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BACK PAIN EPISODES OF CARE IN FAMILY PRACTICE: ANALYSIS USING ELECTRONIC MEDICAL RECORD DATA

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BACK PAIN EPISODES OF CARE IN FAMILY PRACTICE: ANALYSIS USING ELECTRONIC MEDICAL RECORD DATA

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ABSTRACT

A large majority of the Canadian population will suffer from back pain in their lifetime. Back pain is one of the most common reasons patients visit their family physician.

The objective of this research is to characterize an episode of back pain care in the context of Canadian family practice and to explore the determinants of episode of care characteristics. Back pain episodes of care and patient-level and episode-level variables were extracted from a database of electronic medical records.

The majority of back pain episodes of care in family practice were found to encompass a single physician visit. Individuals seeking care for other musculoskeletal and/or psychosocial conditions during the episode of back pain care had greater health care utilization during the episode.

These findings have family physician workload implications and will aid policy-makers in the distribution of resources for this prominent health condition in primary care.

KEYWORDS: Back Pain, Family Practice, Episode of Care, Health Care Utilization

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TABLE OF CONTENTS

CERTIFICATE OF EXAMINATION ii

ABSTRACT iii

ACKNOWLEDGEMENTS iv

TABLE OF CONTENTS v

LIST OF TABLES viii

LIST OF FIGURES ix

LIST OF APPENDICES x

LIST OF ABBREVIATIONS xi

CHAPTER ONE – INTRODUCTION
1.1 A Brief Introduction to the Episode of Care Concept 1
1.2 Back Pain: Prevalence and Costs 1
1.3 The Course of Back Pain 3
1.4 Guidelines for Management of Back Pain Care 5

CHAPTER TWO – LITERATURE REVIEW
2.1 Prevalence of Care-Seeking for Back Pain 8
2.2 Determinants of Care-Seeking for Back Pain 8
2.3 Determinants of Medication Prescription for Back Pain 10
2.4 Determinants of Investigations for Back Pain 11
2.5 Determinants of Referrals for Back Pain 12
2.6 Comorbidity and Back Pain Health Care Utilization 13
2.7 The Concept of an Episode of Care 15
2.8 Back Pain Episodes of Care 18
2.8.1 Episodes of Back Pain Care and Back Pain Recurrence 18
2.8.2 Episodes of Back Pain Care and the RAND Experiment 19
2.8.3 Episodes of Back Pain Care and Utilization Duration 21
2.8.4 A Unified Back Pain Episode of Care Definition 22
2.9 Rationale for Thesis Research 23

CHAPTER THREE – METHODS
3.1 Objectives 26
3.2 Thesis Framework 29
3.3 Data Source: The DELPHI Project 31
3.4 The International Classification of Primary Care (ICPC) 32
3.5 Episodes of Back Pain Care Defined Using ICPC Data 33
3.6 Study Population 39

3.7 Hierarchical Structure of the Data 40
3.8 Definition and Creation of Outcome Variables 41
3.8.1 Number of Visits 41
3.8.2 Episode Length 41
3.8.3 Medication 42
3.8.4 Investigation 42
3.8.5 Referral 44
3.9 Definition and Creation of Independent Variables 46
3.9.1 Patient-Level Independent Variables 46
3.9.2 Episode-Level Independent Variables 46
3.9.2a Severity 46
3.9.2b History of Back Pain Visits 47
3.9.2c Comorbidity 47
3.9.2d Care-Seeking 50
3.9.2e Prior Yearly Care-Seeking Intensity 51
3.10 Data Analysis Objective One: Back Pain Episode of Care Characterization.. 54
3.11 Data Analysis Objective Two: Determinants of Episodes of Back Pain Care 54
3.11.1 Missing Data 54
3.11.2 Collinearity 55
3.11.3 Influential Points 55
3.11.4 Interaction 55
3.11.5 Bivariate Analyses 55
3.11.6 Multivariable Analyses 56
3.11.6a Zero-Truncated Negative Binomial Model 56
3.11.6b Random Effects Logistic Regression 57
3.11.6c Logistic Regression 57
3.12 'Time-Window' Sensitivity Analysis 58

CHAPTER FOUR – RESULTS
4.1 Description of Sample 59
4.2 Objective One: Characterization of Episodes of Back Pain Care 64
4.3 Objective Two: Determinants of Number of Physician Visits 68
4.4 Objective Two: Determinants of Episode Length 72
4.5 Objective Two: Determinants of Medication 76
4.6 Objective Two: Determinants of Investigation 80
4.7 Objective Two: Determinants of Referral 84
4.8 Overview of Results from Multivariable Analyses 85
4.9 'Time-Window' Sensitivity Analysis 85

CHAPTER FIVE – DISCUSSION AND CONCLUSIONS
5.1 Strengths of Research 90
5.2 Objective One: Characterization of Back Pain Episodes of Care 91
5.2.1 Episode of Care Duration 91
5.2.2 Medication 92
5.2.3 Investigation 93
5.2.4 Referral 94
5.3 Objective Two: Determinants of Back Pain Episodes of Care 96

5.3.1 Comorbidity and Health Care Utilization..... 96
5.3.2 Summary of Other Determinants of Health Care Utilization..... 98
5.4 Generalizability of Results..... 101
5.4.1 Comparison of Episodes Included and Excluded..... 101
5.4.2 Comparison of DELPHI Population and Canadian Population..... 102
5.5 Policy Implications..... 102
5.6 Limitations of Research..... 104
5.7 Future Research..... 105
5.8 Conclusion..... 106

BIBLIOGRAPHY..... 107

APPENDICES..... 113

CURRICULUM VITAE..... 130

LIST OF TABLES

Chapter	Table	Description	Page
3	1	Summary of Outcome Variables	45
3	2	Summary of Independent Variables	52
3	3	Outcome Variable Data Distribution and Analysis Solution Overview	53
4	4	Description of Episode of Care Sample	61
4	5	Episode of Care Characteristics	66
4	6	Bivariate Analyses of Number of Visits	70
4	7	Multivariable Zero-Truncated Negative Binomial Analysis of Number of Visits	71
4	8	Bivariate Analyses of Episode Length	74
4	9	Multivariable Zero-Truncated Negative Binomial Analysis of Episode Length	75
4	10	Bivariate Analyses of Medication	78
4	11	Multivariable Random Effects Logistic Analysis of Medication	79
4	12	Bivariate Analyses of Investigation	82
4	13	Multivariable Logistic Analysis of Investigation	83
4	14	Bivariate Analyses of Referral	87
4	15	Multivariable Logistic Analysis of Referral	88
4	16	Comparison of Regression Results from Number of Visits, Episode Length, Medication, Investigation, and Referral Outcomes	89

LIST OF FIGURES

Chapter	Figure	Description	Page
3	1	Research Framework: Determinants of Care Received During Back Pain Episode of Care	30
3	2	Complete Episodes of Care	36
3	3	Incomplete Episodes of Care	37
3	4	Flow Chart of Episode of Care Inclusion	38
3	5	Hierarchical Structure of Data	40
3	6	90-day Lag Period for Investigations and Referrals	43
3	7	Period of Comorbidity	50

LIST OF APPENDICES

Appendix	Description	Page
A	Extended Investigation Definition	113
B	Extended Referral Definition	115
C	List of Back-Related Terms	117
D	List of Chronic ICPC Diagnostic Codes	118
E	List of Musculoskeletal ICPC Diagnostic Codes	120
F	List of Psychosocial ICPC Diagnostic Codes	122
G	Comparison of Included and Excluded Episodes of Care	125
H	Comparison of ICPC DELPHI Population and 2006 Canadian Census Population	126
I	'Time-Window' Sensitivity Analysis of Number of Visits	128
J	'Time-Window' Sensitivity Analysis of Investigation	129

LIST OF ABBREVIATIONS

Abbreviation	Meaning
DELPHI	Deliver Primary Health Care Information
EMR	Electronic Medical Record
ICPC	International Classification of Primary Care
CT Scan	Computed Tomography Scan
MRI	Magnetic Resonance Imaging
BMD Scan	Bone Mineral Density Scan
SLR Test	Straight Leg Raise Test
OR	Odds Ratio
IRR	Incidence Rate Ratio
SD	Standard Deviation

CHAPTER ONE - INTRODUCTION

This chapter will introduce the concept of an episode of care. The introductory chapter will also cover the epidemiology of back pain, its costs and course. As well, the current guidelines from family medicine and general internal medicine will be presented, as background to the focus of this thesis, the utilization of back pain care in family practice.

1.1 A Brief Introduction to the Episode of Care Concept

As the thesis title states, the concept of an episode of care will be utilized in this research. This is an epidemiologic concept of health care utilization and physician management of a condition. An episode of care is a single or series of temporally continuous physician visits for a specific health condition [1]. A more extensive exploration of this concept is included in chapter two.

1.2 Back Pain: Prevalence and Cost

Back pain is one of the most common health conditions affecting the Canadian population and the rest of the developed world. The 1995 Saskatchewan Health and Back Pain Survey found that the point prevalence of back pain in Saskatchewan was 28.7%, while the lifetime prevalence of back pain was 84% [2]. A cross-Canada telephone survey conducted for the Canadian Chiropractic Association found that 64% of the population had experienced back pain in the past year and 71% had suffered from back pain in the prior two years [3]. In the 2000 Canadian Community Health Survey, a household survey of the national population, 18.6% of participants reported having chronic back problems

(lasting 6 months or longer) at the time of the survey [4]. A literature review of international studies of back pain prevalence between 1981 and 1998 found that the point prevalence of back pain from the highest quality research (excluding the Saskatchewan study presented above) was between 13.7% and 19%, while the one-year period prevalence was between 39% and 44.9% [5].

Back pain is a significant burden on the health care system and is especially demanding in family practice or general practice. Back pain and back complaints are the second most common reason patients visit their family physician [6, 7]. The 1990 United States National Ambulatory Medical Care Survey found that 2.8% of all physician visits among adults were primarily for back pain; and when secondary and tertiary reasons for physician visits were included, 4.5% of all physician visits were back pain-related [6]. An investigation of physician claims data, using ICD-9 codes, found that 3.5 million physician visits for back pain had been made across Canada between April 1998 and March 1999 [8]. Approximately 66.3 people visited a physician for back pain per 1,000 in the population [8]. In an analysis that stratified physician visits for back pain by province, Ontario had the lowest rate of visit (60.5 residents seeking back pain care per 1000 residents), while Nova Scotia had the highest rate (89.2 patients visiting per 1,000 in the population) [8].

Back pain generates a huge financial burden on the health care system and also creates great financial strain for sufferers. In Canada in 1998, $16.3 billion were spent on musculoskeletal disorders [9]. These disorders, back pain included, had the second highest proportion of total expenditures (behind spending for cardiovascular disease). The indirect costs of musculoskeletal disorders ($13.7 billion), from decreased productivity as a result of short-term and long-term disability, was roughly five times larger than the

direct costs of musculoskeletal disorders ($2.6 billion) from treatment expenditure including physician services and drugs [9]. A systematic review of the costs of back pain found that direct societal yearly costs of back pain care in the United States ranged from $12 billion to $14 billion in 1996 [10]. The indirect costs of back pain, including the costs of occupational and lifestyle changes as a result of the pain, ranged from $7 billion to $28 billion per year between 1996 and 2004 [10]. Carey et al. (1995) found that an episode of low back pain in a North Carolina primary practice cost an average of $509 [11]. Of individuals experiencing recent back pain, 15% reported that they took time off work and 20% of that cohort were absent from work a period of one year or greater [3].

The personal burden of back pain extends beyond financial costs. Individuals suffering from back pain often experience decreased quality of life, with 56% of back pain sufferers having limited physical activity, 40% reporting trouble concentrating on tasks as a result of back pain, and 33% reporting less time spent with family and friends [3]. Overall, back pain is a frequent problem in the Canadian health care system and a personal hardship for the vast majority of Canadians at some point in their lives.

1.3 The Course of Back Pain

Back pain has a highly variable course and outcome for people with similar injuries or similar symptoms at onset. Back pain has been categorized in many different ways in the literature. A commonly used categorization was proposed by Von Korff (1994) who described four types: transient back pain, recurrent back pain, chronic back pain, and acute back pain [12].

(a)Transient back pain is a back pain episode that lasts 90 sequential days or less and then does not reoccur over a one-year period.

(b) Recurrent back pain is defined as multiple episodes of pain in a one-year period with pain present in less than half the days in that period.

(c) Chronic back pain is one or multiple episodes of pain in a one-year period in which pain is present on more than half the days in the period.

(d) Acute back pain is back pain that is not chronic or recurrent and is characterized with an abrupt beginning.

Since withholding medical treatment from individuals suffering from back pain is unethical, the natural history and clinical course of the health condition are intertwined and difficult to isolate [12]. A review of the epidemiology of back pain found that improvement initially occurs rapidly in the 3 months following the initiation of pain with a slower rate of improvement thereafter [13]. Studies have documented that 7 weeks (from the initial physician visit) was the median recovery period [14]. Van de Hoogen et al. (1998) found that 70% of patients still had back pain 4 weeks after the initial physician visit, 48% at eight weeks, 35% at 12 weeks and 10% at 12 months [14]. Von Korff and Saunders (1996) conducted a review of studies reporting outcome data for patients visiting family physicians [15]. They found that within a month after the first back pain primary care physician visit most patients showed improvement in pain and disability. But, at one month follow-up 66-75% of patients had at least mild pain and functional limitations, while moderate and severe pain and limitation was experienced by 33% and 25% of patients respectively. The authors also reported long term outcomes that were measured at least 3 months after the initial physician visit for back pain. In the long term, 33% of patients experienced at least moderate pain, 15% experienced severe pain, and 25% experienced activity limitations [15]. A prospective, 5-year study of patients who visited a general practitioner for back pain found that 45% of patients reported pain and disability

1 year following the initial physician visit and 52% of patients reported pain and disability at 5 years [16]. Recurrence of back pain is common and van den Hoogen et al. (1998) found that 75% of patients who recovered from back pain within a 1-year study period also had a relapse of pain within that year [14]. In summary, back pain does improve relatively quickly at the onset of complaints, but improvements slow indefinitely, and those who fully recover are prone to reoccurrences of pain.

1.4 Guidelines for Management of Back Pain Care

Management of back pain in family practice must take into consideration the natural and clinical progression of the condition. What makes back pain care in the primary care setting difficult is that physician intervention will not have an effect on the disability or pain outcome in the majority of cases [17]. It has been estimated that 80% of patients with low back pain will improve without any physician intervention, while an additional group of back pain patients will develop chronic pain regardless of the interventions provided [17]. As a result, only a minority of patients who seek care from physicians will be better off compared to the self-management of the condition.

Of individuals with back pain, 95% have uncomplicated or mechanical back pain, with only 1 out of 150 patients with a malignant cause of back pain and only 2 out of 100 patients with radiculopathy [17]. In primary care, 85% of patients receive a non-specific back pain diagnosis, while herniated disc and spinal stenosis make up a small percentage of diagnoses for back pain [17]. The National Ambulatory Medical Care Survey found that among all patients presenting to family physicians with back pain, 75% were diagnosed with non-specific back pain and only 10% were diagnosed with degenerative disc diseases, 3% with a herniated disc, and 2% with spinal stenosis [6].

To assist family physicians in managing back pain, guidelines have been developed. These include guidelines for the appropriate use of diagnostic investigations, utilization of medications, and referrals [18-23]. The current guidelines state that a thorough history should be taken to determine the risks for back pain including occupational risks [18] and psychosocial risks [21]. A detailed physical examination should be undertaken to assess the severity of back pain and to detect any abnormalities [24]. Conservative therapy and management of back pain at treatment onset is a unanimous recommendation [18-23]. Prescription of medications to ease the symptoms of back pain (pain medications, muscle relaxants, antidepressants, and sedatives) is appropriate as of the first physician visit for back pain [19, 20]. Physicians should encourage back pain patients to remain active and participate in rehabilitation and strengthening exercises/stretches from the onset of pain [24].

Guidelines suggest that diagnostic imaging be reserved for complicated cases of back pain as physical abnormalities of the spine are often found in patients with and without back symptoms [21, 23]. X-rays, CT scans and MRIs should be used only if the back pain patient has a 'red flag' or if conservative therapy has not led to pain improvement after 4 to 6 weeks. 'Red flags' include patient age less than 20 years or greater than 50 years, fever, anaemia, previous history or presence of cancer, history of trauma, pain at rest, weight loss, diabetes, immunosuppression, drug or alcohol abuse, steroid use, broad-spectrum neurological symptoms, chest pain, or structural abnormality of the spine [18-20, 23].

Referral to a back pain specialist (i.e. neurologist) should take place if back pain has not improved in the 4 to 6 week period following the initial physician visit [21].

Physical therapy should also be suggested to patients not responding to conservative management of back pain [21].

As is the case with most health conditions, the clinical practice guidelines for back pain are constantly being updated as new research reveals more effective management and treatment. For example, archived guidelines suggested bed rest, traction, and facet joint injections for the treatment of back pain, which have since been dismissed [25]. With this in mind, the aforementioned back pain management recommendations and subsequent method design and result interpretation are relevant until clinical practice guidelines for back pain are revised further.

CHAPTER TWO – LITERATURE REVIEW

This literature review was conducted to identify gaps in the literature on the topic of back pain health care utilization and to determine the possible contributions a study using electronic medical record (EMR) data could make to the existing literature. This chapter will orient the reader to the literature on the topic and its limitations.

2.1 Prevalence of Care-Seeking for Back Pain

The proportion of individuals with back pain who seek care for this condition varied depending on the definition of back pain and the definition of care-seeking behaviour. In a review of the epidemiology of back pain conducted by Kent et al. (2005), the proportion of people with back pain who sought care for the condition ranged from 28.6% to 61% [13]. Cote et al. (2001) found that only 14.1% of individuals with back pain sought care from a general practitioner in a four week period [22]. A study from North Carolina found that 24% of adults in 1991 had sought care from a physician in their most recent episode of back pain and 82% of individuals had sought care for back pain during their lifetime [26].

2.2 Determinants of Care-Seeking for Back Pain

What determines why some individuals seek medical care for back pain while others rely on self-management of the condition? Care-seeking trends for back pain have been investigated for specific groups of individuals. A study among scaffolders from the Netherlands found that seeking care from a general practitioner for back pain was significantly associated with back pain sickness absence from work, but it was not

associated with age, education, psychosocial work conditions, general comorbidity, or musculoskeletal comorbidity [27]. A similar study (using questionnaires) was conducted among individuals working in nursing homes in the Netherlands [28]. Those who sought care from general practitioners for back pain were more likely to have a body mass index greater than 30, work the night shift, have chronic or severe pain, have high perceived pain disability, and have sciatica, when compared to those who did not seek back pain care. A study which investigated individuals working in physical jobs in the Netherlands found that among the demographic, physical, emotional, family, work and musculoskeletal comorbidity characteristics evaluated, only high physical workload and lower social support from supervisory staff were associated with seeking care for back pain [29]. Data in these studies were obtained by retrospective self-report, which could lead to recall bias. Moreover, specific populations were included in these studies which likely limited the generalizability of the results.

General population studies of the determinants of back pain care-seeking have been conducted. Carey et al. (1996) conducted a population-based study of a random sample of North Carolina adults [26]. The authors found that care-seeking for back pain (from a medical doctor or chiropractor) was associated with non-white race, sciatica, work-related back pain, and fewer prior episodes of back pain. While a strength of this study was the broader generalizability of the findings, a limitation was the selection of severe, disabling cases of back pain (which are not representative of back pain in the general population). A case-control study that examined the predictors of back pain care-seeking in a working population in rural Sweden found that doing routine work without learning new skills increased the risk of back pain care-seeking significantly in men, while poor social support and satisfaction in the workplace were not significantly

associated with care-seeking [30]. Driving a vehicle and increased energy expenditure in the workplace for women and occupational forward-bending and heavy lifting in men were significantly associated with an increased risk of back pain care-seeking. The fact that all back pain care providers (family physicians, physiotherapists, chiropractors, osteopaths, and homeopaths) were grouped together was a limitation of the study, as care-seeking determinants may have varied by provider type.

In the Canadian context, the Saskatchewan Health and Back Pain Survey, (a mailed survey of the general population conducted in 1995) collected self reported information on demographic, socioeconomic, quality of life, comorbidity, and health care utilization characteristics [22]. The investigators found that individuals who sought care for back pain were more likely to have lower education, lower income, more severe pain, a history of back pain, pain from a work-related or vehicular accident, a part-time job or no job, and comorbid conditions [22]. A limitation of the study was that the sample included individuals with back pain and/or neck pain and did not differentiate between the two.

In sum, back pain characteristics, and physical and emotional occupational factors have consistently been found to influence care-seeking behaviour for back pain.

2.3 Determinants of Medication Prescription for Back Pain

Few studies have investigated the patient characteristics associated with back pain medication prescription. Cherkin et al. (1998) conducted a study of patients visiting a primary care group clinic for low back problems and found that patient sociodemographic characteristics, previous physician visits for back pain, employment status, and general and mental health status were not associated with medication prescription. Age and self-perception of pain, including severity and activity limitation did influence the prescribing

of back pain medications [31]. A strength of this study was the comprehensiveness of the medication record which was obtained from patient interviews and an automated pharmacy system. A study from the Netherlands by Schers et al. found that prescription of medications for back pain was more likely in patients 45 years of age or older compared to those less than 45 and less likely as the duration of symptoms lengthened [32]. Medication prescription was found to be associated with straight leg raise (SLR) test limitations and a shorter period of back pain in a study of patients from 40 primary care centres in Spain [33].

