview and if chosen, you will then be given an informed consent form to sign.

Will I receive feedback on the results of this research?

You will receive a summary of the results before it is published to make sure you agree that the information you provided is represented in the text.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Peter Larmer, at Peter.larmer@aut.ac.nz or telephone 09 921 9999 ext. 7322.

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTECH, Kate O'Connor, ethics@aut.ac.nz, 921 9999 ext. 6038.

Whom do I contact for further information about this research?

Researcher Contact Details:

Debbie Wilson, at Debbie.wilson@middlemore.co.nz or telephone 021 830 235.

Project Supervisor Contact Details:

Peter Larmer, at Peter.larmer@aut.ac.nz or telephone 09 921 9999 ext. 7322.

Approved by the Auckland University of Technology Ethics Committee on 17th of September 2013,

AUTECH Reference number 13/213

Consent

Green survey

Introduction

This survey has been designed to explore your opinions regarding green (more environmental) practices at your workplace. This is important because green practices have recently been developed here at Counties.

Taking part is voluntary. If you decide to take part you are consenting to contribute to a research study. The aim of this survey is to explore your opinions and experiences over time as green practices develop further. The primary researcher is Debbie Wilson, who is the Sustainability Officer at Counties. The surveys provide information for her Doctoral thesis.

This is the first of two surveys. Each survey takes about 15 minutes. There will be about 12 months between each survey.

Tick the box at the end of the survey if you agree to being contacted for the second survey. There is another tick box which asks if you would mind being emailed further in the event that these data require further exploration. Please remember you may opt out at any point.

If you have any concerns regarding the nature of the survey please contact Doctor Peter Larmer (p.larmer@aut.ac.nz) who is Head, School of Rehabilitation and Occupation Studies at AUT University. Confidentiality will be maintained at all times. Results of the study will be published and presented at conference. Any identifying data will be removed to protect your privacy.

On completion of this survey you will be given the option to enter into a prize draw to win a \$200 Westfield voucher.

There is a draw for each of the surveys so you have TWO chances of winning. Winners will be notified by email shortly after the closure dates.

Thank you for your time and good luck with the draws!

1. Do you consent to Counties Manukau Health using these data for research purposes?

- ☐ Yes
☐ No

Appendix G: Evaluation form

Thank you for completing the Green survey.

Please take some additional time filling in this evaluation form.

Your feedback will help ensure the survey is delivered in the best format.

1. Did you find the content clear?
2. How would you describe the presentation?
3. Would you say the language used was clear and readily understood?
4. Did you have enough space to write your answers to the questions requiring comments?
5. Were you able to skip any questions, if you chose to?
6. Were you redirected into a separate survey to enter into the prize draw?
7. Did the prize amount appeal?
8. Would you prefer the prize to take a different form? (e.g. cash, item)

Appendix H: Survey

Introduction

Counties Manukau Health has recently started on a journey into being more environmentally friendly. As a result of this we have been measuring our carbon emissions and have introduced recycling in some areas. This survey has been designed to identify a baseline for sustainability and support a transformation towards lower carbon healthcare by identifying areas for attention. The survey also aims to explore your opinions regarding more environmentally friendly or green practices at your workplace. Your opinions count because the success of this programme requires each and every one of us to contribute. The aim of this survey is to explore your opinions and experiences over time as green practices develop further.

Taking part is voluntary. If you decide to take part you are consenting to contribute to a research study. The primary researcher is Debbie Wilson, who is the Sustainability Officer at Counties. The surveys provide information for her Doctoral thesis and the qualification is being undertaken at AUT University.

This is the first of two surveys. Each survey takes less than 10 minutes. There will be about 12 months between each survey.

Tick the box at the end of the survey if you agree to being contacted for the second survey. There is another tick box which asks if you would mind being emailed further in the event that these data require further exploration. Please remember you may opt out at any point.

If you have any concerns regarding the nature of the survey please contact Dr Peter Larmer (p.larmer@aut.ac.nz) who is Head, School of Rehabilitation and Occupation Studies at AUT University. Confidentiality will be maintained at all times. Results of the study will be published and presented at conference. Any identifying data will be removed to protect your privacy.

On completion of this survey you will be given the option to enter into a prize draw to win a \$200 Westfield voucher.

There is a draw for each of the surveys so you have TWO chances of winning. Winners will be notified by email shortly after the closure dates.

1. Do you consent to Counties Manukau Health using these data for research purposes?

- ☐ Yes
- ☐ No

Please fill in the following demographic data. This will help describe the sample as a means of comparing the results and understanding the findings.

2. Are you male or female?

- ☐ Male
- ☐ Female

3. What is your age?

4. Which best describes your professional group?

- ☐ Nurse
- ☐ Doctor
- ☐ Allied Health
- ☐ Administration
- ☐ Non-clinical

Other (please specify)

5. Which site do you work at mostly?

- ☐ Middlemore Hospital
- ☐ Manukau Super Clinic
- ☐ Manukau Surgery Centre

Other (please specify)

6. What type of contract do you have?

- ☐ Permanent
- ☐ Temporary
- ☐ Casual

7. What is your ethnicity? Tick all that apply:

- ☐ Maori
- ☐ Pasifika
- ☐ New Zealand European/Pakeha
- ☐ Asian
- ☐ Other

Other (please specify)

Indicate how important the following statements are to you.

8. Recycling should be a priority at work.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. We need to dispose of food waste separately.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. It is important to use products that are made from recycled materials where the cost is comparable.

Not at all	Slightly	Neutral	Moderately	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. It is important to rely less on single use products where the cost is comparable.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Think about your recycling behaviour at work.

12. I am able to recycle office paper at work.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

13. I am able to recycle my plastic, glass and aluminium at work.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. I am able to put my food waste into a separate food waste bin at work.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Do you put waste into yellow bags?

16. Non clinical waste sometimes ends up in the clinical waste stream, for example: waste being wrongly placed into a yellow bag.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. Clinical waste sometimes ends up in the non clinical waste stream, for example: waste being wrongly placed into a white bag.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. It takes more me time to separate my waste to recycle it.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. I think it is important that we recycle and it is worth making an extra effort.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. What else can we do to improve our waste management?



The next questions relate to things that may have helped develop your aware...

In this case green practices include a range of ways that lessen the impact healthcare provision has on the environment. Examples include reducing waste and limiting wasteful practices, conserving energy, using safer chemicals, making healthier food choices and buying products that meet environmental criteria.

21. My manager actively supports green practices.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22. Posters should be used as a way of explaining green practices.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. I have seen posters:

- ☐ Yes
☐ No

24. The environmental webpage is a useful way of sharing important information about green practices.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

25. I have seen the environmental webpage:

- ☐ Yes
☐ No

26. Notices are a useful way of sharing information about green practices.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

27. I have seen notices:

- ☐ Yes
☐ No

28. Talking to colleagues is a useful way of sharing information about green practices.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

29. I have spoken with colleagues about green practices:

- ☐ Yes
☐ No

30. Staff meetings are a useful way of sharing information about green practices.

Never	Rarely	Sometimes	Mostly	Always
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

31. Green practices have been discussed at a staff meeting:

☐ Yes

☐ No

Below are some questions about your awareness of green practices.

32. I am aware that green practices will help to reduce pollution.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

33. I understand that by implementing green practices we are setting a good example to patients and families.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

34. I understand Counties can save money by adopting green practices.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

35. I understand the incidence of chronic diseases in our community can be reduced by adopting green practices.

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

36. It is important that green practices extend to these following areas:

	Not at all	Slightly	Moderately	Very	Extremely
Building energy use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Patient and staff travel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water use and consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Procurement of services and products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Waste reduction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Healthier food choices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reducing the use of chemicals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate the importance of the next statement.

37. I need training and information regarding the impact of green practices on climate change and pollution levels

Not at all	Slightly	Moderately	Very	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

38. What else would you like to see or make a comment about regarding a green programme?

Just before you go

39. It is important for the validity of the research that survey respondents fill out both the first and the second survey. Do you agree to be contacted for the second survey?

☐ Yes

☐ No

40. I agree to being emailed at a later date if necessary to further discuss the information provided.

☐ Yes

☐ No

Please provide email address

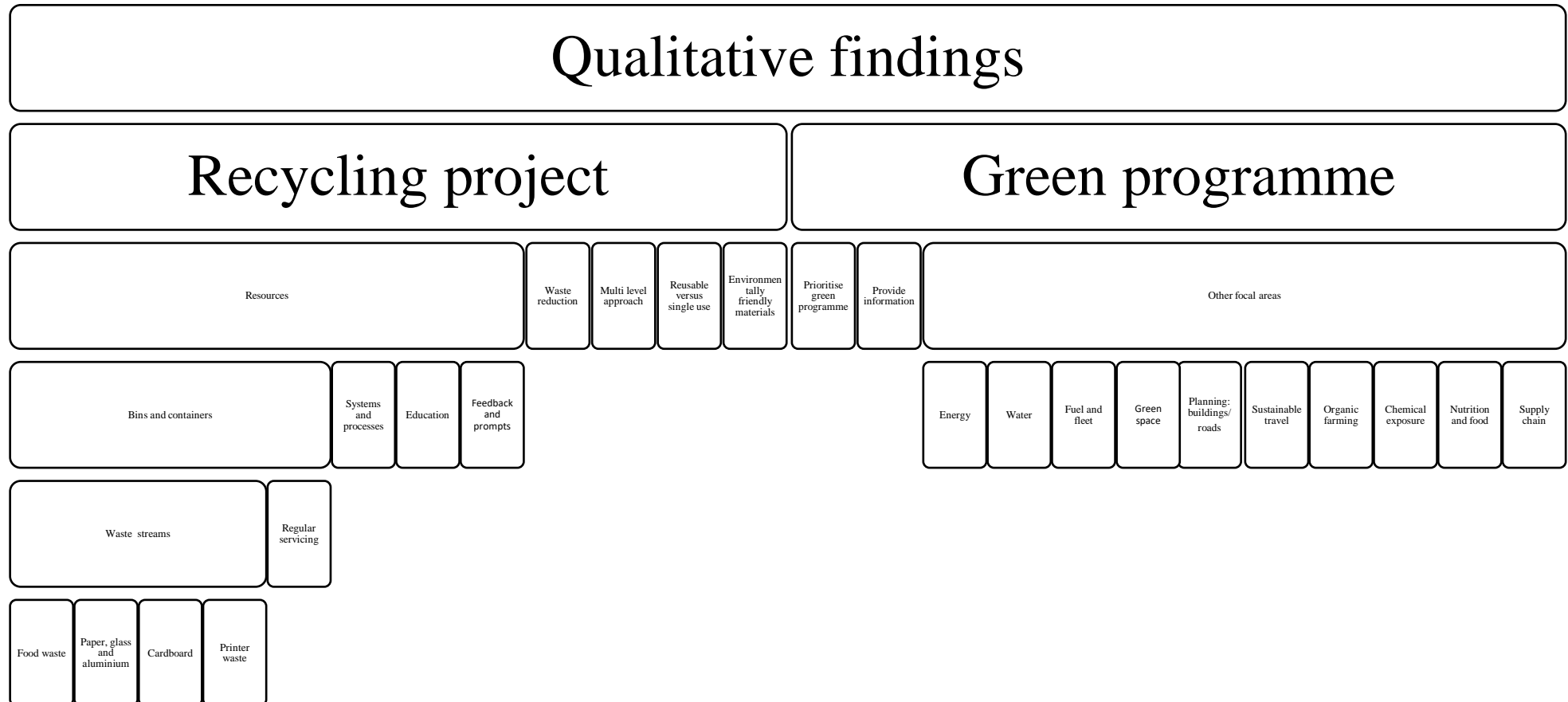
You have completed the survey good luck with the prize draw! (please click ...

