ADVANCING INTERPROFESSIONAL PRIMARY HEALTH CARE SERVICES IN RURAL SETTINGS FOR PEOPLE WITH CHRONIC LOW BACK DISORDERS: A TEAM AND TECHNOLOGY APPROACH

Thesis Submitted to the College of Graduate and Postdoctoral Studies in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the College of Medicine, University of Saskatchewan

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Abstract

Background Rural Canadians are more likely to have chronic back disorders than their urban counterparts. Their barriers to accessing providers with expertise in chronic back disorder management include: reduced availability of local practitioners and lengthy travel requirements. Joining an urban Physical Therapist (PT) with expertise in chronic back disorders with a rural primary team and patient using telehealth may be an option for this disparity in access.

Methods This dissertation includes three studies presented in the following manuscripts: 1) A systematic review examining the use of videoconferencing by PTs for the management of musculoskeletal conditions; 2) A comparison of three different intervention groups: PT_{alone}, Nurse Practitioner alone (NP_{alone}), and NP/PT_{team} to determine the agreement of the models of care on diagnosis and management decisions; and 3) an examination of the experiences of patients and practitioners involved in a ***team and technology*** model of care for chronic back disorders.

Results Gaps in the literature included: few large RCTs and comparative studies, an absence of studies examining interprofessional models of care, no examination of combined telehealth and in-person types of care, and the need for more rigorous study designs to facilitate meta-analysis. The NP/PT_{team} made similar decisions regarding diagnosis and management for chronic back disorders compared to an in-person PT. This demonstrated that the contribution of PT to the team resulted in the same findings as a PT who examined a patient independently. It is a feasible method of managing chronic back disorders in rural areas, and is met with satisfaction by patients and practitioners. Analysis of semi-structured interviews of patients and practitioners who experienced the ***team and technology*** model of care identified the following themes: access to care for chronic back disorders, effective interprofessional practice (team), enhanced clinical care for CBD, and technology.

Conclusions A ***team and technology*** approach to care is comparable to in-person PT for diagnosis and management decisions in chronic back disorders. This approach can enhance access to care for chronic back disorders in rural areas and result in improved clinical care for rural residents with chronic back disorders**.**

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Dedication

This thesis is dedicated to my dad, Rus Lovo, for instilling in me the absolute love of education, and providing me with every possible opportunity to learn and succeed to prepare me for this step. It is also dedicated to my mom, Linda Lovo, who passed away 20 years ago now, for teaching me to push myself to do my very best, in all that I do, and for loving and supporting me every minute of her life. I think you would love this, mom.

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List of Abbreviations

CBD Chronic Low Back Disorder

FHT Family Health Team

ICF International Classification of Functioning, Disability and Health

NP Nurse Practitioner

PICO Population, Intervention, Comparison, Outcome

PT Physical Therapist

RCT Randomized Controlled Trial

WHO World Health Organization

Chapter 1: Introduction

People living in rural and remote parts of Canada face healthcare access disparities compared with those who live in urban areas.(1–4) For rural and remote Canadians with chronic back disorders, additional barriers to care include a shortage of health professionals with specific training in managing musculoskeletal conditions.(5) As a result, lack of appropriate care can result in further chronicity, impairment and functional decline. Telehealth technologies, also known as secure videoconferencing, may facilitate uniting interprofessional teams to provide more patient-centered approaches to care for chronic back disorders in rural and remote regions. Despite clear advantages of telehealth, there is a paucity of research, including randomized controlled trials, evaluating interventions to manage musculoskeletal conditions with videoconferencing. Moreover, no research has compared the use of a team via videoconferencing to other types of care for chronic back pain.

This chapter will cover the relevant issues surrounding this gap in healthcare: rural and remote access issues, the role that physical therapy plays on the healthcare team in the management of back pain, and the ways that videoconferencing technology is currently being used for musculoskeletal management. It will also present the research objectives, provide an overview of methods, as well as the relevance of this doctoral dissertation research.

This dissertation includes three distinct manuscripts presented in chapters 2 through 4. Chapter 2 (manuscript 1) is a systematic review on the use of live secure videoconferencing technologies by physical therapists (PTs) for management of musculoskeletal conditions. Chapter 3 (manuscript 2) presents the concordance of diagnostic and management recommendations between three approaches of back pain assessment: in-person Physical Therapist (PT); in-person Nurse Practitioner (NP) (usual care); and a team where the NP and patient are joined remotely by a PT using secure videoconferencing technology. Chapter 4 (manuscript 3) is an evaluation of the experience of participants and health care providers (i.e. NPs and PT) practicing in an interprofessional team chronic back pain assessment via telehealth. Chapter 5 includes a discussion and conclusion for the entire dissertation.

1.1 Rural and Remote Healthcare Access

1.1.1 Healthcare Access

Defined simply, access is the ability to get health care when needed. (6) Andersen and Davidson (7) expanded this definition to include descriptions of barriers or facilitators to the realized access of health services and assurance of enhanced health outcomes. Aspects of access include: availability (what is available versus the demand); accessibility (where the services are located); accommodation (how are the services are provided compared to limitations people face in receiving them); affordability; and acceptability to the patient. (8) Russell et al.(6) reviewed numerous definitions of access and recommended consideration be given to the type of service needed as well as the needs of the population requiring it. In addition to the Andersen (7) components of access, Russell added geography (how easy is it to get to the service), timeliness (how much time it takes to get care), and awareness (how much the population knows about the services open to them) as important components of access.

1.1.2 Rural Healthcare Access

The Canadian Rural Revitalization Foundation defines ‘rural’ as describing a place with a low density of people, or a place where you have to travel a long way to reach more population density.(9) Thirty-three percent of Saskatchewan’s population lives in rural regions and 16% of rural dwellers are over age 65.(9) Rural Saskatchewan people are older, have less education, less income, and less health care access than people living in urban areas in the rest of the province.(1) This means that, in general, rural people not only make less money than people in urban areas, they need to spend more on things like healthy food and travel for healthcare. There is a general agreement that geography and environment impact healthcare access, and therefore, health.(10, 11)

1.1.3 Rural Care Access Considerations

Components of access include availability of facilities, health care professionals, travel/transportation and costs associated with care.(1,13) Access to health care services in rural Canada is considerably reduced compared with urban locations. Rural socioeconomic challenges, location of communities and aging rural citizens make rural people more susceptible to health problems.(1,13)

Poor weather and associated travel challenges can make it harder in rural areas to access healthcare.(2,1,18) In addition to travel, expenses of care, and wait times are the components that contribute to "realized" access in rural areas.(11) Furthermore, the continuity of care in rural regions can be disconnected by communication, file management issues, and regionalization of services.(12)

The Public Health Agency of Canada considers health services to be a health determinant.(13) Reduced access may not be the only drawback for rural people seeking care. The other question is appropriateness of health care systems in rural settings. Lack of appropriate care is identified as a reason for the higher rates of chronic health conditions in rural regions.(14,15) Appropriate care for musculoskeletal conditions like chronic back pain should include health care team members who practice a biopsychosocial approach[1] to care such as PTs and potentially other team members such as psychologists.(16) Des Meules and Pong suggested that: "the importance of disease prevention and health promotion is well-recognized in public health and clinical settings. What is less clear is whether conventional strategies, mostly developed by urban program planners for urban residents, are equally effective in rural settings." (1, page vi) Primary care models in rural and urban areas may not look exactly the same.

Although health professionals' perspectives on rural healthcare delivery are rarely described in the literature, it would be beneficial to consider the voice of rural health professionals working in rural areas as new care models are examined. Considerations should include what facilitators are required, what team members would help them deliver better and more appropriate care, and ensure these needs are addressed.(17) For example, aside from clinical support, they may benefit from interprofessional education and advocacy (regulatory and professional association involvement), and communication tools that enhance interprofessional practice.(17)

Russell et al. provided a framework for consideration when evaluating rural healthcare access.(6) Several areas within the framework spoke to primary health limitations in achieving equitable physical therapy access in rural Canada. Ideas such as 'hub and spoke' care models and fly-in service are currently-used management strategies in rural Australia.(6) The authors identified "lack of funding and incentives for electronic

[1] The biospychosocial approach is described in more detail in section 1.2.4.2

connectivity for non-general practitioner primary health care providers”(6, page 7) as a gap in policy. They also noted that privately - supplied services, where there is a fee to the patient/client for service, are a barrier to care.

Rural and remote Canadians have less access to primary healthcare than urban residents. This includes reduced primary musculoskeletal care: reduced availability of professionals trained to manage chronic musculoskeletal concerns is one factor in this disparity. Innovative ways to improve access to care in rural areas are needed to improve patient-centered management for chronic conditions.

1.2 Chronic Back Disorders

1.2.1 Epidemiology of Chronic Back Disorders

Back pain is a prevalent public health issue with high social and economic costs. (21, 19) Up to 85% of people have back pain during their lifetime.(18) Chronic low back disorders are the *leading* cause of morbidity worldwide, compared to 289 other disease and conditions, considering years lived with disability.(19) Bone and Joint Canada estimates the expense of chronic back disorders in Canada to be 6-12 billion per year, not including work time lost and the cost of insurance coverage.(20) The World Health Organization (21) described that only 15-20% of spinal problems have a specific, identifiable diagnosis, while the other 80-85% are non-specific. The most common type, non-specific back pain, means there is not a particular disease or identified structure at fault. There is great variability in diagnoses and management of spinal problems, some of which become chronic back disorders. Chronic back disorders are defined as presentation of pain for 3 months or longer, and might include related hip and leg symptoms.(22) Concurrent psychological diagnoses, age, and symptom recurrence of back pain are factors that make recovery more difficult. (23, 21) Chronic back disorders are often accompanied by psychological sequelae, disrupted function and disability, thus it is important to consider not only physical issues, but psychological circumstances as well. (24)

Twenty percent of Canadians report having chronic back disorders (lasting for 6 months or more) and this results in pain, disability, and loss of function (2009-2010 data).(25) Chronic back disorders are a frequent reason for primary healthcare visits,

diagnostic imaging and specialist consultation.(26–28) Twenty-five percent of primary physician visits in the United Kingdom are for musculoskeletal problems, 14% for chronic back disorders alone.(28) Unfortunately, comparable Canadian data are not available. Chronic back pain is a prevalent, costly health problem that can present additional challenges in rural and remote regions.

1.2.2 Chronic Back Disorders in Rural Areas

People living in rural or remote regions are 30% more likely to have chronic back disorders (25) however, access to physical therapy services is limited in rural areas. In rural regions people must travel long distances to receive care for chronic back disorders, which can mean travel in inclement weather, time off work and from family, and high costs associated with traveling for care. Only 10% of PTs practice in rural areas in Saskatchewan (29) while approximately 30% of the population reside in rural areas.

An Australian study qualitatively examined rural peoples' experience with back pain.(30) The first theme was the paucity of patient-centered resources in their home communities. The physician was relied upon for back pain management, and it was noted that there were no specific/tailored services for chronic back disorders. The second theme was that patients reported the rural healthcare team had lower levels of knowledge in pain management. Patients also identified that limited availability of interprofessional care was a weakness in their local systems. They desired access to professionals who were knowledgeable in pain management, and thought telemedicine might be useful in this regard. Reflecting on these findings suggests a place for physical therapists, which is a profession with a unique skill set to enhance musculoskeletal management.