2.4 Determinants of Investigations for Back Pain

To date, few studies have focused exclusively on the determinants of diagnostic investigations for back pain. Research from the Veterans Health Study looked at patient predictors of patterns of use of plain lumbar radiographs comparing those with new investigations, repeat investigations, prior investigations, and no investigations in a population of Veterans with self-reported back pain who sought ambulatory care in the Boston area [34]. The authors found that health-related quality of life and general health perception were negatively associated with patterns of radiograph use, but age, income, education, and the presence of comorbidity were not related. The homogenous study population limits the generalizability of the study. Another limitation was that the 'prior investigations' category combined the prior radiographs for the current episode of back pain and for previous episodes into a single measure, when these could be distinct categories.

A study of North Carolina adults found that worker's compensation claims, longer pain duration before physician visit, and increased physician assessment of pain were

positively associated with X-ray investigations. White race, disc disease, sciatica and poor functional status were associated with CT or MRI investigations [35]. Although the data were collected prospectively by means of chart extract and patient interview (a strength of data completeness), the data were from a single state which could potentially limit generalizability.

The exploration of determinants of back pain investigations has also been conducted as part of larger health care utilization research. A study of back pain patients from 75 physicians in Spain found that X-ray investigation was significantly associated with having two or more episodes of back pain, longer duration of pain, greater disability, and poor scores on the straight leg raise (SLR) test [33]. Similar results were found for CT scans and MRIs except there was no association with previous episodes of back pain and male sex predicted the occurrence of these investigations [33]. A study from the Netherlands found that diagnostic investigation was not associated with age but was associated with the duration of back pain and the impact of pain symptoms on everyday life [32].

In summary, a prominent trend in the literature was the association between more severe and more persistent back pain and an increased tendency to conduct diagnostic investigations.

2.5 Determinants of Referrals for Back Pain

Little literature is available on the predictors of referral for back pain in primary care. A study from the Netherlands found referral to physiotherapy was more likely with extended duration of back pain symptoms and during subsequent physician visits (after the index visit) [32]. A study of Spanish primary care centres found that referral to physical therapy was significantly associated with a longer episode of back pain, a greater intensity

of pain, a poorer straight leg raise (SLR) test score, and more than two prior episodes of back pain [33]. Referral to an orthopaedic or neurological surgeon was associated with greater pain disability, more severe leg pain, longer back pain episodes and male sex [33].

2.6 Comorbidity and Back Pain Health Care Utilization

There are many studies relating back pain to other comorbid health conditions. A literature review conducted by Hestbaek et al. (2003) provided a good overview of the association between back pain and other physical conditions [36]. The authors reported significant relationships between back pain and headaches or migraines, cardiovascular disease, respiratory disorders, general poor health, gynaecological conditions, neck pain, allergies, constipation, irritable bowel syndrome, and diabetes. A significant positive relationship was found between back pain and all the aforementioned conditions, except diabetes (which had a significant negative relationship). The authors concluded that back pain appeared to be associated with a pattern of poor health. Three possible explanations for their findings were reported: back pain caused other health conditions, other health conditions caused back pain, or back pain and other health conditions had common origins [36]. Many studies have found significant positive relationships between back pain and psychosocial factors or conditions [37-39].

A reoccurring theme in the literature was the role of comorbidity in the utilization of health services by back pain patients. Studies previously presented have set the stage for this discussion. Molano et al. (2001) found that seeking care from a general practitioner for back pain was not significantly associated with musculoskeletal or general comorbidity [27]. Similarly, IJzelenberg and Burdorf (2004) found that seeking care for back pain was not associated with comorbidity [28]. Selim et al. (2000) found that mental

comorbidities and other comorbidities were not significantly related to the pattern of investigations for back pain [34]. And Cherkin et al. (1998) found that general and mental health status (a proxy for comorbidity) were not associated with the prescription of back pain medications [31].

Significant yet contradicting relationships between the presence of comorbidity and back pain health care utilization also exist in the literature. A study of patients from Kaiser Permanente in Colorado found that comorbid conditions, including anxiety, asthma, diabetes, depression, hypertension, and thyroid disease were more likely present in patients with a greater number of low back pain episodes of care [40]. Comorbidity was measured with the Chronic Disease Score, which assigned individuals to different disease categories based on medication prescriptions filled in the year prior to the observation period [40]. The number of episodes of care was defined as the number of 30-day periods that included a low back pain health care event. This measure of health care utilization was flawed because two physician visits one week apart (on either side of the pre-defined period) or two visits one year apart were recorded equally. Results from the Saskatchewan Health and Back Pain Survey indicated that individuals with comorbid conditions, including but not limited to arthritis, breathing disorders, cardiovascular disesase, diabetes and mental disorders, were more likely to have sought care for neck and/or back pain [22]. A limitation of the study was that the health care utilization variable only captured care-seeking for back pain in the four weeks prior to the survey and individuals who sought recent care likely reported comorbid conditions that were recently diagnosed [22].

Alternatively, in a study utilizing data from the 1989 National Health Interview Survey, Hurwitz and Morgenstern (1999) found that patients with comorbid conditions

tended to seek care for back pain less often [41]. The likelihood of back pain care-seeking was lowest for patients with two or more comorbid conditions and for patients with vision impairments and skin disorders. Patients with disabling comorbidity were less likely to seek care for back pain when compared to patients with no comorbidity, while patients with non-disabling comorbidity were more likely to seek care. Patients who sought care for their comorbid conditions and patients with musculoskeletal and non-musculoskeletal comorbidities were also less likely to have sought back pain care when compared to individuals without comorbid conditions [41]. The authors concluded that in patients with multiple conditions, medical care-seeking had to be prioritized, and the potential outcomes of seeking care for back pain in comparison to other conditions likely lead patients to utilize self-care for back pain [41]. This study did have its limitations in that the health care utilization variable only captured care-seeking in the two-week period before the interview, which would not have given a complete picture of the utilization of health services for back pain and other conditions.

In summary, four studies found no significant relationship between back pain health care utilization and the presence of comorbid conditions; two studies found a significant positive relationship between back pain care-seeking and comorbidity; and one study found a negative relationship between seeking care for back pain and the presence of comorbid conditions.

2.7 The Concept of an Episode of Care

There are different episodes in health, including episodes of illness, episodes of disease, and episodes of care that should be distinguished and contrasted. An episode of disease is the period of time from when the pathophysiological disease manifests itself

within the individual until the disease completes its progression, is cured, or the individual dies. Alternatively, an episode of illness is the time interval in which the individual is displaying poor health or sickness with the existence of signs and/or symptoms [1]. Signs and symptoms may or may not receive a diagnosis, and as a result, may exist with or without an episode of disease. Similarly, a disease may or may not be accompanied by symptoms and thus may or may not be associated with an episode of illness.

An episode of care, the focus of this thesis research, is an epidemiologic concept of health care utilization and physician management of a health condition. An episode of care is a temporally continuous series of health services used in response to a specific disease, illness, or health concern [1]. These services may be from a single health care provider or from multiple health care providers and multiple health care facilities. An episode of care may not be a result of illness or disease, but may be for preventative care or for health maintenance purposes [1, 42]. The prevalence of illness and disease is most commonly greater than the prevalence of the corresponding episode of care, since health care is not utilized in every instance of illness and/or disease [43]. Multiple episodes of care may be occurring simultaneously for different health conditions and multiple episodes of care for the same condition are possible longitudinally [42, 44]. In summary, more specific to a single provider interpretation, an episode of care can be defined as a distinct health condition or concern from the first physician visit until the last physician encounter for the specific condition [44].

Examining the utilization of health services in terms of episodes of care is advantageous over examination of individual physician visits, the number of days of care, or a fixed observation period. These rough measures of health services use are inefficient

because they are simple volume measures and much detail of the pattern of physician encounters is lost [42]. For example, similar overall health care utilization (i.e. the same number of physician visits over the same period of time), could be the result of very distinct health care-seeking patterns. One individual may have had multiple short episodes of care and another individual may have had one long episode. The episode of care framework is preferable when examining physician management of a health condition. The management of a condition cannot be examined on a visit to visit basis as multiple physician encounters are often necessary to treat/manage a health condition or meet the needs of a patient [43].

A theoretical framework for episodes of care is essential for their use. The boundaries of the episode, including beginning and end, the recurrent nature of episodes of care, and the course of the episode (resource allocation within the episode) must be defined. The episode of care start can be defined as the first request for medical health care, the first in-person physician encounter, the establishment of a diagnosis, or the commencement of treatment for the condition [1]. The episode end can be defined as the last visit with the health care provider or the conclusion of medical care for the health condition [1]. This definition implies that the patient's medical information is available after the last physician visit. The defined end of the episode of care can be expanded to include the definition of multiple or recurrent episodes of care. In these terms, the episode of care end could be the termination of medical services, or a break, for a distinct period of time, in the use of health services for the specific health condition (time-window) [42]. The course of the episode of care should include all the health services utilized for the health condition during the episode time period [42]. It should not be assumed that all services utilized in the time period are part of the episode of care, but only those specific

to the condition of study [1]. Finally, the defined parameters of an episode of care should be specific to the health condition(s) under study and should vary depending on how the health condition(s) are defined [42].

2.8 Back Pain Episodes of Care

Few studies have utilized the concept of an episode of care for back pain and fewer studies have investigated characteristics of an episode of back pain care. Examples from the literature that have employed this concept to answer specific research questions are presented in the following sections.

2.8.1 Episodes of Back Pain Care and Back Pain Recurrence

Three studies utilizing the concept of an episode of back pain care did so to explore the reasons for repeated episodes of care or recurrence of care. Two studies by Wasiak et al. (2003 and 2004) used administrative data from the worker's compensation system to examine the recurrence of care for back pain. In both studies, an episode of back pain care was defined as one or multiple health care provider visits, emergency room visits, and/or hospital stays with a claim description for the lower back area [45, 46]. Patients with claims for back pain in the year prior and those without a three-year follow-up period were excluded from the study. In the 2003 study, an episode of care recurrence was defined as a series of back pain visits with a distinct break period in health care utilization for back pain between two visits (two distinct episodes of care flanking the distinct break). The purpose of this research was to determine the effect of different break periods between episodes of care on recurrence rates. The authors concluded that the episode of care recurrence rate was sensitive to the break period: at small break periods, a

one day increase in the period caused large decreases in the rate of recurrence; at larger break periods, a one day increase in the break period caused much smaller decreases in recurrence rates [45].

The second study focused on an episode of care definition with a break period of 45 or 60 days. The aim of the 2004 study was to determine risk factors for recurrence of episodes of care. The main finding was that patients with longer initial episodes of care were more likely to have repeated episodes of care [46]. A sensitivity analysis revealed that the length of break period did not have a significant effect on the outcome. These results from the utilization of worker's compensation data have limited generalizability since the dataset included only work-related back pain.

McPhillips-Tangum et al. (1998) conducted a qualitative study to explore the reasons for repeated physician visits for back pain among patients with three or more episodes of care in a three year period. The authors defined repeated episodes of care as a series of one or more low back pain visits separated from another visit or series of low back pain visits by a period of at least 90 days (i.e. a 90 day break period). By means of interviews and follow-up surveys, the authors found that the most frequently reported reasons for repeated visits were: difficulty performing normal activities, desire to discover the cause of the pain, and increased pain [47].

2.8.2 Episodes of Back Pain Care and the RAND Experiment

The RAND Health Insurance Experiment was an experiment conducted to determine the effects of cost-sharing in health insurance plans between 1974 and 1982. Families from urban and rural populations were randomly sampled (to represent the American population) and were randomly assigned to insurance plans with different cost-

sharing formats. The detailed use of health services was then tracked for three or five years. From this experiment, the record of health services use and the participant's health, demographic and economic characteristics were of interest, not the effects of cost-sharing. Three studies used this data to evaluate care-seeking for back pain. An episode of care was defined as a visit or sequence of physician visits for back pain in which each visit was separated by less than 3 months. A visit separated by more than 3 months from the last visit was considered the start of a new episode of care. The first study aimed to determine what factors influenced an individual to seek care from a chiropractor for back pain in contrast to other health care providers [48]. The authors found that geographic location, higher education level, white race, and male sex were significantly associated with choosing a chiropractor as the primary episode of care provider. They found no consistent significant association between general health index and psychological well-being and chiropractic care-seeking.

The second study investigated the cost of episodes of back pain care among different health care providers [49]. Although the results were not relevant to the current thesis research, lessons can be learned from the limitations of the study. Services were allocated to specific episodes of care if they occurred 1 week before the episode or 4 weeks after the episode. A lag period after the episode of care seemed reasonable to account for delays in recording, but no justification was given for the period before the episode. All health services utilized during the defined time period were allocated to the episode of care, whereas, only back pain-specific services (and therefore costs) should have been included in the episode.

The third study examined the characteristics associated with having a back pain episode of care in the experiment time period [50]. A free insurance plan, younger age, less

education, white race, low functional status, high pain rating and the location of the health care centre were associated with having an episode of back pain care. Smoking status, degree of physical activity, body mass index, general health status, anxiety, and depression were not significantly associated with having an episode of back pain care. A strength of the studies utilizing data from the RAND experiment was that sensitivity analyses of the unit analysed were undertaken and consistent results were found between the analyses of patients and the analyses of episodes of care (clustered within patients). Although the concept of an episode of back pain care was clearly defined in these studies, a limitation was that the protocol did not distinguish between incident episodes (new episodes of care) and prevalent episodes (existing episodes of care), so episodes of care without a clear beginning were included in the analysis. This likely would not have influenced the predictors of care-seeking behaviour but would have led to underestimation of the average length and number of physicians visits in an episode of care.

2.8.3 Episodes of Back Pain Care and Utilization Duration

Research that explores the duration or utilization period of episodes of care is sparse. Roland et al. (1983) conducted a prospective study of back pain episodes of care in general practice [51]. The authors included only incident episodes with a 28 day back pain-free period before the episode of care. A recurrent episode was defined as a single or series of physician visits which were at least 28 days after the last physician back pain visit. The investigators found that the episode of care length was associated with strain during straight leg raise (SLR) tests, and duration of pain before first physician visit [51]. Age, height, weight, obesity, social class, and occupation were not associated with the

episode of care duration. Since the data were collected from a single group practice, the generalizability of the findings is limited. Additionally, 40 independent variables were included in the multivariable regressions of 230 episodes of care, so the finding of significance of these two variables could be due to chance alone.

Research by Jette et al. (1994) expanded the study of episode of back pain care outcomes by investigating episode intensity as a dependent variable. One objective of the research was to describe physiotherapy episodes of back pain care using data recorded by staff members at private and hospital-based physiotherapy practices [52]. Geographic region of practice and symptom or complaint duration before the episode start were significantly associated with both episode of care duration and episode of care intensity (number of visits in episode divided by duration of episode). Type of treatment, practice type, insurance coverage and age were not significant predictors of the duration or intensity of the episode of care. A major limitation of this study was the lack of a clear episode of back pain care definition.

2.8.4 A Unified Back Pain Episode of Care Definition

In an attempt to standardize the concept of an episode of back pain care, de Vet et al. (2002) conducted a literature review of Medline sources [53]. The authors found nine studies using the concept of an episode of care and found that the definition of an episode was most often arbitrary and poorly justified. Based on a consensus from the literature, the authors concluded with a suggestion of a unified definition of a back pain episode of care: "An episode of care for low back pain is defined as a consultation or a series of consultations for low back pain, preceded and followed by at least three months without consultation for low back pain" [53]. Although the review was limited to sources from

Medline and did not include grey literature or literature from other databases, the literature review conducted for this thesis research could not identify any additional sources from the search period.

2.9 Rationale for Thesis Research

From a review of the back pain health care utilization literature, a number of gaps in research and understanding were highlighted. Much information exists on why individuals enter the health care system for back pain management but few studies have examined the pattern of health care utilization once a patient has entered the health care system. For example, what factors influence a patient to return for multiple back pain visits with their family physician and another patient to have only a single encounter with their general practitioner? Information to answer this question is currently missing from the literature and this thesis research attempts to provide it.

As identified at the beginning of this chapter, there were few studies that examined how back pain was managed in terms of diagnostic investigations, referrals, and medication prescriptions. The existent studies, however, were conducted in a physician-visit-framework or based on a pre-defined period of observation. As discussed previously, these are inefficient units of analysis in which to evaluate the management of a condition. These methods provide only a rough volume outcome and omit the patterns of care-seeking. Studying health services utilization in this manner can be misleading by combining multiple episodes of back pain care or truncating episodes of care. The episode of care framework can be considered a much more efficient and meaningful unit of analysis and will be utilized in this thesis research.

Although this thesis will not be the first study to examine episodes of back pain care, it will contribute to the complete characterization of a back pain episode of care. Currently, back pain medication prescriptions, referrals made, and investigations ordered have not been examined in an episode of care framework. This thesis research attempts to accomplish this and provide a more complete picture of back pain management and utilization of health services using this framework.

In addition, the current literature using the episode of care framework is not without limitations. A majority of the studies accounted for the correlation of episodes of care within patients, but each study utilizing this concept failed to take the correlation of episodes of care within physicians into consideration. Additionally, while most studies defined the episode of back pain care, and many studies indicated that the analysis was limited to incident episodes (new episodes), the end of the episode was not defined for purposes beyond that of recurrence of care. In a study of episodes of care it is crucial to have episodes with a clear start and a distinct end [42]. The fault of the majority of studies was that they had a fixed follow-up or observation period, so information on health care utilization after the final physician visit in the observation period was unknown. In other words, a large limitation of research in this field was the inclusion of right-censored episodes of care in analysis. The current thesis research will explore only complete episodes of care (with a distinct start and end) and will adjust for clustering among physicians.

As presented in this chapter, from previous research, the role of comorbidity on health care utilization for back pain is unclear. Varied results were found in the literature. Some studies concluded that the presence of comorbid conditions increased care-seeking for back pain, others reported comorbid conditions decreased back pain care-seeking, and

others still found no significant relationship between comorbidity and health care utilization. Furthermore, the literature is ambiguous regarding whether the presence of comorbid conditions or care-seeking for the said comorbid conditions affected the back pain care-seeking and health care utilization behaviours. This thesis research will attempt to disentangle the relationship between comorbidity and back pain health care utilization and contribute to distinguishing between the presence of comorbidity and care-seeking for comorbid conditions. One hypothesis of this thesis is that, because of compelling health problems, patients with comorbidities will visit less often for back pain than patients with no comorbidities.

Another missing component to the back pain literature was the exploration of the topic with the use of electronic medical record (EMR) data. With the rise of technology in health care and primary care, health information is now recorded in electronic databases. These data are an important source of information because they are not biased by active participation or recall bias. This thesis research will characterize an episode of back pain care and will examine the predictors of back pain health care utilization using EMR data.

Back pain is one of the most frequent reasons individuals visit their family physician. In the dataset utilized in this thesis research, 6% or 1 out of every 17 family physician visits were for back pain. Since family physicians see roughly 20-30 patients a day, they will on average manage back pain every day. An understanding of why some back pain patients utilize more resources than others is important to determine why the burden of back pain on the health care system is so high and to determine efficient distribution of scarce resources. Additionally, an understanding of back pain episodes of care would be valuable for physician workload estimations.

CHAPTER THREE - METHODS

3.1 Objectives

The objectives of this research were: foremost, to characterize an episode of care for back pain; and second, to examine the determinants of episodes of back pain care in the context of Canadian family practice. This research was conducted using a population of patients with back pain isolated from EMR data from family practices in South-western Ontario. This research will examine all back pain in family practice: pain assigned a specific diagnosis (i.e. herniated disc) and pain that retains a symptomatic diagnosis; back pain that is complicated (i.e. radiculopathy) and pain that is mechanical or uncomplicated in nature (i.e. strain).

Objective One: To characterize an episode of back pain care in a Canadian family practice context.

Question 1:

What is the mean and median number of physician visits in an episode of care for back pain?

Question 2:

What is the mean and median length (in days) of a back pain episode of care?

Question 3:

a) How many medications are prescribed for back pain during an episode of back pain care?

b) What medications are prescribed for back pain during an episode of back pain care?

Question 4:

a) How many back pain investigations are ordered during a back pain episode of care?

b) What back pain investigations are ordered during a back pain episode of care?

Question 5:

a) How many referrals are made for back pain during an episode of back pain care?

b) What referrals are made for back pain during an episode of back pain care?

Objective Two: To explore the determinants of episode of care characteristics, specifically number of physician visits, episode length, medications prescribed, investigations ordered, and referrals made. The possible predictors include age, sex, comorbidity, and care-seeking variables.

Hypothesis 1:

a) Patients with comorbid chronic conditions, musculoskeletal conditions, and/or psychosocial conditions will have fewer physician visits in the back pain episode of care compared to those with no comorbid conditions.

b) The duration (in days) of back pain episodes of care will be shorter for patients with comorbid chronic conditions, musculoskeletal conditions, and/or psychosocial conditions compared to those with no comorbid conditions.

Hypothesis 2:

a) Patients seeking care for chronic conditions, musculoskeletal conditions and/or psychosocial conditions during the episode of back pain care will have fewer physician visits during the episode compared to those who did not seek care for these non-back pain conditions.

b) Patients seeking care for chronic conditions, musculoskeletal conditions and/or psychosocial conditions during the back pain episode of care will have a shorter episode duration (in days) compared to those who did not seek care for these non-back pain conditions during the episode.