Thank you so much for your time and invaluable input.

Appendix I: a) Overview of the NVivo findings

Recycling Project
<i>Organisation</i>
Environmentally friendly materials
Reusable versus single use
Recycling is not the only solution
Reducing waste at the outset
<i>Programme</i>
Bins and containers
Systems and processes
Education
Feedback and prompts
<i>Waste streams</i>
Food waste
Paper, glass and aluminium
Cardboard
Printer waste
Wider Sustainability (Green) Programme
<i>Organisation</i>
<i>Programme</i>
Energy conservation
Water
Fuel and fleet management
Green space
Planning around infrastructure
Sustainable modes of transportation
Organic farming
Chemical exposure
Nutrition and food
Procurement

Appendix I: b) Overview of Initial Qualitative Findings



Exploratory Factor Analysis

V1	F1	F2	F3	F4	F5	F6	F7	F8	Rotated Factor Pattern (Standardized Regression Coefficients)									
									Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8		
BeliefsAttitud	CoreValues2014								Recycling_Priority_2014	0.25	0.03	0.04	0.04	0.40	0.03	0.08	0.25	
									FoodWaste_Separately_2014	0.20	0.20	0.24	-0.03	0.15	-0.01	0.10	0.07	
									Use_RecycleProducts_2014	0.05	0.05	0.23	0.08	0.60	-0.08	0.05	0.05	
									Less_SingleUse_2014	0.11	-0.04	0.11	-0.16	0.55	-0.06	0.19	0.06	
									Recycle_Important_2014	0.16	0.21	0.08	-0.03	0.53	-0.05	0.05	0.29	
Knowledge	TransfValues2014								Extend_EnergyUse_2014	0.81	-0.05	-0.11	0.08	0.04	0.04	-0.04	0.05	
									Extend_Travel_2014	0.59	-0.01	0.19	0.03	-0.05	0.08	-0.06	-0.01	
									Extend_Water_2014	0.74	0.03	0.10	-0.04	0.01	0.01	0.02	0.12	
									Extend_Procurement_2014	0.81	0.03	0.01	0.04	0.04	-0.07	0.08	0.09	
									Extend_Waste_2014	0.65	0.05	0.18	-0.03	0.16	-0.11	0.07	0.12	
Knowledg	Aware2014								Extend_Food_2014	0.64	0.04	0.16	-0.09	0.01	0.10	-0.02	-0.04	
									Extend_Chemical_2014	0.46	0.15	0.33	-0.17	0.08	-0.05	-0.01	0.15	
									Green_GoodExample_2014	0.12	0.11	0.13	0.00	0.29	0.11	-0.11	0.55	
									Reduce_Pollution_2014	0.15	0.04	-0.06	0.06	0.25	0.13	-0.12	0.62	
									Hospital_Save_Money_2014	0.26	0.12	-0.11	0.04	-0.02	0.21	0.06	0.63	
Engagep	Recept2014								Reduce_ChronicDisease_2014	0.11	0.15	0.26	-0.10	-0.16	0.15	0.05	0.44	
									Posters_Useful_2014	0.12	0.68	0.00	-0.18	0.02	-0.19	0.04	0.11	
									Webpage_Useful_2014	0.03	0.51	0.17	-0.06	-0.09	0.01	0.18	0.13	
									Notices_Useful_2014	0.05	0.70	-0.08	-0.11	0.03	0.02	0.06	0.20	
									Talking_Colleagues_Useful_2014	0.22	0.28	0.06	0.23	0.14	0.02	-0.01	0.07	
Fact	Wrkntm2014								StaffMeeting_Useful_2014	0.30	0.30	-0.12	0.11	0.08	0.09	0.00	0.20	
									Seen_Posters_2014	0.01	0.01	0.01	0.49	-0.13	-0.15	0.24	0.15	
									Seen_Webpage_2014	0.03	0.09	0.16	0.12	-0.11	0.00	0.24	0.12	
									Seen_Notices_2014	-0.03	-0.07	0.08	0.27	-0.12	0.18	0.31	0.18	
									Manager_Recycler_2014	0.10	0.11	0.00	0.34	-0.17	-0.18	0.26	0.21	
Sgglegh									Spoken_Colleagues_Green_2014	0.06	-0.28	0.08	0.30	0.15	0.07	0.12	0.14	
									Discuss_StaffMeeting_Green_2014	0.08	-0.13	-0.09	0.45	0.05	0.10	0.14	0.15	
									Recycle_Paper_Work_2014	-0.03	-0.01	-0.07	-0.05	0.15	0.02	0.68	0.12	
									Recycle_PGA_Work_2014	-0.01	-0.11	0.04	0.12	-0.03	0.00	0.60	0.15	
									Recycle_FoodWaste_Work_2014	0.06	0.11	0.10	-0.09	-0.09	-0.18	0.44	-0.12	
BeliefsAttitud	CoreValues2015								Recycling_Priority_2015	0.27	0.22	0.08	0.13	0.36	0.14	0.01	0.01	
									FoodWaste_Separately_2015	0.10	0.26	0.06	0.01	0.31	0.28	-0.01	0.01	
									Use_RecycleProducts_2015	0.08	0.03	0.14	0.04	0.62	0.08	-0.12	-0.01	
									Less_SingleUse_2015	0.25	-0.10	0.00	0.04	0.28	0.20	0.00	-0.11	
									Recycle_Important_2015	0.18	0.26	0.14	0.08	0.41	0.13	-0.11	-0.01	
Knowledge	TransfValues2015								Extend_EnergyUse_2015	0.22	-0.05	0.51	0.07	0.16	0.09	0.01	0.09	
									Extend_Travel_2015	0.03	-0.03	0.62	0.12	0.13	0.23	-0.03	-0.08	
									Extend_Water_2015	0.16	0.08	0.72	0.08	0.04	-0.02	-0.08	0.11	
									Extend_Procurement_2015	0.07	0.03	0.59	0.06	0.14	0.17	0.00	0.04	
									Extend_Waste_2015	0.07	0.03	0.64	0.05	0.29	0.02	-0.04	0.05	
Knowledg	Aware2015								Extend_Food_2015	0.33	-0.01	0.41	-0.03	0.04	0.28	-0.03	-0.17	
									Extend_Chemical_2015	0.21	0.03	0.62	-0.03	0.03	0.12	0.09	-0.06	
									Green_GoodExample_2015	0.05	0.08	0.32	-0.08	0.13	0.57	0.01	0.11	
									Reduce_Pollution_2015	0.05	-0.01	0.10	-0.15	0.16	0.65	0.07	0.16	
									Hospital_Save_Money_2015	0.08	0.13	0.17	-0.12	-0.17	0.71	0.11	0.16	
Engagep	Recept2015								Reduce_ChronicDisease_2015	0.14	0.15	0.20	-0.11	-0.22	0.56	0.04	0.10	
									Posters_Useful_2015	0.03	0.66	0.10	0.02	0.00	0.07	0.02	-0.12	
									Webpage_Useful_2015	-0.20	0.52	0.23	0.27	-0.09	0.19	-0.03	0.15	
									Notices_Useful_2015	-0.04	0.67	-0.03	0.19	0.13	0.14	0.02	-0.02	
									Talking_Colleagues_Useful_2015	0.16	0.33	-0.01	0.33	0.09	0.28	-0.10	-0.11	
Fact	Wrkntm2015								StaffMeeting_Useful_2015	0.10	0.43	-0.03	0.19	0.09	0.22	-0.08	-0.02	
									Seen_Posters_2015	-0.06	0.03	-0.04	0.54	0.09	0.04	0.06	-0.13	
									Seen_Webpage_2015	-0.12	0.13	0.19	0.46	-0.06	-0.06	0.02	0.07	
									Seen_Notices_2015	-0.03	0.07	0.02	0.54	0.08	-0.09	0.07	-0.06	
									Manager_Recycler_2015	-0.07	0.20	0.02	0.41	-0.01	0.12	0.23	-0.07	
Sgglegh									Spoken_Colleagues_Green_2015	0.05	-0.16	0.23	0.48	0.05	0.02	-0.10	0.05	
									Discuss_StaffMeeting_Green_2015	0.22	-0.01	-0.08	0.67	-0.16	-0.06	0.01	0.05	
									Recycle_Paper_Work_2015	-0.11	0.01	-0.03	0.10	0.27	0.19	0.58	-0.16	
									Recycle_PGA_Work_2015	0.03	-0.01	-0.21	0.16	0.09	0.22	0.54	-0.03	
									Recycle_FoodWaste_Work_2015	0.09	0.13	0.01	0.15	-0.21	-0.01	0.38	-0.10	
Weighted variance explained by each factor, eliminating other factors									8.6	6.4	7.7	4.6	5.2	5.9	3.7	5.0		

Excluded – non-significant findings

Core Values

No significant differences were found for this construct. The differences between the years were negligible and no effect was detected from year, professional group, gender or location (see Tables 5.10 and 5.11).

Contrasts for core values

Contrast (all items simultaneously)	p-value
Year	0.48
Professional group, Sex and Location as confounders	0.38
Professional group	0.45
Sex	0.19
Location	0.61

Changes in core values 2014-2015

<u>Change from 2014 to 2015</u> <u>in item:</u>	Estimate	95% Confidence bounds		p Value	FDR p threshold	Accepted?
		Lower	Upper			
Recycling Priority	-0.09	-0.03	0.03	0.11	0.01	No
Food Waste Separately	-0.05	-0.09	0.09	0.54	0.02	No
Use Recycled Products	-0.06	-0.14	0.02	0.16	0.01	No
Less Single Use	-0.02	-0.12	0.08	0.70	0.03	No
Recycle Important	0.00	-0.14	0.14	0.97	0.05	No

Receptivity

No significant changes were found within this construct. Once again, the difference between the years was negligible, and no effect was detected from year, professional group, gender or location (see Tables 5.12 and 5.13).

Contrasts for receptivity

Contrast (all items simultaneously)	p-value
Year	0.15
Professional group, Sex and Location as confounders	0.44
Professional group	0.14
Sex	0.78
Location	0.47

Changes in receptivity 2014-2015

<u>Change from 2014 to 2015</u> <u>in item:</u>	Estimate	95% Confidence bounds		p Value	FDR p threshold	Accepted?
		Lower	Upper			
Posters	0.05	-0.06	0.17	0.35	0.02	No
Webpage	-0.03	-0.15	0.09	0.62	0.03	No
Notices	-0.11	-0.23	0.01	0.10	0.01	No
Talking	-0.13	-0.25	-0.01	0.04	0.01	No
Meeting	-0.01	-0.14	0.13	0.84	0.05	No

Transformational Values

No significant changes found within this construct although females tended to score higher on the items listed within this construct (see Tables 5.14 and 5.15).