1.2.3 Physical Therapy Access for Chronic Back Disorders

Many jurisdictions in Canada, including Saskatchewan, have regulated direct access to physical therapy care.(31–34) This means that people can seek physical therapy care as a first access point, and without referral from a primary care physician, nurse practitioner, or specialist. PTs have been shown to enhance management of musculoskeletal conditions through triage, and spinal triage can improve the efficiency of orthopedic surgery waitlists.(35,36) Experienced PTs have higher levels of knowledge in managing back pain than physician interns, residents, and all physicians except

orthopedic surgeons.(37) Bath et al. found no significant difference between a PT and an orthopedic surgeon regarding diagnostic categorization of people with chronic back disorders.(38) Furthermore, other primary care providers in rural Saskatchewan expressed difficulty managing chronic back disorders due to poor availability of physical therapy in their home rural regions.(38)

Bath et al. reported 64.7% of the participants over a 3-year period of a physical therapy spinal triage program in urban Saskatchewan were from rural locations.(39) This is a high percentage given only one third of Saskatchewan residents live in rural areas.(9) They indicated that spinal triage PTs may be an important aspect of primary care for low back disorders, in addition to facilitating reduction of wait times for diagnostics and specialist care. Bath and Janzen evaluated satisfaction of patients and professionals following the physical therapy spinal triage assessment.(39) There was a high level of satisfaction with the service, but both participants and referring care providers identified a lack of access to treatment/rehabilitation in their rural community as a perceived barrier to effective care. Despite all of these findings supporting inclusion of PTs, they are rarely involved in primary health care interprofessional teams.

PTs are an important component of the primary management for chronic back disorders, however, few PTs practice in rural areas.(29) As a result much of the care for chronic back disorders in these regions is provided based on a medical model, with the local primary care providers who are NPs and family physicians. Rural patients may travel long distances to urban centers to see PTs, requiring time away from work and family, travel in inclement weather, and difficulty getting recommended follow-up near their home communities. When patients do not have adequate primary care, sequelae such as persisting functional and psychological concerns can be exacerbated.(24)

Nelson et al. (40) described a “transformed” health care system as one where patient and population needs dictate health care models and professional scopes. Each community and individual will have different needs for care (6), so a needs assessment requires community and individual involvement. Situations that will affect the need for enhanced physical therapy services include but are not limited to: work environments and occupational risks (such as higher rates of back injury in a farming community); cultural considerations (Indigenous populations have higher rates of chronic disorders like back

pain, arthritis and diabetes) (41); distance and availability of transport to a regional center. This list is not exhaustive, and other factors may also influence the need for physical therapy services. Communities and patients may perceive their need for physical therapy differently, depending on factors such as: cultural understanding of pain, disability and health promotion; work activities; and family situation. For example, if a person is responsible for young children or elders, they may not be able to travel for care as easily as a person without family responsibilities.

In order to improve access to PT in rural areas, Andersen and Davidson (7) suggested a need to focus on two major components: contextual factors such as governance, facility, health professional, and community/regional issues; and individual factors surrounding each patient (their living situation, health insurance or lack thereof, work setting and support system). Both contextual and individual factors have facilitators and barriers that affect physical therapy access. Social determinants of health are found within contextual and individual factors. In addition to poor availability of physical therapy service, the members of rural communities may not have information about physical therapy or why they would benefit, income to facilitate travel to a regional center or to pay for private service, and they may have comorbidities that affect their ability to travel to a service that is a distance away. This combination of contextual and individual factors results in less physical therapy access in rural locations. Understanding these issues is important to ensure services are appropriately tailored to community needs. Appropriate and reliable evaluation of these issues will then be important outcomes for policy makers in determining the impact and community relevance of interventions, which can inform future resource allocation for rural health systems.

Access to physical therapy in rural and remote regions is clearly reduced compared to urban areas. Given that physical therapists are important team members for chronic back disorder management, innovative models and approaches of introducing physical therapy into rural health teams are needed.

1.2.4 Theoretical Models for Understanding Chronic Back Disorders

1.2.4.1 International Classification of Functioning, Disability and Health

The World Health Organization's International Classification of Functioning, Disability and Health (ICF) is a useful framework for the description and evaluation of

chronic back disorders.(16) Outcomes are demonstrably better when health service planning includes consideration of multiple factors including: body structure and function (impairment); activity limitations (disability); participation in life activities; environmental contexts; and the effect of the condition on the whole person (Figure 1). The ICF can not only be useful in guiding management for a health condition at an individual level, but also as a holistic evaluation framework for health services and interventions.

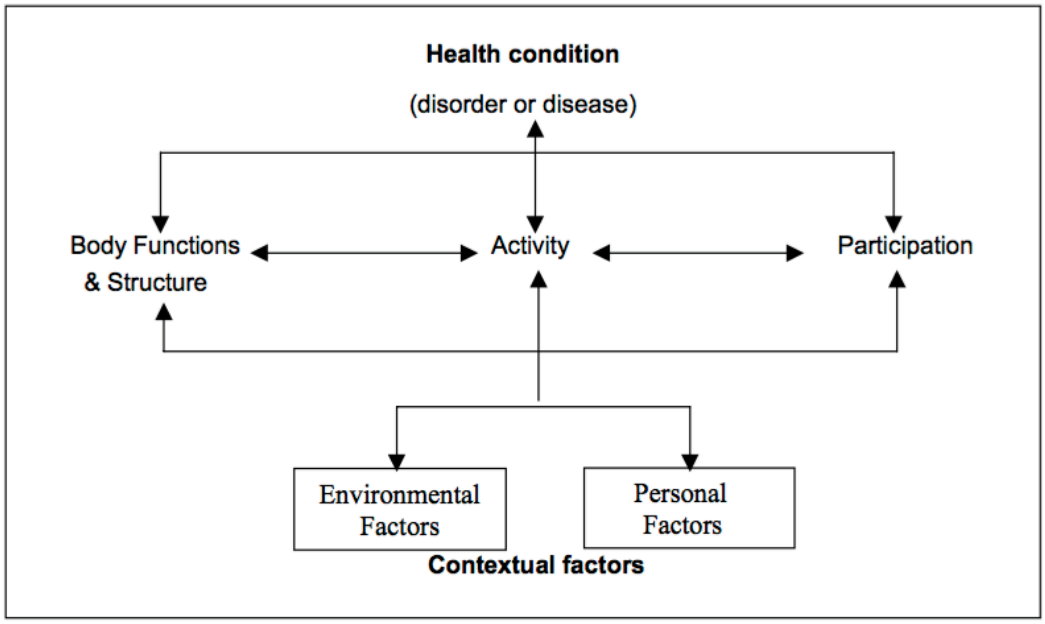

Figure 1. International Classification of Functioning, Disability and Health Framework (14, page 4)

1.2.4.2 The Biopsychosocial Model

The biopsychosocial model is a basis for the World Health Organization's ICF (16) to explain back pain. The biopsychosocial model combines a medical model (about the disease) and a social model (effect of the environment) to describe disability. This model considers the organic or biological factors, personal and societal factors that affect a health condition (in this case, back pain). This is macro-level, a way of looking at chronic back disorder and considering all in the aspects of a person's life that might impact the experience of having the condition. It is important that interventions and outcome measures for back pain interventions consider the biopsychosocial model given the impact that all of these factors have on chronic back pain.

1.3 Technology in Healthcare Delivery

1.3.1 Telehealth, Telerehabilitation, and Secure Videoconferencing

Telehealth joins patients with healthcare professionals using video, audio and health information, and it can include tele-education, tele-consultation (clinical) and home monitoring services.(42) Clinical uses of telehealth might be referred to as telemedicine, telecare, secure videoconferencing and for physical therapy, it can be called telerehabilitation. The use of telehealth in medicine (telemedicine) has become widespread. Telemedicine describes health care delivery and provision of health care information through technologies.(43) Navarro et al. (44) described that in some jurisdictions, telemedicine is being used for multiple forms of health consultations (nephrology, oncology, neurology, nutrition, physical and occupational therapy, and others). It is used in telemonitoring for chronic conditions, pain management and rehabilitation service delivery in the home.(45-47) The clinical use of telehealth is the focus of this dissertation.

Chipps et al. described that "videoconferencing involves a video screen, camera and sound system... video systems vary in terms of the degree of resolution of the video image. Connectivity between sites also varies ranging from high-speed communication networks with high bandwidth to telephone lines for communication and transmission with low bandwidth." (47, page 236, 42) It can be used for educational and/or clinical applications, and can improve speed and efficiency of health service delivery. In 2014 more than 411,778 clinical sessions (all healthcare types) occurred in Canada using telehealth, which was 120% more sessions than just 4 years prior.(42)

1.3.2 Physical Therapy and Secure Videoconferencing

Telerehabilitation technologies such as secure videoconferencing can be used to join urban PTs with rural primary healthcare teams to enhance the management of chronic back disorders through comprehensive interprofessional management. There is emerging evidence for the use of real time video technologies in musculoskeletal physical therapy. Musculoskeletal intervention studies using videoconferencing have focused mainly on physical therapy management of knee, lumbar and upper extremity conditions (47–51); however, none report using an interprofessional team approach. Previous studies

using telerehabilitation models for physical therapy interventions have shown high satisfaction levels (52–54) and positive patient experiences.(47) A systematic review by Kairy et al. (55) demonstrated positive health outcomes after telerehabilitation that were comparable to in-person rehabilitation sessions. Andersen and Davidson explained "efficient access" is "attained by promoting health outcomes while minimizing the resources required to attain improved outcomes."(7, page 15) One of the promising arguments for improving access to physical therapy in rural areas is the low cost compared to that of other primary providers; however, cost analyses for physical therapy and videoconferencing are scarce in the literature.(55) Tousignant et al. (56) and Levy et al.(57) completed the first cost analyses on telerehabilitation and physical therapy in musculoskeletal disorders. Tousigant found overall that in-person visits cost approximately $12 more (for the healthcare system) than telerehabilitation visits.(56) Telerehabilitation savings compared to in person care were 18% from a systems perspective. There was no difference in cost when patients' homes were less than 30 km from the in-person physiotherapy service, suggesting that cost savings may be higher when patients travel greater distances for care. Levy reported significant travel and travel cost savings for the patient when home telerehabilitation was used.(57) Studies that have been completed focus on implementation and travel costs, and no studies have investigated costs as they relate to quality of life or health outcomes. Continuing to rigorously evaluate health outcomes, process outcomes (use of services and satisfaction (58)), and system outcomes (health system performance (58)) will be important in accurately describing the value physical therapy adds to rural communities and health systems. The next section will review the concept of joining the PT to the interprofessional team using telehealth.

1.4 Joining Interprofessional Primary Care Teams via Secure Videoconferencing

1.4.1 Interprofessional Teams in Primary Care

The Saskatchewan Ministry of Health's 2011 Human Resources Plan described two main goals that fit with the present research: patient- and family-centered care providers, and collaborative, interprofessional healthcare practices.(59) The report also

indicated that appropriate access to services in rural and remote regions is a priority and that technology will be important in achieving this step. The Ministry acknowledged that interprofessional teams are a vital step in reaching their healthcare goals.