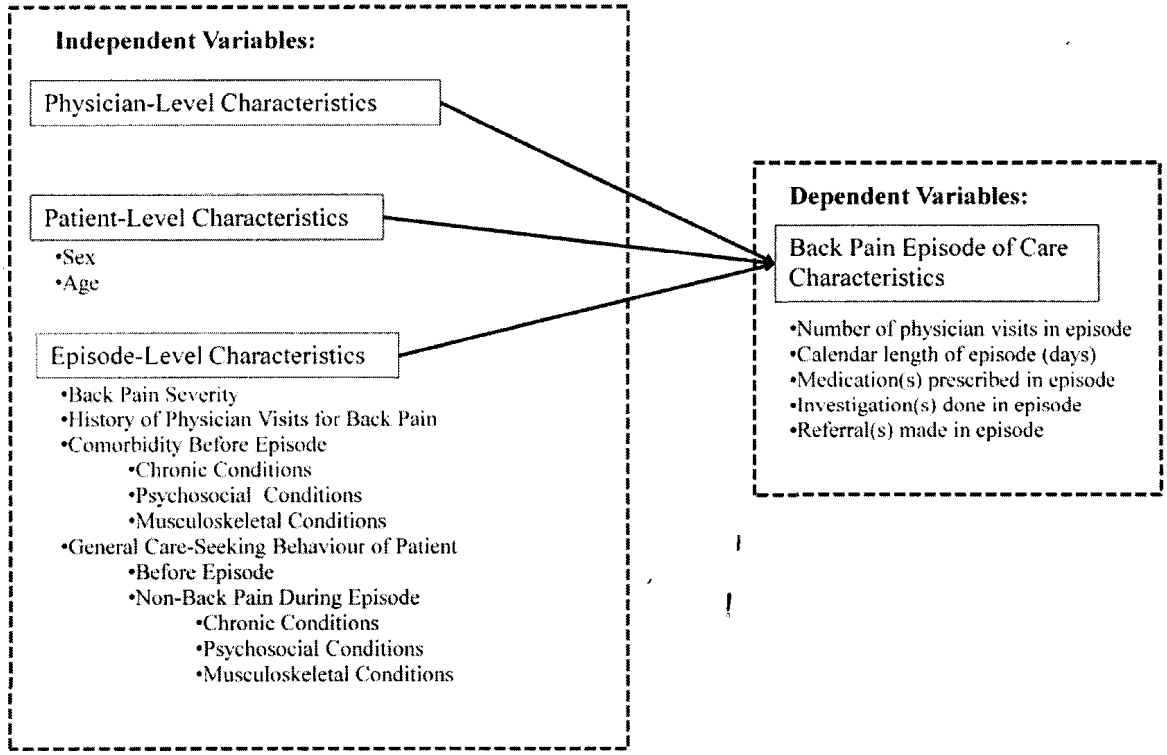
Hypotheses 1 and 2 specifically examine the number of physician visits in the episode and the episode length (two health care utilization outcomes). We hypothesize that comorbid conditions diagnosed before the episode of care and seeking care for comorbid conditions during the episode will decrease the utilization of back pain health services. As portrayed in Chapter Two, the relationship between comorbidity and back pain health care utilization found in the literature was inconclusive. The study by Ritzwoller et al. (2006) found a significant positive relationship between comorbidity and seeking care for back pain, while the study by Hurwitz and Morgenstern (1999) found a significant negative relationship and was deemed more methodologically sound [41]. The interpretation of the findings provided by Hurwitz and Morgenstern (1999) was that the use of back pain care was influenced by the presence of other conditions and the probable outcomes from physician management of these conditions. Seeking care for back pain was of low priority since care for other conditions was seen as more beneficial [41]. This rationale was

convincing in light of the fact that the majority of patients who seek care for back pain are no better off than if they had self-managed the condition [17].

3.2 Thesis Framework

From the review of the back pain literature, potential determinants of back pain health care utilization were highlighted, as examined in Chapter Two. The variables used in this research were potential predictors of health care utilization or care-seeking behaviour identified in the literature that could be extracted from the EMR database. Figure 1 displays the research framework of the determinants of care received during a back pain episode of care. The five dependent variables correspond to the five research questions of Objective One and are each a variable of health care utilization: number of physician visits, length of episode, medications prescribed, investigations ordered, and referrals made. The independent variables, or possible predictors of episode of care characteristics, are stratified into physician-level, patient-level and episode-level variables. Physician-level variables are characteristics of the family physicians managing the back pain patients. This stratum contains no specific variables as this is not the research interest. The variables included in the patient-level stratum are sex [33, 54] and age [31, 32, 48, 50]. The episode-level variables are back pain severity [26, 29, 31-33, 35, 51], history of visits for back pain [26, 33, 35], and comorbidity and non-back pain care-seeking behaviour[22, 40, 41]. The objective of this research is to explore multiple predictors of back pain health care utilization. However, as illustrated with the research hypotheses, there is a focus on comorbidity and non-back pain care-seeking behaviour.

Figure 1: Research Framework: Determinants of Care Received During Back Pain Episode of Care



3.3 Data Source: The Deliver Primary Health Care Information (DELPHI) Project

The Deliver Primary Health Care Information (DELPHI) project is an on-going project, established in 2003, of the Centre for Studies in Family Medicine at the University of Western Ontario. With funding from the Canadian Foundation for Innovation and the Ontario Primary Health Care Transition Fund, the DELPHI project created and maintains a longitudinal electronic medical record (EMR) database. The primary objectives of the project were: 1) to improve communication in the interdisciplinary primary care setting through the use of the EMR system and; 2) to characterize, evaluate, and improve the quality of primary health care [55]. The practices and health care providers were recruited through identification of users and potential users of the EMR software of interest. Additionally, recruitment was done through advertising the project by means of the email discussion group of the Family Medicine Education and Research Network associated with the Centre for Studies in Family Medicine.

Ten family practices and 29 allied health professionals from South-western Ontario were recruited for the DELPHI project. Of the 10 practices recruited, 3 were single physician practices and 7 were group practices (more than one family physician); 7 practices were located in rural settings and 3 were situated in urban settings. Of the 25 family physicians involved in the study, 9 were female and 16 were male. The mean estimated age of the recruited physicians (using an estimate of 28 years old at time of graduation from medical school) was 52.5 years; the youngest physician was 33 years of age and the oldest physician was 81 years of age.

Patients from each recruited practice were informed of the project through posters and information pamphlets at the offices of their health care provider and passive consent

was obtained [55]. Ethics review was conducted and granted by the University of Western Ontario Research Ethics Board (study number 11151E). Privacy concerns were resolved with the Information and Privacy Commissioner of Ontario.

The collaboration with HealthScreen Solutions Inc., an EMR software developer was an integral step in the development of the DELPHI project. This collaboration was necessary to modify the EMR software for purposes of research, specifically the addition of ICPC coding (which is subsequently discussed) and to develop data extraction software. Anonymized data were extracted from each practice roughly quarterly and combined to form a pooled database. Currently, three years of patient data have been extracted (October 1, 2005 to September 30, 2008). Patient information on investigations, referrals, laboratory tests, medications, allergies, immunizations, physical information (i.e. weight, height, blood pressure), and problem lists are extracted from the EMR of each practice [55]. Information on the date and purpose of each physician encounter is also extracted. In addition, ICPC-coded data are extracted (which will be discussed later). The ICPC data are recorded in the EMR through a series of drop-down menus, while the other domains are recorded with a combination of drop-down menus and free text. The DELPHI database does not include identifying information; such as health card number, full date of birth or full postal code; each patient and physician was given a unique study identifier.

3.4 The International Classification of Primary Care (ICPC)

ICPC is a classification system to code the important aspects of a primary care physician encounter. These include the diagnosis, intervention, and reason for encounter, or in other words, the physician's interpretation of why the patient visited the doctor on

that particular day [56]. The classification system is based on 17 'chapters', corresponding to the different systems of the body. For example, chapter D corresponds to the digestive system and its health conditions, and chapter K to the circulatory system. The coding of health conditions is consistent between chapters for ease of use. ICPC-2-R has been translated into 9 languages and is therefore ideal for comparisons across countries and across populations [56].

Family physicians involved in the DELPHI project were trained regarding the proper use of ICPC and a random sample of approximately 10% of the DELPHI patient population was coded using the classification system. As of September 30, 2008, there were 3,525 ICPC patients contributing 18,871 ICPC-coded physician visits. The recording or coding of ICPC data did not start with all patients in a single cohort as this would have been too laborious for the physicians gaining familiarity with a new coding system. A 'ramp-up' method was designed in which each day a few patients from the physician's list were randomly selected to be coded using ICPC. Once a patient was selected, each subsequent physician visit was coded using ICPC in order to obtain a longitudinal record.

3.5 Episodes of Back Pain Care Defined Using ICPC Data

A back pain episode of care was defined as a single back pain physician visit or a series of back pain physician visits preceded and followed by a period of at least 90 days without one such back pain physician visit. A 90 day 'time window' was implemented based on a consensus from the back pain episode of care literature [53]. A back pain physician visit was defined as a physician visit with one of four ICPC diagnostic codes for back pain: L02 'Back symptom/complaint'; L03 'Low back symptom/complaint'; L84

'Back syndrome without radiating pain'; and L86 'Back syndrome with radiating pain'. To be more specific, the start of an episode of care was defined as a back pain physician visit preceded by a period of 90 days or greater of ICPC coding without a back pain physician visit. Similarly, the episode end was defined as a back pain physician visit followed by a minimum 90 day ICPC-coded period without a back pain physician visit. ICPC coding started with the first recorded physician visit with an ICPC diagnostic code and ended with the data collection period, in this case, September 30, 2008. As a result, the 90 day 'time windows' preceding the episode start must encompass at least one non-back pain physician visit. Alternatively, the 90 day 'time window' following the episode end may include one, none, or many non-back pain physician visits. All the back pain physician visits between the episode start and episode end are included in the episode of care. In other words, there must be a period less than 90 days between each back pain physician visit in the same episode of care. The episode of care could be a single physician visit (as in Patient A of Figure 2) or could be multiple physician visits (as in Patient B of Figure 2). As a result of the defined episode of care structure, there could be multiple episodes of care for a single patient as long as they are separated by 'time windows' of at least 90 days. Patient C in Figure 2 displays the case of multiple episodes of care; the initial episode with a single visit and the subsequent episode with two visits. All complete episodes of care were flanked by 90 day 'time windows' without physician visits for back pain.

A single or series of physician visit(s) that did not have a minimal 90 day 'time window' preceding and following it was an incomplete episode of care. Figure 3 displays three such incomplete episodes of care. Patient D in Figure 3 was lacking the 90 day 'time window' preceding the episode of care. Patient E in Figure 3 was lacking the 90 day

'time window' following the episode of care. And Patient F in Figure 3 was missing the 90 day 'time windows' preceding and following the episode of care.

Figure 2: Complete Episodes of Care

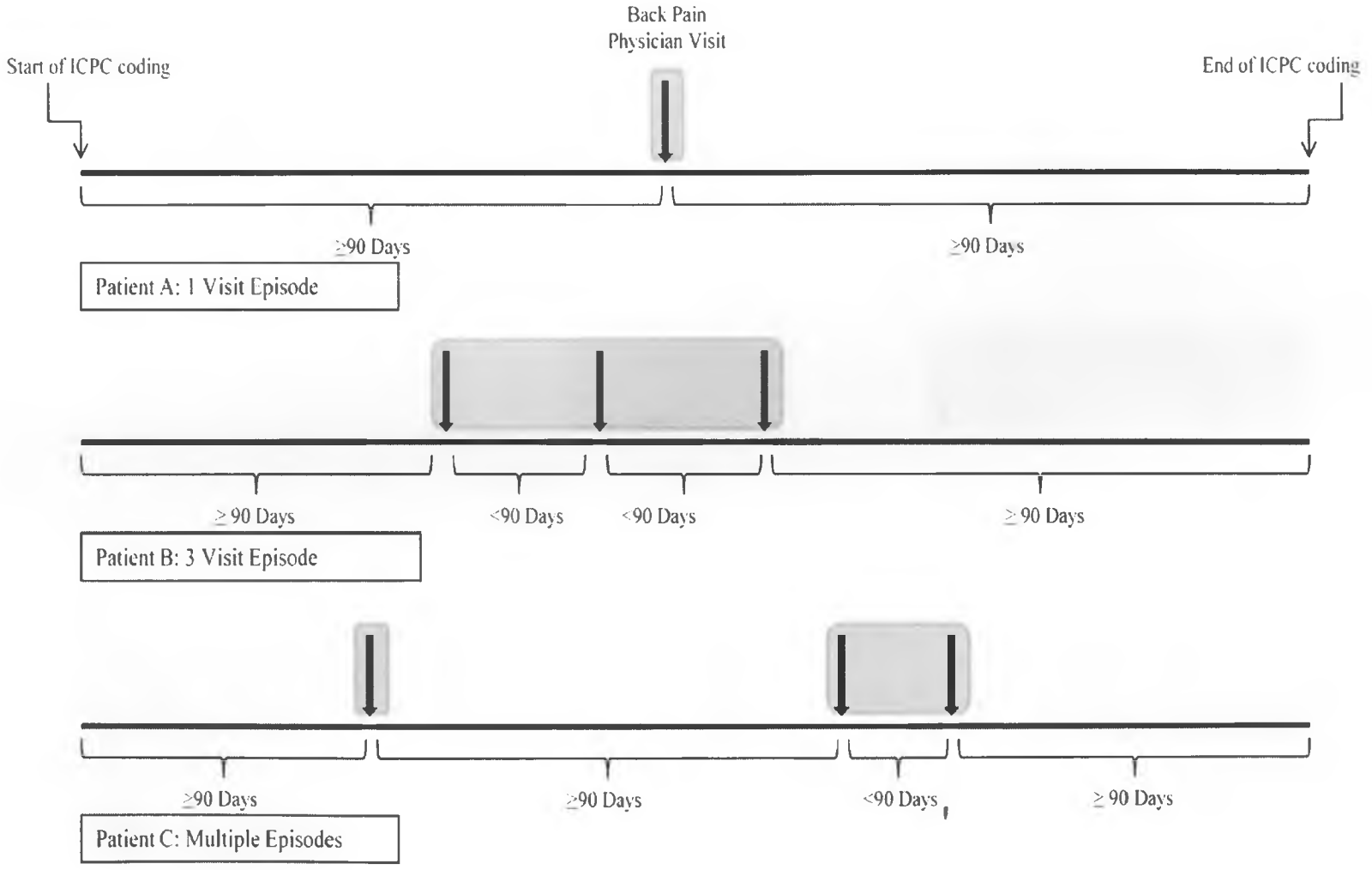


Figure 3: Incomplete Episodes of Care

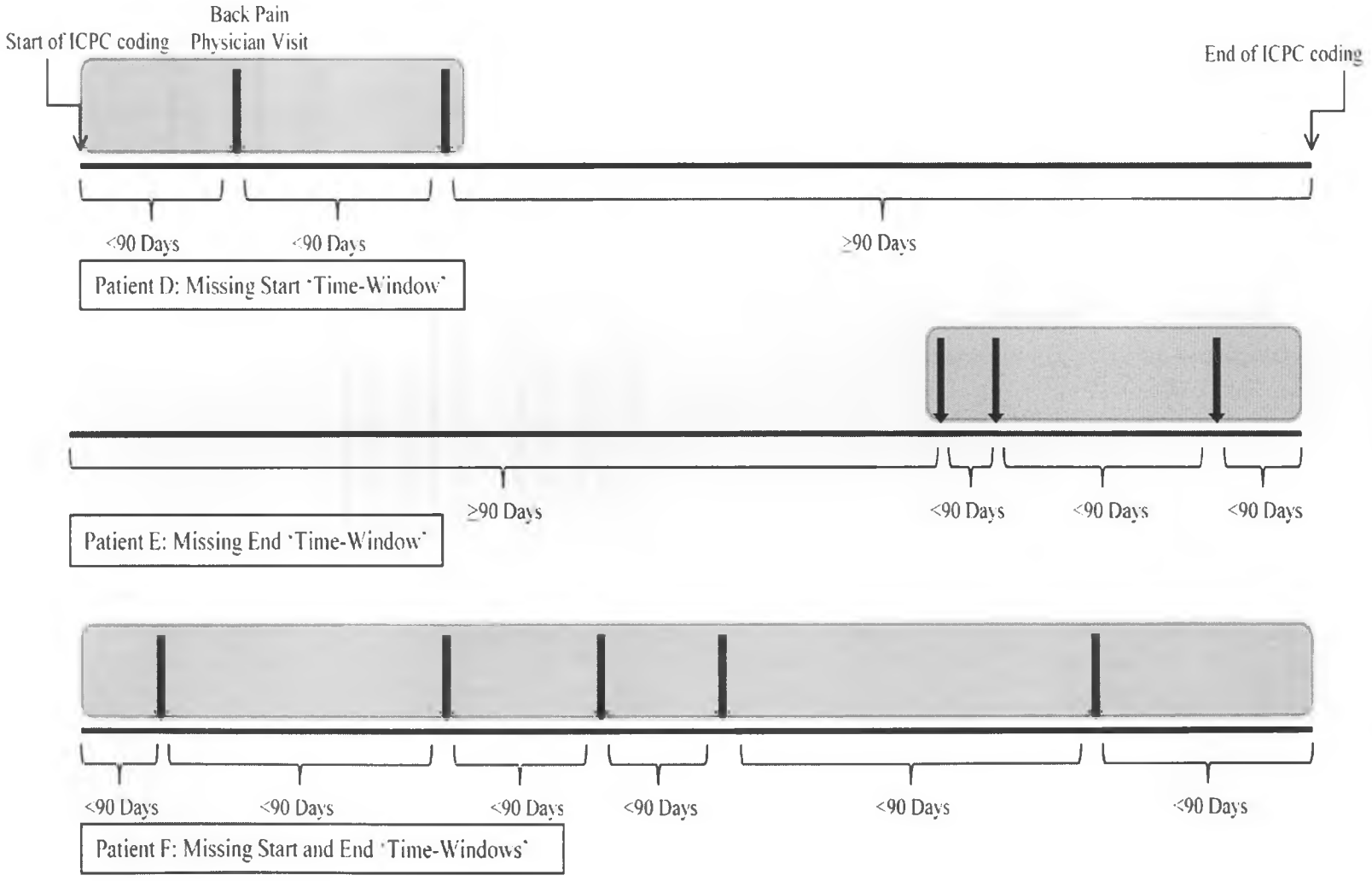
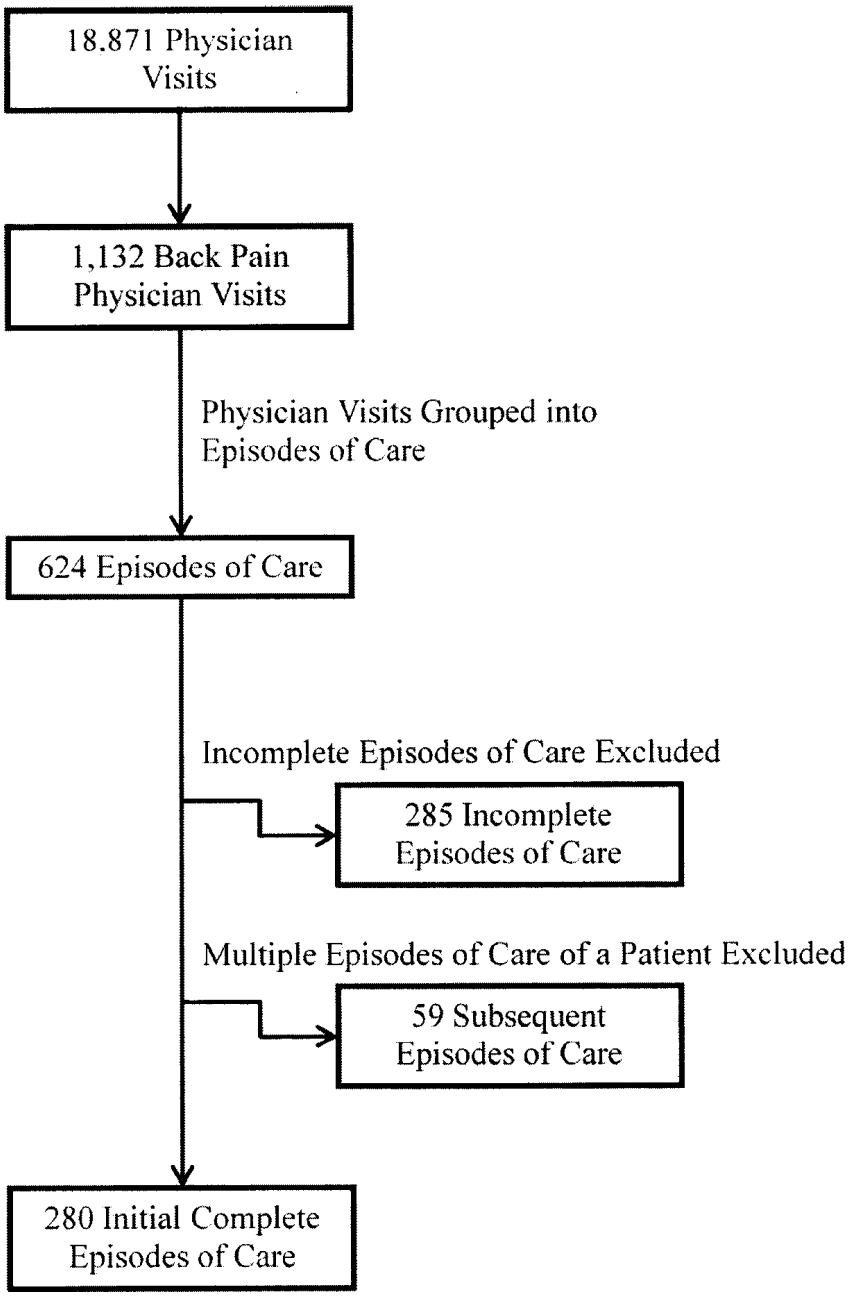


Figure 4: Flow Chart of Episode of Care Inclusion



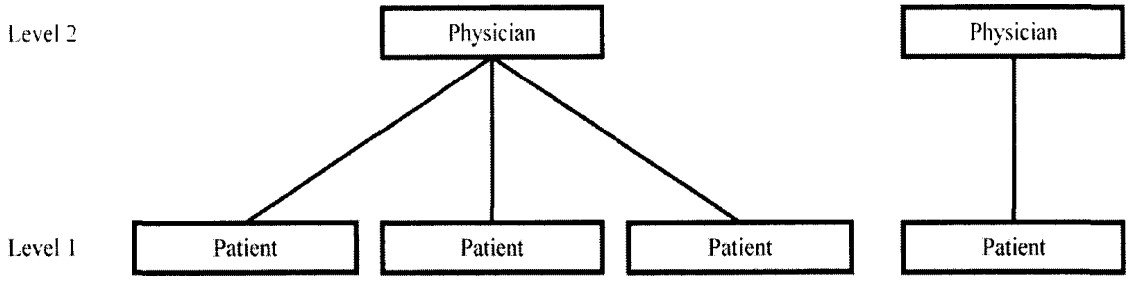
3.6 Study Population

The ICPC subpopulation of the DELPHI dataset was studied in this research. ICPC diagnostic codes were employed to define the back pain population. There were 464 patients with one or more ICPC diagnostic codes for back pain (4 codes) from the ICPC population of 3,525 patients. There were 1,132 back pain physician visits out of the 18,871 ICPC-coded physician visits (Figure 4). Using the episode of care definition presented in Section 3.5, the back pain physician visits were grouped into 624 episodes of back pain care. Episodes of back pain care were the unit of analysis in this research. All first, or initial, episodes of care of a patient were included in the analysis, while subsequent episodes (second or third episodes) were excluded. Subsequent episodes of care (59) were excluded from the analysis to ensure the independence of the observations. All complete episodes of care were included in the analysis, while all incomplete episodes were excluded. Incomplete episodes of care (285) were excluded to ensure that the management of back pain was completely captured. Episodes of care in which the start or end were outside of the observation period could not be completely characterized. Ultimately, 280 initial complete episodes of back pain care were included in the study. Figure 4 depicts a flow chart of the inclusion and exclusion criteria.