Contrasts for transformational values

Contrast (all items simultaneously)	p-value
Year	0.06
Professional group, Sex and Location as confounders	<0.0001
Professional group	0.005
Sex	<0.0001
Location	0.63

Changes transformational values 2014-2015

<u>Change from 2014 to 2015</u> <u>in item:</u>	Estimate	95% Confidence bounds		p Value	FDR p threshold	Accepted?
		Lower	Upper			
Energy use	-0.14	-0.24	-0.04	0.01	0.01	No
Travel	-0.02	-0.19	0.08	0.63	0.05	No
Water	-0.05	-0.17	0.07	0.36	0.03	No
Procurement	-0.09	-0.18	0.01	0.09	0.01	No
Waste	-0.06	-0.12	0.06	0.30	0.02	No
Food	-0.09	-0.17	-0.01	0.04	0.01	No
Chemical	-0.07	-0.17	0.03	0.14	0.01	No

EFA Factor Correlations

Inter-Factor Correlations								
		Transformational values 2014	Receptivity 2014-2015	Transformational values 2015	Work context 2014-2015	Core values 2014-2015	Awareness 2015	Segregation behaviour 2014-2015
Receptivity 2014-2015	0.40							
Transformational values 2015	0.30	0.27						
Work context 2014-2015	-0.03	0.11	0.10					
Core values 2014-2015	0.30	0.25	0.04	0.08				
Awareness 2015	0.31	0.31	0.24	0.15	0.30			
Segregation behaviour 2014-2015	0.06	0.09	0.14	0.30	0.00	0.06		
Awareness 2014	0.33	0.23	0.13	0.11	0.17	0.17	0.18	

Change in Segregation Behaviour 2014-2015

Change from 2014 to 2015 in	Estimates		DF	t Value	Pr > |t|	FDR p threshold	Accepted?
	Estimate	Standard Error					
Foodwaste	0.1131	0.0829	534	1.36	0.1731	0.05	No
Plastics-Glass-Aluminium	0.5211	0.08074	534	6.45	<.0001	0.016667	Yes
Paper	0.2061	0.07887	534	2.61	0.0092	0.025	Yes
Contrasts							
Label	Num DF	Den DF	F Value	Pr > F			
Effect of year	3		534	15.69 <.0001			
Strata, Sex and Location as confounders	9		534	5.52 <.0001			

Fit Statistics	
-2 Res Log Likelihood	5597.97
AIC (smaller is better)	5607.97
AICC (smaller is better)	5608.01
BIC (smaller is better)	5597.97
CAIC (smaller is better)	5602.97
HQIC (smaller is better)	5597.97
Generalized Chi-Square	34811.79
Gener. Chi-Square / DF	20.73

Covariance Parameter Estimates				
Cov Parm	Subject	Group	Estimate	Standard Error
Intercept	Email_Addr		0.5276	0.06451
Recycle_Type*(Email_Addr)		Recycle_Type Recycle_FoodWaste_Work	0.8151	0.1183
Recycle_Type*(Email_Addr)		Recycle_Type Recycle_PGA_Work	0.3952	0.08879
Recycle_Type*(Email_Addr)		Recycle_Type Recycle_Paper_Work	0.1578	0.06604
Residual			20.7336	1.1002

Solutions for Fixed Effects										
Effect	NAME OF FORMER VARIABLE	NAME OF FORMER VARIABLE	Sex	Location	Strate	Estimate	Standard Error	DF	t Value	Pr > |t|
Recycle_Type		Recycle_FoodWaste_Work				2.3988	0.2748	763	8.73	<.0001
Recycle_Type		Recycle_PGA_Work				2.8474	0.2436	763	11.69	<.0001
Recycle_Type		Recycle_Paper_Work				4.6063	0.2231	763	20.64	<.0001
Year*Recycle_Type	Y2014	Recycle_FoodWaste_Work				-0.1131	0.0829	534	-1.36	0.1731
Year*Recycle_Type	Y2014	Recycle_PGA_Work				-0.5211	0.08074	534	-6.45	<.0001
Year*Recycle_Type	Y2014	Recycle_Paper_Work				-0.2061	0.07887	534	-2.61	0.0092
Year*Recycle_Type	Y2015	Recycle_FoodWaste_Work				0 .	.	.	.	.
Year*Recycle_Type	Y2015	Recycle_PGA_Work				0 .	.	.	.	.
Year*Recycle_Type	Y2015	Recycle_Paper_Work				0 .	.	.	.	.
Recycle_Type*Sex		Recycle_FoodWaste_Work	Female			-0.3794	0.1842	534	-2.06	0.0399
Recycle_Type*Sex		Recycle_FoodWaste_Work	Male			0 .	.	.	.	.
Recycle_Type*Sex		Recycle_PGA_Work	Female			-0.04236	0.1618	534	-0.26	0.7936
Recycle_Type*Sex		Recycle_PGA_Work	Male			0 .	.	.	.	.
Recycle_Type*Sex		Recycle_Paper_Work	Female			0.06749	0.1471	534	0.46	0.6466
Recycle_Type*Sex		Recycle_Paper_Work	Male			0 .	.	.	.	.
Recycle_Type*Location		Recycle_FoodWaste_Work		MMH		0.005843	0.205	534	0.03	0.9773
Recycle_Type*Location		Recycle_FoodWaste_Work		MSC		0 .	.	.	.	.
Recycle_Type*Location		Recycle_PGA_Work		MMH		0.5617	0.1799	534	3.12	0.0019
Recycle_Type*Location		Recycle_PGA_Work		MSC		0 .	.	.	.	.
Recycle_Type*Location		Recycle_Paper_Work		MMH		-0.3852	0.1634	534	-2.36	0.0188
Recycle_Type*Location		Recycle_Paper_Work		MSC		0 .	.	.	.	.
Recycle_Type*Strate		Recycle_FoodWaste_Work			Clinician	0.134	0.1472	534	0.91	0.3629
Recycle_Type*Strate		Recycle_FoodWaste_Work			NonClinician	0 .	.	.	.	.
Recycle_Type*Strate		Recycle_PGA_Work			Clinician	0.006013	0.1312	534	0.05	0.9635
Recycle_Type*Strate		Recycle_PGA_Work			NonClinician	0 .	.	.	.	.
Recycle_Type*Strate		Recycle_Paper_Work			Clinician	-0.4102	0.121	534	-3.39	0.0007
Recycle_Type*Strate		Recycle_Paper_Work			NonClinician	0 .	.	.	.	.

Type III Tests of Fixed Effects				
Effect	Num DF	Den DF	F Value	Pr > F
Recycle_Type	3		763	633.54 <.0001
Year*Recycle_Type	3		534	15.69 <.0001
Recycle_Type*Sex	3		534	1.96 0.1197 not sig
Recycle_Type*Location	3		534	8.64 <.0001 sig
Recycle_Type*Strate	3		534	5.57 0.0009 sig

Change in Core Values 2014-2015

Change from 2014 to 2015 in	Estimates							
	Estimate	Standard Error	DF	t Value	Pr > |t|	FDR p threshold	Accepted?	
	Recycling Priority	-0.09434	0.0584	2343	-1.62	0.1064	0.01	No
	Foodwaste Separately	-0.04583	0.07424	2343	-0.62	0.5371	0.01666667	No
	Use Recycle Products	-0.06223	0.04409	2343	-1.41	0.1583	0.0325	No
	Less Single Use	-0.01822	0.0471	2343	-0.39	0.6989	0.025	No
	Recycle important	-0.00281	0.07193	2343	-0.04	0.9688	0.05	No
Contrasts								
Label	Num DF	Den DF	F Value	Pr > F	Accepted?			
Effect of year	5	2343	0.9	0.4823	No			
Strata, Sex and Location as confounders	15	2343	1.07	0.3827	No			

-2 Res Log Likelihood	6834.6
AIC (smaller is better)	6946.6
AICC (smaller is better)	6949
BIC (smaller is better)	7168.3

Effect	NAME OF FORMER VARIABLE	NAME OF FORMER VARIABLE	Sex	Location	Strate	Estimate	Standard Error	DF	t Value	Pr > |t|
CoreVal_Type		FoodWaste_Separately				3.9624	0.164	2343	24.16	<.0001
CoreVal_Type		Less_SingleUse				3.8242	0.1875	2343	20.4	<.0001
CoreVal_Type		Recycle_Important				4.1925	0.1458	2343	28.76	<.0001
CoreVal_Type		Recycling_Priority				3.9738	0.1505	2343	26.41	<.0001
CoreVal_Type		Use_RecycleProducts				3.6556	0.1964	2343	18.62	<.0001
Year*CoreVal_Type	Y2014	FoodWaste_Separately				0.09434	0.0584	2343	1.62	0.1064
Year*CoreVal_Type	Y2014	Less_SingleUse				0.04583	0.07424	2343	0.62	0.5371
Year*CoreVal_Type	Y2014	Recycle_Important				0.06223	0.04409	2343	1.41	0.1583
Year*CoreVal_Type	Y2014	Recycling_Priority				0.01822	0.0471	2343	0.39	0.6989
Year*CoreVal_Type	Y2014	Use_RecycleProducts				0.00281	0.07193	2343	0.04	0.9688
Year*CoreVal_Type	Y2015	FoodWaste_Separately				0				
Year*CoreVal_Type	Y2015	Less_SingleUse				0				
Year*CoreVal_Type	Y2015	Recycle_Important				0				
Year*CoreVal_Type	Y2015	Recycling_Priority				0				
Year*CoreVal_Type	Y2015	Use_RecycleProducts				0				
CoreVal_Type*Sex		FoodWaste_Separately	Female			0.1928	0.1079	2343	1.79	0.074
CoreVal_Type*Sex		FoodWaste_Separately	Male			0				
CoreVal_Type*Sex		Less_SingleUse	Female			0.1091	0.1195	2343	0.91	0.3613
CoreVal_Type*Sex		Less_SingleUse	Male			0				
CoreVal_Type*Sex		Recycle_Important	Female			0.216	0.09564	2343	2.26	0.024
CoreVal_Type*Sex		Recycle_Important	Male			0				
CoreVal_Type*Sex		Recycling_Priority	Female			0.1254	0.09892	2343	1.27	0.2051
CoreVal_Type*Sex		Recycling_Priority	Male			0				
CoreVal_Type*Sex		Use_RecycleProducts	Female			0.2763	0.1268	2343	2.18	0.0294
CoreVal_Type*Sex		Use_RecycleProducts	Male			0				
CoreVal_Type*Location		FoodWaste_Separately		MMH		0.01519	0.1197	2343	0.13	0.899
CoreVal_Type*Location		FoodWaste_Separately		MSC		0				
CoreVal_Type*Location		Less_SingleUse		MMH		-0.07267	0.1334	2343	-0.54	0.5861
CoreVal_Type*Location		Less_SingleUse		MSC		0				
CoreVal_Type*Location		Recycle_Important		MMH		0.1108	0.1073	2343	1.03	0.3018
CoreVal_Type*Location		Recycle_Important		MSC		0				
CoreVal_Type*Location		Recycling_Priority		MMH		0.1102	0.1105	2343	1	0.3187
CoreVal_Type*Location		Recycling_Priority		MSC		0				
CoreVal_Type*Location		Use_RecycleProducts		MMH		0.02672	0.1421	2343	0.19	0.8508
CoreVal_Type*Location		Use_RecycleProducts		MSC		0				
CoreVal_Type*Strate		FoodWaste_Separately			Clinician	-0.1442	0.09197	2343	-1.57	0.1171
CoreVal_Type*Strate		FoodWaste_Separately			NonClinician	0				
CoreVal_Type*Strate		Less_SingleUse			Clinician	-0.1304	0.1048	2343	-1.24	0.2135
CoreVal_Type*Strate		Less_SingleUse			NonClinician	0				
CoreVal_Type*Strate		Recycle_Important			Clinician	-0.1346	0.0799	2343	-1.69	0.0921
CoreVal_Type*Strate		Recycle_Important			NonClinician	0				
CoreVal_Type*Strate		Recycling_Priority			Clinician	-0.1214	0.08321	2343	-1.46	0.1447
CoreVal_Type*Strate		Recycling_Priority			NonClinician	0				
CoreVal_Type*Strate		Use_RecycleProducts			Clinician	-0.01902	0.1097	2343	-0.17	0.8624
CoreVal_Type*Strate		Use_RecycleProducts			NonClinician	0				