Starfield defined that a primary care model for service delivery ensures optimal use of resources and health outcomes.(60) In interprofessional collaborative care "the right professional provides the highest quality of care in the right setting and at the right time based upon the needs of the individual patient".(39, page 5) Tham et al. advocated for the use of interprofessional teams in primary care models for rural health strategies. Their protocol utilized a framework to evaluate structure (health service performance), process (use of services and satisfaction) and health outcomes. They selected measurable indicators (qualitative and quantitative) and involved community in their research and planning (integrated knowledge translation).(58)

Goldman described interprofessional development of Family Health Teams (FHTs) in Ontario. One FHT was tasked with creating interprofessional clinical protocols.(17) The protocols as described were similar to a clinical pathway.(61) The FHT also utilized interprofessional education to strengthen their teams. The evaluation of the team building processes identified feedback from the interprofessional team on key points to team-building like: standardization of care protocols; community and administrative engagement; leadership involvement; and ability to learn about each other through small group interactions. Adequate team and stakeholder involvement throughout planning is essential to prepare for these issues.

1.4.2 Physical Therapy on the Primary Care Team for Musculoskeletal Disorders

Murphy et al.(62) described three successful models of interprofessional primary care teams in the United States where PTs demonstrated leadership roles in the evaluation of musculoskeletal problems: the U.S. Army; Kaiser Permanente; and Department of Veterans Affairs. In the U.S. Army, following triage, PTs might have referred to specialists or made referrals for diagnostic imaging. At Kaiser Permanente and Veterans Affairs, PTs were the lead providers on interprofessional teams receiving musculoskeletal referrals. Bath et al. (39) described a Canadian model of primary physical therapy triage for spinal conditions whereby PTs evaluated all of the patients referred to orthopedic surgeons and provided recommendations for management. Caseload efficiency for the

surgeons was improved because people who did not require surgery were removed from the orthopedic surgeon's wait list in favor of more appropriate recommendations. In the context of this thesis, we will examine a model where a PT utilizes telehealth technology to consult on an interprofessional team, leading to assessment and management recommendations for patients with CBD.

1.4.3 Barriers to Interprofessional Team Building over Secure Videoconferencing

Since PTs are in short supply in rural areas, innovative ways of joining them with rural interprofessional teams are important. As rural professionals are already very busy, it is important that planning time for a new interprofessional initiative is part of their regular work hours, and administrative support and education on processes are essential. (17) Goldman presented numerous barriers from the perspective of FHT interprofessional members: they worried about increased workload, change to present care, and changing their own duties. Open discussion early in the process to acknowledge and address these concerns is important. Interestingly, Goldman felt that having professionals located in different areas was a barrier to teambuilding.

1.5 Considerations for New Rural Service Model Concept

In summary, needs assessment as well as community, practitioner, and government engagement are essential in integrating new models of health services into a rural community. Parker et al. indicated: "differing socioeconomic and geographic characteristics of rural communities means that the way interprofessional practice occurs in rural contexts will necessarily differ from that occurring in metropolitan contexts". (63) Nason et al. described a framework to evaluate the return on investment from interprofessional teams. They recommended measurement of knowledge, practice change, and effect on the health system.(64)

There is limited access to PTs in rural and remote regions. People with chronic back disorders would benefit from the addition of PTs to their rural interprofessional healthcare teams due to the expertise of PTs in the management of these problems. (35,37,39) Secure videoconferencing or telehealth is being utilized in the assessment and management of some musculoskeletal conditions by PTs. A systematic review will be helpful to identify the trends in use of secure videoconferencing by PTs and to identify

research gaps. It will also inform clinical interventions. Further evaluation is necessary to examine the agreement of interprofessional secure videoconferencing management to other common forms of management (in person PT and in person NP for example), and to understand the participant and provider experiences with new models of interprofessional care utilizing technology.

1.6 Research Objectives and Overview of Methods and Approaches

1.6.1 Research Objectives of Dissertation

This dissertation will address the following research questions:

1. a) What is the validity and reliability of secure videoconferencing for PT assessment or management of musculoskeletal conditions (manuscript 1)?
   b) What are the impacts of use of secure videoconferencing/telehealth technologies on health, process, and system outcomes in musculoskeletal disorders (manuscript 1)?
2. What is the diagnostic and management concordance of an interprofessional assessment session performed through telehealth compared to a PT or NP only in-person assessment (manuscript 2)?
3. What is the experience of the interprofessional team members and the patients who undergo a team and technology model of care for management of chronic back disorders (manuscript 3)?

An overview of the methods and approaches used to address each of the objectives is presented below.

1.6.2 Examining the Use of Secure Videoconferencing to Improve Access to Physical Therapy for Chronic Back Disorders in Rural Areas: A Systematic Review.

The systematic review (manuscript 1) investigates the uses of secure videoconferencing methods by PTs for management of musculoskeletal conditions. The population of interest was adults 18-80 with musculoskeletal disorders of chronic nature. Where applicable, the control group was usual care. Randomized controlled trials, pre-experimental case designs and quasi-experimental designs were included.

A systematic literature search was performed on 4 databases, and a hand search was undertaken. The search included 2003-2016, English articles only, whose participants were adults undergoing musculoskeletal physical therapy interventions using

secure videoconferencing technologies. The systematic review informed the concordance and telehealth experience research designs.

1.6.3 A Physiotherapist and Nurse Practitioner Model of Care for Chronic Back Pain using Videoconferencing: Diagnostic and Management Concordance

Twenty-seven people with chronic back disorders from Saskatoon and area were each assessed by a PT in person, a NP in person, and a PT joining a NP and patient via secure videoconferencing. The three intervention arms completed a diagnostic classification tool, which described the patient diagnosis and management recommendations for each of the 27 patients. Diagnostic and management decisions for the three groups were compared for agreement. The tool was developed and used in a previous spinal triage study and adapted for use in the present study based on feedback from the health care providers participating in the concordance study.(39) (Appendix A)

1.6.4 Experience of Patients and Health Professionals with Team and technology Approach to Care

In a rural telehealth pilot, 60 participants were recruited and randomly assigned into one of 3 interventions: 1) PT in-person; 2) NP in-person (usual care) or 3) an interprofessional telehealth group (linking an urban consulting PT to a rural NP located with the patient). The PT and NP involved in the interprofessional videoconferencing group completed a semi-structured interview. Out of 20 participants in the telehealth group, n=19 completed the satisfaction with telehealth survey. Six out of 19 completed a follow up semi-structured interview about their experience with telehealth. In total, n=2 health professionals and n=6 participants completed the semi-structure interview on their experience with team and technology. Transcripts from the recorded semi-structured interviews were used for inductive thematic analysis.

1.7 Relevance and Implications

The use of team and technology to manage chronic back disorders in rural regions is a relatively new concept for physical therapy. This innovative model of care unites specialized urban PTs with rural interprofessional health teams using secure videoconferencing to enhance the management of chronic back disorders in the

community. This may have an impact on health outcomes, quality of life, patient satisfaction, and interprofessional team collaboration in managing back disorders.

This research will examine the experience of patients and health professionals who are receiving a team and technology approach to their primary healthcare management for back pain. Overall, this dissertation has the potential to inform new models of service delivery for rural and remote regions, and to address disparities in access to care for people with chronic back disorders.

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Chapter 2: Use of videoconferencing technologies for physical therapy in people with musculoskeletal conditions: A systematic review

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Stacey Lovo Grona's contribution to this systematic review was the complete literature view, all quality analyses, title, abstract and text screening, as well as writing of the manuscript.

2.1 Abstract

Background Physical therapists are key players in the management of musculoskeletal conditions, which are common in rural and remote communities. There are few physical therapists in rural regions compared to potential need, so care is either not provided or must be sought in urban centers, requiring travel, time away from work and family to access services. Telerehabilitation strategies, such as real-time videoconferencing, are emerging as possible solutions to address shortages in rural physical therapy services.

Objectives This review will: 1) determine the validity and the reliability of secure videoconferencing for physical therapy management of musculoskeletal conditions; 2) determine the health, system and process outcomes when using secure videoconferencing for physical therapy management of musculoskeletal conditions.

Methods A protocol driven systematic review of four databases was carried out by two independent reviewers. Study criteria included: English language articles from 01/2003 to 12/2016, physical therapy management using secure videoconferencing, pertaining to adults 18-80 years, with chronic musculoskeletal disorders. Randomized controlled trials, pre-experimental studies and case-control studies were included. Quality analysis was performed utilizing standardized tools specific for the study designs.

Results and Conclusions Validity and reliability studies were identified as having high risk of bias. Intervention studies were of moderate quality, and found positive impact on health outcomes and satisfaction. Two studies evaluated costs, with evidence of cost savings in one study. More robust research is required to evaluate long-term effects of

telerehabilitation for physical therapy management of musculoskeletal disorders, including cost-benefit analyses.

Keywords

Physical therapy, musculoskeletal, telemedicine, telehealth, videoconferencing, rural

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2.2 Background

There are substantial barriers to access health care services in rural Canada compared with urban locations.(1) In addition to higher injury rates, rural and remote residents are 30% more likely to have chronic back disorders (2) and arthritis.(3) Reduced access to appropriate health care is thought to be a reason for higher rates of chronic health conditions in rural areas.(4,5)

Physical therapy is an important component of the management of musculoskeletal disorders, yet it is not readily available for rural and remote residents.(6) For example only 10% of physical therapists practice in rural Saskatchewan, Canada (7), while approximately 30% of the population lives in these regions. Furthermore, rural physical therapists are more likely to be generalist practitioners compared to their urban counterparts.(6) Thus, there is a need for innovative strategies to improve access to more specialized physical therapy care for musculoskeletal disorders in high need rural and remote communities.

Telerehabilitation like secure videoconferencing may be a viable option to improve rural access to physical therapy.(8) Telerehabilitation strategies have been utilized with moderate success to triage orthopedic wait-list patients (9) and link physical therapists with therapy aides in rural regions for home exercise programming.(10) A systematic review on clinical outcomes, process, healthcare use and costs associated with telerehabilitation found that “similar (clinical) outcomes can be obtained using telerehabilitation as compared to a face-to-face or other control interventions”(16,p. 430); however, minimal evidence related to healthcare utilization or cost analyses was noted.

Recommendations for further research from this review included a need for larger sample sizes and more rigor through use of control groups as well as more in depth description of participant experiences. A more recent systematic review focusing on validity and reliability of internet-based physical therapy assessment for musculoskeletal conditions found good validity for range of motion, pain, strength, balance testing, gait and functional assessment.(12) However, the use of videoconferencing technologies for musculoskeletal physical therapy interventions has never been summarized in the literature prior to the present systematic review. The inclusion of both interventions and assessment methods in this systematic review will provide a more up to date and comprehensive resource to help guide the use of videoconferencing technologies in musculoskeletal physical therapy practice.