3.7 Hierarchical Structure of the Data

The data collection methods of the DELPHI project resulted in a hierarchical structure to the data that is presented in Figure 5. There were two levels in the data: the physician-level, and the patient-level. As a result, the correlation of patients clustering within physicians needed to be accounted for in the statistical analysis.

Figure 5: Hierarchical Structure of Data



3.8 Definition and Creation of Outcome Variables

Five dependent variables were created: *number of visits*, *episode length*, *medication*, *referral*, and *investigation*. The *number of visits* and *episode length* variables were created using only ICPC diagnostic codes and the defined framework of an episode of care. In addition to the episode of care definition, the other variables, *medication*, *referral* and *investigation*, were constructed using aspects of the EMR other than the ICPC component, including the longitudinal records of patient's referrals, investigations, and medications. The dependent variables were initially defined in a descriptive manner to satisfy the first objective of the research and then, based on their distribution, were re-categorized for the final multivariable models.

3.8.1 Number of Visits

N*umber of visits* was a count variable defined as the number of in-office physician visits for back pain (physician visits coded with one of the 4 back pain diagnostic codes) during the episode of care. If the episode of care encompassed one physician visit, the value of *number of visits* was equal to one.

3.8.2 Episode Length

Episode length was a count variable defined as the inclusive number of days between the first physician visit in the episode and the last physician visit in the episode. In the case of a single visit episode, the length was defined as one day. The variable was created by calculating a date difference between the episode end date and the episode start date (with the addition of one day to include the first day and the last day).

3.8.3 Medication

The *medication* variable was defined as the number and type of back pain-specific medications prescribed during the episode of care. For descriptive purposes (Objective One), medication was defined as an interval variable with categories: zero medications, one, two, three, four, and five or more. *Medication* was also categorized by type, including pain, osteoporosis-specific, anti-depressant/anti-anxiety, muscle relaxant/anti-spasmodic, and sedative as suggested by the literature [6, 31].

Based on the distribution of number of medications, *medication* was dichotomized for the analysis of Objective Two: zero medications; one or more medications.

This variable captured the back pain-specific medication prescriptions that were recorded in the EMR during back pain physician visits in the episode of care. For back pain patients in our sample, 1,720 medications were prescribed on a back pain physician visit. Only drugs specific to the management of back pain (listed above) were of interest. To identify back pain-relevant medications in the episode of care, each drug name was queried on HealthyOntario.com to determine the medication function. HealthyOntario.com is owned by the Government of Ontario and created and maintained by the Ministry of Health Promotion for the purposes of promoting well-being and healthy living among Ontario residents [57].

3.8.4 Investigation

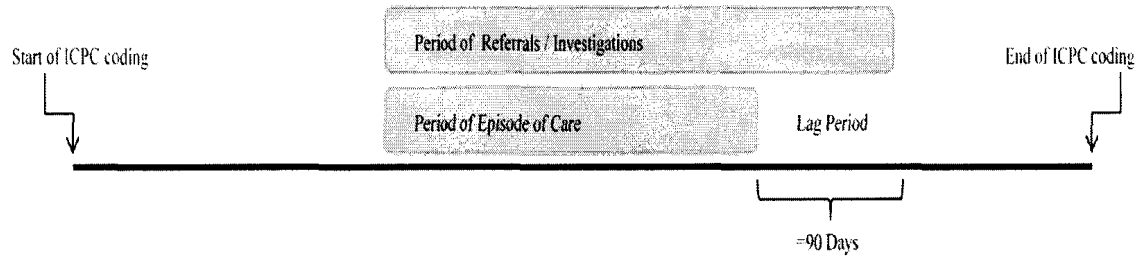
The *investigation* variable was defined as the number and type of back pain-related investigations ordered during the episode of care. For descriptive purposes (Objective One), *investigation* was defined as an interval variable with the following categories: zero investigations, one, two, and three or more. *Investigation* was also

categorized by type including X-ray, Computed Tomography (CT) scan, Magnetic Resonance Imaging (MRI), Bone Mineral Density (BMD) scan, and Other (including ultrasound, electromyogram, and unspecified back pain investigations).

Based on the distribution of number of investigations, *investigation* was defined as a dichotomous variable in the final model (Objective Two): zero investigations and one or more investigations during the episode of care.

An investigation was included in an episode of care if it was dated between the start date of the episode and the end date of the episode plus 90 days. The investigation was only included if it was one of the previously listed varieties and the purpose of the investigation was for back pain/symptoms/complaints or was not specified. Non-specific investigations were included since the purpose of investigation was often not recorded when it was linked to a physician visit for back pain. Investigations explicitly for other body parts (i.e. broken leg) were excluded. A more detailed explanation of how the investigation types were deemed back pain-specific and a justification for the 90 day lag period in the variable definition is included in Appendix A. A visual depiction of the lag period is provided in Figure 6.

Figure 6: 90-day Lag Period for Investigations and Referrals



3.8.5 Referral

The *referral* variable was defined as the number and type of back pain-related referrals made during the episode of care. For descriptive purposes (Objective One), *referral* was defined as an interval variable: zero referral, one, and two. *Referral* was also categorized by type for descriptive purposes: neurology, orthopaedics, internal medicine, general surgery, psychiatry, general practice, pain clinic, rehabilitation, radiology, rheumatology, sports medicine, anaesthesiology, and non-specific.

In the final model (Objective Two) due to the distribution of number of referrals, *referral* was defined as a dichotomous variable: zero referrals and one or more referrals.

A referral was included in the episode of care if the date of the record was between the episode start date and episode end date plus 90 days. Only back pain-related referrals (listed above) with a recorded purpose of back pain/symptoms/complaints or with a non-specific purpose were included. Non-specific referrals were included because the referral purpose was often undefined if the referral was linked to a back pain physician visit. Referrals for explicitly non-back pain conditions were excluded. A detailed explanation of how the referral types were deemed back pain-specific and a justification for the 90 day lag period in the variable definition is included in Appendix B. A visual depiction of the lag period is provided in Figure 6.

Table 1: Summary of Outcome Variables

Dependent Variable	Definition	Objective One (Descriptive)	Objective Two (Hypothesis Testing)
Number of Visits	Number of physician visits during the episode of care.	Count Variable	Count Variable
Episode Length	Length of episode of care in number of days.	Count Variable	Count Variable
Medication	Number and type of medications prescribed during the episode of care.	Interval Variable (0, 1, 2, 3, 4, 5 or more) Type Categorization	Dichotomous Variable 0 medications 1 or more medications
Investigation	Number and type of investigations ordered during the episode of care (plus 90 days).	Interval Variable (0, 1, 2, 3 or more) Type Categorization	Dichotomous Variable 0 investigations 1 or more investigations
Referral	Number and type of referrals made during the episode of care (plus 90 days).	Interval Variable (0, 1, 2) Type Categorization	Dichotomous Variable 0 referrals 1 or more referrals

3.9 Definition and Creation of Independent Variables

The independent variables were classified into three groups: physician-level, patient-level, and episode-level variables. The physician-level variables were controlled for with the unique study identifier of each physician.

3.9.1 Patient-Level Variables

The patient-level independent variables included *age* and *sex*. *Age* was modelled as a continuous variable. *Sex* was modelled as a binary variable: male and female.

3.9.2 Episode-Level Variables

Episode-level variables included *severity*, *history of back pain visits*, *chronic comorbidity*, *musculoskeletal comorbidity*, *psychosocial comorbidity*, *chronic care-seeking*, *musculoskeletal care-seeking*, *psychosocial care-seeking*, and *prior yearly care-seeking intensity*.

3.9.2a Severity

The *severity* variable denotes whether the back pain was relatively more or less severe. Back pain severity was not recorded in the EMR or was not recorded in an accessible component of the EMR (such as the physician's notes). As a result, a proxy measure for severity of back pain was developed based on the ICPC back pain diagnosis on the first back pain physician visit in the episode of care. If the first diagnostic code was L02 'Back symptom/complaint' or L03 'Low back symptom/complaint', the dichotomous *severity* variable was coded 'less severe'. Alternatively, in the case that the first diagnostic code was L84 'Back syndrome without radiating pain' or L86 'Back syndrome

with radiating pain', the *severity* variable was coded 'more severe'. These diagnostic codes connote back pain with movement limitations and back pain with radiating pain respectively; and are intuitively more serious than the former diagnoses (of L02 and L03).

3.9.2b History of Back Pain Visits

The *history of back pain visits* variable denotes whether the patient had physician visits for back pain before the episode of care start. The *history of back pain visits* variable was a binary variable coded 'yes' if there were one or more back pain physician visits before the start of the episode of care and 'no' if there were no back pain physician visits before the episode start. The prior back pain physician visits had to occur in the period between the start of ICPC coding and the start of the episode of care. This variable was developed to indicate if the episode was the initial episode of care or a subsequent episode of care, but was limited by the data collection period of the dataset. For example, physician visits for back pain could have occurred before the start of data collection and *history of back pain visits* would have been coded 'no'. As a result, this variable would more accurately be interpreted as the presence of recent history of physician visits for back pain.

3.9.2c Comorbidity

The comorbid health conditions of the back patients were captured with a set of variables: *chronic comorbidity*, *musculoskeletal comorbidity*, and *psychosocial comorbidity*. Comorbid conditions were considered health conditions that were present in the same time period as the back pain episode of care. These variables were created with ICPC diagnostic codes and data from the EMR problem list record, which contained a

free text description of the health problem and a record creation date. The 2,501 EMR problem list records for back pain patients were mapped to ICPC diagnostic codes. Any discrepancy in coding was discussed with a family physician participating in the DELPHI project. A health condition or diagnostic code could only be included in one category of comorbidity with psychosocial conditions having top priority, followed by musculoskeletal conditions, and then chronic conditions. The comorbidity variables were dichotomous due to the distribution of the number of conditions in each of the categories.

Chronic comorbidity was defined as a dichotomous variable: zero chronic conditions and one and more chronic conditions diagnosed before the episode of back pain care. The top five chronic conditions experienced by back pain patients were also examined for descriptive purposes. A list of ICPC-coded chronic conditions developed by international ICPC experts Lamberts and Okkes (personal communication), was used as a guideline for the inclusion of conditions in the chronic category. Two South-western Ontario family physicians individually examined all ICPC diagnostic codes and made a judgement if each were chronic. The ultimate list of chronic ICPC diagnostic codes in a Canadian context encompassed the codes that both family physicians regarded as chronic. Please see Appendix D for a complete list of the 78 chronic conditions and corresponding ICPC codes.

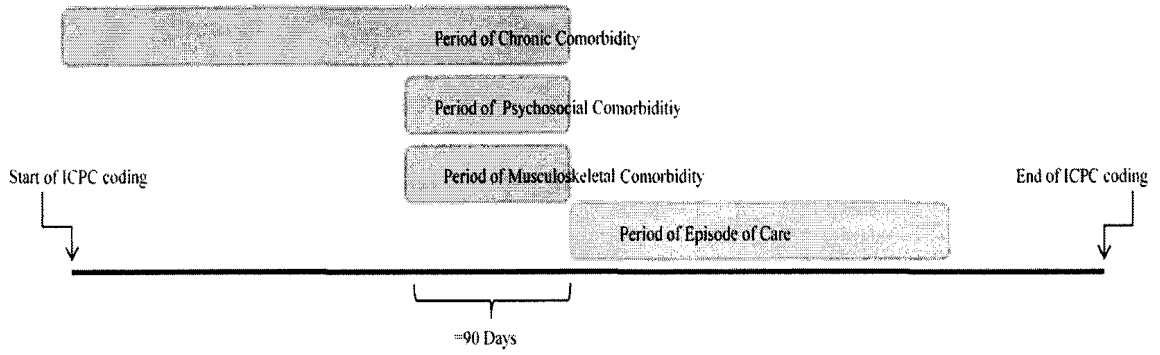
Musculoskeletal comorbidity was a dichotomous variable: zero musculoskeletal conditions and one or more musculoskeletal conditions diagnosed within 90 days before the episode of care start. The top five musculoskeletal conditions of back pain patients were examined for descriptive purposes. The 'chapter' organization of ICPC was used to define musculoskeletal conditions. These conditions were defined as any diagnostic code

from the 'Musculoskeletal (Locomotion)' ICPC chapter (any 'L' diagnostic code). Please see Appendix E for a complete list of the 47 musculoskeletal conditions.

Psychosocial comorbidity was also a dichotomous variable: zero psychosocial conditions and one or more psychosocial conditions diagnosed within 90 days before the episode of care start. The top five psychosocial conditions contributing to this variable were explored for descriptive purposes. The definition of psychosocial conditions was more complex and included: 1) any diagnostic code from the 'Psychological' ICPC chapter (any 'P' diagnostic code); 2) any diagnostic code from the 'Social Problems' ICPC chapter (any 'Z' diagnostic code); and 3) any ICPC diagnostic code of fear which were present in each ICPC chapter and were most often the _25-_27 codes. Please see Appendix F for a complete list of the 109 psychosocial conditions.

The definitions of the comorbidity variables differed slightly due to the nature of the conditions. Inherent in the definition of a chronic condition is that it is persistent. On the other hand, it was assumed that musculoskeletal and psychosocial conditions could come and go throughout a patient's lifetime and were therefore confined to a 90 day period. There was one exception: if a musculoskeletal or psychosocial health condition was originally on the chronic condition list, these conditions were included if they were diagnosed anytime before the episode start (not just within 90 days before the episode start). Please see Figure 7 for a visual definition of the comorbidity variables.

Figure 7: Period of Comorbidity



3.9.2d Care-Seeking

The non-back pain care-seeking behaviour of the patient during the episode of care was categorized in the same manner as the comorbidity variables. *Chronic care-seeking* was defined as a dichotomous variable: care-seeking for zero chronic conditions and care-seeking for one or more chronic conditions during the episode of back pain care (between the episode start and episode end). *Musculoskeletal care-seeking* was also a dichotomous variable stratified by: seeking care for zero musculoskeletal conditions and seeking care for one or more musculoskeletal conditions during the episode of back pain care. Similarly, *psychosocial care-seeking* was defined as a dichotomous variable: care-seeking for zero psychosocial conditions and care-seeking for one or more psychosocial conditions during the episode of care for back pain. The top five conditions in each stratum were explored for descriptive purposes. ICPC diagnostic codes recorded during physician visits between the episode start and episode end were used to identify care-seeking. The health conditions in the three categories were defined in the same manner as in the comorbidity variables.

3.9.2e Prior Yearly Care-Seeking Intensity

The variable *prior yearly care-seeking intensity* was defined as the intensity of general health care-seeking behaviour before the start of the episode of care. This variable was intended to capture whether the patient was a high user of health services or a low user (i.e. did the patient visit their family physician more often or less often). The equation defining this variable is found below:

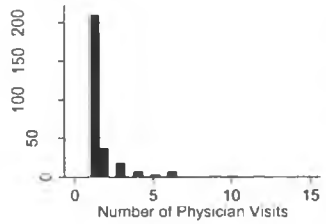
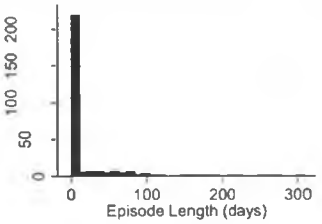
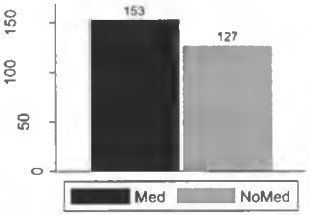
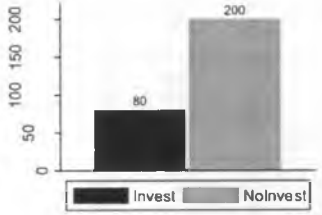
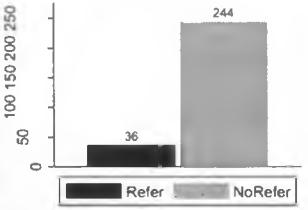
$$Prior\ Yearly\ Care\ Seeking\ Intensity = \frac{Number\ of\ Physician\ Vists}{Period\ of\ ICPC\ coding} \times 365.$$

The denominator is the time period in days from the first recorded ICPC physician visit to the episode of back pain care start. The numerator is the number of ICPC-coded physician visits in this time period. The variable *prior yearly care-seeking intensity* gives the number of physician visits per year in the period before the episode of care and was modelled as a continuous variable.

Table 2: Summary of Independent Variables

Dependent Variable	Definition	Variable Type
Age	Patient age in years.	Continuous
Sex	Sex of the patient.	Dichotomous Male Female
Severity	Severity of the back pain episode of care.	Dichotomous Variable Less Severe More Severe
History of Back Pain Visits	History of physician visits for back pain before the episode of care.	Dichotomous Variable No Yes
Chronic Comorbidity	Number of chronic conditions diagnosed before the episode of care.	Dichotomous Variable 0 conditions 1 or more conditions
Musculoskeletal Comorbidity	Number of musculoskeletal conditions diagnosed within 90 days before the episode of care.	Dichotomous Variable 0 conditions 1 or more conditions
Psychosocial Comorbidity	Number of psychosocial conditions diagnosed within 90 days before the episode of care.	Dichotomous Variable 0 conditions 1 or more conditions
Chronic Care-Seeking	Number of chronic conditions sought care for during the episode of care.	Dichotomous Variable 0 conditions 1 or more conditions
Musculoskeletal Care-Seeking	Number of musculoskeletal conditions sought care for during the episode of care.	Dichotomous Variable 0 conditions 1 or more conditions
Psychosocial Care-Seeking	Number of psychosocial conditions sought care for during the episode of care.	Dichotomous Variable 0 conditions 1 or more conditions
Prior Yearly Care-Seeking Intensity	Intensity of care-seeking (# visits/time) from the start of ICPC coding until the episode of care start.	Continuous

Table 3: Outcome Variable Data Distribution and Analysis Solution

	Dependent Variable				
	Number of Visits	Episode Length	Medication	Investigation	Referral
Distribution	 Range: 1-12	 Range 1-309			
Challenges	• Count Variable • Over-dispersed o Mean=1.58 o Variance=2.07 • No zero values • Clustering within Physicians	• Count Variable • Over-dispersed o Mean=20.68 o Variance =2419.55 • No zero values • Clustering within Physicians	• Dichotomous Variable • Clustering within Physicians	• Dichotomous Variable • Clustering within Physicians	• Dichotomous Variable • Clustering within Physicians
Solution	Zero-Truncated Negative Binomial Regression with clustering at physician level.	Zero-Truncated Negative Binomial Regression with clustering at physician level.	Random Effects Logistic Regression (physician is random effect).	Logistic Regression with clustering at physician level.	Logistic Regression with clustering at physician level.