Effect	Num DF	Den DF	F Value	Pr > F
CoreVal_Type	5	2343	1121.88	<.0001
Year*CoreVal_Type	5	2343	0.9	0.4823
CoreVal_Type*Sex	5	2343	1.48	0.1935
CoreVal_Type*Location	5	2343	0.72	0.6107
CoreVal_Type*Strate	5	2343	0.94	0.451

Dimensions	
Covariance Parameters	56
Columns in X	45

Number of Observations Read	3880
Number of Observations Used	2751
Number of Observations Not Used	1129

Cov Parm	Subject	Group	Estimate
Email_Address			0.3124
Var(1)	Email_Address	CoreVal_Type FoodWaste_Separately	16.4229
Var(2)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(3)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(4)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(5)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(6)	Email_Address	CoreVal_Type FoodWaste_Separately	11.7187
Var(7)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(8)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(9)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
Var(10)	Email_Address	CoreVal_Type FoodWaste_Separately	23.9826
CSH	Email_Address	CoreVal_Type FoodWaste_Separately	0.1162
Var(1)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(2)	Email_Address	CoreVal_Type Less_SingleUse	19.2540
Var(3)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(4)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(5)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(6)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(7)	Email_Address	CoreVal_Type Less_SingleUse	24.343
Var(8)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(9)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
Var(10)	Email_Address	CoreVal_Type Less_SingleUse	23.9826
CSH	Email_Address	CoreVal_Type Less_SingleUse	0.04612
Var(1)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(2)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(3)	Email_Address	CoreVal_Type Recycle_Important	6.7515
Var(4)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(5)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(6)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(7)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(8)	Email_Address	CoreVal_Type Recycle_Important	9.3476
Var(9)	Email_Address	CoreVal_Type Recycle_Important	23.9826
Var(10)	Email_Address	CoreVal_Type Recycle_Important	23.9826
CSH	Email_Address	CoreVal_Type Recycle_Important	0.2109
Var(1)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(2)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(3)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(4)	Email_Address	CoreVal_Type Recycling_Priority	8.913
Var(5)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(6)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(7)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(8)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
Var(9)	Email_Address	CoreVal_Type Recycling_Priority	9.8149
Var(10)	Email_Address	CoreVal_Type Recycling_Priority	23.9826
CSH	Email_Address	CoreVal_Type Recycling_Priority	0.1978
Var(1)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(2)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(3)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(4)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(5)	Email_Address	CoreVal_Type Use_RecycleProducts	20.3727
Var(6)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(7)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(8)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(9)	Email_Address	CoreVal_Type Use_RecycleProducts	23.9826
Var(10)	Email_Address	CoreVal_Type Use_RecycleProducts	19.6082
CSH	Email_Address	CoreVal_Type Use_RecycleProducts	0.2107

Change from 2014 to 2015 in:	Estimate	Standard Error	DF	t Value	Pr > |t|	FDR p threshold	Accepted?
Energy Use	-0.1392	0.05404	3335	-2.53	0.0115	0.007	No
Travel	-0.02399	0.04978	3335	-0.48	0.6299	0.050	No
Water	-0.05125	0.05632	3335	-0.91	0.3629	0.025	No
Procurement	-0.08991	0.05259	3335	-1.71	0.0874	0.030	No
Waste	-0.05949	0.05796	3335	-1.03	0.3048	0.017	No
Food	-0.06703	0.04231	3335	-2.06	0.0397	0.008	No
Chemical	-0.07347	0.04876	3335	-1.48	0.1399	0.013	No
Contrasts							
Label	Num DF	Den DF	F Value	Pr > F	Accepted?		
Effect of year	7		3335	1.92	0.0628		
Strata, Sex and Location as confounders	21		3335	3.74	<.0001		Yes

Fit Statistics

-2 Res Log Likelihood 7889.9

AIC (smaller is better) 8081.9

AICC (smaller is better) 8088.2

BIC (smaller is better) 8501.5

Effect	NAME OF FORMER VARIABLE	NAME OF FORMER VARIABLE	Location	Strata	Estimate	Standard Error	DF	t Value	Pr > |t|
Extend_Type		Extend_Chemical			0.0195	0.1043	3335	24.46	<.0001
Extend_Type		Extend_EnergyUse			4.1971	0.1526	3335	27.51	<.0001
Extend_Type		Extend_Food			3.7791	0.1752	3335	21.57	<.0001
Extend_Type		Extend_Procurement			3.9337	0.1501	3335	26.21	<.0001
Extend_Type		Extend_Travel			3.7692	0.1691	3335	22.29	<.0001
Extend_Type		Extend_Waste			4.4102	0.1462	3335	30.16	<.0001
Extend_Type		Extend_Water			4.0211	0.1506	3335	26.71	<.0001
Year*Extend_Type	Y2014	Extend_Chemical			0.1382	0.05404	3335	2.53	0.0113
Year*Extend_Type	Y2014	Extend_EnergyUse			0.02399	0.04978	3335	0.48	0.6299
Year*Extend_Type	Y2014	Extend_Food			0.0125	0.05632	3335	0.91	0.3629
Year*Extend_Type	Y2014	Extend_Procurement			0.08991	0.05259	3335	1.71	0.0874
Year*Extend_Type	Y2014	Extend_Travel			0.05949	0.05796	3335	1.03	0.3048
Year*Extend_Type	Y2014	Extend_Waste			0.06703	0.04231	3335	2.06	0.0397
Year*Extend_Type	Y2014	Extend_Water			0.07347	0.04876	3335	1.48	0.1399
Year*Extend_Type	Y2015	Extend_Chemical			0				
Year*Extend_Type	Y2015	Extend_EnergyUse			0				
Year*Extend_Type	Y2015	Extend_Food			0				
Year*Extend_Type	Y2015	Extend_Procurement			0				
Year*Extend_Type	Y2015	Extend_Travel			0				
Year*Extend_Type	Y2015	Extend_Waste			0				
Year*Extend_Type	Y2015	Extend_Water			0				
Extend_Type*Sex		Extend_Chemical	Female		0.3866	0.105	3335	3.68	0.0002
Extend_Type*Sex		Extend_Chemical	Male		0				
Extend_Type*Sex		Extend_EnergyUse	Female		-0.02261	0.09941	3335	-0.23	0.8201
Extend_Type*Sex		Extend_EnergyUse	Male		0.4199	0.1127	3335	3.73	0.0002
Extend_Type*Sex		Extend_Food	Female		0				
Extend_Type*Sex		Extend_Food	Male		0.1764	0.09699	3335	1.82	0.069
Extend_Type*Sex		Extend_Procurement	Female		0				
Extend_Type*Sex		Extend_Procurement	Male		0.278	0.1085	3335	2.56	0.0104
Extend_Type*Sex		Extend_Travel	Female		0				
Extend_Type*Sex		Extend_Travel	Male		0.09814	0.09533	3335	1.03	0.3033
Extend_Type*Sex		Extend_Waste	Female		0				
Extend_Type*Sex		Extend_Waste	Male		0.3205	0.09649	3335	3.29	0.001
Extend_Type*Sex		Extend_Water	Female		0				
Extend_Type*Sex		Extend_Water	Male		0				
Extend_Type*Location		Extend_Chemical	MMH		-0.1824	0.1197	3335	-1.53	0.1256
Extend_Type*Location		Extend_Chemical	MSC		0				
Extend_Type*Location		Extend_EnergyUse	MMH		-0.0562	0.1129	3335	-0.5	0.6187
Extend_Type*Location		Extend_EnergyUse	MSC		0				
Extend_Type*Location		Extend_Food	MMH		-0.061	0.1278	3335	-0.48	0.6332
Extend_Type*Location		Extend_Food	MSC		0				
Extend_Type*Location		Extend_Procurement	MMH		-0.06981	0.1104	3335	-0.63	0.5273
Extend_Type*Location		Extend_Procurement	MSC		0				
Extend_Type*Location		Extend_Travel	MMH		-0.195	0.1229	3335	-1.59	0.1125
Extend_Type*Location		Extend_Travel	MSC		0				
Extend_Type*Location		Extend_Waste	MMH		-0.127	0.1087	3335	-1.17	0.2426
Extend_Type*Location		Extend_Waste	MSC		0				
Extend_Type*Location		Extend_Water	MMH		-0.117	0.1115	3335	-1.05	0.294
Extend_Type*Location		Extend_Water	MSC		0				
Extend_Type*Strata		Extend_Chemical	Clinician		-0.13	0.09005	3335	-1.44	0.1488
Extend_Type*Strata		Extend_Chemical	NonClinician		0				
Extend_Type*Strata		Extend_EnergyUse	Clinician		0.06535	0.0835	3335	0.78	0.4339
Extend_Type*Strata		Extend_EnergyUse	NonClinician		0				
Extend_Type*Strata		Extend_Food	Clinician		0.1211	0.09817	3335	1.23	0.2173
Extend_Type*Strata		Extend_Food	NonClinician		0				
Extend_Type*Strata		Extend_Procurement	Clinician		0.02235	0.09071	3335	0.28	0.7818
Extend_Type*Strata		Extend_Procurement	NonClinician		0				
Extend_Type*Strata		Extend_Travel	Clinician		0.1446	0.09334	3335	1.55	0.1215
Extend_Type*Strata		Extend_Travel	NonClinician		0				
Extend_Type*Strata		Extend_Waste	Clinician		-0.0939	0.07898	3335	-1.19	0.2345
Extend_Type*Strata		Extend_Waste	NonClinician		0				
Extend_Type*Strata		Extend_Water	Clinician		-0.08921	0.08196	3335	-1.09	0.2765
Extend_Type*Strata		Extend_Water	NonClinician		0				