The use of telerehabilitation is becoming increasingly common; however, evidence to support its use in enhancing access to physical therapy services among people with musculoskeletal disorders is limited. The objectives of this review are to: 1) examine the validity and reliability of secure videoconferencing, 2) determine the impacts on health, process and systems outcomes of using secure videoconferencing for physical therapy interventions on musculoskeletal conditions.

2.3 Methods

2.3.1 Selection Criteria

A PICO (**P**opulation, **I**ntervention, **C**omparison, **O**utcome) approach guided this protocol-driven systematic review. (13) The population was adults 18-80 with chronic musculoskeletal disorders (> 3 months duration).(14) Interventions were physical therapy assessment or treatment, conducted through real-time secure videoconferencing (telerehabilitation). Comparison groups received usual care. Outcome measures of interest included: validity and reliability measures; health outcomes (pain, function, or measures specific to the body part involved); system outcomes (wait times, cost analyses); and process outcomes (satisfaction, experience and number of physical therapy sessions).(11) Randomized controlled trials (RCTs), quasi-experimental and crossover designs, as well as case studies were included. Two different types of studies were identified: validity and reliability, and intervention studies. Validity and reliability studies

did not always have interventions or comparison groups, so the measure was compared to a gold standard or usual practice situation.

Studies were excluded if physical therapists were not involved in the rehabilitative care, or if the intervention did not involve live videoconferencing for musculoskeletal conditions.

2.3.2 Search Strategy and Article Screening

A rigorous search was developed and conducted with a research librarian (15) of 4 databases from 2003- December 28, 2016 (Figure 2.1) followed by hand search of identified full text article reference lists. Search terms are detailed in Appendix 1.

Two physical therapists with training in systematic review independently performed title, abstract and full text screen to determine potential articles using DistillerSR web-based software from Evidence Partners (16). Discrepancies were addressed through discussion and consensus. Quality review was determined in a similar independent review process, with discrepancies addressed through discussion and mutual agreement.

2.3.3 Data Extraction

Articles were grouped into: 1) validity and reliability, and 2) intervention studies. Data extraction for validity and reliability studies included: title, authors, study design, inclusion/exclusion criteria, group description, intervention and timeframe of evaluation, participant numbers, age, dropout reasons, measures of validity (concurrent/criterion) and intra/inter-rater reliability. For those studies examining validity of musculoskeletal tests, telerehabilitation was compared to face-to-face measures. Data extracted for intervention studies included outcomes for health, processes and systems, conclusions, and future recommendations.

2.3.4 Quality Analysis

The Quadas-2 Tool for Diagnostic Accuracy Studies (17) was utilized to assess risk of bias for the articles evaluating validity and reliability (Table 2.1). The Quadas-2 Tool rates risk of bias as low, high (one or more risk areas) or unclear.(17) For case series studies, the criteria described by Hombrados and Waddington (18) was utilized for two studies (Table 2.6). Intervention studies were assessed for bias with the Cochrane Risk of

Bias Tool.(15) One or more areas identified as having a high risk of bias resulted in a determination of high risk of bias for the study.(15) Quality assessment for a qualitative study was evaluated using criteria explained by Popay et al. (Table 2.5).(19) We did not exclude studies from the review based on risk of bias.

2.4 Results

Details of study selection are included in Figure 2.1. Of the initial 1439 studies identified for review, 17 full texts met the inclusion criteria. One hundred and twenty-one participants were evaluated in the eight included validity and reliability studies. Six studies examined validity and reliability, one study examined only validity and another, only reliability. Statistical evaluation of validity and reliability measures is reported for all studies in Table 2.

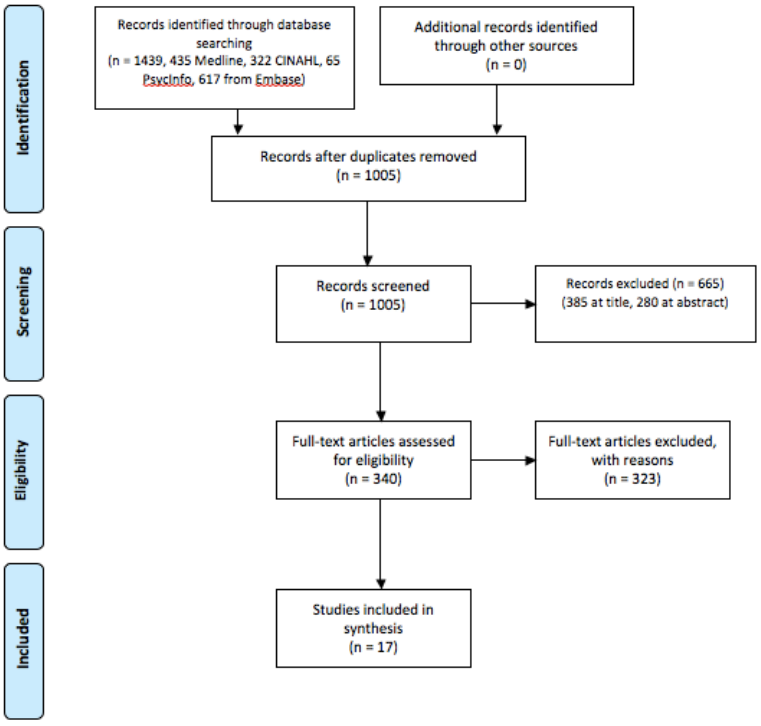

Figure 2.1. Results of Systematic Search (Layout reference Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6):e1000097.doi:10/1371/journal.pmed1000097)

Tables 2.3 and 2.4 provide characteristics of intervention studies. Nine intervention studies were identified: two case studies, one qualitative evaluation without a

control, three RCTs, one retrospective pre-post design, one pre-experimental design without control, and 1 nonrandomized quasi-experimental design with control.

Health outcomes extracted included pain, function and quality of life, and body site-specific special tests. Process outcomes (patient outcomes or professional practice outcomes (20)) extracted were experience, satisfaction, and presence of interprofessional team members. Systems outcomes were economic indicators such as costs and cost-benefits analyses.

Intervention studies were variable in their analyses. Wong et al. (21) and Russell (22) used comparison of means. Eriksson (23) and Tousignant (24) used Mann Whitney U test (between group findings), and Wilcoxon test (within groups). Eriksson (23) was the only study to analyze pain visual analogue scale findings, which demonstrated reduced pain for telehealth greater than the control group. Wong (21) and Eriksson (23) demonstrated improved health related quality of life scores for intervention groups, and Erikkson identified better improvement for the intervention than the control.(23) Tousignant (24) demonstrated that both intervention and control improved in knee function, but the control group continued to improve at the final measurement period, which was not seen in the intervention group. Non-inferiority for telerehabilitation was analyzed by Russell et al. using within group differences and linear mixed models.(25). Levy et al. (26) used Wilcoxon matched pairs to analyze repeated measures. Levy's study was the only intervention which included both in-person and telerehabilitation visits.(26) They found improved health related quality of life and function. Levy was one of only 2 studies that provided economic analysis.(26,27) Tousignant (27) used Students t-tests to find between group differences in costs and two-way ANOVA investigate the effect of distance on outcomes. Kairy's study utilized a qualitative thematic approach for analysis of experience. (28) For all intervention studies, the knee was the most common body part studied. Due to varying study designs, populations and analyses, it was not possible to do meta-analysis.

Risk of bias was determined to be high for validity and reliability studies, using the Quadas -2 Tool (see Table 2.1).(17) Table 2.5 demonstrates the quality assessment for the qualitative study (28) which had low risk of bias. Table 2.6 presents the evaluation of risk of bias for two case series (22,29), which had overall high risk of bias. Table 2.7

demonstrates risk of bias findings for intervention studies, evaluated with the Cochrane Risk of Bias Tool.(15) Only two studies (27,30) out of fie studies had low risk of bias.

2.5 Discussion

This systematic review identified 17 full-texts involving real-time physical therapy interventions utilizing secure videoconferencing. Validity, reliability, satisfaction and health outcomes were frequently measured outcomes. Typically, patients are satisfied with the use of videoconferencing for telerehabilitation. Diagnostic comparison and intervention studies showed too much variability in outcomes measured, methodologies and study designs to facilitate meta-analysis. Study rigor was lacking in some intervention studies due to absence of randomization and control groups, as well as limited participant numbers. There were three intervention studies identified as having low risk of bias. (25,27,28)

In regards to validity and reliability studies, low validity was found for: shoulder (31) and elbow(32) joint assessment, nerve tests around the elbow,(32) and postural evaluation of lumbar spine.(33) Scar assessment of the knee was not reliable.(34) Other measures for shoulder,(31) elbow,(32) lumbar,(33,35) lower extremity,(36) knee(34,37) and ankle(38) were reported valid and reliable for inter and intra-rater reliability with the exception of the elbow,(32) where only intra-rater reliability was found to be acceptable for diagnosis. Risk of bias could be related to several sources: some studies used students instead of professionals as assessors, which may have impacted findings. In general, sample sizes were small. Finally, in repeated measures studies, there is potential for participants to learn movements and procedures, which could alter results. Standard error of measurement (SEM) was not used for reliability studies. SEM is an important assessment of “trial-to-trial noise in the data” or absolute reliability.(39)

Intervention studies identified health outcomes such as pain, function, quality of life and site-specific measures to be similar for face-to-face and telerehabilitation groups. Two studies measured cost (systems outcome)(26,27) and 2 included patient experience (process outcome).(28,40) Patient satisfaction was high to very high for telerehabilitation in the 3 studies in which it was measured.(21,25,26) Kairy et al.(28) identified qualitative themes from 5 cases of home telerehabilitation on post total knee arthroplasty patients (Table 4). Improved pain, vitality and function compared to control were found in a non-

randomized study; (23) and improved function and pain in knee pain participants without a control.(21) A non-randomized, non-controlled retrospective study on veterans receiving home telerehabilitation showed improved function, strong satisfaction, travel and cost savings.(41) Results from two RCTs demonstrated: improved function with telerehabilitation after total knee arthroplasty for short term but not longer-term measurements (27), and telerehabilitation was confirmed non-inferior to control for knee function in a larger RCT.(26) This means that pain and function were significantly better for the telerehabilitation group versus the control group. A larger RCT confirming non-inferiority is a finding that can support clinicians who are considering using telerehabilitation methods for rural and remote patients with knee concerns, and highlights the need for further non-inferiority studies for musculoskeletal populations. Lack of improvement over longer-term trials provides information about the potential need for more support over the length of time of telerehabilitation, and potentially the need for some face-to-face sessions interspersed with telerehabilitation. With respect to planning rigorous research methodologies in the future, larger samples are important to progress this research. A higher number of comparable studies and designs used by investigators might allow meta-analysis in future. In general, risk of bias issues identified in intervention studies included possible motivation (cases), lack of blinding and randomization, and incomplete data reporting. Lack of control in many of the studies limited the ability to relate the outcomes directly to the treatment.

Ideas provided by researchers to improve study designs included usage of an expert assistant, video or pictures to ensure best understanding of procedures, and ensuring that the video camera is sufficient for examinations. Truter et al. (42) recommended that lumbar evaluation procedures for videoconferencing should be developed specifically for that scenario, to ensure best practice. They also recommended evaluating an interprofessional approach to back pain management.(33) Recommendations to ensure detailed history taking, to improve rapport and trust, were noted. This included explaining the telerehabilitation to the patient – to ensure best capture of audio and video.