3.10 Data Analysis Objective One: Characterization of Episodes of Back Pain Care

Data analyses were conducted on the entire sample consisting of 280 initial complete episodes of back pain care using Stata 9. To characterize an episode of back pain care, in terms of number of visits, episode length, investigations, referrals, and medications, and to satisfy Objective One of this research, descriptive analyses were conducted. The distribution of the *number of visit* and *episode length* dependent variables were explored. The number of medications prescribed, investigations ordered, and referrals made were examined. The frequency of the medication, investigation, and referral types were also explored for descriptive purposes.

3.11 Data Analysis Objective Two: Determinants of Episodes of Back Pain Care

Statistical analyses were done separately for the five dependent variables: *number of visits*, *episode length*, *medication*, *investigation*, and *referral*. Ultimately, the descriptive analyses for Objective One led to the dependent variable modelling solutions. *Medication*, *investigation*, and *referral* were ultimately each modelled as dichotomous variables. *Number of visits* and *episode length* were modelled as count variables. Table 3 presents an overview of the distributions of the five dependent variables and their analytical challenges and solutions.

3.11.1 Missing Data

There were no missing data for any of the variables included in the analysis.

3.11.2 Collinearity

Collinearity between independent variables was ruled out with the use of a correlation matrix. Each correlation coefficient from the matrix was 0.36 or less, which indicated no strong correlation between variables. Assessing collinearity was an integral first step to ensure the regression coefficients were precise, as the inclusion of highly correlated variables in a multivariable model could significantly alter the correlation coefficients [58].

3.11.3 Influential Points

The presence of influential points was assessed for *age* and *prior yearly care-seeking intensity* (continuous independent variables) with the use of simple plots. Outlying points were not found to lead the relationship between the independent variable and dependent variables.

3.11.4 Interaction

Interactions between the independent variables were not assessed as this was not an a priori research goal and no evidence of interaction was found in the literature. Furthermore, in a model to identify multiple predictors of an outcome, testing for all first-order interactions would most certainly lead to false-positives [58].

3.11.5 Bivariate Analyses

Bivariate analyses were conducted between the dependent variables and each of the eleven independent variables. Two sample t-tests, and Pearson correlation coefficients were used to detect significant relationships between the count dependent variables

(*number of visits* and *episode length*) and the independent variables. Chi-square tests and two sample t-tests were used to explore the associations between the categorical dependent variables (*medication*, *investigation*, and *referral*) and the independent variables.

3.11.6 Multivariable Analyses

The exploratory bivariate statistical tests were used to screen independent variables for inclusion in the final multivariate models. All variables with a p-value of 0.2 or less were included in the final model as suggested by Vittinghoff et al. (2005) with regards to detecting multiple important predictors [58]. The comorbidity (*chronic comorbidity*, *musculoskeletal comorbidity*, and *psychosocial comorbidity*) and care-seeking (*chronic care-seeking*, *musculoskeletal care-seeking*, and *psychosocial care-seeking*) variables were forced into the models of *number of visits* and *episode length* in order to test the hypotheses under Objective Two.

3.11.6a Zero-Truncated Negative Binomial Model

A zero-truncated negative binomial regression (Stata command *ztnb*) was used to model *number of visits* and *episode length,* both count variables. A negative binomial distribution was used instead of a Poisson distribution because the data were over-dispersed with a mean of 1.58 and a variance of 2.07 in the case of *number of visits* and 20.68 and 2419.55 in the case of *episode length.* A Poisson distribution assumes the mean and variance are equal. A zero-truncated model was used since outcomes of zero were not possible in a dataset containing only patients with an episode of care, which must be a minimum of one back pain physician visit and one day in length. A negative binomial

regression would have predicted impossible zero outcome values. The *ztnb* option *cluster* was used to account for the lack of independence among patients with the same family physician. This option created robust standard errors. Without accounting for clustering in the analysis, the standard errors of the regression coefficients would have been inaccurate (likely under estimated) and the tests of significance would have been erroneous. A likelihood ratio test was conducted to test that the negative binomial distribution was a better fit for the data compared to the Poisson distribution.

3.11.6b Random Effects Logistic Regression

A random effects logistic regression (Stata command *xtlogit* option *re*) was used to model the binary outcome *medication*. The *physician* variable was modelled as a random effect to account for the within-physician correlation in the error term of the regression. Random effects models are an efficient way to deal with large numbers of clusters but relatively small numbers of observations within the clusters [59]. A random effects model is more efficient than a fixed effects model because the maximum likelihood estimator uses information from between clusters and within clusters instead of just the variability from within clusters as is the case of the fixed effects estimator [58]. A likelihood ratio test was conducted to ensure that the random effects logistic regression was more suited to the data than the simple logistic regression.

3.11.6c Logistic Regression

A simple logistic regression (Stata command *logistic*) was used to model the dichotomous outcomes *investigation* and *referral*. This model was selected because the random effects of the *physician* variable were found to be insignificant when the random

effects logistic regressions were run. Instead, the *cluster* option in Stata was used to account for the lack of independence of observations within physicians by generating robust standard errors. The Hosmer-Lemeshow goodness of fit test was conducted to ensure that the model fit the data.

3.12 'Time Window' Sensitivity Analysis

As summarized in Chapter One, an episode of back pain care defined around a 90 day period lacking back pain physician visits ('time window') was most commonly found in the literature and recommended [53]. We conducted a sensitivity analysis of two dependent variables, *number of visits* and *investigation*, by using 'time windows': 30 days, 60 days and 120 days. The final models were replicated using the bivariate analyses to screen variables for inclusion ($p \leq 0.2$ inclusion cut-off).

CHAPTER FOUR - RESULTS

4.1 Description of Sample

The sample contains 280 initial complete episodes of back pain from a three year period between October 2005 and September 2008. A description of the characteristics, both patient and episode-level, of the episode of care sample is provided in Table 4. This table also presents the top five most frequent conditions in each of the comorbidity and care-seeking categories. With respect to the patient-level characteristics, the age distribution was approximately normal ranging from 7 to 91 years of age and with a mean age of 58.4 years. Forty-five percent of the sample was male. The episode-level characteristics encompass the remaining description of the sample. Roughly half of the sample (52.1%) had back pain that was relatively more severe during the episode of care, while 62 out of the 280 episodes of care (22.5%) were preceded by physician visits for back pain (had a history of back pain visits). The mean prior yearly care-seeking intensity of back pain patients was 6.6 physician visits per year before the episode of care. The care-seeking intensity before the episode of care ranged from 0.9 to 23.6 physician visits/year.

Chronic comorbidity was common with 75% of the episode of back pain care patients having a diagnosis of one or more chronic conditions before the episode start. 'Hypertension uncomplicated' was the most common chronic comorbidity and was diagnosed before 41.1% of the episodes of care. 'Lipid disorder', 'diabetes non-insulin dependent', 'hypothyroidism', and 'ischaemic heart disease without angina' were the next most frequent chronic conditions and were present in 10-20% of episodes of care. Musculoskeletal comorbidity was present in less than 40% of episodes of care and

psychosocial comorbidity was present in less than 20% of episodes of care. As presented in Table 4, the top five musculoskeletal conditions in order of frequency were 'osteoarthrosis other', 'musculoskeletal disease other', 'osteoarthrosis of knee', 'osteoporosis', and 'osteoarthrosis of hip'. Each of these health conditions was present in between 17.8% and 4.6% of episodes of back pain care. With no single condition present in more than 5% of episodes of care, the top five psychosocial conditions were 'anxiety disorder/anxiety state', 'depressive disorder', 'dementia', 'sleep disturbance', and 'personality disorder'.

Care-seeking for chronic, musculoskeletal, and psychosocial conditions during the episode of care were less common than comorbid conditions in the same strata. During 30% of the episodes of back pain care, the patient sought care for one or more chronic conditions. The top five conditions were similar to the chronic comorbid conditions with the addition of 'atrial fibrillation', 'asthma', and 'chronic obstructive pulmonary disorder'. Care-seeking for each of the top five chronic conditions was present in less than 11% of episodes of back pain care. Musculoskeletal care-seeking and psychosocial care-seeking were each present in less than one fifth of the episodes of care for back pain. Musculoskeletal care-seeking was most common for 'osteoarthrosis of knee', 'shoulder symptom/complaint', 'osteoarthrosis of hip', 'osteoporosis', and 'neck symptom/complaint', but each were present in less than 3% of episodes of care. The top five care-seeking psychosocial conditions were the same as the most frequent comorbid conditions and were each present in a maximum of 3.6% of episodes.

Table 4: Description of Episode of Care Sample (N=280)

Characteristic		Description / Frequency (%)
Patient-Level Characteristics		
Age (years)	Mean	58.4 years
	Range	7 - 91 years
Sex	Male	126 (45.0%)
	Female	154 (55.0%)
Episode-Level Characteristics		
Severity	Less	134 (47.9%)
	More	146 (52.1%)
History of Back Pain Visits	No	217 (77.5%)
	Yes	63 (22.5%)
Prior Yearly Care-Seeking Intensity (physician visits/year)	Mean	6.6
	Range	0.9 – 23.6
	Number / Type (Top Five)	**Frequency (%)[1]**
Chronic Comorbidity Distribution	0 Conditions	70 (25.0%)
	1 Condition	71 (25.4%)
	2 Conditions	48 (17.1%)
	3 Conditions	27 (9.6%)
	4 Conditions	33 (11.8%)
	5 Conditions	16 (5.7%)
	6 or more Conditions	15 (5.4%)
Chronic Comorbidity Description	Hypertension uncomplicated	116 (41.4%)
	Lipid disorder	52 (18.6%)
	Diabetes non-insulin dependent	49 (17.5%)
	Hypothyroidism/myxoedema	32 (11.4%)
	Ischaemic heart disease without angina	28 (10.0%)

NOTE:
[1] Percent of 'description' is equal to the number of episodes with comorbidity/care-seeking out of the total episode of care sample. May not add up to 100% as some episodes have no comorbidity/care-seeking and others have multiple.

Table 4: Description of Episode of Care Sample Continued (N=280)

Characteristic	Number / Type (Top Five)	Frequency (%)[1]
Musculoskeletal Comorbidity Distribution	0 Conditions	171 (61.1%)
	1 Condition	70 (25.0%)
	2 Conditions	25 (8.9%)
	3 or more Conditions	14 (5.0%)
Musculoskeletal Comorbidity Description	Osteoarthrosis other	50 (17.9%)
	Musculoskeletal disease other	26 (9.3%)
	Osteoarthrosis of knee	21 (7.5%)
	Osteoporosis	20 (7.1%)
	Osteoarthrosis of hip	13 (4.6%)
Psychosocial Comorbidity Distribution	0 Conditions	230 (82.1%)
	1 Condition	40 (14.3%)
	2 or more Conditions	10 (3.6%)
Psychosocial Comorbidity Description	Anxiety disorder/anxiety state	9 (3.2%)
	Depressive disorder	7 (2.5%)
	Dementia	6 (2.1%)
	Sleep disturbance	4 (1.4%)
	Personality disorder	4 (1.4%)
Chronic Care-Seeking Distribution	0 Conditions	196 (70.0%)
	1 Condition	64 (22.9%)
	2 or more Conditions	20 (7.1%)
Chronic Care-Seeking Description	Hypertension uncomplicated	30 (10.7%)
	Diabetes non-insulin dependent	21 (7.5%)
	Lipid disorder	9 (3.2%)
	Ischaemic health disease without angina	6 (2.1%)
	Chronic obstructive pulmonary disease	4 (1.4%)
	Atrial fibrillation/flutter	4 (1.4%)
	Asthma	4 (1.4%)

NOTE:
[1] Percent of 'description' is equal to the number of episodes with comorbidity/care-seeking out of the total episode of care sample. May not add up to 100% as some episodes have no comorbidity/care-seeking and others have multiple.

Table 4: Description of Episode of Care Sample Continued (N=280)

Characteristic	Number / Type (Top Five)	Frequency (%)[1]
Musculoskeletal Care-Seeking Distribution	0 Conditions	230 (82.1%)
	1 Condition	42 (15.0%)
	2 Conditions	8 (2.9%)
Musculoskeletal Care-Seeking Description	Osteoarthrosis of knee	8 (2.9%)
	Shoulder symptom/complaint	7 (2.5%)
	Osteoarthrosis of hip	5 (1.8%)
	Osteoporosis	5 (1.8%)
	Neck symptom/complaint	4 (1.4%)
Psychosocial Care-Seeking Distribution	0 Conditions	230 (82.1%)
	1 Condition	41 (14.6%)
	2 or more Conditions	9 (3.2%)
Psychosocial Care-Seeking Description	Depressive disorder	10 (3.6%)
	Sleep disturbance	9 (3.2%)
	Anxiety disorder/anxiety state	6 (2.1%)
	Dementia	4 (1.4%)
	Personality disorder	3 (1.1%)

NOTE:
[1] Percent of 'description' is equal to the number of episodes with comorbidity/care-seeking out of the total episode of care sample. May not add up to 100% as some episodes have no comorbidity/care-seeking and others have multiple.

4.2 Objective One: Characterization of Episodes of Back Pain Care

Table 5 characterizes an episode of back pain care in family practice, to complete the first objective of this research. Roughly 75% of the 280 initial complete episodes of back pain care included one visit to the family physician and consequently were a single day in length. The number of physician visits within the episode ranged from 1 to 12. Two-visit episodes of care encompassed 12.9% of the sample, 6.1% of episodes had 3 visits; 2.1% of episodes included 4 visits; and 4.3% of episodes had 5 or more physician visits. A similar right-skewed distribution, with a range from 1 to 309 days was found for episode length in days. Episodes from 2 to 69 days in length made up 13.9% of the sample, while episodes lasting 70 days and greater contributed 11.1% of the episode sample.

One or more medications were prescribed by the physician in over half of the episodes of back pain care (54.7%). Pain medications were most commonly prescribed and were present in nearly half of all episodes of care. Anti-depressant/anti-anxiety and muscle relaxant/anti-spasmodic medications were each prescribed in about 10% of episodes of care, while sedative and osteoporosis-specific medications were each prescribed in roughly 3% of episodes. Back pain investigations were present in roughly 30% of episodes of back pain care. Family physicians ordered X-rays most commonly, in about one fifth of episodes, followed by CT scans (6.1% of episodes) and MRIs (3.9% of episodes). The vast majority (87.1%) of episodes of care did not include a referral. Referrals for neurology, orthopaedics, internal medicine, and general surgery were most frequent, but each was present in less than 4% of episodes of care. There were no back

pain-specific referrals to rehabilitation, radiology, rheumatology, sports medicine or anaesthesiology.

Table 5: Episode of Care Characteristics (N=280)

Characteristics	Number / Type	Frequency (%)[1]
Number of Visits	1 visit	209 (74.6)
	2 visits	36 (12.9)
	3 visits	17 (6.1)
	4 visits	6 (2.1)
	5 or more visits	12 (4.3)
	Mean	1.6
	Median	1
	Range	1-12
Episode Length (days)	1 day	210 (75.0)
	2-9 days	5 (1.8)
	10-19 days	7 (2.5)
	20-29 days	7 (2.5)
	30-39 days	4 (1.4)
	40-49 days	6 (2.1)
	50-59 days	5 (1.8)
	60-69 days	5 (1.8)
	70 or more days	31 (11.1)
	Mean	20.7
	Median	1
	Range	1-309
Medication Distribution	0 medications	127 (45.3)
	1 medication	71 (25.3)
	2 medications	35 (12.5)
	3 medications	22 (7.9)
	4 medications	8 (2.9)
	5 or more medications	17 (6.1)
Medication Description	Pain	139 (49.6)
	Anti-depressant/Anti-anxiety	30 (10.7)
	Muscle Relaxant/Anti-Spasmodic	24 (8.6)
	Sedative	9 (3.2)
	Osteoporosis-Specific	8 (2.9)

Table 5: Episode of Care Characteristics Continued (N=280)

Characteristic	Number / Type	Frequency (%)[1]
Investigations Distribution	0 investigations	200 (71.4)
	1 investigation	60 (21.4)
	2 investigations	14 (5.0)
	3 or more investigations	6 (2.2)
Investigation Description	X-Ray	61 (21.8)
	CT	17 (6.1)
	MRI	11 (3.9)
	BMD	7 (2.5)
	Other[2]	6 (2.1)
Referral Distribution	0 referrals	244 (87.1)
	1 referral	24 (8.6)
	2 referrals	12 (4.3)
Referral Description	Neurology	10 (3.6)
	Orthopaedics	8 (2.9)
	Internal Medicine	5 (1.8)
	General Surgery	5 (1.8)
	Psychiatry	3 (1.1)
	General Practice	3 (1.1)
	Pain Clinic	1 (<1)
	Non-specific	13 (4.6)

NOTE:

[1] Percent of 'description' is equal to the number of episodes with medication/investigation/referral out of the total episode of care sample. May not add up to 100% as some episodes have no medication/investigation/referral and others have multiple.

[2] The 'Other' category includes ultrasound, electromyogram, and unspecified back pain investigations.

4.3 Objective Two: Determinants of Number of Physician Visits

Bivariate Analyses: Each episode of care included one or more back pain physician visits. Table 6 presents the bivariate analyses between the number of back pain physician visits and each of the patient-level and episode-level characteristics. A statistically significant relationship between sex and number of back pain physician visits was found in which men tended to have more visits during the episode of care (1.83 compared to 1.38, $p<0.009$). Patients seeking care for musculoskeletal conditions had significantly more episode of care back pain physician visits than those who did not seek care for said conditions (2.28 versus 1.43, $p<0.001$) Patients seeking care for psychosocial conditions during the episode of back pain care had significantly more back pain physician visits during the episode compared to those who did not (2.32 versus 1.42, $p<0.001$). Severity of back pain, history of physician visits for back pain, comorbidity, seeking care for chronic conditions during the episode, age, and prior yearly care-seeking intensity were not significantly associated with the number of back pain physician visits.

Multivariable Analysis: A zero-truncated negative binomial regression was used to model *number of visits*. The clustering of episodes of care within physicians was adjusted for with robust standard errors. Variables included in the final model were selected from the results of the bivariate analyses (test significance of 0.2 or less). Additionally, comorbidity and care-seeking variables were forced into the model to test the research hypotheses (Chapter Three). Table 7 presents the results of the final analysis. The incidence rate ratio (IRR) for each independent variable holding the other variables in the model constant is reported. The number of back pain physician visits during an episode of

back pain care was 64% less for females compared to males (IRR=0.36, p<0.002). Patients with musculoskeletal comorbidity had a 60% increase in the number of back pain physician visits during an episode of back pain care compared to those without musculoskeletal comorbidity (IRR=1.60, p<0.008). Patients with psychosocial conditions had roughly 70% less back pain physician visits per episode of care when compared to those without (IRR=0.32, p<0.008). Patients seeking care for musculoskeletal conditions and those seeking care for psychosocial conditions during the episode had 2.60 (p<0.001) and 8.05 (p<0.001) times more back pain physician visits per episode respectively when compared to patients who did not seek care for such conditions. For each physician visit/year increase in care-seeking intensity before the episode, the number of back pain physician visits per episode increased by 12%. The significant result of the likelihood ratio test confirmed that the data were over-dispersed and indicated that the zero-truncated negative binomial regression was more suitable than the zero-truncated Poisson regression.

Table 6: Bivariate Analyses of Number of Visits (N=280)

Characteristic	Number of Visits (days)			
	n	Mean	SD	p-value[1]
Sex				
Male	126	1.83	1.90	0.009
Female	154	1.38	0.85	
Severity				
Less Severe	134	1.45	1.28	0.145
More Severe	146	1.70	1.56	
History of Back Pain Visits				
No	217	1.51	1.34	0.122
Yes	63	1.83	1.72	
Chronic Comorbidity (before episode)				
0 conditions	70	1.60	1.50	0.886
1 or more conditions	210	1.57	1.42	
Musculoskeletal Comorbidity				
0 conditions	171	1.48	1.33	0.150
1 or more conditions	109	1.73	1.60	
Psychosocial Comorbidity				
0 conditions	230	1.57	1.46	0.823
1 or more conditions	50	1.62	1.32	
Chronic Care-Seeking (during episode)				
0 conditions	196	1.53	1.50	0.395
1 or more conditions	84	1.69	1.27	
Musculoskeletal Care-Seeking				
0 conditions	230	1.43	1.20	<0.001
1 or more conditions	50	2.28	2.10	
Psychosocial Care-Seeking				
0 conditions	230	1.42	1.15	<0.001
1 or more conditions	50	2.32	2.21	
	r		p-value[2]	
Age	0.007		0.905	
Prior Yearly Care-Seeking Intensity	0.113		0.059	

NOTE: Results from [1]two-sample t-tests and [2]correlation coefficients.