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Extend_Type	7		3335	763.87 <.0001
Year*Extend_Type	7		3335	1.92 0.0628
Extend_Type*Sex	7		3335	7.2 <.0001
Extend_Type*Location	7		3335	0.75 0.6316
Extend_Type*Strata	7		3335	2.92 0.0048

Covariance Parameter Estimates

Cov Parm	Subject	Group	Estimate
Email_Address			0.2763
Var(1)	Email_Address	Extend_Type Extend_Chemical	8.6176
Var(2)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(3)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(4)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(5)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(6)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(7)	Email_Address	Extend_Type Extend_Chemical	13.8215
Var(8)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(9)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(10)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(11)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(12)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(13)	Email_Address	Extend_Type Extend_Chemical	21.1711
Var(14)	Email_Address	Extend_Type Extend_Chemical	21.1711
CSH			0.0286
Var(1)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(2)	Email_Address	Extend_Type Extend_EnergyUse	7.9137
Var(3)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(4)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(5)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(6)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(7)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(8)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(9)	Email_Address	Extend_Type Extend_EnergyUse	14.851
Var(10)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(11)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(12)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(13)	Email_Address	Extend_Type Extend_EnergyUse	21.1711
Var(14)	Email_Address	Extend_Type Extend_EnergyUse	-0.1275
Var(1)	Email_Address	Extend_Type Extend_Food	21.1711
Var(2)	Email_Address	Extend_Type Extend_Food	21.1711
Var(3)	Email_Address	Extend_Type Extend_Food	12.7382
Var(4)	Email_Address	Extend_Type Extend_Food	21.1711
Var(5)	Email_Address	Extend_Type Extend_Food	21.1711
Var(6)	Email_Address	Extend_Type Extend_Food	21.1711
Var(7)	Email_Address	Extend_Type Extend_Food	21.1711
Var(8)	Email_Address	Extend_Type Extend_Food	21.1711
Var(9)	Email_Address	Extend_Type Extend_Food	13.7318
Var(10)	Email_Address	Extend_Type Extend_Food	21.1711
Var(11)	Email_Address	Extend_Type Extend_Food	21.1711
Var(12)	Email_Address	Extend_Type Extend_Food	21.1711
Var(13)	Email_Address	Extend_Type Extend_Food	21.1711
Var(14)	Email_Address	Extend_Type Extend_Food	21.1711
CSH			0.1888
Var(1)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(2)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(3)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(4)	Email_Address	Extend_Type Extend_Procurement	6.219
Var(5)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(6)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(7)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(8)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(9)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(10)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(11)	Email_Address	Extend_Type Extend_Procurement	10.5942
Var(12)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(13)	Email_Address	Extend_Type Extend_Procurement	21.1711
Var(14)	Email_Address	Extend_Type Extend_Procurement	21.1711
CSH			-0.2044
Var(1)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(2)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(3)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(4)	Email_Address	Extend_Type Extend_Travel	10.4882
Var(5)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(6)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(7)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(8)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(9)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(10)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(11)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(12)	Email_Address	Extend_Type Extend_Travel	14.4228
Var(13)	Email_Address	Extend_Type Extend_Travel	21.1711
Var(14)	Email_Address	Extend_Type Extend_Travel	21.1711
CSH			0.02385
Var(1)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(2)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(3)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(4)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(5)	Email_Address	Extend_Type Extend_Waste	4.3922
Var(6)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(7)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(8)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(9)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(10)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(11)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(12)	Email_Address	Extend_Type Extend_Waste	21.1711
Var(13)	Email_Address	Extend_Type Extend_Waste	8.0491
Var(14)	Email_Address	Extend_Type Extend_Waste	21.1711
CSH			0.00227
Var(1)	Email_Address	Extend_Type Extend_Water	21.1711
Var(2)	Email_Address	Extend_Type Extend_Water	21.1711
Var(3)	Email_Address	Extend_Type Extend_Water	21.1711
Var(4)	Email_Address	Extend_Type Extend_Water	21.1711
Var(5)	Email_Address	Extend_Type Extend_Water	21.1711
Var(6)	Email_Address	Extend_Type Extend_Water	21.1711
Var(7)	Email_Address	Extend_Type Extend_Water	7.6728
Var(8)	Email_Address	Extend_Type Extend_Water	21.1711
Var(9)	Email_Address	Extend_Type Extend_Water	21.1711
Var(10)	Email_Address	Extend_Type Extend_Water	21.1711
Var(11)	Email_Address	Extend_Type Extend_Water	21.1711
Var(12)	Email_Address	Extend_Type Extend_Water	21.1711
Var(13)	Email_Address	Extend_Type Extend_Water	21.1711
Var(14)	Email_Address	Extend_Type Extend_Water	7.9873
CSH			-0.1848

Change in Receptivity 2014-2015

Change from 2014 to 2015 in		Estimates					FDR@ threshold	Accepted?
	Estimate	Standard Error	DF	t Value	Pr > |t|			
Posters	0.05315	0.05645	2299	0.94	0.3465	0.017	No	
Webpage	-0.03134	0.06334	2299	-0.49	0.6208	0.025	No	
Notices	-0.1054	0.06427	2299	-1.64	0.1011	0.013	No	
Talking	-0.1255	0.0617	2299	-2.03	0.042	0.010	No	
Meeting	-0.01381	0.0697	2299	-0.2	0.843	0.050	No	

		Contrasts					FDR@ threshold	Accepted?
Label	Num DF	Den DF	F Value	Pr > F				
Effect by Year	5		2299	1.62	0.1515			No
Strata, Sex and Location as Confounders	15		2299	1.01	0.4449			No

Fit Statistics		Solution for Fixed Effects					FDR@ threshold	Accepted?
-2*ResLogLikelihood	7138.5							

AIC (smaller is better)							FDR@ threshold	Accepted?
	7250.5							

AICC (smaller is better)							FDR@ threshold	Accepted?
	7252.9							

BIC (smaller is better)							FDR@ threshold	Accepted?
	7472.2							

Effect	NAME OF FORMER VARIABLE	NAME OF FORMER VARIABLE	Sex	Location	Strate	Estimate	Standard Error	DF	t Value	Pr > |t|
Recep_Type		Notices_Usel			2299	3.9622	0.1661	2299	23.86	<.0001
Recep_Type		Posters_Usel			2299	4.1211	0.1886	2299	21.85	<.0001
Recep_Type		StaffMeeting_Usel			2299	3.5239	0.1923	2299	18.32	<.0001
Recep_Type		Talking_Collegues_Usel			2299	3.6468	0.1821	2299	20.02	<.0001
Recep_Type		Webpage_Usel			2299	3.3633	0.1859	2299	18.1	<.0001
Year*Recep_Type	Y2014	Notices_Usel			2299	-0.05315	0.05645	2299	-0.94	0.3465
Year*Recep_Type	Y2014	Posters_Usel			2299	0.03134	0.06334	2299	0.49	0.6208
Year*Recep_Type	Y2014	StaffMeeting_Usel			2299	0.1054	0.06427	2299	1.64	0.1011
Year*Recep_Type	Y2014	Talking_Collegues_Usel			2299	0.1255	0.0617	2299	2.03	0.042
Year*Recep_Type	Y2014	Webpage_Usel			2299	0.01381	0.0697	2299	0.2	0.843
Year*Recep_Type	Y2015	Notices_Usel				0	-	-	-	-
Year*Recep_Type	Y2015	Posters_Usel				0	-	-	-	-
Year*Recep_Type	Y2015	StaffMeeting_Usel				0	-	-	-	-
Year*Recep_Type	Y2015	Talking_Collegues_Usel				0	-	-	-	-
Year*Recep_Type	Y2015	Webpage_Usel				0	-	-	-	-
Recep_Type*Sex		Notices_Usel	Female			-0.00121	0.1086	2299	-0.01	0.9911
Recep_Type*Sex		Notices_Usel	Male			0	-	-	-	-
Recep_Type*Sex		Posters_Usel	Female			0.01589	0.1223	2299	0.13	0.8966
Recep_Type*Sex		Posters_Usel	Male			0	-	-	-	-
Recep_Type*Sex		StaffMeeting_Usel	Female			0.1469	0.1238	2299	1.19	0.2357
Recep_Type*Sex		StaffMeeting_Usel	Male			0	-	-	-	-
Recep_Type*Sex		Talking_Collegues_Usel	Female			0.09134	0.1168	2299	0.78	0.4342
Recep_Type*Sex		Talking_Collegues_Usel	Male			0	-	-	-	-
Recep_Type*Sex		Webpage_Usel	Female			0.07507	0.1202	2299	0.62	0.5323
Recep_Type*Sex		Webpage_Usel	Male			0	-	-	-	-
Recep_Type*Location		Notices_Usel		MMH		-0.1099	0.1213	2299	-0.91	0.3647
Recep_Type*Location		Notices_Usel		MSC		0	-	-	-	-
Recep_Type*Location		Posters_Usel		MMH		-0.2414	0.1372	2299	-1.76	0.0786
Recep_Type*Location		Posters_Usel		MSC		0	-	-	-	-
Recep_Type*Location		StaffMeeting_Usel		MMH		0.02391	0.1385	2299	0.17	0.8629
Recep_Type*Location		StaffMeeting_Usel		MSC		0	-	-	-	-
Recep_Type*Location		Talking_Collegues_Usel		MMH		-0.09071	0.132	2299	-0.69	0.4919
Recep_Type*Location		Talking_Collegues_Usel		MSC		0	-	-	-	-
Recep_Type*Location		Webpage_Usel		MMH		-0.1147	0.1344	2299	-0.85	0.3936
Recep_Type*Location		Webpage_Usel		MSC		0	-	-	-	-
Recep_Type*Strate		Notices_Usel			Clinician	-0.1786	0.09107	2299	-1.96	0.05
Recep_Type*Strate		Notices_Usel			NonClinician	0	-	-	-	-
Recep_Type*Strate		Posters_Usel			Clinician	-0.1029	0.1064	2299	-0.97	0.3337
Recep_Type*Strate		Posters_Usel			NonClinician	0	-	-	-	-
Recep_Type*Strate		StaffMeeting_Usel			Clinician	0.01636	0.1085	2299	0.15	0.8801
Recep_Type*Strate		StaffMeeting_Usel			NonClinician	0	-	-	-	-
Recep_Type*Strate		Talking_Collegues_Usel			Clinician	-0.02131	0.1014	2299	-0.21	0.8336
Recep_Type*Strate		Talking_Collegues_Usel			NonClinician	0	-	-	-	-
Recep_Type*Strate		Webpage_Usel			Clinician	-0.2194	0.1048	2299	-2.09	0.0363
Recep_Type*Strate		Webpage_Usel			NonClinician	0	-	-	-	-