The review published by Mani et al. on validity and reliability of internet-based physical therapy for musculoskeletal assessment supports our findings.(12) Different

quality assessment tools were utilized for the present review and search terms differed between the two reviews. The authors of the present paper identified similar non-valid assessment components as Mani,(12) suggesting these areas require further focus and development of methods to ensure validity and reliability over telerehabilitation. Our review agrees with the suggestion of Mani et al. that having a trained person with the patient would improve the quality of studies, and this would also apply for intervention studies. Mani suggested it might not be desirable to complete assessments for body parts where validity/reliability were not shown. Improved technologies should be assessed in these situations, as they may improve reliability/validity of assessment procedures. For example, with limitations in scar assessment, higher quality resolution and standardized scar measurement processes may be feasible to evaluate. We agree with Mani's comment "future studies should focus on technological innovation and strategies to overcome these barriers in telerehabilitation".(12,p. 12)

Jennet et al. (43) conducted a systematic review of the socioeconomic impact of telehealth, but there were no studies identified that investigated rehabilitation. Their overarching recommendations included need for: more rigorous RCTs, studies that include health and systems outcomes, and cost studies that include the social impact on people and practitioners. Results of the present review underscore Jenet's recommendations. Two studies in the present review included economic analyses.(26,27) The cost-analysis study from Tousignant et al. (27) was a multicenter RCT with a large sample. They noted early total cost savings when there was greater distance from in-person care, however, the economic analyses did not include cost-benefit analyses, which help to understand the cost impacts for the patient in addition to the health system. Kairy et al. (44) advised that it is important to match cost savings with health outcomes, which has not yet been done. This remains an area for future research.

In most of the included studies the physical therapist is relying on the patient on the other end to execute their instructions adequately during assessment. There were no studies in which an interprofessional healthcare team member was located with the patient. Evaluation of interprofessional care models utilizing videoconferencing technology for the management of musculoskeletal dysfunction is an important future research need. Additional gaps identified for future research included: cost-benefit

analyses, consideration given to patient costs (such as time from work and home, and costs incurred as a result of being away), and longer follow-up measurement periods.

Lawton (45) cited the obvious limitation of telerehabilitation, which is the inability of the physical therapist to touch the patient. Kairy et al. (44) indicated that evaluation of programming that facilitates both methods (in-person and telerehabilitation) is necessary, and the present findings concur with that recommendation. Many health outcomes improve equally for telerehabilitation and control groups, thus supporting equivalency of telerehabilitation models. However, lack of improvement over time was noted in one high quality RCT (25) for the telerehabilitation group, where the control continued to improve. This may speak to the reported preference of patients for some in-person visits combined with telerehabilitation. (28)

2.5.1 Strengths and Limitations

To our knowledge, this is the first systematic review to evaluate interventions using telerehabilitation for musculoskeletal physical therapy care in addition to reliability and validity studies. There are several limitations in this review. Only English language studies were included, therefore relevant published studies, gray literature or unpublished theses in other languages would not have been picked up. Technologies like wearable garments, smartphone, web and software applications, and virtual reality were excluded if there was not real time involvement of a physical therapist. Interventions that did not explicitly include a physical therapist, like occupational therapy and exercise only, were not included.

We have several recommendations for future research in this area. In the validity and reliability studies, participant selection, inclusion criteria and methodology of assessment were sources of potential bias, and should be addressed in future studies. Enhanced rigor of methodologies for validity and reliability studies including participant selection, expert assessors located with the patient, selection of statistical tests and most advanced technology utilized. Lack of control groups and blinding in intervention studies were the major risks noted for bias, however blinding is not always possible or realistic in clinical intervention studies. We recommend further emphasis on randomization and control of intervention studies, as well as economic analyses, patient experience, and interventions that include both face-to-face and telehealth care. A final recommendation

is intervention studies examining interprofessional care models that include physical therapists.

We also have several recommendations and consideration for the use of videoconferencing in physical therapy practice. Telerehabilitation should be described in detail to potential patients to ensure understanding of the setting, which aligns with appropriately detailed consent processes in face-to-face clinical scenarios. A trained assistant located with the patient, or an interprofessional team member, may facilitate and improve the telerehabilitation encounter. Utilization of reliable equipment that optimizes video and audio capacities is recommended. Assessments should be tailored for the purpose of telerehabilitation, taking into account the nature of the environment. Patients should be encouraged to share their experiences, and any personal impacts, from the use of telerehabilition to ensure the clinical care follows the best possible patient-centered approach. Including in-person visits with telerehabilitation programming, when possible, may be beneficial for patient care in some circumstances. For example, after an initial assessment via videoconferencing, subsequent 'hands on' care could be delivered by a physical therapist closer to where the patient lives if possible.

2.6 Conclusions

The use of telerehabilitation may be a viable option for musculoskeletal physical therapy services. Validity and reliability were demonstrated for a number of musculoskeletal physical therapy assessments (31,33,35,38,42,46–48) with the exception of poor validity for elbow (32) and shoulder joint 38] assessment, elbow nerve tests, (32) lumbar posture,[40] and reliability of scar assessment.(34)

Positive impact on health outcomes was noted in intervention studies, for both telerehabilitation and face-to-face groups. More information is needed on patient experience, as well as models to combine telerehabilitation and face-to-face care, and interprofessional models of care. Telerehabilitation models demonstrate cost savings; however, cost-benefit analyses to evaluate the impact of costs for the patient have not yet been done.

To improve advocacy efforts for telerehabilition for musculoskeletal physical therapy, additional large RCTs are needed. Future research should include additional focus on process outcomes like experience and presence of other healthcare team

members, systems outcomes such as cost-benefit analyses, and hybrid programming (some in person visits and some telerehabilitation visits).

2.7 Declarations of Conflicts of Interest

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2.8 References

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Table 2.1 Risk of Bias for Reliability and Validity Studies (Whiting, 2011)

Authors	Could the selection of patients introduce bias?	Are there concerns that the included patients and setting do not match the review question?	Could the conduct or interpretation of the index test introduce bias?	Are there concerns that the index test, its conduct, or its interpretation differ from the review question?	Could the reference standard, its conduct or its interpretation differ from the review question?	Are there concerns that the target condition as defined by the reference standard does not match the question?	Could patient flow introduce bias?	Risk of Bias
Lade, McKenzie, Steele, Russell 2012	yes	no	yes	no	yes	no	no	High
Truter, Russel, Fary 2014	yes	yes	yes	yes	no	yes	no	High
Steel, Lade, McKenzie, Russell, 2012	yes	no	yes	no	yes	no	no	High
Russell, Truter, Blumke, Richardson, 2010	no	yes	yes	no	yes	no	no	High
Russell, Blumke, Richardson, Truter 2010	no	yes	yes	yes	yes	no	no	High

Cabana, Boissy, Tousignant, Moffet, Corriveau, Dumais, 2010	no	no	no	no	no	no	yes	High
Russell, Jull, Wooton, 2003	yes	yes	yes	yes	no	no	no	High
Palacin-Marin, Esteban-Marino, Olea, Herrera-Viedma, Arroyo-Morales, 2013	no	yes	yes	yes	yes	yes	no	High

Table 2.2 Data and Statistical Tests for Reliability and Validity Studies

Authors	Methods/ Design	Inclusion/Exclusion	Mean Age (Range)	N (end)	Reliability	Validity
Lade, McKenzie, Steele, Russell, 2012	Randomized cross-over design. Elbow.	Inclusion=elbow injury or pain, >18 years, English. Exclusion=poor vision or hearing	38 years, SD 13	11	- Diagnosis: **90%, p=0.001** agreement intra-rater, 64%, p=0.11, non-significant inter-rater - ROM, nerve tests, special orthopedic tests, pain response, joint assessment, strength and limiting factor, significant intra-rater and inter-rater **(>68% agreement, p<0.006**) - Severity scale 88% intra-rater (**0.83 weighted kappa**) and 85% inter-rater (**0.82 weighted kappa**) - Numerical Analogue Scale 95% intra-rater and 94% inter-rater (both **0.95 weighted kappa)**	- 73% agreement for systems diagnosis for validity, **p=0.013** - ROM, special ortho tests, pain, strength and limiting factor high validity (>68%, **p<0.006)** -86% exact agreement severity scale for validity, (**weighted kappa 0.69)** 71% similar agreement validity for VAS **(weighted kappa 0.45)** -Nerve tests p=0.62, joint assessment p=0.39 (not valid)

Steel, Lade, McKenzie, Russell, 2012	Randomized, cross-over design. Shoulder.	Inclusion:>18 years, English, Exclusion=poor vision or hearing, concomitant medical that would compromise safety,	30.7 years, SD 14.2. Range 18-60 years	28	-Pathoanatomical diagnosis: intra-rater reliability 100%, inter-reliability reliability 73.08%. (p value not given) -Systems diagnosis: intra-rater and inter-rater **82.1%, p<0.001** -Reliability for physical exam parameters was 66.9-98.3% (intra and inter-rater), **p<0.001 except nerve mobility p=0.007** -Pain: intra-rater and inter-rater: 97.2% , **k=0.95** -Severity: 97.7% inter-rater 99.2% both **k=0.83**	- Pathoanatomical diagnosis 59.72%, (moderate, p value not given) - Systems diagnosis **78.6% agreement, p<0.001**) - ROM **87.4% agreement,** orthopedic tests **75.9%,** strength **87.1%, all p<0.001** - Nerve testing **56.1%, p=0.012** - Joint assessment not significant, p=0.38 - Pain: 76.8% agreement, **k=0.5**, 96% - Severity: 96% **k = 0.66**
Truter, Russell, Fary 2014	Randomized cross-over design: Lumbar.	Inclusion=current or recent LBP. Exclusion= medical safety, lack of communication, inability to mobilize, current severe back pain, neurological symptoms.	43 years (range not provided)	36 (entry), 28 (end). 2 did not attend, 4 dropouts not explained	-Not assessed.	- Posture not valid, kappa below threshold of 0.4 - ROM **all >80% exact agreement, p<=0.001** - Limit to movement 55% agreement**, k=0.37** - Worst movement 65% agreement, **k=0.55** - SLR **r=0.64, p<0.001.** SLR symptoms k=0.64, sensitivity with internal rotation and dorsiflexion **p<0.01**, sensitivity with neck flexion not significant.
Russell, Truter, Blumke, Richardson, 2010	Randomized cross-over. Lower extremity.	Inclusion: pain in lower limb not associated with a joint dysfunction.	26 years, (18-63 years)	19	-System diagnosis 100% intra-rater reliability **(p<0.001**), 89% inter-rater reliability for agreement **(P=0.048).** - Categorical data: intra-rater reliability 94.5% exact and 99.2% similar agreement, **weighted kappa 0.99**. Inter-rater 93% exact and 97.7% similar agreement, **0.98 weighted kappa**. - Binary data: intra-rater 97.4% agreement, inter-rater 95.1% agreement, **p<0.001**	- System diagnosis 79% agreement for validity (p<0.022). - Categorical variables for pain and AROM 77.3% exact and 90.3% similar agreement with **kappa 0.76.** Binary data 82.9 % agreement, **p<0.001**.
Russell,	Randomized	Inclusion: ankle	24.5 years,	15	-Pathoanatomical diagnosis 93.3% exact 6.7 %	- Pathoanatomical diagnosis 53.5% exact and