Table 7: Multivariable Zero-Truncated Negative Binomial Analysis of Number of Visits (N=280)

Characteristic	Incidence Rate Ratio	95% Confidence Interval	p-value
Sex			
Male	1.00		
Female	0.36	0.19 - 0.70	0.002
Severity			
Less Severe	1.00		
More Severe	1.35	0.74 –2.44	0.328
History of Back Pain Visits			
No	1.00		
Yes	1.65	0.90 – 3.02	0.107
Chronic Comorbidity			
0 Conditions	1.00		
1 or more Conditions	0.50	0.25 - 1.01	0.053
Musculoskeletal Comorbidity			
0 Conditions	1.00		
1 or more Conditions	1.60	1.13 - 2.26	0.008
Psychosocial Comorbidity			
0 Conditions	1.00		
1 or more Conditions	0.32	0.14 - 0.75	0.008
Chronic Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	1.54	0.79 - 3.00	0.204
Musculoskeletal Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	2.60	1.82 - 3.72	<0.001
Psychosocial Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	8.05	3.70 - 17.57	<0.001
Prior Yearly Care-Seeking Intensity[1]	1.12	1.04 - 1.21	0.003
Likelihood Ratio Test[2]	$Chi^2 = 73.32$		p-value <0.001

Notes:

[1]IRR of a one-point increase on the care-seeking intensity scale.

[2]Likelihood ratio test denotes a significant over-dispersion of the data that is more adequately modelled with a negative binomial compared to a Poisson distribution.

4.4 Objective Two: Determinants of Episode Length

Bivariate Analyses: The length of the episode of back pain care ranged from 1 to 309 days. Table 8 presents the bivariate analyses between the episode length and each of the independent variables. Episodes of care experienced by male patients were significantly longer in terms of number of days when compared to episodes experienced by females (27.6 days versus 15 days, $p<0.033$). Patients who had visited the physician in the past for back pain had a significantly longer episode of care than those with no history (33.6 days compared to 16.9 days, $p<0.018$). Episodes of care were significantly longer in patients who sought care for musculoskeletal conditions compared to those who did not seek care for such conditions during the episode of care (50.0 days versus 14.3 days, $p<0.001$). Patients who sought care for psychosocial conditions during the episode had a significantly longer episode of care in comparison to those who did not (47.0 days compared to 15.0 days, $p<0.001$). Finally, there was a significant positive relationship between prior yearly care-seeking intensity and episode length ($r=0.162$, $p<0.007$). Severity of back pain, comorbidity before the episode, seeking care for chronic conditions during the episode, and age were not significantly associated with the number of physician visits.

Multivariable Analysis: A zero-truncated negative binomial regression was conducted to model *episode length* and the results are presented in Table 9. The final model included all variables from the bivariate analyses with a p-value of 0.2 or less and the comorbidity and care-seeking variables to test the hypotheses. The clustering effect of patients within physicians was adjusted for with robust standard errors. The incidence rate ratio (IRR)

presented for each independent variable in Table 9 was controlled for the other variables in the model. The number of days per episode was 82% less for females compared to males (IRR=0.18, p<0.001). Patients with comorbid musculoskeletal conditions compared to patients without the conditions, had an episode length (in days) roughly four and a half times greater (IRR=4.59, p<0.001). Patients seeking care for chronic conditions during the episode of care had 2.7 times more days per episode compared to those who did not seek care for such conditions (IRR=2.70, p<0.019). Patients who sought care for musculoskeletal conditions when compared to those who did not seek care had 2.32 times more days per episode (IRR=2.32, p<0.012). Patients seeking care for psychosocial conditions during the episode of care had 19 times more days per episode compared to patients who did not seek care for psychosocial conditions (IRR=19.27, p<0.001). For each one-point increase on the care-seeking intensity scale, the length of the episode in days increased 32% (IRR=1.32, p<0.001). The likelihood ratio test presented in Table 9 confirmed that the zero-truncated negative binomial model provided a better fit to the data compared to the zero-truncated Possion model (due to over-dispersion of the data).

Table 8: Bivariate Analyses of Episode Length (N=280)

Characteristic	Episode Length (days)			
	n	Mean	SD	p-value[1]
Sex				
Male	126	27.6	59.8	0.033
Female	154	15.0	37.7	
Severity				
Less Severe	134	16.0	42.5	0.132
More Severe	146	24.9	54.4	
History of Back Pain Visits				
No	217	16.9	42.6	0.018
Yes	63	33.6	66.0	
Chronic Comorbidity (before episode)				
0 conditions	70	20.0	52.2	0.894
1 or more conditions	210	20.9	48.3	
Musculoskeletal Comorbidity				
0 conditions	171	16.6	41.4	0.084
1 or more conditions	109	27.0	59.0	
Psychosocial Comorbidity				
0 conditions	230	20.3	48.1	0.760
1 or more conditions	50	22.6	54.6	
Chronic Care-Seeking (during episode)				
0 conditions	196	18.2	49.2	0.203
1 or more conditions	84	26.4	48.9	
Musculoskeletal Care-Seeking				
0 conditions	230	14.3	37.1	>0.001
1 or more conditions	50	50.0	79.1	
Psychosocial Care-Seeking				
0 conditions	230	15.0	40.6	>0.001
1 or more conditions	50	47.0	72.3	
	r		p-value[2]	
Age	0.016		0.790	
Prior Yearly Care-Seeking Intensity	0.162		0.007	

NOTE: Results from [1]two-sample t-tests and [2]correlation coefficients.

Table 9: Multivariable Zero-Truncated Negative Binomial Analysis of Episode Length (N=280)

Characteristic	Incidence Rate Ratio	95% Confidence Interval	p-value
Sex			
Male	1.00		
Female	0.18	0.06 - 0.51	0.001
Severity			
Less Severe	1.00		
More Severe	1.92	0.60 - 6.08	0.269
History			
No	1.00		
Yes	1.90	0.70 - 5.18	0.209
Chronic Comorbidity			
0 Conditions	1.00		
1 or more Conditions	0.47	0.12 - 1.98	0.300
Musculoskeletal Comorbidity			
0 Conditions	1.00		
1 or more Conditions	4.59	1.83 - 11.54	0.001
Psychosocial Comorbidity			
0 Conditions	1.00		
1 or more Conditions	0.50	0.05 - 5.36	0.564
Chronic Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	2.70	1.18 - 6.18	0.019
Musculoskeletal Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	2.32	1.20 - 4.48	0.012
Psychosocial Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	19.27	3.82 - 97.12	<0.001
Prior Yearly Care-Seeking Intensity[1]	1.32	1.14 - 1.53	<0.001
Likelihood Ratio Test[2]	$Chi^2 = 1.2x10^4$	p-value <0.001	

NOTES:

[1]IRR of a one-point increase on the intensity of care-seeking scale.

[2]Likelihood ratio test denotes a significant over-dispersion of the data that is more adequately modelled with a negative binomial compared to a Poisson distribution.

4.5 Objective Two: Determinants of Medication

Bivariate Analyses: Roughly half of the 280 episodes of care included medication prescription(s). Bivariate analyses were conducted between the binary variable *medication* and each of the independent variables and are presented in Table 10. Patients with a history of back pain physician visits were significantly more likely to have a back pain medication prescribed during the episode of care in contrast to those without a history of back pain visits (66.7% compared to 51.1%, $p<0.029$). Patients seeking care for conditions of a musculoskeletal nature during the episode of care were more likely to have a back pain medication prescribed during this time period (72.0% compared to 50.9%, $p<0.007$). Those who sought care for psychosocial conditions were significantly more likely to be prescribed back pain medication during the episode of care (76.0% versus 50.0%, $p<0.001$). Statistically insignificant variables included sex, severity, comorbidity, seeking care for chronic conditions, age, and prior yearly care-seeking intensity.

Multivariable Analysis: A random effects logistic regression was conducted to model the determinants of *medication* (results are presented in Table 11). The *physician* variable was the random effect. There were 15 clusters (15 physicians) with a minimum of 3observartions (episodes of care) in each cluster and a maximum of 65. On average, there were 18.7 episodes of back pain care per physician. Variables with a p-value of 0.2 or less in the bivariate analyses were included in the model. The odds ratios (ORs) presented for each independent variable were adjusted for the other variables in the model. The odds of medication prescription was roughly two and a half times greater for patients seeking care

for musculoskeletal conditions during the episode of care compared to those not seeking care for the conditions (OR=2.65 , $p<0.009$). Patients seeking care for psychosocial conditions had 4 times the odds of getting medications prescribed during the episode when compared to their non-care-seeking counterparts (OR=3.99, $p<0.001$). The significant result of the likelihood ratio test presented in Table 9 indicated that the random effects of *physician* were significant.

Table 10: Bivariate Analyses of Medication (N=280)

Characteristic	Medication		p-value[1]
	0 (N= 127) N(%)	1 or more (N=153) N(%)	
Sex			
Male	57 (45.2%)	69(54.8%)	0.971
Female	70 (45.5%)	84(54.5%)	
Severity			
Less Severe	60 (44.8%)	74 (55.2%)	0.852
More Severe	67 (45.9%)	79 (54.1%)	
History of Back Pain Visits			
No	106 (48.9%)	111 (51.1%)	0.029
Yes	21 (33.3%)	42 (66.7%)	
Chronic Comorbidity (before episode)			
0 conditions	38 (54.3%)	32 (45.7%)	0.083
1 or more conditions	89 (42.4%)	121 (57.6%)	
Musculoskeletal Comorbidity			
0 conditions	81 (47.4%)	90 (52.6%)	0.397
1 or more conditions	46 (42.2%)	63 (57.8%)	
Psychosocial Comorbidity			
0 conditions	103 (44.8%)	127 (55.2%)	0.679
1 or more conditions	24 (48.0%)	26 (52.0%)	
Chronic Care-Seeking (during episode)			
0 conditions	92 (46.9%)	104 (53.1%)	0.417
1 or more conditions	35 (41.7%)	49 (58.3%)	
Musculoskeletal Care-Seeking			
0 conditions	113 (49.1%)	117 (50.9%)	0.007
1 or more conditions	14 (28.0%)	36 (72.0%)	
Psychosocial Care-Seeking			
0 conditions	115 (50.0%)	115 (50.0%)	0.001
1 or more conditions	12 (24.0%)	38 (76.0%)	

	Mean	SD	Mean	SD	p-value[2]
Age	57.7	19.2	59.0	16.6	0.089
Prior Yearly Care-Seeking Intensity	6.2	4.0	6.9	4.9	0.218

NOTE: Results from [1]chi-square tests and [2]two-sample t-tests.

Table 11: Multivariable Random Effects Logistic Analysis of Medication (N=280)

Characteristic	Odds Ratio	95% Confidence Interval	p-value
History of Back Pain Visits			
No	1.00		
Yes	1.85	0.97 - 3.54	0.061
Chronic Comorbidity			
0 Conditions	1.00		
1 or more Conditions	1.68	0.87 - 3.23	0.121
Musculoskeletal Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	2.65	1.27 - 5.49	0.009
Psychosocial Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	3.99	1.83 - 8.68	<0.001
Age[1]	1.00	0.98 - 1.02	0.971
Likelihood Ratio Test[2]	$Chi^2 = 5.26$		p-value = 0.011

NOTES:
[1]OR of a one-year increase in age
[2]Likelihood ratio test denotes a significant random effect of physician that is more adequately modelled with the random effects logistic regression compared to the simpler logistic regression.

4.6 Objective Two: Determinants of Investigation

Bivariate Analyses: Back pain investigation(s) were ordered by the family physician in 80 out of the 280 episodes of care (28.6%). Table 12 presents the results from the bivariate analyses between the binary outcome *investigation* and all patient and episode-level characteristics. Episode of care patients with prior physician visits for back pain were less likely to have an investigation ordered than those without a history of back pain physician visits (17.5% versus 31.8%, $p<0.027$). Patients who sought care from their physician for chronic conditions during the episode of care compared to those who did not were more likely to have an investigation ordered in the episode (36.9% compared to 25.0%, $p<0.043$). Care-seeking for musculoskeletal conditions during the episode was associated with a greater likelihood of investigation (44.0% versus 25.2%, $p<0.008$). There was a significant positive relationship between patient age and the likelihood of back pain investigations ordered during the episode of care. Patients who had investigations ordered where 5 years older than those who did not have investigations ordered (62 years versus 57 years, $p<0.030$). No significant association was found between investigation and sex, severity, comorbidity, psychosocial care-seeking or the intensity of care-seeking before the episode of care.

Multivariable Analysis: A multivariate logistic analysis was conducted to explore the determinants of *investigation* and results are presented in Table 13. All variables with a p-value less than 0.2 in the bivariate analyses were included in the final model. The clustering of patients within physicians was adjusted for with robust standard errors. The odds ratio (OR) of each independent variable presented was adjusted for the other

variables in the model. The odds of having an investigation ordered was 60% lower for patients with a history of physician visits for back pain compared to patients with no prior back pain physician visits (OR=0.40, $p<0.005$). Patients seeking care for chronic conditions, musculoskeletal conditions, and psychosocial conditions had greater odds of having investigation(s) ordered during the episode of back pain care. Those seeking care for chronic condition(s) during the episode had an odds of investigation 77% greater than their non-care-seeking counterparts (OR=1.77, $p<0.011$). The odds of having a back pain investigation ordered during the episode was 2.75 times greater in episodes where care was sought for musculoskeletal conditions compared to episodes were no such care was sought (OR=2.75, $p<0.011$). The odds of having an investigation during the episode of back pain care was 75% greater for patients who sought care for psychosocial conditions during the episode compared to those who did not seek care (OR=1.75, $p<0.049$). The Hosmer-Lemeshow goodness of fit test included in Table 13 indicated that the model adequately fit the data.

Table 12: Bivariate Analyses of Investigation (N=280)

Characteristic	Investigation		
	0 (N=200) N(%)	1 or more (N=80) N(%)	p-value[1]
Sex			
Male	92 (73.0%)	34(26.0%)	0.595
Female	108 (70.1%)	46(28.9%)	
Severity			
Less Severe	98 (73.1%)	36 (26.9%)	0.545
More Severe	102 (69.9%)	44 (30.1%)	
History of Back Pain Visits			
No	148 (68.2%)	69 (31.8%)	0.027
Yes	52 (82.5%)	11 (17.5%)	
Chronic Comorbidity (before episode)			
0 conditions	54 (77.1%)	16 (22.9%)	0.222
1 or more conditions	146 (69.5%)	64 (30.5%)	
Musculoskeletal Comorbidity			
0 conditions	124 (72.5%)	47 (27.5%)	0.617
1 or more conditions	76 (69.7%)	33 (30.3%)	
Psychosocial Comorbidity			
0 conditions	169 (73.5%)	61 (26.5%)	0.103
1 or more conditions	31 (62.0%)	19 (38.0%)	
Chronic Care-Seeking (during episode)			
0 conditions	147 (75.0%)	49 (25.0%)	0.043
1 or more conditions	53 (63.1%)	31 (36.9%)	
Musculoskeletal Care-Seeking			
0 conditions	172 (74.8%)	58 (25.2%)	0.008
1 or more conditions	28 (56.0%)	22 (44.0%)	
Psychosocial Care-Seeking			
0 conditions	169 (73.5%)	61 (26.5%)	0.103
1 or more conditions	31 (62.0%)	19 (38.0%)	

	Mean	SD	Mean	SD	p-value[2]
Age	57.0	18.3	62.0	16.0	0.030
Prior Yearly Care-Seeking Intensity	6.3	4.4	7.3	4.8	0.115

NOTE: Results from [1]chi-square tests and [2]two-sample t-tests.

Table 13: Multivariable Logistic Analysis of Investigation (N=280)

Characteristic	Odds Ratio	95% Confidence Interval	p-value
History of Back Pain Visits			
No	1.00		
Yes	0.40	0.21 - 0.75	0.005
Psychosocial Comorbidity			
0 Conditions	1.00		
1 or more Conditions	1.17	0.58 - 2.38	0.656
Chronic Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	1.77	1.14 - 2.74	0.011
Musculoskeletal Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	2.75	1.26 - 5.99	0.011
Psychosocial Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	1.75	1.01 - 3.06	0.049
Age[1]	1.01	1.00 - 1.02	0.121
Prior Yearly Care-Seeking Intensity[2]	1.01	0.96 - 1.06	0.672
Hosmer-Lemeshow[3]	$Chi^2 = 12.83$	p-value = 0.118	

NOTES:
1OR of a one-year increase in age
[2]OR of a one-point increase on the intensity of care-seeking scale
[3]Hosmer-Lemeshow goodness of fit test indicates adequate model fit

4.7 Objective Two: Determinants of Referral

Bivariate Analyses: From the sample of 280 episodes of care, 36 (12.9%) had one or more back pain referrals made during the episode. Statistical tests between the presence of referral and each of the independent variables were conducted, and the results are presented in Table 14. Patients seeking care for musculoskeletal conditions during the episode of back pain care were significantly more likely to have a back pain referral than patients who were not seeking care for those conditions during the episode (28.0% versus 9.6%, $p<0.001$). Patients who sought care for psychosocial conditions during the episode were also more likely to have a referral than those who did not seek care for such conditions (28.0% versus 9.6%, $p<0.001$). Patients with higher care-seeking intensity before the episode of care were more likely to have a back pain referral. Patients who had a referral had a care-seeking intensity 2.5 physician visits/year greater than patients who did not have a referral (8.8 versus 6.3, $p<0.002$). Sex, pain severity, comorbidity, chronic care-seeking during the episode, and age were not significantly associated with whether a patient was referred during a back pain episode of care.

Multivariable Analysis: A multivariable logistic regression was conducted to model *referral*. Results of this regression are presented in Table 15. Independent variables with a p-value of 0.2 or less from the bivariate analyses were included in the final model. The clustering of patients within physicians was accounted for with robust standard errors. The odds ratio (OR) presented was that adjusted for the other variables in the final model. The odds of a patient being referred during the episode of care increased nearly two-fold for patients with a history of physician visits for back pain compared to those with a lack

of history (OR=1.99, p<0.007). The presence of care-seeking for musculoskeletal conditions and care-seeking for psychosocial conditions increased the odds of back pain referral by 3.70 (p<0.001) and 3.83 (p=0.008) times respectfully compared to a lack of care-seeking behaviour. The odds of referral increased by 10% with each one-point increase on the care-seeking intensity scale (OR=1.10, p<0.018). The Hosmer-Lemeshow test of goodness of fit is included in Table 15. The statistically insignificant result shows that the model did fit the data.

4.8 Overview of Results from Multivariable Analyses

Table 16 provides an overview of the results of the five multivariable models for *number of visits*, *episode length*, *medication*, *investigation* and *referral*. This table was included for ease of review.

4.9 'Time-Window' Sensitivity Analysis

The results of the 'time-window' sensitivity analysis for *number of visits* and *investigation* are found in Appendix I and Appendix J respectively (the 90-day 'time-window' is shaded). The determinants of *number of visits* varied with the 'time-window'. Seeking care for musculoskeletal conditions during the episode and prior yearly care-seeking behaviour were consistently positively associated with the number of physician visits during the episode of back pain care. The negative relationship between female sex and number of visits in the episode was present in all but one of the 'time-window' analyses. The increased number of back pain visits in patients seeking care for psychosocial conditions during the episode of care was an association also present in most of the 'time-window' analyses. Significant relationships between severity, chronic

comorbidity, musculoskeletal comorbidity, and psychosocial comorbidity and number of physician visits were only each present in one 'time-window' analysis. For *investigation*, the analyses using different 'time-windows' yielded more consistent results. Patients with a history of back pain visits consistently were less likely to have a back pain investigation during the episode of care. Patients seeking care for musculoskeletal conditions during the episode were more likely to have an investigation during the episode of care in each 'time-window'.

Table 14: Bivariate Analyses of Referral (N=280)

Characteristic	Referral		
	0 (N=244) N (%)	1 or more (N=36) N (%)	p-value[1]
Sex			
Male	111 (88.1%)	15(11.9%)	0.667
Female	133 (86.4%)	21(13.6%)	
Severity			
Less Severe	119 (88.8%)	15 (11.2%)	0.426
More Severe	125 (85.6%)	21 (14.4%)	
History of Back Pain Visits			
No	193 (88.9%)	24 (11.1%)	0.095
Yes	51 (81.0%)	12 (19.0%)	
Chronic Comorbidity (before episode)			
0 conditions	60 (85.7%)	10 (14.3%)	0.680
1 or more conditions	184 (87.6%)	26 (12.4%)	
Musculoskeletal Comorbidity			
0 conditions	151 (88.3%)	20 (11.7%)	0.467
1 or more conditions	93 (85.3%)	16 (14.7%)	
Psychosocial Comorbidity			
0 conditions	201 (87.4%)	29 (12.6%)	0.790
1 or more conditions	43 (86.0%)	7 (14.0%)	
Chronic Care-Seeking (during episode)			
0 conditions	171 (87.2%)	25 (12.8%)	0.938
1 or more conditions	73 (86.9%)	11 (13.1%)	
Musculoskeletal Care-Seeking			
0 conditions	208 (90.4%)	22 (9.6%)	<0.001
1 or more conditions	36 (72.0%)	14 (28.0%)	
Psychosocial Care-Seeking			
0 conditions	208 (90.4%)	22 (9.6%)	<0.001
1 or more conditions	36 (72.0%)	14 (28.0%)	

	Mean	SD	Mean	SD	p-value[2]
Age	58.5	17.9	57.8	17.0	0.808
Prior Yearly Care-Seeking Intensity	6.3	4.2	8.8	5.7	0.002

NOTE: Results from [1]chi-square tests and [2]two-sample t-tests.