Effect	Num DF	Den DF	F Value	Pr > F
Recep_Type	5	2299	756.36	<.0001
Year*Recep_Type	5	2299	1.62	0.1515
Recep_Type*Sex	5	2299	0.5	0.7755
Recep_Type*Location	5	2299	0.92	0.4682
Recep_Type*Strate	5	2299	1.68	0.1352

Covariance Parameter Estimates		Group		Estimate	
Cov Parm	Subject				
Email_Address					0.3676
Var(1)	Email_Address	Recep_TypeNotices_Usel			12.1738
Var(2)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(3)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(4)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(5)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(6)	Email_Address	Recep_TypeNotices_Usel			10.718
Var(7)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(8)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(9)	Email_Address	Recep_TypeNotices_Usel			27.251
Var(10)	Email_Address	Recep_TypeNotices_Usel			27.251
CSH	Email_Address	Recep_TypeNotices_Usel			0.04624
Var(1)	Email_Address	Recep_TypePosters_Usel			27.251
Var(2)	Email_Address	Recep_TypePosters_Usel			19.8008
Var(3)	Email_Address	Recep_TypePosters_Usel			27.251
Var(4)	Email_Address	Recep_TypePosters_Usel			27.251
Var(5)	Email_Address	Recep_TypePosters_Usel			27.251
Var(6)	Email_Address	Recep_TypePosters_Usel			27.251
Var(7)	Email_Address	Recep_TypePosters_Usel			16.0434
Var(8)	Email_Address	Recep_TypePosters_Usel			27.251
Var(9)	Email_Address	Recep_TypePosters_Usel			27.251
Var(10)	Email_Address	Recep_TypePosters_Usel			27.251
CSH	Email_Address	Recep_TypePosters_Usel			0.2493
Var(1)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(2)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(3)	Email_Address	Recep_TypeStaffMeeting_Usel			18.2696
Var(4)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(5)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(6)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(7)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(8)	Email_Address	Recep_TypeStaffMeeting_Usel			18.553
Var(9)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
Var(10)	Email_Address	Recep_TypeStaffMeeting_Usel			27.251
CSH	Email_Address	Recep_TypeStaffMeeting_Usel			0.2682
Var(1)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(2)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(3)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(4)	Email_Address	Recep_TypeTalking_Collegues_Usel			14.9238
Var(5)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(6)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(7)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(8)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
Var(9)	Email_Address	Recep_TypeTalking_Collegues_Usel			16.0166
Var(10)	Email_Address	Recep_TypeTalking_Collegues_Usel			27.251
CSH	Email_Address	Recep_TypeTalking_Collegues_Usel			0.1779
Var(1)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(2)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(3)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(4)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(5)	Email_Address	Recep_TypeWebpage_Usel			19.7296
Var(6)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(7)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(8)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(9)	Email_Address	Recep_TypeWebpage_Usel			27.251
Var(10)	Email_Address	Recep_TypeWebpage_Usel			16.334
CSH	Email_Address	Recep_TypeWebpage_Usel			0.04973

Change in Awareness 2014-2015

Change from 2014 to 2015 in	Estimate	Estimates	Standard Error	DF	t Value	Pr > |t|	FDR p threshold	Accepted?	
Green Good Example	-0.1432		0.04615	1793	-3.1	0.0019	0.013	Yes	Yes
Reduce Pollution	-0.1351		0.05894	1793	-2.29	0.022	0.017	No	
Hospital Save Money	-0.0203		0.07274	1793	-0.28	0.78	0.050	No	
Reduce Chronic Disease	-0.08168		0.04996	1793	-1.63	0.10	0.025	No	
Contrasts									
Label	Num DF	Den DF	F Value	Pr > F				Accepted?	
Effect of year	4		1793	3.52	0.0071			Yes	Yes
Strata, Sex and Location as confounders	12		1793	2.2	0.0099			Yes	Females score higher

Fit Statistics	
-2 Res Log Likelihood	5224.7
AIC (smaller is better)	5298.7
AICC (smaller is better)	5300.1
BIC (smaller is better)	5445.2

Effect	NAME OF FORMER	NAME OF FORMER VARIABLE	Sex	Location	Strate	Estimate	Standard Error	DF	t Value	Pr > |t|
VARIABLE										
Aware_Type		Green_GoodExample				3.9552	0.1488	1793	26.59	<.0001
Aware_Type		Hospital_Save_Money				3.3305	0.1795	1793	19.72	<.0001
Aware_Type		Reduce_ChronicDisease				3.176	0.2206	1793	14.4	<.0001
Aware_Type		Reduce_Pollution				4.2056	0.1541	1793	27.3	<.0001
Year*Aware_Type	Y2014	Green_GoodExample				0.1432	0.04615	1793	3.1	0.0019
Year*Aware_Type	Y2014	Hospital_Save_Money				0.1351	0.05894	1793	2.29	0.022
Year*Aware_Type	Y2014	Reduce_ChronicDisease				0.0203	0.07274	1793	0.28	0.7802
Year*Aware_Type	Y2014	Reduce_Pollution				0.08168	0.04996	1793	1.63	0.1023
Year*Aware_Type	Y2015	Green_GoodExample				0				
Year*Aware_Type	Y2015	Hospital_Save_Money				0				
Year*Aware_Type	Y2015	Reduce_ChronicDisease				0				
Year*Aware_Type	Y2015	Reduce_Pollution				0				
Aware_Type*Sex		Green_GoodExample	Female			0.3045	0.09888	1793	3.08	0.0021
Aware_Type*Sex		Hospital_Save_Money	Female			0				
Aware_Type*Sex		Hospital_Save_Money	Male			0.3163	0.1167	1793	2.71	0.0068
Aware_Type*Sex		Reduce_ChronicDisease	Female			0.3276	0.1408	1793	2.33	0.0201
Aware_Type*Sex		Reduce_ChronicDisease	Male			0				
Aware_Type*Sex		Reduce_Pollution	Female			0.1365	0.1018	1793	1.34	0.18
Aware_Type*Sex		Reduce_Pollution	Male			0				
Aware_Type*Location		Green_GoodExample		MMH		0.01394	0.1114	1793	0.13	0.9004
Aware_Type*Location		Green_GoodExample		MSC		0				
Aware_Type*Location		Hospital_Save_Money		MMH		0.096	0.1315	1793	0.73	0.4655
Aware_Type*Location		Hospital_Save_Money		MSC		0				
Aware_Type*Location		Reduce_ChronicDisease		MMH		-0.1308	0.1593	1793	-0.82	0.4116
Aware_Type*Location		Reduce_ChronicDisease		MSC		0				
Aware_Type*Location		Reduce_Pollution		MMH		-0.1512	0.1146	1793	-1.32	0.1873
Aware_Type*Location		Reduce_Pollution		MSC		0				
Aware_Type*Strate		Green_GoodExample			Clinician	-0.03372	0.07962	1793	-0.42	0.672
Aware_Type*Strate		Green_GoodExample			NonClinician	0				
Aware_Type*Strate		Hospital_Save_Money			Clinician	-0.01412	0.09984	1793	-0.14	0.8875
Aware_Type*Strate		Hospital_Save_Money			NonClinician	0				
Aware_Type*Strate		Reduce_ChronicDisease			Clinician	0.08627	0.1259	1793	0.69	0.4933
Aware_Type*Strate		Reduce_ChronicDisease			NonClinician	0				
Aware_Type*Strate		Reduce_Pollution			Clinician	0.01604	0.08294	1793	0.19	0.8467
Aware_Type*Strate		Reduce_Pollution			NonClinician	0				

Effect	Type 3 Tests of Fixed Effects	Num DF	Den DF	F Value	p Value
Aware_Type		4	1793	1113.22	<.0001
Year*Aware_Type		4	1793	3.52	0.01
Aware_Type*Sex		4	1793	3.94	0.00
Aware_Type*Location		4	1793	2.28	0.06
Aware_Type*Strate		4	1793	0.38	0.83

Covariance Parameter Estimates			
Cov Parm	Subject	Group	Estimate
Email_Address			0.4294
Var(1)	Email_Address	Aware_Type Green_GoodExample	5.7311
Var(2)	Email_Address	Aware_Type Green_GoodExample	26.201
Var(3)	Email_Address	Aware_Type Green_GoodExample	26.201
Var(4)	Email_Address	Aware_Type Green_GoodExample	26.201
Var(5)	Email_Address	Aware_Type Green_GoodExample	5.6444
Var(6)	Email_Address	Aware_Type Green_GoodExample	26.201
Var(7)	Email_Address	Aware_Type Green_GoodExample	26.201
Var(8)	Email_Address	Aware_Type Green_GoodExample	26.201
CSH	Email_Address	Aware_Type Green_GoodExample	-0.3389
Var(1)	Email_Address	Aware_Type Hospital_Save_Money	26.201
Var(2)	Email_Address	Aware_Type Hospital_Save_Money	14.2745
Var(3)	Email_Address	Aware_Type Hospital_Save_Money	26.201
Var(4)	Email_Address	Aware_Type Hospital_Save_Money	26.201
Var(5)	Email_Address	Aware_Type Hospital_Save_Money	26.201
Var(6)	Email_Address	Aware_Type Hospital_Save_Money	12.8805
Var(7)	Email_Address	Aware_Type Hospital_Save_Money	26.201
Var(8)	Email_Address	Aware_Type Hospital_Save_Money	26.201
CSH	Email_Address	Aware_Type Hospital_Save_Money	0.1095
Var(1)	Email_Address	Aware_Type Reduce_ChronicDisease	26.201
Var(2)	Email_Address	Aware_Type Reduce_ChronicDisease	26.201
Var(3)	Email_Address	Aware_Type Reduce_ChronicDisease	27.021
Var(4)	Email_Address	Aware_Type Reduce_ChronicDisease	26.201
Var(5)	Email_Address	Aware_Type Reduce_ChronicDisease	26.201
Var(6)	Email_Address	Aware_Type Reduce_ChronicDisease	26.201
Var(7)	Email_Address	Aware_Type Reduce_ChronicDisease	24.747
Var(8)	Email_Address	Aware_Type Reduce_ChronicDisease	26.201
CSH	Email_Address	Aware_Type Reduce_ChronicDisease	0.3232
Var(1)	Email_Address	Aware_Type Reduce_Pollution	26.201
Var(2)	Email_Address	Aware_Type Reduce_Pollution	26.201
Var(3)	Email_Address	Aware_Type Reduce_Pollution	26.201
Var(4)	Email_Address	Aware_Type Reduce_Pollution	7.1012
Var(5)	Email_Address	Aware_Type Reduce_Pollution	26.201
Var(6)	Email_Address	Aware_Type Reduce_Pollution	26.201
Var(7)	Email_Address	Aware_Type Reduce_Pollution	26.201
Var(8)	Email_Address	Aware_Type Reduce_Pollution	7.304
CSH	Email_Address	Aware_Type Reduce_Pollution	-0.2647

Change from 2014 to 2015 is:	Estimate	Standard Error	DF	t Value	Pr > |t|	FDR p threshold	Accepted?
Seen Posters	0.02791	0.02332	2842	0.86	0.39	0.070	No
Seen Webpage	0.1499	0.07161	2842	2.09	0.036	0.025	No
Seen Notices	0.1141	0.03681	2842	3.1	0.002	0.010	Yes
Manager_Recycler	0.124	0.03329	2842	3.72	0.0002	0.008	Yes
Spoken_Colleague_Green	0.05958	0.02612	2842	2.28	0.023	0.017	No
Discuss_Staff_Meeting_Green	0.1001	0.03406	2842	2.94	0.0033	0.013	Yes
Contrasts							
Label	Num DF	Den DF	F Value	Pr > F			
Effect of year	6	2842	5.93	<.0001	Yes		yes
Strata, Sex and Location as confounders	18	2842	1.02	0.427	No		no

Note on interpretation: Work Context is a special case, as all items bar "Manager_Recycler" (Question 21) are dichotomous. All items were fitted using a linear model nonetheless. A value of "2" for the dichotomous items means "Yes", and a value of "1" means "No". The estimates above can be interpreted directly as the increase in proportion of those who had seen posters, web pages, etc. between 2014 and 2015. However, the estimate for "Manager_Recycler" is the average increase on a Likert-type scale of 1 (Never) to 5 (Always), in the "Solution for Fixed Effects" below, the estimates for the dichotomous items can be interpreted as 1 added to the probability of a "Yes" response in 2014.