Blumke, Richardson, Truter 2010	cross-over, Ankle.	pain/dysfunction, English, communication independently mobile, >18 years. Exclusion: unsafe medical condition.	SD 10.8 years		similar intra-rater. Inter-rater 46.7%exact, 53.3% similar -Systems diagnosis 93.3% intra- and inter-rater, p<0.01 -Categorical data 94.3% exact and 4.9% similar agreement for intra-rater, k=0.99. Inter-rater 90.8% exact and 6.5% similar agreement, k= 0.98. -Binary data 99.2% agreement intra and 99.9% inter-rater, **p<0.001**	40% similar -Systems diagnosis 80%, p<0.04. -Categorical data 76.4% exact, similar 12.9% (**k=0.92**). -Binary data 99.3%, **p<0.001**
Cabana, Boissy, Tousignant, Moffet, Corriveau, Dumais, 2010	Randomized cross-over. Total Knee Arthroplasty	Inclusion: recently discharged after surgery.	62 years (age range not provided)	15	-Kripendorff's alpha **0.8** knee flexion ROM, **0.85** knee extension, **0.87** for swelling, **0.85** for strength, **0.86** for TUG, **0.79** Tinetti, **0.76** Berg Balance. - 0.34 for scar (poor reliability)	-Not measured
Russell, Jull, Wooton, 2003	Quasi-experimental, non-randomized, control.Knee..	Not indicated.	24	1	- Intra-rater reliability **ICC = 1.00** for flexion and extension - Inter-rater reliability **ICC = 1.0** flexion and **0.96** extension	**-ICC = 1.0** flexion and **0.99** extension
Palacin-Marin, Esteban-Marino, Olea, Herrera-Viedma, Arroyo-Morales, 2013	Quasi-experimental, cross-over design. Lumbar.	Inclusion:18,Spanish, computer use. Exclusion: spinal disease, infection, tumour, osteoporosis, fracture, structural deformity,inflammatory disease, cauda equina, radicular symptoms,	37 (no range given)	15	-Lateral flexion intra-rater reliability **ICC = 0.95, flexion 0.94, flexion/lateral flexion 0.96, Sorenson 0.94, ASLR 0.95.** -Inter-rater reliability **ICC = 0.92** lateral flexion, **0.92 flexion, 0.93** flexion/lateral flexion, Sorensen **0.92,** ASLR **0.93.**	- Cronbach alpha reliability estimates lateral flexion **0.751**, flexion **0.992**, right side flexion 0.972, Sorensen **0.796**, ASLR **0.968**, Oswestry **0.994**, VAS **0.94**, SF-12 Physical 0.971, Mental SF-12 0.973, Kinesiophobia scale 0.977

		impaired cognition.				

ICC – intraclass correlation, VC = videoconferencing, VAS=visual analogue scale, ROM = Range of Motion, pathoanatomical diagnosis = structure at fault, systems diagnosis – overall diagnosis, SLR = straight leg raise, ASLR = anterior straight leg raise, SF-12= health related quality of life scale

Table 2.3 Intervention Studies: Quantitative Data

Authors	Methods and Groups	Inclusion/exclusion	Mean Age (range)	Number and Dropouts	Intervention	Health Outcomes Pain	Health Outcome SF-36	Health Outcome of Function	Health Outcome Site Specific	Process (Experience, Satisfaction)	Systems Outcomes (costs)
Wong, Hui, Woo, 2005	Pre-experimental design, no control group, pre and post measures	Inclusion: knee pain, functional difficulty. Exclusion: precluding medical, current PT, previous fracture or surgery	75 years, SD 7	27 (entry), 20 (end) 5 dropouts, 2 moved or medical issue	VC (home exercise, education, group sharing) 12 weeks	Not measured	SF-36 improved in 2 domains (physical functioning **p<0.001** and bodily pain **p<0.003**	-Improved knowledge of knee pain **p<0.001** -No change in knee ROM	-WOMAC significance reduced pain 44% **(p<0.024)** reduced stiffness 37**% (p<0.026),** improved function 38%, **(p<0.008)** -Improved quadricep strength **p<0.001,** TUGT reduced time **p=0.006,** Berg Balance Scale **improved p=0.000**	-Satisfaction 80% agree or strong agree with all aspects	Not measured
Eriksson, Lindstrom, Gard, Lysholm, 2009	Quasi-experimental design, non-randomized ,controlled. Shoulder	Inclusion: Swedish language, OA, RA Exclusion: humeral fracture,	70 years (53-85) telehealth group, 73	25 (entry) 22 (end). 3 dropout (no reason)	8 weeks telehealth or usual PT	-VAS improved telehealth **p=0.002**, control **p<0.001**,	-SF-36 significant improved vitality **p=0.004** telehealth and **p=0.001** control,	-SRQ-S improved telehealth **p=0.002** and control **p=0.016** and between	-Shoulder external rotation and flexion improved telehealth p=0.002 and external rotation **p=0.004,** flexion **0.019** for control -Between groups	Not measured	Not measured

		cuff arthropathy, safety, psych or neuro diagnosis, hearing/vision impairment, dementia	years (50-86) usual care			-Between groups telehealth greater than control **p<0.001**	function telehealth **0.021,** general and mental health telehealth **p=0.012 and p=0.004.** -Between groups: improvement of telehealth more than control for pain p=0**.004** and vitality **p=0.001**	groups, more for telehealth than for control **p<0.001** -Constant Score: telehealth **p=0.002,** control **p<0.001**, between groups telehealth > control **p<0.001**	difference telehealth>control external rotation **p<0.02**		
Tousignant Moffet, Boissy, Corriveau, Cabana, Marquis, 2011	RCT for TKA, telehealth vs home PT	Not indicated	66 years	48 entry, 41 analyzed: 3 telehealth lost: medical and moving, 4 control lost to randomization and surgery	2x/week, 8 weeks. Repeated measures 0, 8 weeks, 4 months	Not measured	SF-36 at 4 months measured but not reported	Berg Balance, 30 s chair stand test, TUGT, Tinetti improved 8 weeks, both groups. p values not given. -T1 and T2 no difference between groups	-WOMAC improved at 8 weeks, both groups (no p value given). At T3, WOMAC control improved significantly (no p value). Between T2 and 3, control functional activities section of WOMAC**, p=0.047.** -Between T1 and T3, control group had better physical functioning **(p=0.019)** and less bodily **pain p=0.013).**	Not measured	Not measured

Russell, Buttrum, Wootton, Jull, 2011	RCT: VC group vs usual PT. TKA	Inclusion: >18 years, unilateral TKA. Exclusion: inability to walk, medically limited to rehab.	68 years +/-7.9 years	3 dropouts (medical and refused consent)	6 weeks, VC vs face to face.	VAS NSD between groups.	Spitzer QOL Uniscale, TUGT, NSD between groups.	-Patient Specific Functional Scale signif-icant difference between groups in favor of telemed, **p=0.04**. -Gait Scale NSD between groups.	-ROM NSD between groups. -WOMAC global NSD between groups but both groups improved from beginning to end of trial **(P<0.01**) (one sided 95% upper CI was 2.07, outside noninferiority margin of 1.3; so telerehab noninferior. WOMAC stiffness was significantly improved in favor of telemed**, p=0.04**. Limb girth, quad muscle strength NSD between groups but did improve significantly within groups.	High satisfaction except visual quality.	
Russell, Buttrum, Wooton, Jull, 2004	Pre-experiment al design one shot case study, no control. TKA.	Not identified	not known	31 (entry) 30 (end) 1 dropout, no reason	VC 6 weeks, 1x/week	Not measured	Not measured	-Functional measures (not specified) improved, p<0.001.	-Physical measurements improved p<0.05 knee flexion and other physical measures were not named.	9/10 perceived benefit of treatment and recommendati on for it. 7/10 auditory, visual quality.	

McMullen, 2012	Pre-experimental design, One shot case study. Hand.	N/A	48 years	n/a	Postop Educate, reassure, progress program. W/surgeon (IP)	NPR reduced but not analyzed statistically.	Not measured	Not measured	DASH improvement 68.5 points, ROM improved but not statistically analyzed.	Facilitation of IP team and local (distant) team care	Anecdotal cost savings but not measured.
Levy, Silverman, Jia,Geiss, Omura, 2015	Retrospective pre-post design.	Inclusion: consent, 3+ appointments predicted, in-person treatment not needed.	69% age 50-64	No dropouts	Telehomecare 80.8% MSK disorders	74% home based telerehab and 25% in person sessions. 15+/-6 treatments	Not reported	VR-12 improved p-0.02	Quick DASH, improved FIM **p<0.001**, MoCA **p=0.01**, 2MWT**p= 0.006**	13 item satisfaction - 96% satisfaction or very satisfied.	Miles saved 2774.7+/-3197.4, travel funds saved1151.5+/-1326.9 (NOT including accommodation, food, work loss)
Tousignant Moffet, Nadeau, Merette, Boissy, Corriveau, Marquis,, Cabana, Ranger, Belziie, Dimendger 2015	Multicenter RCT: telerehab vs. usual home visits	Inclusion: awaiting TKA, discharge internet, 1 hour away. Excluded: health problems, LE surgery prior 9 months, upcoming surgery 4	66	205 (entry), 197 (end) 7 dropouts: unhappy with group randomization, recovered internet problems	8 weeks, 2x/week	Not reported	Not reported	Not reported	Not reported	Not reported	-Costs : telerehab saves 18% costs. ($263 savings) (95% CI) -13% cost savings for telehealth group per treatment -Total cost): NSD

		months, cognition, postop complications weight bearing restriction >2 weeks after surgery.		NO PT available, attendance							(P=0.11-0.26) for cost b/t groups when home <30 km. >30km, **p=0.002 and =0.001**

VC = videoconferencing, OA = osteoarthritis, RA = rheumatoid arthritis, TKA = total knee replacement, PT = physical therapy, ROM = range of motion, SF-36 health related quality of life measure, SRS-Q, LE = lower extremity, FIM = Functional Independence Measure, MoCA Montreal Cognitive Assessment, 2MWT=2 minute walk test,

Table 2.4 Intervention Study: Qualitative Study Data

Author	Intervention	Participants	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	satisfaction
Kairy et al. 2009	Pre-experimental case study design. 8 weeks telerehab, 16 in home sessions	N=5, 3 females, 2 males, 44-72 years	Improving access to services with reduced need for transportation	Development of a strong therapeutic relationship while maintaining a sense of personal	Desire for complementing telerehab with in person visits (it would have been helpful at times to see the PT in person).	Providing standardized yet tailored and challenging exercise programs using	Perceived ease of use of telerehab equipment.	Feeling of an ongoing sense of support	Participants agreed that telerehab was a good alternative to in -person PT.

				space. Patients felt heard.		telerehab.			