Table 15: Multivariable Logistic Analysis of Referral (N=280)

Characteristic	Odds Ratio	95% Confidence Interval	p-value
History of Back Pain Visits			
No	1.00		
Yes	1.99	1.21 - 3.27	0.007
Musculoskeletal Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	3.83	2.75 - 5.35	<0.001
Psychosocial Care-Seeking			
0 Conditions	1.00		
1 or more Conditions	3.70	1.42 - 9.69	0.008
Prior Yearly Care-Seeking Intensity[1]	1.10	1.02 - 1.20	0.018
Hosmer-Lemeshow[2]	$Chi^2 = 3.02$		p-value = 0.933

NOTE:
[1]OR of a one-point increase on the care-seeking intensity scale
[2]Hosmer-Lemeshow goodness of fit test indicates adequate model fit

Table 16: Comparison of Regression Results from Number of Visits, Episode Length, Medication, Investigation, and Referral Outcomes

Characteristic	Dependent Variable				
	Number of Visits	Length	Medication	Investigation	Referral
Female	-	-			
More Severe					
History of Back Pain Visits				-	+
Chronic Comorbidity					
Musculoskeletal Comorbidity	+	+			
Psychosocial Comorbidity	-				
Chronic Care-Seeking		+		+	
Musculoskeletal Care-Seeking	+	+	+	+	+
Psychosocial Care-Seeking	+	+	+	+	+
Age					
Prior Yearly Care-Seeking Intensity	+	+			+

LEGEND:
+ Significant positive relationship
- Significant negative relationship
Blank indicates no significant relationship in multivariable analysis or $p>0.2$ in bivariate analysis

CHAPTER FIVE – DISCUSSION AND CONCLUSION

5.1 Strengths of Research

This was one of the first studies to characterize an episode of back pain care, in terms of number of physician visits, episode length, medications prescribed, investigations ordered, and referrals made in family practice. This research made an important contribution to the literature in that the majority of prior studies had characterized the management of back pain on a visit-per-visit basis. As previously mentioned, this is not the most clinically meaningful unit of analysis in which to capture the management of health conditions. Furthermore this was the first study to date to characterize an episode of back pain care using electronic medical record data. With the rise in the use of electronic medical records, the methodologies utilized in this thesis research will be increasingly valuable to investigate episodes of care of non-back pain conditions.

An additional strength of the current research was the use of only complete episodes of back pain care. The definition of an episode of care utilized in this research exceeded the definitions used in previous episode studies because it clearly defined the start and the end of the episode. By including only episodes of care that have a distinct start and end in the analysis, one captures the complete management of back pain.

Furthermore, with the inclusion of variables of comorbidity and non-back pain (comorbid) care-seeking during the episode of care, this research helped to disentangle the relationship between comorbid conditions and back pain health care utilization.

5.2 Objective One: Characterization of Back Pain Episodes of Care

5.2.1 Episode of Care Duration

We found that roughly 75% of episodes of care encompassed a single physician visit for back pain and thus were a single day in length. The mean number of physician visits in the episode was 1.6; the mean length of the episode was 20.7 days. The current research and few past studies characterizing episode duration utilized similar episode of care definitions with the exception that the prior studies allowed clinical expertise to over-rule the rigid episode of care framework. In a study using administrative data from the RAND Health Insurance Experiment, Shekelle et al. (1995), found that 40% of episodes of care from all back pain providers (not just family physicians) were one visit in length [48]. The authors reported a mean of 6 physician visits per episode of care and a median of 2. The variation in results was likely due to different physician populations. Shekelle et al. (1995) reported longer episodes of back pain care because they included back pain management by chiropractors, physiotherapists, and back pain specialists. Furthermore, prior studies found that 20-25% of patients with back pain or other benign medical problems were unsatisfied with the management of their condition, which may have caused them to seek care from other care-providers [17]. With this in mind, our findings of episode length may be truncated as a result of patients visiting family physicians outside of the DELPHI project. Additionally, as will be discussed in Section 5.4.1, our methodology preferentially excluded longer episodes of care which may have contributed to the variation.

Another study using data from the RAND Health Insurance Experiment found that 80% of back pain episodes of care in general practice were 2 visits or less [49]. The authors

found that the mean number of physician visits was 2.3 and the median was 1; the mean length of the episode of care was 21 days and the median was 1 day. These findings were very similar to our results.

5.2.2 Medication

We found that over half of the episodes of back pain care included one or more prescriptions for back pain-specific medications. The most commonly prescribed medication was for pain, followed by anti-depressant or anti-anxiety medications. No previous studies to date have investigated medication prescription within the framework of an episode of back pain care. General prescribing patterns for patients with back pain are readily reported in the literature. Cherkin et al (1998) found that 80% of patients visiting a physician for the first time during an episode of back pain were prescribed medications, with 41% prescribed a single medication, 34% two medications, and 4% three or more medications [31]. The authors found that the most frequently prescribed medications were non-steroidal anti-inflammatory drugs, prescribed to 87% of patients, and muscle relaxants, prescribed to nearly one-third of patients [31]. Hart et al. (1995) found that medications were prescribed in 60% of back pain visits with a general practitioner and that the most commonly prescribed medications were non-steroidal anti-inflammatory drugs in 29% of visits and muscle relaxants or sedatives in 20% of visits [6]. Schers et al. (2000) found that 53% of patients were prescribed medications on their first back pain visit with a general practitioner and 41% of patients received prescriptions during follow-up visits [32]. Gonzalez-Urzelai and associates (2003) reported that 70.5% and 35.2% of patients with back pain who visited general practitioners in Spain were prescribed non-steroidal anti-inflammatory drugs and muscle relaxants respectively [60].

Since the comparative studies used physician visits as the unit of analysis instead of episodes of care, lower rates of medication prescription were expected (since an episode could encompass more than one physician visit increasing the probability of prescription). However, the rates of medication prescription were elevated in comparison to the current findings and were likely the result of different, more comprehensive data sources. The first study obtained data from patient interviews and an automated pharmacy system [31]. The studies by Hart et al., Schers et al., and Gonzalez-Urzelai and associates collected data by means of physician surveys [6, 32, 60]. Since the comparative studies examined similar patient populations, the variation in results provided evidence that the electronic medical record of medication was probably incomplete. A possible explanation for the discrepancy was the presence of concurrent paper-based prescriptions (not captured in the EMR); further research is needed to investigate this possibility.

5.2.3 Investigation

We found that approximately 30% of back pain episodes of care included a back pain investigation, with X-rays included in nearly 22% of episodes, CT scans included in 6.1% and MRIs included in 3.9%. This research contributed to the literature in terms of patterns of back pain investigations within an episode of care framework. Previous studies looked at the frequency of back pain investigations among patients with back complaints. Carey et al. (1996) found that among individuals seeking care from health professionals who commonly treat back pain (i.e. chiropractors, neurologic surgeons, orthopaedic surgeons and general practitioners), 47% had an X-ray and 9% had a CT scan or MRI [35]. They collected data by means of chart extract and follow-up patient telephone interviews. Exploratory analyses from Kaiser Permanente Northwest region found that X-

rays were used for diagnostic purposes in 16% of back pain cases, CT scans were utilized in 5% of cases, and MRIs in 1% of cases [61]. Lumbar radiographs were ordered in 18% of back patients in a study of back pain management among Spanish general practitioners [60]. In a study by Schers et al. (2000), where general practitioners completed on-line surveys following low back pain physician visits, X-rays were conducted in 2% of initial physician visits and 7% of subsequent physician visits in a four month period [32]. Using administrative data from Ontario, Iron et al. (2004) found that 17.3% of patients with incident back pain had an X-ray, 3.7% had a CT scan, and 0.74% had a MRI in a one-year period [62].

Despite the fact that the episode of care concept was not used in these comparative studies and different data sources were examined, the findings were similar to the results of the current thesis research. These findings were loosely consistent with the recommended management of back pain in family practice, with the use of diagnostic imaging only for more serious or persistent back pain, which is a small proportion of the back pain presenting to family practice. Furthermore, the similarity of findings indicated that the EMR records on investigations were relatively complete and that a 90 day 'lag period' was adequate for capturing back pain investigations from an EMR.

5.2.4 Referral

We found that less than 15% of back pain episodes of care included a back pain-specific referral. The most common referrals were to neurology and orthopaedics. A study by Hart et al. (1995), using data from the National Ambulatory Medical Care survey, found that a referral to physiotherapy occurred in 30% of physician visits for back pain and referrals to back pain specialists occurred in 5% of back pain physician visits [6]. From

a physician survey subsequent to back pain visits, Schers et al. (2000) found that 22% of patients were referred for physiotherapy during initial back pain physician visits and 50% of patients were referred on subsequent physician visits [32]. In a study of Spanish general practices 11% of patients received a referral during the index back pain family physician visit, and all were to orthopaedics [60]. Moreover, half of the back pain patients who returned for a subsequent visit to their family physician were referred to a specialist and the vast majority of those referrals were to orthopaedics [60].

The results of the current research are consistent with the literature in terms of referral to back pain specialists (i.e. orthopaedics). However, there was a noteworthy difference between the findings from prior studies and the current research. No referrals to physiotherapy or rehabilitation within the episode of care were captured. It was not likely that our sample differed from the average back pain population, but rather that the data source utilized was limited. Referrals to physiotherapy or rehabilitation were likely recorded differently in the EMR than other referral types. Referral to rehabilitation often consists of multiple treatments compared to a one-visit evaluation that is characteristic of other back pain referrals. The electronic medical record of the referral is frequently made when the appointment date for the referral is set. It is possible that with multiple visits, the establishment of the record with the appointment does not occur. Interviews with the physicians participating in the DELPHI project to determine referral recording patterns would authenticate this interpretation.

5.3 Objective Two: Determinants of Back Pain Episodes of Care

5.3.1 Comorbidity and Health Care Utilization

Hypothesis 1: We hypothesized that individuals with comorbid chronic conditions, musculoskeletal conditions, or psychosocial conditions would have fewer physician visits in the episode of care and would have shorter length episodes (in days) due to a prioritization of these health conditions above back pain. No significant relationship between chronic comorbidity and the number of visits or episode length was found. Episode duration (in terms of number of visits and number of days) was greater in individuals with one or more musculoskeletal comorbid conditions. In contrast to our hypothesis, individuals with back pain and other musculoskeletal conditions sought more back pain care. It appeared that patients with diverse or broad musculoskeletal conditions, including back pain, ranked these as a higher health priority compared to back pain alone and thus sought more care. As we hypothesized, the number of physician visits decreased with the presence of psychosocial comorbidity, but episode length was not significantly associated with the presence of these comorbid conditions. This relationship was likely a result of psychosocial conditions being a higher health priority than back pain. To investigate this hypothesis more extensively, more information on the disabling or life-altering effects of the comorbid conditions would have to be obtained to get a better idea of health priorities. This information was not available in the dataset utilized.

Hypothesis 2: We hypothesized that individuals seeking care for chronic conditions, musculoskeletal conditions, or psychosocial conditions during the episode of care would have fewer back pain visits and have episodes shorter in length (in days). The rationale for this hypothesis was that patients would prioritize non-back pain health

conditions before back pain and preferentially seek care for these other conditions due to the recognition of small benefits from back pain care-seeking. Patients seeking care for chronic conditions during the episode of care had episodes of greater length (in days), but did not have significantly more physician visits. Patients seeking care for musculoskeletal or psychosocial conditions during the episode of care had significantly more physician visits per episode and episodes of greater length (in days). Our hypothesis was disproven. Patients with back pain and other conditions were not prioritizing care-seeking for back pain behind these other conditions. It appeared that patients seeking non-back pain care had more complex back pain health care needs and addressed these at the same family physician encounters.

The main finding of this research that was closely related to the assessment of Hypothesis 1 and Hypothesis 2 was that patients who sought care for musculoskeletal and/or psychosocial conditions during the episode of back pain care utilized more back pain health care services. These patients had more physician visits, a longer episode duration (in days), and were more likely to receive back pain-specific medication prescriptions, investigations, and referrals when compared to patients who did not seek care for such conditions during the episode of care. The same consistent positive relationship was not found for patients with musculoskeletal and/or psychosocial comorbidity. The increased health services utilization was associated with care-seeking for the conditions during the episode of back pain care, not merely having been diagnosed with said conditions before the episode start. This was not a result of more severe back pain clustering in patients with multimorbidity, as back pain severity was adjusted for in the model. This could have been the result of more complex back pain management when a patient had more than one care-worthy condition concurrently. A study by Bayliss et al.

(2003) would support this interpretation. The authors conducted qualitative interviews with multimorbid patients from family practices and found that comorbidity was a barrier to care [63]. The majority of participants reported that symptoms, lifestyle changes, or treatment of one condition interfered with the management of another condition [63].

A limitation of the association between care-seeking and health care utilization should be noted. Multiple diagnoses were possible on each back pain physician visit and there was no reason to believe differential diagnosis occurred based on when the physician visit occurred. However, as the number of physician visits increased, the opportunity for additional diagnoses (aside from back pain) also increased. Therefore, the probability of receiving a musculoskeletal or psychosocial diagnosis during the episode of care increased with each physician visit during the episode. There was also increased opportunity for medications, investigations and referrals in longer episodes of care, which could then be equated to the care-seeking relationship. The non-significant and fairly consistent relationship between care-seeking for chronic conditions and health care utilization indicated that, although this was a potential limitation, it did not affect the results of the research.

5.3.2 Summary of Other Determinants of Health Care Utilization

The five dependent variables, *number of visits*, *episode length*, *medication*, *investigation*, and *referral* were not independent. The distinct pattern in results when comparing the five models confirmed that, in fact, these variables were related (see Table 16).

An interesting finding was that patients with psychosocial comorbidity tended to have fewer back pain physician visits during the episode of care, while patients seeking

care for psychosocial conditions during the episode tended to have more back pain physician visits. Contrary to our results, Cote et al. (2001) found that patients with self-reported mental disorders were more likely to seek care for back or neck pain and that individuals who sought back pain care had worse self-perceived mental health status compared to those who did not seek care [22]. Ritzwoller et al. (2006) found that anxiety, depression, and psychosis were more common in patients with a greater number of low back pain episodes of care [40]. This was consistent with our findings because comorbid conditions were assigned based on the Chronic Disease Score, which used records of prescription medications filled (a result of care-seeking). The presence of psychosocial conditions, adjusted for care-seeking in family practice, was likely negatively associated with back pain health care utilization due to seeking specialist care for these conditions and ranking them a high priority (above family physician management of back pain). Alternatively, when the patient sought psychosocial care from a family physician their back pain care was more complex including more physician visits per episode.

Males had more physician visits and had episodes of care that were longer in duration when compared to females. Kovacs et al. (2006) found similar health services utilization results in that sex was a predictor of diagnostic investigations and males were more likely to get CT scans and MRIs for back pain [33]. However, Chenot et al. (2008) found that sex was not associated with back pain health services utilization once sociodemographic and back pain characteristics were controlled for [54]. A German study found that women were significantly more likely than men to have back pain [64]. Moreover, females were more likely to report back pain [65] and were more likely to seek care for their back pain as compared to males [66]. The variation in findings indicates that entering the health care system and a continuation of health care-seeking once in the

system are unique. Men are more likely to continue seeing a physician after the index visit for back pain. We suspect that this was the result of the nature of back pain, in that men sought care more often for occupation-related back pain and may have continued to visit for reasons of worker's compensation. Unfortunately, we did not have the data to assess this interpretation.

Patients with a history of physician visits for back pain were less likely to have an investigation ordered during the episode. This was consistent with the findings of Carey et al. (1996), who found that patients who had experienced episodes of back pain previously were significantly less likely to receive an X-ray investigation for their current back pain [35]. Additionally, we found that patients with prior back pain physician visits were more likely to have a referral made during the episode of back pain care. From these findings it can be interpreted that diagnostic investigation was the first avenue for back pain treatment and management (in that patients with a history of back pain physician visits likely had an investigation in prior episodes of care). If an investigation yielded no solution and the back complaints continued or returned, referrals were made in subsequent episodes of care.

A significant positive relationship was found between *prior yearly care-seeking intensity* and *number of visits*, *episode length*, and *referral*. These findings were expected and indicated that individuals maintained their behaviour of health care-seeking in the episode of back pain care. Individuals who were relatively high users of the health care system continued to be high users in episodes of back pain care. Nonetheless, having this variable in each model meant that all other significant relationships were independent of the effect of being a general high user of the health care system.

5.4 Generalizability of Results

5.4.1 Comparison of Episodes of Care Included and Excluded

As a result of the rigid episode of care framework, 55% of episodes were excluded from the analysis. There were no significant differences between the patients who had their episodes of back pain care included in the analysis and patients who had their episodes excluded. The mean age of included patients was 58.4 years while the mean age of excluded patients was 56.7 years, but this variation was not statistically significant ($p<0.232$). Included and excluded episodes also had the same sex distribution with females contributing 55% of included episodes and 48% of excluded episodes ($p<0.109$). However, the number of physician visits in the episode of care did significantly differ between the episodes included in the analysis and those excluded. Of the back pain episodes of care included in the study, 74.6% were one physician visit in length. Alternatively, 64.8% of episodes of back pain care excluded from the study were one visit in length ($p<0.008$). In other words, longer episodes of care were more likely excluded from the study. These results can be found in Appendix G. Although this was a limitation of the study, it was anticipated and unavoidable. Without an infinite observation period, longer episodes of care will always be less likely to start and/or to finish in the study timeframe when compared to shorter episodes. The fact that this research preferentially excluded longer episodes of care will likely have little impact on the generalizability of the determinants of back pain episodes of care, since the large majority of episodes encompass only a single physician visit in family practice.

5.4.2 Comparison of DELPHI Population and Canadian Population

The DELPHI ICPC population was older and had a higher proportion of females when compared to the 2006 Canadian census population [67]. As recorded in Appendix H, the median age of the DELPHI ICPC population was 54 years, while the median age of the Canadian census population was 39.5 years. Furthermore, 56% of the ICPC population was female, while 51% of the census population was female. This comparison does not indicate that the population under study was different from the Canadian population because the DELPHI ICPC population included a random sample of individuals who sought care from a family physician. Females and older individuals are known to seek care more often in general practice, and thus would have been more likely to be included in the sample. The extent to which the findings from this research can be generalized to populations beyond South-western Ontario is unknown. In previous studies, episode of care were found to differ by geographical region of care-seeking [48, 50, 52].

5.5 Policy Implications

Patients with complex and multiple concurrent problems are becoming recognized as more frequent than we had noted in the past. Fortin et al. (2005) found that roughly 90% of patients in Canadian family practice had more than one chronic condition and 50% of patients had 5 or more concurrent chronic conditions [68]. The authors reported that the prevalence of multiple health conditions increased with age in both men and women. We also found high levels of comorbidity in our study with 75%, 38.9%, and 17.9% of back pain patients having one or more chronic conditions, musculoskeletal conditions and psychosocial conditions respectively.

Multimorbidity is a large burden in family practice. Starfield et al. (2003) found that patients with higher levels of comorbidity had higher utilization of health resources than patients with lower levels of comorbidity [69]. The authors also found that more physician visits for the index conditions (conditions under study) and the comorbid conditions consistently took place with general practitioners compared to specialist practitioners [69]. These findings are in accordance with our results in which patients with back pain and other conditions, worthy of physician management, utilized more back pain health services and contributed more to the burden of back pain in the primary health care system.

Our results and previous findings indicate that the overall health of patients should be managed instead of the treatment and care of individual conditions (i.e. back pain). We are not the first to make this recommendation. In a 2009 editorial, Kurtz blamed fragmentation of care, or the focus towards individual systems instead of the whole body, as the cause of the problems in the health care system [70]. Similarly, Grumbach (2003) highlighted the need for medical generalism, or a broad health focus, to provide better quality care [71].

These findings also have family physician workload implications in that physicians can recognize that the treatment of back pain in patients seeking care for other conditions will be more complex; the episodes of care will be a greater duration and encompass the utilization of more services. A specific recommendation from this research is to revise the guidelines for back pain management to potentially treat back pain alongside other health conditions more efficiently. The improvement of back pain management is important as sub-optimal treatment, leading to longer periods of back

pain, is very costly to the health care system and to individuals, from lost wages and decreased productivity.

5.6 Limitations of Research

The limitations of this research pertain to the data source utilized. Firstly, information on the nature of back pain was not recorded in the EMR or was not recorded in an accessible component of the EMR. Prior studies have found that back pain duration [32, 33, 35, 51, 52], chronicity [28], disability [28, 31-33, 35], and results from Straight Leg Raise (SLR) tests [33, 51] were related to back pain health care utilization. These variables were likely recorded in the physician's notes and could be accessed with an electronic chart extract.

Another limitation of using EMR data is the inability to assess the completeness of the data. We were unable to differentiate between missing data (when physicians failed to record information in the EMR) and zero counts, such as no medications prescribed, or no investigations ordered. However, there was no reason to believe that the physicians preferentially recorded data based on the episode of care or the patient, so this likely would not have biased our results.

Another limitation (or possible misinterpretation) pertains to the *medication*, *investigation*, and *referral* variables. These variables captured what was recorded in the EMR and not what ultimately resulted. The *medication* variable described what medications were prescribed during the back pain episode of care and did not indicate if the patient filled the prescriptions or was compliant with taking the medications. Similarly, the *referral* and *investigation* variables depicted the referrals and investigations recorded in the EMR during an episode of care but did not capture if these were

eventually conducted. These variables, although open to misinterpretation, were sufficient to satisfy the objective of the research which was to characterize what was happening in a back pain episode of care in family practice.