As an example, the modelled probability of a "Yes" to "Seen Notices" in 2014 was 35.06%, and the modelled difference between 2015 and 2014 in this probability was 11.41 percentage points (meaning that the modelled probability of a "Yes" to "Seen Notices" in 2015 was 46.46%), and similarly for the other dichotomous items. The modelled score for "Manager_Recycler" was 3.2807 in 2014, and the modelled difference between the 2015 and 2014 score for this same item was 0.124 (so that the modelled average score in 2015 was 3.3147).

For the actual presentation of the results, I suggest converting the dichotomous estimates below to the probability estimates (i.e. subtract 1 from the estimates - except for Manager_Recycler, of course).

Fit Statistics	
-2 Res Log Likelihood	5150.9
AIC (smaller is better)	5302.9
AICC (smaller is better)	5313
BIC (smaller is better)	5621.7

Effect	NAME OF FORMER VARIABLE	NAME OF FORMER VARIABLE	Sex	Location	Strata	Estimate	Standard Error	DF	t Value	Pr > |t|
WC_Type		Discuss_StaffMeeting_Green				1.232	0.09023	2842	13.65	<.0001
WC_Type		Manager_Recycler				3.2807	0.2091	2842	15.74	<.0001
WC_Type		Seen_Notices				1.3505	0.08412	2842	16.05	<.0001
WC_Type		Seen_Posters				1.3868	0.08792	2842	15.89	<.0001
WC_Type		Seen_Webpage				1.2715	0.0786	2842	16.18	<.0001
WC_Type		Spoken_Colleague_Green				1.6672	0.09712	2842	17.17	<.0001
YearWC_Type	Y2014	Discuss_StaffMeeting_Green				-0.02791	0.03332	2842	-0.86	0.388
YearWC_Type	Y2014	Manager_Recycler				-0.1499	0.07161	2842	-2.09	0.0364
YearWC_Type	Y2014	Seen_Notices				-0.1141	0.03681	2842	-3.1	0.002
YearWC_Type	Y2014	Seen_Posters				-0.124	0.03329	2842	-3.72	0.0002
YearWC_Type	Y2014	Seen_Webpage				-0.05958	0.02612	2842	-2.28	0.0226
YearWC_Type	Y2015	Discuss_StaffMeeting_Green				0	0.03406	2842	-2.84	0.0033
YearWC_Type	Y2015	Manager_Recycler				0	0	0	0	0
YearWC_Type	Y2015	Seen_Notices				0	0	0	0	0
YearWC_Type	Y2015	Seen_Posters				0	0	0	0	0
YearWC_Type	Y2015	Seen_Webpage				0	0	0	0	0
WC_Type*Sex		Spoken_Colleague_Green	Female			0.01545	0.05759	2842	0.27	0.7885
WC_Type*Sex		Discuss_StaffMeeting_Green	Male			0	0	0	0	0
WC_Type*Sex		Manager_Recycler	Female			0.1291	0.1319	2842	0.98	0.3278
WC_Type*Sex		Seen_Notices	Male			0	0	0	0	0
WC_Type*Sex		Seen_Posters	Female			0.03131	0.05312	2842	0.59	0.5556
WC_Type*Sex		Seen_Webpage	Male			0	0	0	0	0
WC_Type*Sex		Seen_Posters	Female			-0.07878	0.05564	2842	-1.42	0.1569
WC_Type*Sex		Seen_Webpage	Female			-0.03618	0.05032	2842	-0.72	0.4722
WC_Type*Sex		Seen_Webpage	Male			0	0	0	0	0
WC_Type*Sex		Spoken_Colleague_Green	Female			-0.0231	0.06165	2842	-0.37	0.7079
WC_Type*Sex		Spoken_Colleague_Green	Male			0	0	0	0	0
WC_Type*Location		Discuss_StaffMeeting_Green		MMH		0	0.06456	2842	1.58	0.114
WC_Type*Location		Discuss_StaffMeeting_Green		NSC		0	0	0	0	0
WC_Type*Location		Manager_Recycler		MMH		0.1057	0.1465	2842	0.72	0.4705
WC_Type*Location		Manager_Recycler		NSC		0	0	0	0	0
WC_Type*Location		Seen_Notices		MMH		0.04943	0.05913	2842	0.84	0.4033
WC_Type*Location		Seen_Notices		NSC		0	0	0	0	0
WC_Type*Location		Seen_Posters		MMH		0.1177	0.06238	2842	1.89	0.0593
WC_Type*Location		Seen_Posters		NSC		0	0	0	0	0
WC_Type*Location		Seen_Webpage		MMH		-0.0147	0.05956	2842	-0.26	0.7949
WC_Type*Location		Seen_Webpage		NSC		0	0	0	0	0
WC_Type*Location		Spoken_Colleague_Green		MMH		0.04385	0.06926	2842	0.63	0.5267
WC_Type*Location		Spoken_Colleague_Green		NSC		0	0	0	0	0
WC_Type*Strata		Discuss_StaffMeeting_Green		Clinician		0.05544	0.05153	2842	1.08	0.2821
WC_Type*Strata		Discuss_StaffMeeting_Green		NonClinician		0	0	0	0	0
WC_Type*Strata		Manager_Recycler		Clinician		-0.02792	0.1259	2842	-0.22	0.8245
WC_Type*Strata		Manager_Recycler		NonClinician		0	0	0	0	0
WC_Type*Strata		Seen_Notices		Clinician		0.05727	0.0464	2842	1.23	0.2172
WC_Type*Strata		Seen_Notices		NonClinician		0	0	0	0	0
WC_Type*Strata		Seen_Posters		Clinician		0.04729	0.04941	2842	0.96	0.3386
WC_Type*Strata		Seen_Posters		NonClinician		0	0	0	0	0
WC_Type*Strata		Seen_Webpage		Clinician		-0.04522	0.04376	2842	-1.03	0.3016
WC_Type*Strata		Seen_Webpage		NonClinician		0	0	0	0	0
WC_Type*Strata		Spoken_Colleague_Green		Clinician		-0.06621	0.05551	2842	-1.11	0.911
WC_Type*Strata		Spoken_Colleague_Green		NonClinician		0	0	0	0	0

Type 3 Tests of Fixed Effects		Num DF	Den DF	F Value	Pr > F
Effect					
WC_Type		6	2842	565.07	<.0001
YearWC_Type		6	2842	5.93	<.0001
WC_Type*Sex		6	2842	0.94	0.4637
WC_Type*Location		6	2842	1.17	0.3188
WC_Type*Strata		6	2842	1.01	0.4172
Dimensions		Num DF	Den DF	F Value	Pr > F
Covariance Parameters		79			
Columns in X		54			
Number of Observations		4656			
Number of Observations Read		3248			
Number of Observations Used		1408			

Covariance Parameter Estimates		Subject	Group	Estimate
Cov Parm	Email_Address			0.0011
Var(1)	Email_Address	WC_Type Discuss_StaffMeeting_Green		4.9518
Var(2)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(3)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(4)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(5)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(6)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(7)	Email_Address	WC_Type Discuss_StaffMeeting_Green		4.9366
Var(8)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(9)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(10)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(11)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
Var(12)	Email_Address	WC_Type Discuss_StaffMeeting_Green		11.1982
CSH	Email_Address	WC_Type Discuss_StaffMeeting_Green		0.2605
Var(1)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(2)	Email_Address	WC_Type Manager_Recycler		34.4715
Var(3)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(4)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(5)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(6)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(7)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(8)	Email_Address	WC_Type Manager_Recycler		29.2979
Var(9)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(10)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(11)	Email_Address	WC_Type Manager_Recycler		11.1982
Var(12)	Email_Address	WC_Type Manager_Recycler		11.1982
CSH	Email_Address	WC_Type Manager_Recycler		0.2612
Var(1)	Email_Address	WC_Type Seen_Notices		11.1982
Var(2)	Email_Address	WC_Type Seen_Notices		11.1982
Var(3)	Email_Address	WC_Type Seen_Notices		4.2342
Var(4)	Email_Address	WC_Type Seen_Notices		11.1982
Var(5)	Email_Address	WC_Type Seen_Notices		11.1982
Var(6)	Email_Address	WC_Type Seen_Notices		11.1982
Var(7)	Email_Address	WC_Type Seen_Notices		11.1982
Var(8)	Email_Address	WC_Type Seen_Notices		11.1982
Var(9)	Email_Address	WC_Type Seen_Notices		4.7929
Var(10)	Email_Address	WC_Type Seen_Notices		11.1982
Var(11)	Email_Address	WC_Type Seen_Notices		11.1982
Var(12)	Email_Address	WC_Type Seen_Notices		11.1982
CSH	Email_Address	WC_Type Seen_Notices		-0.1505
Var(1)	Email_Address	WC_Type Seen_Posters		11.1982
Var(2)	Email_Address	WC_Type Seen_Posters		11.1982
Var(3)	Email_Address	WC_Type Seen_Posters		11.1982
Var(4)	Email_Address	WC_Type Seen_Posters		4.2093
Var(5)	Email_Address	WC_Type Seen_Posters		11.1982
Var(6)	Email_Address	WC_Type Seen_Posters		11.1982
Var(7)	Email_Address	WC_Type Seen_Posters		11.1982
Var(8)	Email_Address	WC_Type Seen_Posters		11.1982
Var(9)	Email_Address	WC_Type Seen_Posters		11.1982
Var(10)	Email_Address	WC_Type Seen_Posters		4.8876
Var(11)	Email_Address	WC_Type Seen_Posters		11.1982
Var(12)	Email_Address	WC_Type Seen_Posters		11.1982
CSH	Email_Address	WC_Type Seen_Posters		0.1597
Var(1)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(2)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(3)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(4)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(5)	Email_Address	WC_Type Seen_Webpage		3.0032
Var(6)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(7)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(8)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(9)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(10)	Email_Address	WC_Type Seen_Webpage		11.1982
Var(11)	Email_Address	WC_Type Seen_Webpage		3.0032
Var(12)	Email_Address	WC_Type Seen_Webpage		11.1982
CSH	Email_Address	WC_Type Seen_Webpage		0.2656
Var(1)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(2)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(3)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(4)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(5)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(6)	Email_Address	WC_Type Spoken_Colleague_Green		5.7628
Var(7)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(8)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(9)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(10)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(11)	Email_Address	WC_Type Spoken_Colleague_Green		11.1982
Var(12)	Email_Address	WC_Type Spoken_Colleague_Green		5.4098
CSH	Email_Address	WC_Type Spoken_Colleague_Green		0.338

Appendix K: Details of the Recycling Waste Streams

Paper/fine card material includes office paper, newspaper, magazines, and boxes made from fine cardboard. This should exclude waxed paper, contaminated material, envelopes with a window, confidential material, and brown heavy-duty cardboard. Paper/fine card should be placed into the green paper recycling bin provided. Orderlies remove the recycling bins from each area and replace full bins with empty bins. The full bins are then taken down to the waste dock. This material is transported and disposed of free of charge and taken to a nearby recycling depot.