Table 2.5 Quality Analysis for Qualitative Study (Popay et al. 1998)

Authors	Explained background, objectives, methods, clear discussion, practice relevance	Obvious subjective meaning and context for participants	Responsive to real-life social settings and circumstance	Sample produces knowledge on situational processes	Compare and contrast info on different sources of knowledge	Are subjective experiences presented as knowledge	Movement of research through data, examples, analysis and interpretation.	Claims of generalizability
Kairy et al., 2009	yes	yes	yes	yes	yes	yes	yes	yes

Table 2.6 Criteria for Assessing Quality of Case Designs. (Hombrados and Waddington, retrieved Jun 2014 from: http://studylib.net/doc/8923791/risk-of-bias-assessment-for-experimental-and-quasi)

Authors	1. Was the method of assignment controlled (selection bias)	2. Was group equivalence ensured (confounding bias)?	3. Were Hawthorne Effects controlled? (motivation bias)	4. Is the intervention influencing the control? (spill-overs and crossovers)	5. Was selective analysis controlled (to prevent reporting bias)?	6. Were other biases controlled for (placebo, etc.)	7.Were Type 1 and 2 errors examined (CI and effect)?	Risk of Bias

Russell, Buttrum, Wootton, Jull, 2004	no	no	no	Not applicable	no	no	no	HIGH
McMullen 2012	no	no	yes	Not applicable	no	no	no	HIGH

Table 2.7 Quality Assessment for Intervention Studies (Higgins et al., 2014)

Authors	Q1. Sequence Generation: Has allocation been adequately controlled?	Q2. Allocation concealment: Was the allocation adequately concealed?	Q3a. Blinding participants - Was knowledge of the allocated intervention adequately prevented during the study?	Q3b.Outcome assessors: Was knowledge of the allocated intervention adequately prevented during the measurement of objective tests?	Q3c. Blinding of personnel Was knowledge of the allocated intervention adequately prevented during the study?	Q4. Incomplete Outcome Data	Q5. Selective Outome Reporting	6. Other sources of bias. Was the study apparently free of other problems that could put it in a high risk of bias?	Risk of Bias
Wong, Hui, Woo, 2005	no	no	no	no	no	yes	yes	no	High
Eriksson, Lindstrom, Gard, Lysholm, 2009	no	no	no	no	no	yes	yes	no	High

Tousignant, Moffet, Boissy, Corriveau, Cabana, Marquis, 2011	yes	yes	no	no	no	yes	yes	no	High
Russell, Buttrum, Wootton, Jull, 2011	yes	yes	yes	yes	yes	yes	yes	yes	Low
Tousignant, Moffet, Nadeau, Merette Boissy, Corriveau,MarquisCabana,Ranger, Belziie, Dimendger, 2015	yes	yes	no	yes	yes	yes	yes	yes	Low

3. Transition from Chapter 2 to Chapter 3

The systematic review (manuscript 1) demonstrated that videoconferencing may be a reasonable way to provide PT services for MSK concerns. The following gaps in the literature were identified regarding the use of secure videoconferencing for the management of MSK conditions by PTs:

1. no studies examining interprofessional models of care in the management of MSK conditions;
2. limited information available on patient experience with secure videoconferencing for the management of MSK conditions;
3. no research examining combined models of care (videoconferencing plus in-person treatment);
4. limited research examining costs, especially regarding cost implications to the patients participating in videoconferencing;
5. ongoing focus needed for larger RCT studies involving secure videoconferencing.

The next manuscript will examine an interprofessional model of care, whereby a PT joins a NP and patient using secure videoconferencing for a full neuromusculoskeletal exam of people with CBD. This novel model of care will be compared to in-person NP and in-person PT assessments. Analysis will be made on the concordance of diagnostic and management decisions made by the health care groups.

4. Chapter 3: A Physiotherapist and Nurse Practitioner Model of Care for Chronic Back Pain using Telehealth: Diagnostic and Management Concordance

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This manuscript is not yet submitted for publication. The target journal for this manuscript is Disability and Rehabilitation. As lead author of this manuscript, Stacey Lovo Grona: led and completed the ethics submission; contributed to participant recruitment protocols; substantially contributed to preparation of measurement tools; completed all assessments of the NP/PT_{team} as the clinical PT on that team; and led and completed data analysis, writing and editing of the manuscript.

3.1 Abstract

Purpose Videoconference links between urban-based physiotherapists and nurse practitioners in rural primary care may overcome access challenges and enhance care for rural and remote residents with chronic low back disorders (CBD). The purpose of this study was to evaluate the concordance of this new model of care with two traditional models.

Materials and Methods Each of 27 participants with CBD were assessed by: 1) a team of a nurse practitioner (NP) located with a patient, joined by a physiotherapist (PT) using videoconferencing; 2) in-person PT; and 3) in-person NP. Diagnostic and management concordance between the 3 groups were assessed with percent agreement and kappa.

Results Overall diagnostic categorization was compared for in-person PT versus NP and team: percent agreement was 77.8% (k=0.474, *p*=0.001) and 74.1% (k=0.359, *p*=0.004), respectively. The PT and team demonstrated strong agreement on "need for urgent surgical referral" (96.3%, k=0.649, p=0.000) and "recommendation for PT follow up" (88.9%, k=0.664, p=0.000).

Conclusions The diagnostic categorization and management recommendations of the team for CBD were similar to decisions made by an in-person PT. This model of care

may provide a method for enhancing access to PT for CBD assessment and initial management in underserved areas.

Keywords telerehabilitation, telemedicine, low back pain, physiotherapy, telehealth

3.2 Introduction

Chronic low back disorders (CBD) are a prevalent and costly health problem that disproportionately impacts rural and remote residents. Twenty percent of Canadians have CBD and those living in rural and remote areas are 30% more likely to have CBD.(1) In the year 2014, Bone and Joint Canada estimated that 6-12 billion dollars per year were spent on CBD in Canada, not including time lost at work.(2) Not only costly to individuals, CBD strain health care resources because of high rates of primary physician care visits (3,4), specialist consultations, and diagnostic procedures.(5,6)

CBD are often multifactorial, including functional disabilities and psychological issues.(7) Physiotherapists (PTs), whose specialized knowledge of musculoskeletal conditions may exceed that of most physicians (with the exception of orthopedic surgeons) (8), have much to offer for improving appropriateness and effectiveness of CBD care. One example is that PTs have been shown to improve musculoskeletal management via triage, and spinal triage can in turn improve orthopedic surgery wait lists.(9,10) PTs can play an important role in primary care for low back disorders and may facilitate reduction of wait times for diagnostics and specialist care.(10) This role could have great potential for health care system savings. However, in rural regions such as the Canadian province of Saskatchewan, there is reduced access to PT, especially to those with focused musculoskeletal knowledge. (11, 12) Although there has been much discussion in Canada about the need for interprofessional teams in primary health care service delivery models,(11) the involvement of PTs in such teams is rare.(12) Lack of access to appropriate CBD care in primary health care is exacerbated in many rural and remote communities.(13–15)

The use of e-health technologies, such as telehealth or secure videoconferencing, is a promising means to help improve access to PT services in rural primary health care settings.(16) Although videoconferencing is effective for conducting a patient interview, (17) performing an effective physical examination via this medium is a barrier perceived by many PT clinicians in the adoption of remotely-delivered services.(18) The

primary concern is that elements of a conventional face-to-face physical examination requires the PT to perform hands-on procedures with the patient; (18) a 'hands-on' assessment cannot be achieved via videoconferencing, so adaptation of the conventional uniprofessional (i.e. PT only) assessment must occur. Previous research has examined the validity of individual components of a PT back pain assessment over videoconferencing versus in person assessment, such as range of motion and straight leg raise assessment. In addition to these assessment components, many components require someone to be with a patient at the videoconferencing end to conduct specific tests. Therefore, a novel approach is required to overcome the traditional barriers associated with a 'hands-on' PT assessment. In rural Saskatchewan, NPs are community primary health care providers in rural and remote regions where physician services are limited and this has been shown to potentially be enhancing access to primary health care in those areas.(19) An interprofessional assessment performed by an urban-based PT collaborating via videoconferencing with a local rural Nurse Practitioner (NP) who can perform relevant portions of the 'hands-on' assessment with a rural patient with CBD, may be a novel solution to overcome the barriers of performing an effective remote examination and development of appropriate management/educational strategies. Although it seems promising, this team approach to CBD assessment and management has yet to be evaluated. It is important to understand whether a team of NP and PT joining by telehealth would make similar decisions regarding diagnosis and management as an in-person PT (which in this case, would be an optimal way of adding a PT to a primary care team). This agreement is called concordance.(20)

Objectives

The objectives of this study were to evaluate the concordance of diagnostic and management recommendations arising from: 1) a team consisting of a NP located with the patient and a PT joining via telehealth, 2) an in-person assessment session with a PT only, and 3) an in-person assessment with a NP only.

3.3 Materials and Methods

3.3.1 Patient Recruitment

Twenty-seven people with CBD were recruited from the Saskatoon area in the Canadian province of Saskatchewan. Inclusion criteria included: aged 18-80 years; low back and/or related leg symptoms, which were bad enough to limit usual activities or daily routine and the symptoms had to be present for at least 3 months. People were excluded if they had third-party payer insurance such as Worker's Compensation Board for their back-related complaints, if they had primarily neck or thoracic pain, or if there were language, reading, or comprehension barriers that would limit their ability to fully participate in the study. All participants provided informed consent for their involvement. The study was approved by the Biomedical Ethics Board of the University of Saskatchewan, #12-340. This study was registered with ClinicalTrials.gov NCT02225535.(21) A detailed study protocol has previously been published.(22)

3.3.2 Health Care Professional Groups

PT and NP are both self-regulated professions in Canada. PTs are licensed in each province and have a Bachelor's or an entry to practice Master's degrees. NPs have a Master's level degree and an advanced scope of practice, including ordering of diagnostic tests, prescription of medication and primary patient management.(23) Although the NP model is not implemented in all countries and jurisdictions, in Canada a NP's scope of practice is advanced, as opposed to the scope of a nurse clinician.

Each participant underwent an assessment with all 3 groups: 1) in-person NP (NP_{alone}); 2) a PT joining an in-person NP though telehealth (NP/PT_{team}); 3) in-person PT (PT_{alone}). The NP and PT on the team were different practitioners than the NP_{alone} and $PT_{alone.}$ Participants were instructed before the first assessment that they must not share any information learned from assessments with the subsequent practitioners, and subsequent practitioners reminded them of this requirement.

The NP and PT on the team were located in different rooms, and the patient was located with the NP. The practitioners on that team had 20 years of experience each. The team underwent interprofessional training on each other's competencies prior to the study, which consisted of review with the PT of neuromusculoskeletal assessment

techniques and clinical reasoning specific to CBD, as well as NP considerations of subjective history, medication management and pain management history. The NP on the team performed hands-on components of the assessment such as deep tendon reflexes, muscle strength testing, dermatomal and nerve mobility testing. The NP_{alone} had more than 30 years experience. PT_{alone} had 10 years experience. Both PTs in this study were trained and practiced at the same spinal triage service.(24) The NPs did not practice at the same location.