An additional limitation was the lack of information on the episode of back pain (episode of illness). The end of an episode of care for back pain may or may not signify the end of the episode of back pain. We cannot distinguish between an episode of care ending due to the commencement of back pain (or a distinct break in the back pain) and a patient with pain ceasing to seek primary care from a DELPHI doctor for the pain. In other words, we do not know why the episode of care ended. Future research should ascertain when the episode of back pain ended and/or why the patient stopped seeking care to distinguish between these two possibilities.

5.7 Future Research

Future research with a longer data collection period would allow the examination of research questions that were not possible with the current dataset. Including an additional period of 1-2 years of EMR data would enable the investigation of determinants of recurrent episodes of care. The inclusion of characteristics of past episodes of back pain care as predictors of current episodes of care could be examined. Additionally, a lengthened observation period would enable an extended exploration of comorbidity and care-seeking and their effects on episode of care recurrence.

Future studies could also incorporate physician characteristics as possible predictors of health care utilization. Prior research has found that physician perceived social factors (including their perception of patient dissatisfaction, patient's need for reassurance, repeated patient visits, and patient family or lifestyle factors) influenced a

physician's tendency to order X-rays for back pain [72]. EMR data alone would not allow this exploration as the only characteristics available were physician sex and year of graduation from medical school. The addition of physician interviews would be necessary to pursue this research objective.

5.8 Conclusion

Back pain is one of the most common reasons patients visit their family physician and is a huge financial burden on the health care system and the public. This was the first study to characterize back pain episodes of care in terms of duration, medications prescribed, investigations ordered and referrals made in a Canadian family practice context. This was also the first study to examine back pain episodes of care using EMR data. We explored the determinants of back pain episodes of care and found that patients seeking care for musculoskeletal and/or psychosocial conditions during the episode of care utilized more back pain health services. The findings suggest that a reconsideration of the current back pain management guidelines is in order to potentially provide better care to multimorbid patients. Furthermore, the methods developed in this research will be valuable for future studies examining the utilization of health services and management of health conditions using EMR data.

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APPENDIX A: Extended Investigation Definition

Extraction of Back Pain-Specific Investigations

To define this dependent variable, exploration of additional components of the EMR were conducted to determine what information was recorded in the EMR and how the data was categorized. A record of investigations was one of the datasets within the EMR extract and included information on the type of investigation (i.e. X-ray), a free text description of the investigation purpose, an appointment date (for the investigation), a record creation date, and an encounter number to link to the schedule of physician visits. The dataset contained all the investigations recorded for the patient, not just those specific to back pain. There were 3,357 investigation records for back pain patients.

To isolate the back pain-specific investigations, a list of back related terms was developed including, back, lumbar and spine. The complete list of back related terms is included in Appendix C. This list was verified for comprehensiveness by examining each investigation description to ensure no back-related terms were omitted and then updated. Furthermore, the validity of the coding scheme was evaluated by examining each back-related description for non-back pain text (i.e. rash on back) and these were excluded. Any investigation type with one or more back-related descriptions was deemed back pain-specific and only these investigation types were included in analysis. The back pain-specific investigation types were X-ray, CT, MRI, BMD, and Other.

Rationale for Lag Period in Definition

Of the investigations for back pain patients, 1,502 (44.7%) could not be linked to the physician visit in which it was ordered and thus could not be linked to the episode of care in this manner. Additionally, the appointment date was missing in 333 or 10% of records. Furthermore, the date of record creation, although having no missing values, was complex in that it could represent the date the investigation was ordered, the date the appointment was booked, or the date the results of the investigation were recorded in the EMR. To overcome this problem, the temporally earliest date between the non-missing appointment date, encounter date, and record creation date was utilized. Accordingly, the earliest date may not represent the date of the physician visit when the investigation was ordered, and could be sometime after this date, so a lag period was incorporated into the definition of this variable. To determine the most appropriate lag period, a complete case analysis of the date of physician visit compared to the record creation date and compared to the appointment date found that the 95th percentile of the difference between the dates was 42 days and 94 days respectively. Due to the episode of care definition, a maximum lag period of 90 days could be accommodated and thus was utilized with the understanding that a small percentage of investigations would be excluded.

APPENDIX B: Extended Referral Definition

Extraction of Back Pain-Specific Referrals

The *referral* variable was created using a similar data exploration and methodology as was used to define the *investigation* variable. The referral dataset was utilized from the EMR and contained information on the type of referral (i.e. neurology), a free text description of the referral purpose, an appointment date (with the referred physician), a record creation date, and an encounter number to link to the schedule of physician visits. There were 1,631 referral records for back pain patients. To isolate referrals for back pain specifically, the same method for screening the investigation types by purpose description was utilized. The same methods of confirming comprehensiveness and validity were also conducted. The types of back pain related referrals included neurology, orthopaedics, internal medicine, general surgery, psychiatry, general practice, pain clinic, rehabilitation, radiology, rheumatology, sports medicine, anaesthesiology, and non-specific.

Rationale for Lag Period in Definition

Similar difficulties that were had when linking the investigation to the episode of care were experienced when linking the referral to the episode of care. Of the total back pain patient referral record, 362 records (22.2%) had a missing encounter date and 356 records (21.8%) had a missing appointment date. The temporally earliest date was utilized for inclusion in the episode of care. The complete case analysis of the date of physician visit compared to the record creation date and compared to the appointment date found

that the 95th percentile of the difference between the dates was 68 days and 250 days (75^{th} percentile 73 days) respectively and a maximum lag period of 90 days was utilized.

APPENDIX C: List of Back-Related Terms

back
Back
BACK
bck
Bck
BCK
spine
Spine
SPINE
spinal
Spinal
SPINAL
spn
Spn
SPN
lumbar
Lumbar
LUMBAR
lmb
Lmb
LMB
sciatica
Sciatica
SCIATICA
lbp
Lbp
LBP
sacrum
Sacrum
SACRUM
coccyx
Coccyx
COCCYX
facet
Facet
FACET

APPENDIX D: List of Chronic ICPC Diagnostic Codes

ICPC Code	ICPC Code Description
A21	Risk factor for malignancy
A23	Risk factor NOS
A90	Congenital anomaly nos/multiple
A93	Premature newborn
A95	Perinatal mortality
A96	Death
B71	Lymphadenitis chronic/non-specific
B72	Hodgkin's disease/lymphoma
B73	Leukaemia
B74	Malignant neoplasm blood other
B78	Hereditary haemolytic anaemia
B79	Congenital anomaly blood/lymph other
B90	HIV infection/AIDS
D90	Hiatus Hernia
D92	Diverticular disease
D93	Irritable bowel syndrome
D94	Chronic Enteritis/ulcerative colitis
F74	Neoplasm of eye/adnexa
F81	Congenital anomaly eye other
F83	Retinopathy
F84	Macular degeneration
F93	Glaucoma
F94	Blindness
F95	Strabismus
H80	Congenital anomaly of ear
H83	Otosclerosis
H84	Presbyacusis
H86	Deafness
K22	Risk factor for cardiovascular disease
K73	Congenital anomaly cardiovascular
K74	Ischaemic heart disease with angina
K76	Ischaemic heart disease without angina
K78	Atrial fibrillation/flutter
K82	Pulmonary heart disease
K86	Hypertension uncomplicated
K87	hypertension complicated
K90	Stroke/cerebrovascular accident
K91	Cerebrovascular disease
K92	Atherosclerosis/peripheral vascular disease
K95	Varicose veins of leg
K96	Haemorrhoids
N70	Poliomyelitis

N74	Malignant neoplasm nervous system
N75	Benign neoplasm nervous system
N76	Neoplasm nervous system unspecified
N85	Congenital anomaly neurological
N86	Multiple sclerosis
N87	Parkinsonism
N88	Epilepsy
N89	Migraine
N94	Peripheral neuritis/neoropathy
N99	Neurological disease other
R79	Chronic bronchitis
R89	Congenital anomaly respiratory
R95	Chronic obstructive pulmonary disease
R96	Asthma
R97	Allergic rhinitis
S91	Psoriasis
S97	Chronic ulcer skin
T78	Thyroglossal duct/cyst
T80	Congenital anomaly endocrine/metabolic
T81	Goitre
T85	Hyperthyroidism/thyrotoxicosis
T86	Hypothyroidism/myxoedema
T89	Diabetes insulin dependent
T90	Diabetes non-insulin dependent
T92	Gout
T93	Lipid disorder
U85	Congenital anomaly urinary tract
W13	Sterilization female
W15	Infertility/subfertility female
W76	Congenital anomaly complicating pregnancy
W85	Gestational diabetes
X11	Menopausal symptom/complaint
X88	Fibrocystic disease breast
Y13	Sterilization male
Y72	Genital herpes male
Y85	Benign prostatic hypertrophy

APPENDIX E: List of Musculoskeletal ICPC Diagnostic Codes

ICPC code	ICPC Code Description
L01	Neck symptom/complaint
L04	Chest symptom complaint
L05	Flank/axilla symptom/complaint
L07	Jaw symptom/complaint
L08	Shoulder symptom/complaint
L09	Arm symptom/complaint
L10	Elbow symptom/complaint
L11	Wrist symptom/complaint
L12	Hand/finger symptom/complaint
L13	Hip symptom/complaint
L14	Leg/thigh symptom/complaint
L15	Knee symptom/complaint
L16	Ankle symptom/complaint
L17	Foot/toe symptom/complaint
L18	Muscle pain
L19	Muscle symptom/complaint NOS
L20	Joint symptom/complaint NOS
L28	Limited function/disability (L)
L29	Musculoskeletal symptom/complaint other
L70	Infection of musculoskeletal system
L71	Malignant neoplasm musculoskeletal
L72	Fracture: radius/ulna
L73	Fracture: tibia/fibula
L74	Fracture: hand/foot bone
L75	Fracture: femur
L76	Fracture: other
L77	Sprain/strain of ankle
L78	Sprain/strain of knee
L79	Sprain/strain of joint NOS
L80	Dislocation/subluxation
L81	Injury musculoskeletal NOS
L82	Congenital anomaly musculoskeletal
L83	Neck syndrome
L85	Acquired deformity of spine
L87	Bursitis/tendinitis/synovitis NOS
L88	Rheumatoid/seropositive arthritis
L89	Osteoarthrosis of hip
L90	Osteoarthrosis of knee
L91	Osteoarthrosis other
L92	Shoulder syndrome
L93	Tennis elbow
L94	Osteochondrosis
L95	Osteoporosis
L96	Acute internal damage knee

L97	Neoplasm musculoskeletal benign/unspecified
L98	Acquired deformity of limb
L99	Musculoskeletal disease other

APPENDIX F: List of Psychosocial ICPC Diagnostic Codes

ICPC Code	Code Description
Psychological	
P01	Feeling anxious/nervous/tense
P02	Acute stress reaction
P03	Feeling depressed
P04	Feeling/behaving irritable/angry
P05	Senility, feeling/behaving old
P06	Sleep disturbance
P07	Sexual desire reduced
P08	Sexual fulfillment reduced
P09	Sexual preference concern
P10	Stammering/stuttering/tic
P11	Eating problem in child
P12	Bedwetting/enuresis
P13	Encopresis/bowel training problem
P15	Chronic alcohol abuse
P16	Acute alcohol abuse
P17	Tobacco abuse
P18	Medication abuse
P19	Drug abuse
P20	Memory disturbance
P22	Child behaviour symptom/complaint
P23	Adolescent behaviour symptom/complaint
P24	Specific learning problem
P25	Phase of life problem adult
P28	Limited function/disability
P29	Psychological symptom/complaint other
P70	Dementia
P71	Organic psychosis other
P72	Schizophrenia
P73	Affective psychosis
P74	Anxiety disorder/anxiety state
P75	Somatization disorder
P76	Depressive disorder
P77	Suicide/suicide attempt
P78	Neuraesthenia/surmenage
P79	Phobia/compulsive disorder
P80	Personality disorder
P81	Hyperkinetic disorder
P82	Post-traumatic stress disorder
P85	Mental retardation
P86	Anorexia nervosa/bulimia
P98	Psychosis NOS/other
P99	Psychological disorders other

Fear

A25	Fear of death/dying
A26	Fear of cancer NOS
A27	Fear of other disease NOS
B25	Fear of AIDS/HIV
B26	Fear of cancer blood/lymph
B27	Fear of blood/lymph disease other
D26	Fear of cancer of digestive system
D27	Fear of digestive disease other
F27	Fear of eye disease
H27	Fear of ear disease
K24	Fear of heart disease
K25	Fear of hypertension
K27	Fear of cardiovascular disease
L26	Fear of cancer musculoskeletal
L27	Fear of musculoskeletal disease other
N26	Fear of cancer of neurological system
N27	Fear of neurological disease other
P27	Fear of mental disorder
R26	Fear of cancer of respiratory system
R27	Fear of respiratory disease other
S26	Fear of cancer of skin
S27	Fear of skin disease other
T26	Fear of cancer of endocrine system
T27	Fear of endocrine/metabolic disease other
U26	Fear of cancer of urinary system
U27	Fear of urinary disease other
W02	Fear of pregnancy
W21	Concern about boday image related to pregnancy
W27	Fear of complications of pregnancy
X22	Concern about breast appearance female
X23	Fear of sexually transmitted disease female
X24	Fear of sexual dysfunction female
X25	Fear of genital cancer female
X26	Fear of breast cancer female
X27	Fear genital/breast disease female other
Y24	Fear of sexual dysfunction male
Y25	Fear of sexually transmitted disease male
Y26	Fear of genital cancer male
Y27	Fear of genital disease male other
Z27	Fear of social problem

Social

Z01	Poverty/financial problem
Z02	Food/water problem
Z03	Housing/neighbourhood problem
Z04	Social cultural problem
Z05	Work problem
Z06	Unemployment problem
Z07	Education problem
Z08	Social welfare problem
Z09	Legal problem
Z10	Health care system problem
Z11	Compliance/being ill problem
Z12	Relationship problem with partner
Z13	Partner`s behaviour problem
Z14	Partner illness problem
Z15	Loss/death of partner problem
Z16	Relationship problem with child
Z18	Illness problem with child
Z19	Loss/death of child problem
Z20	Relationship problem parent/family
Z21	Behaviour problem parent/family
Z22	Illness problem parent/family
Z23	Loss/death of parent/family member problem
Z24	Relationship problem friend
Z25	Assault/harmful event problem
Z28	Limited function/disability (Z)
Z29	Social problem NOS

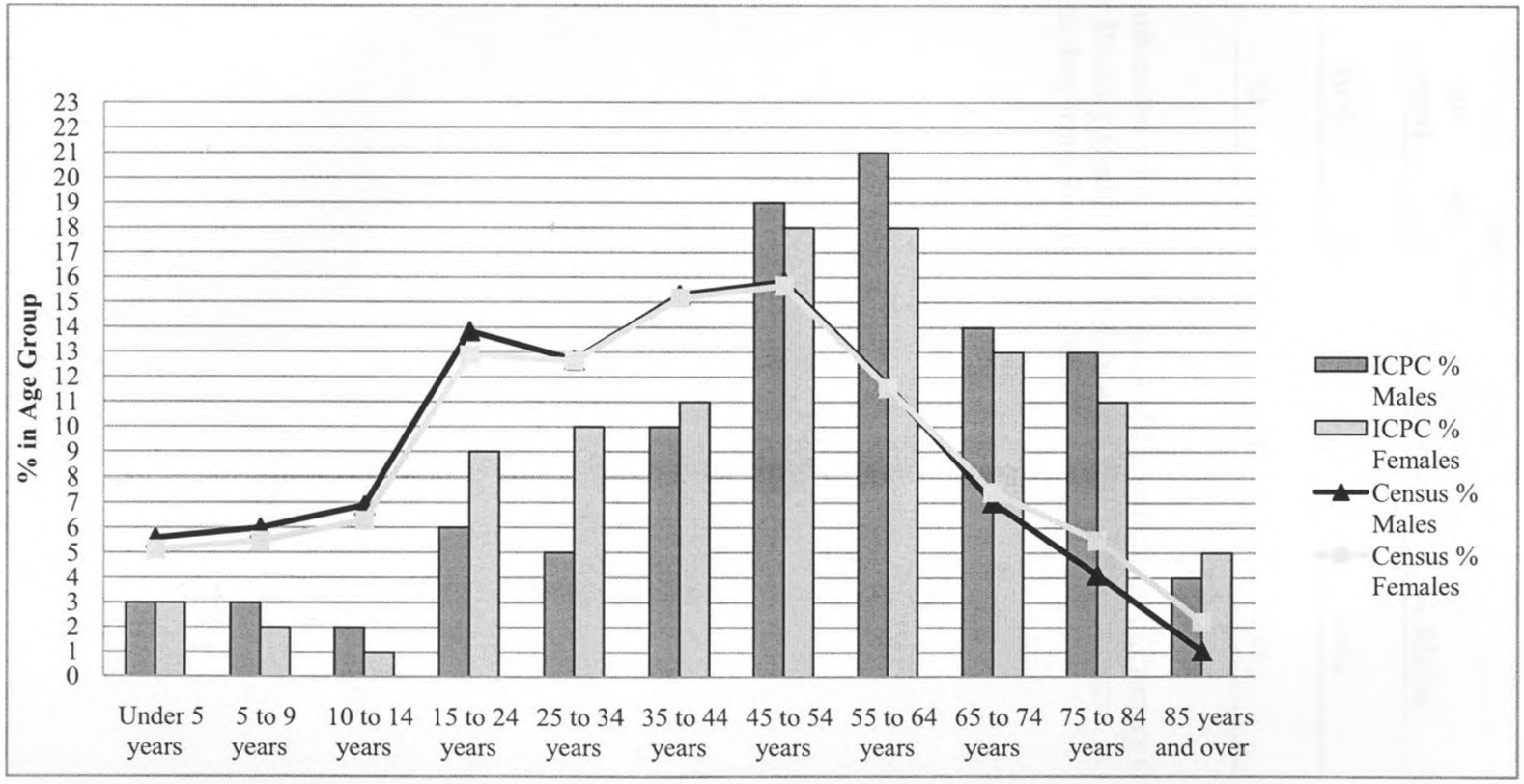
APPENDIX G: Comparison of Included and Excluded Episodes of Care

Characteristic	Included Episodes of Care N=280 (45%)	Excluded Episodes of Care* N=344 (55%)	p-value[+]
Mean Age	58.4	56.7	0.232
Sex n (%)			
Female	154 (55)	167 (48.5)	0.109
Male	126 (45)	177 (51.5)	
Number of Visits n (%)			
1	209 (74.6)	223 (64.8)	0.008
2 or more	71 (25.4)	121 (35.2)	

* A patient may contribute to the included episodes of care and the excluded episodes of care. A patient may contribute more than one excluded episode of care.
[+] Results from two-sample t-tests and Chi-square tests.

APPENDIX H: Comparison of ICPC DELPHI Population and 2006 Canadian Census Population

Graph H: Age-Sex Distribution of ICPC DELPHI (N=3,525)[1] and 2006 Canadian Census (N= 31,612,895)[2] Populations



Notes:

[1] Sample of patients coded with the International Classification of Primary Care (ICPC) from the Deliver Primary Health Care Information (DELPHI) Project.

[2] 2006 Canadian census data from Statistics Canada [67].

Table H: Age and Sex Comparison between the ICPC DELPHI (N=3,525)[1] and 2006 Canadian Census Populations (N= 31,612,895)[2]

	Median Age (years)	Median age Males (years)	Median age Females (years)	% Males	% Females
Census Population	39.5	38.6	40.4	49%	51%
ICPC Population	54	53	56	44%	56%

Notes:
[1] Sample if patients coded with the International Classification of Primary Care (ICPC) from the Deliver Primary Health Care Information (DELPHI) Project.
[2] Canadian census data from Statistics Canada [67].

APPENDIX I: 'Time-Window' Sensitivity Analysis of Number of Visits

Characteristic	Time Window			
	30 Days N=351	60 Days N=321	90 Days N=280	120 Days N=229
Female	-	-	-	
More Severe		+		
History of Back Pain Visits				
Chronic Comorbidity				-
Musculoskeletal Comorbidity			+	
Psychosocial Comorbidity			-	
Chronic Care-Seeking		+		+
Musculoskeletal Care-Seeking	+	+	+	+
Psychosocial Care-Seeking		+	+	+
Age				
Prior Yearly Care-Seeking Intensity	+	+	+	+

Legend:
+ Significant positive relationship
- Significant negative relationship
Blank cell indicates no significant relationship in multivariable analyses or p>0.2 in bivariate analysis

APPENDIX J: 'Time-Window' Sensitivity Analysis of Investigation

Characteristic	Time Window			
	30 Days N=351	60 Days N=321	90 Days N=280	120 Days N=229
Female				
More Severe				
History of Back Pain Visits	-	-	-	-
Chronic Comorbidity				
Musculoskeletal Comorbidity				
Psychosocial Comorbidity				
Chronic Care-Seeking			+	+
Musculoskeletal Care-Seeking	+	+	+	+
Psychosocial Care-Seeking			+	
Age				+
Prior Yearly Care-Seeking Intensity				

Legend:
+ Significant positive relationship
- Significant negative relationship
Blank cell indicates no significant relationship in multivariable analyses or p>0.2 in bivariate analysis