Each recycle bin incurs a \$2 per bin per week rental charge. Bins come in two sizes, 120L and 240L. The 240L bins are estimated to weigh approximately 30kg, equating to \$66 per tonne versus \$160 per tonne of GW. Paper is weighed and weights are provided to enable tracking of results of all recycling programmes. Just under half of paper/fine card is recycled in Auckland; most of this material is recycled off shore.

Cardboard as a commodity is deemed more valuable and is preferably flattened at the point of segregation, transported by orderlies to a large cage situated in the waste dock and taken free of charge to the recycling depot where it is weighed. A rebate of \$20 per tonne⁴ is paid as an incentive since the material is unballed, collected as a loose material. Interestingly, if the cardboard was bailed on site, the rebate would be somewhere in the region of \$150-250 per tonne. The bulk of this cardboard is recycled in Auckland.

Comingle recycling includes glass, aluminium and plastic; all items are required to be clean and free from contamination (food or fluid) and placed into the blue bin provided. Glass of any colour is accepted aside from tempered glass. Tempered and ceramic glass is not recyclable in New Zealand, and therefore should be kept out of the blue recycle bin. Aluminium is a very valuable commodity and is part of this comingled waste stream. Fifty per cent of aluminium is recycled in New Zealand, the remainder off shore. Plastic is more complicated as there is such a wide range, each with different commercial values. Plastics that are deemed recyclable will have a classification number assigned. All numbers from one through to seven are recycled in many parts of

⁴As of November 2016

New Zealand, yet differences as a result of regional and waste supplier variables make this a complex and less than straightforward process.

Reclaim, our current contracted provider of recycling services, recommends capturing plastics number 1, 2, and, 4 since these have a higher commercial value and are more easily recycled. This leaves numbers 3, 5, 6, and 7 which are all deemed less valuable and not so easy to recycle, or sell on, to be recycled. However, for many people who value recycling and who try to recycle as effectively as possible, they simply do not throw any material away that displays a recycling classification number. In addition, the information available to customers is tailored towards a wider availability of services rather than to the customers who can only access a limited set of recycling services. Therefore, what is perceived as being recyclable does not always reflect what is recyclable. Further complications arise when hospital contracts come up for renewal and suppliers might change. Market supply and demand also fluctuates as a result of global economic forces meaning the commodity market value also dictates the level of rebate and service availability.

Comingle recycling is a significant component of the recycling waste stream since it contains all three materials, as explained. The blue bins are charged in the same way as the green bins, with a liner exchange when bins are emptied included as part of the service agreement. Once again, it is cheaper to dispose of than GW by comparison, but the internal collection and transportation of the recycling bins add to the non-clinical support services resource allocation. Comingle waste is weighed as a total volume then further segregated into the individual components, most of which is ultimately sold to off shore markets; to be recycled.

Soft plastic material was only captured from the inwards goods department prior to programme implementation. Since introducing the theatre recycling programme, the volume of this material being diverted from landfill has markedly increased. Soft plastic is pliable and surrounds many materials and supplies used within healthcare. Many tonnes of soft plastic were previously sent to landfill and recycling this material is beneficial from an environmental and cost perspective. Each tonne of soft plastic is awarded a \$50 rebate⁵, yet it does take a large volume of soft plastic to amount a tonne

⁵As of November 2016

since it is a very lightweight material. Ninety-eight per cent of the soft plastic is dispatched offshore to be recycled.

Commercial polystyrene was introduced as a recycling service as a result of the organisation wide recycling programme. Only large sized polystyrene can be recycled in New Zealand, collected in large hessian bags (poly bags), and held on frames in the waste dock. The material is taken to a nearby recycling depot where it is extruded (heated and compressed) and packaged, dispatched to China to be recycled. The cost per poly bag is \$6 representing an increased cost to the organisation.

Appendix L: Inclusion and Exclusion Criteria Used for Patient Activity Data

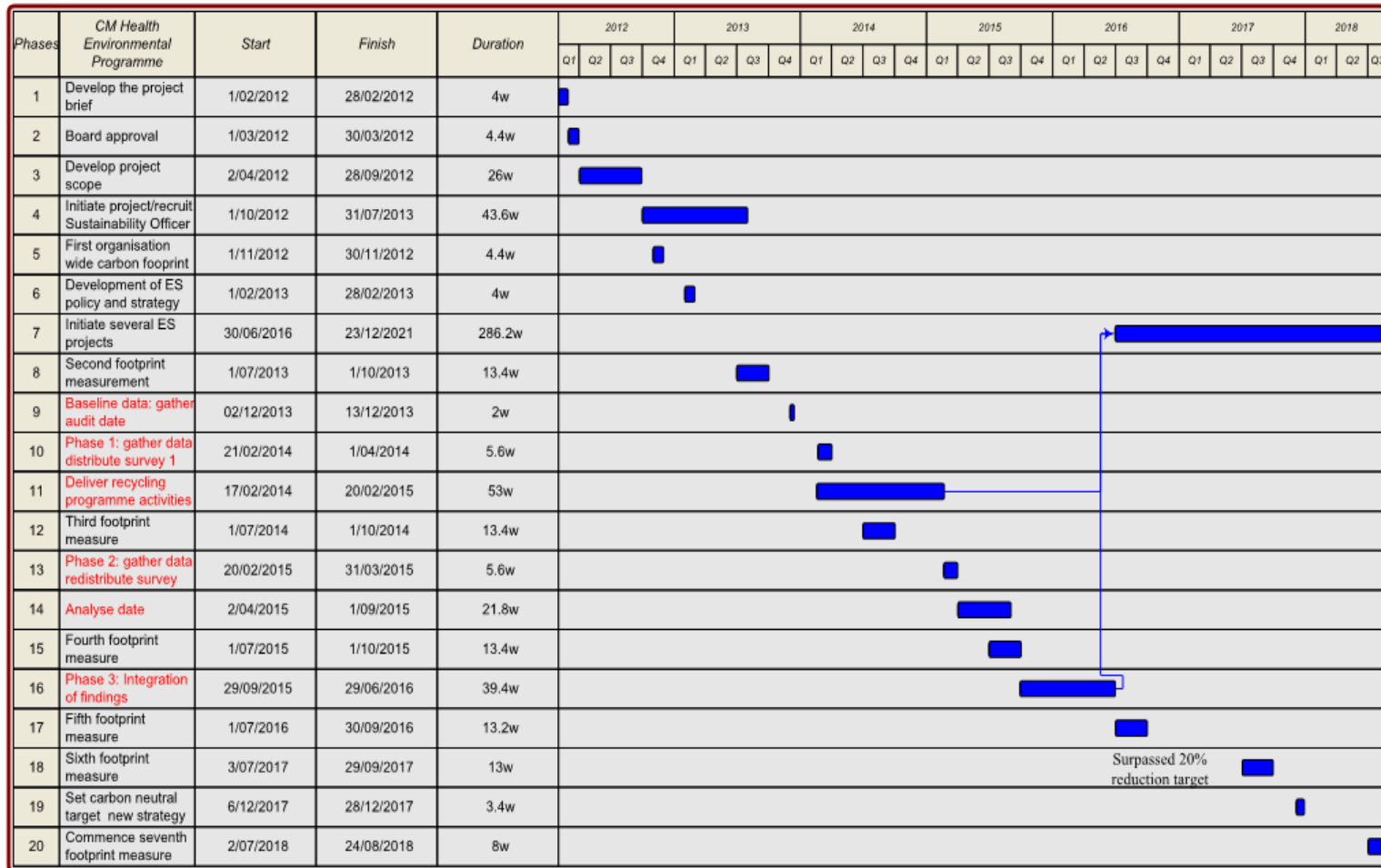
Inpatient Selection Criteria:

- 1) Count all day stays and inpatients discharged from Middlemore and Manukau Super Clinic. NB. Inpatient admissions include patients staying in ED over 3 hours who were not actually transferred into an inpatient ward.
- 2) Included outsource patients i.e. patients from Ascot hospital, as these use energy in the same way as funded patients.
- 3) Included AWOL (MH patients on leave) and BCS (deceased patients but will use their organs).
- 4) Excluded community units (ARHOP community: 'FRNGRC','PUKGRC','SRU-A', Mental Health community: 'AFFM', 'AFFP', 'AFFT', 'PSA', 'PWAYKR', 'TOR', 'TUPRESP', 'TWTH' and Women Health community: 'BOTM', 'BOTNRY', 'PAPM', 'PAPNRY', 'PUKM', 'PUKNRY') that are not part of the hospital.

Outpatient Selection Criteria:

- 1) Outpatient clinic appointments that patients attended at Middlemore and Manukau Super Clinic.
- 2) Excludes cancelled appointments and appointments where patient did not attend (DNAs).
- 3) Excludes telephone consultations.
- 4) Excludes virtual clinics and chart reviews (identified by session purpose description).

Appendix M: Gantt Chart ES Programme and Research 2018





Waste

- Segregation and identification
- Yellow bag reduction (↓ costs)
- Number of recycling bins (4Green/2 Blue)
 - *Equals roughly 8 -10 tonnes per year diverted from landfill (↓ costs)*



8 of these trucks



Secure document destruction

- ↓ costs by going from weekly to monthly
- \$45 per month of savings
- If all services followed suit annual savings would be in the region of \$30,000

Reduce-Reuse-Recycle

Reusable versus single use

- Stainless steel instead of single use plastic
- Recycling even more



- Reusable kitchenware

- Keep cups



- Green team/Super users

Don't forget

- Check out the ES WebPages
- Register for a free composting course
22 May at Ko Awatea (TBC)
- Register for the [e-Update](#)
- PT Expo and Car pooling event in
May/June

Debbie.wilson@middlesmore.co.nz