3.3.3 Measures

All participants completed an intake questionnaire that included information on: 1. personal and medical history; 2. length of time with pain; and 3. numeric pain rating scale (based on the previous 24 hours, rated separately for current, least and most pain on a visual analogue scale from 0-10, with 0 being no pain and 10 being pain as bad as possible).(25) They also completed the Modified Oswestry Disability Questionnaire which consisted of 10 functional items on a 6 point scale.(26,27) Figure 3.1 demonstrates the flow of participants through the assessment groups and the outcome measures collected.

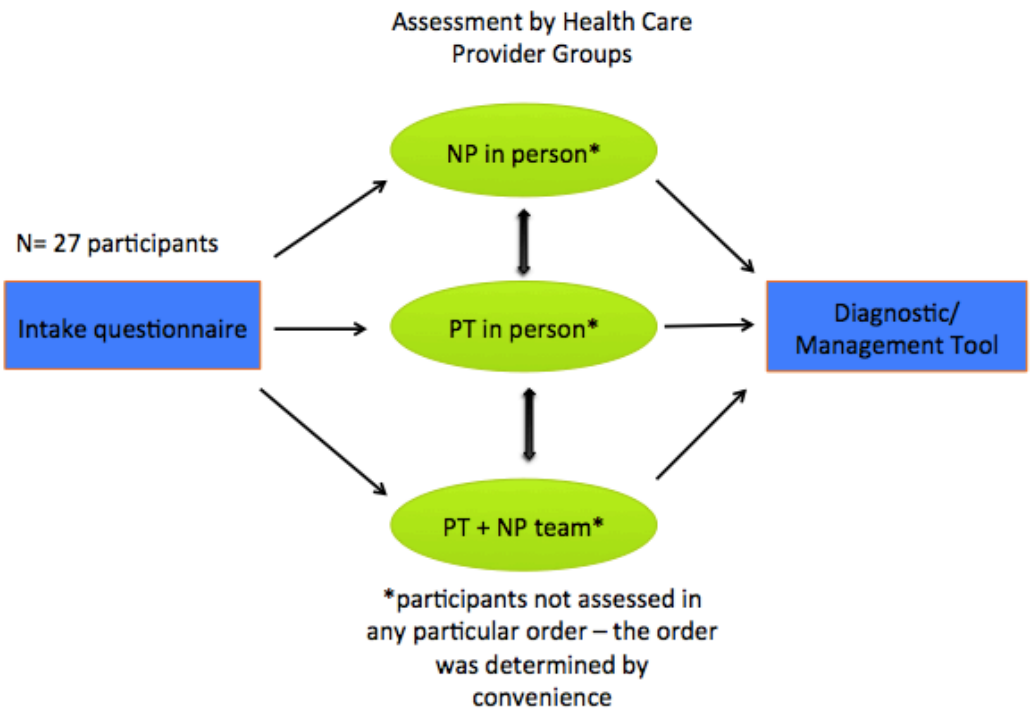

Figure 3.1. Overview of Study Design and Timing of Measures

The time of assessment for each participant, for each health care provider group was recorded. Each group (PT_{alone}, NP_{alone} and PT/NP_{team} completed an online password protected diagnostic classification tool that was previously developed and used in a spinal triage study (28) stored on a software database that was modified to capture an interprofessional management approach (modified tool in Appendix A). The diagnostic classification tool was divided into two main components: diagnostic classification and management recommendations. Variables of diagnostic classification included: 1. Diagnostic Triage: "back pain", "medical", "mechanical other body part" or "spinal cord/ cauda equina" as primary source of problem; 2. Low Back Pain Triage: "serious spine", "nerve root", "non-specific back pain/mechanical" or "not spine related". Variables of treatment recommendations included: "no follow-up", "urgent surgical", "emergent surgical", "PT/Rehab", "surgical and PT/Rehab", "other specialist", "education and self-management", "refer to primary for pharmaceutical management", "imaging or other diagnostics", "lab or other". The categories represented nominal variables.

3.3.4 Analysis

A descriptive analysis of the study sample and the assessment durations for each provider type/group was recorded. The Shapiro-Wilk Test was used to evaluate for normal distribution of variables. Parametric tests were used for normally distributed variables, and non-parametric tests for non-normally distributed variables. For those variables that were not normally distributed, median and interquartile range were presented, whereas normally distributed variables were described with mean and standard deviation. Duration of assessments was compared with independent t-test for PT_{alone} and NP_{alone} and with Wilcoxon's for PT_{alone} vs PT/NP_{team} and NP_{alone} vs PT/NP_{team}.

Overall observed agreement for diagnostic and management categories was calculated as the proportion of cases on which the providers agreed. Level of agreement for diagnostic and management recommendation categories between each provider group (i.e. PT/NP_{team} vs. PT_{alone} and NP_{alone}) was evaluated with kappa (k).(29) Kappa compares category ratings (in this case diagnostic and management recommendation classifications) by independent evaluators and accounts for agreement due to chance. Category adjacency was considered and although some adjacency is inherent in clinical

assessment, in this case categories were determined nominal rather than incremental, so weighted kappa was not used.(30) The classifications of Bertilson et al. were utilized for the present study to interpret kappa values: " <0 'no agreement better than chance', 0-0.2 'poor', 0.21-0.40 'slight', 0.41-0.60 'moderate', 0.61-0.80 'good' and 0.81-1.0 'excellent'.(29) Categories with zero or low cell counts were collapsed and re-coded as kappa is not appropriate to use in cases with 0 cell counts or higher than 90% (or less than 10%) prevalence of an outcome. For diagnostic classification and treatment recommendations, 3 calculations were made on each group, thus, a Bonferroni correction was applied to set the alpha value at 0.017 (ie: 0.5/3).

It was pre-determined that a sample size of 22 patient participants was required to achieve 80% power at 0.60 kappa.(31) The kappa sample calculation is based on 2 raters. A sample size calculation reference for more than 2 raters was not available.

3.4 Results

3.4.1 Participant Demographics

Forty-nine potential participants with CBD were screened. Twenty-seven participants initiated and completed this study. Three cancelled due to resolution of symptoms, 2 cancelled due to illness, 14 had scheduling conflicts and 3 did not attend scheduled assessments. Participant demographics are presented in Table 4.1. More than half of the participants were over age 50 yrs. Sixty-seven percent were overweight or obese as defined by Body Mass Index (BMI),(32) and 70% were female. Fifty-six percent of participants worked full or part-time, while the remainder were students or were retired. The median amount of time living with low back pain was 7 years. Moderate or severe disability (measured as values greater than 20 on the Oswestry Disability Index) (33) was reported by 55.5% of participants.

Table 3.1. Participant Demographic and Health Characteristics

Characteristics	**Frequency (%)**	**Descriptive Statistics**
Age <50 years ≥ 50	 12 (44.4) 17 (58.6)	Mean 53.7 SD 18.1 Range 21-78
Sex - Female	19 (70.4)	
- Male	8 (29.6)	

BMI (kg/m^2)* categories (34) ≥ 25.00 overweight ≥ 30.00 obese	 12 (44.4) 6 (22.2)	Median 27.6 IQR 5.31
Work Status Full time Part time Students Retired Not answered	 8 (29.6) 7 (25.9) 2 (7.4) 9 (33.3) 1	
Comorbidities Headache history Lung/breathing problems Heart problems Stomach problems Other bone/joint problem	 7 (25.9) 3 (11.1) 3 (11.1) 4 (14.8) 20 (74)	
Time with Back Pain (years) < 7 years ≥ 7 years not reported	 11 (40.7) 14 (51.9) 2	Median 7 SE 35.8 IQR 19.5
NPRS Least Most Average	 	 Mean 1.93 Mean 7.70 Mean 4.78
Modified Oswestry (27) Minimal (0-20%) Moderate (21-40%) Severe or greater (>41%)	 12 (44.4) 10 (37) 5 (18.5)	

*BMI=Body Mass Index, SD = standard deviation, IQR = interquartile range, NPRS = Numeric Pain Rating Scale

3.4.2 Comparison between Health Care Professional Groups

NP_{alone} had 22, PT_{alone} group had 21 assessment durations recorded, and NP/PT_{team} had 22 durations recorded. Recording errors account for the 5 times not recorded for NP_{alone} and NP/PT_{team}, and 6 times not recorded for PT_{alone}. The time spent by the NP alone was normally distributed (mean 13.1 minutes, standard deviation 4.1), PT alone was normally distributed (mean 36.0 minutes, standard deviation 8.5), and PT/NP team was not normally distributed (median 31 minutes, interquartile range 13 minutes). Assessment durations for NP_{alone} and PT_{alone} were significantly different ($p < 0.00$) with NP_{alone} having a significantly shorter assessment duration. NP_{alone} had a significantly

shorter duration than PT/NP_{team} ($p < 0.00$). PT_{alone} and PT/NP_{team} did not demonstrate a difference in time spent with participants ($p = 0.24$). Three high-duration outliers were noted for time spent with the $PT/NP_{team.}$ When these outliers were removed, the distribution for time spent with PT/NP_{team} was normally distributed (mean 29.4 minutes, standard deviation 6.40 minutes). When compared with NP_{alone} and PT_{alone} using a t-test, there is still a significant difference between PT/NP_{team} and NP_{alone} (t-test $p<0.00$) and there is also a significant difference between PT/NP_{team} and PT_{alone} (t-test $p<0.00$).

Evaluation of Concordance

Inter-rater percent agreements for diagnostic and management categories are described in Table 3.2. Overall, the lower back was determined to be the primary source of pain in 92.6% of cases by the PT_{alone}, 85.2% by the NP_{alone} and 100% by the PT/NP_{team}. Both PT_{alone} and NP_{alone} classified only 74% of the participants as presenting with mechanical back pain, whereas the PT/NP_{team} felt that mechanical back pain was responsible for 77.8% of cases. PT_{alone} and PT/NP_{team} felt that 7.4% of participants had a non-spine related concern, whereas NP_{alone} felt that 11.1% of participants had a non-spine related problem.

The most common management recommendation made by all provider groups was "PT follow-up" (81.5% for PT_{alone}, 51.9% NP_{alone}, 71.4% for the PT/NP_{team}). The PT_{alone} and NP_{alone} felt that 3.7 % of cases (1 out of 27) required "urgent surgical referral". The PT/NP_{team} referred 7.4% to "urgent surgical referral". PT_{alone} referred 22.2% of participants back to their primary care provider for workup, while the PT/NP_{team} referred back 14.8%, and the NP_{alone} did not refer any patients back for physician workup.

Table 3.2. Prevalence of Diagnostic and Management Recommendations by Group

Variable	PT_{alone} **n/27 (%)**	NP_{alone} **n/27 (%)**	PT/NP_{team} **n/27 (%)**
Diagnosis*:			
Problem in back	25 (92.6)	23 (85.2)	27 (100)
Medical	0	0	2 (7.4)
Mechanical/Other body part	3 (11.1)	5 (18.5)	1 (3.7)
Spinal cord/ cauda equina	0	1 (3.7)	2 (7.4)
LBP Triage			
Serious spine pathology	0	1 (3.7)	2 (7.4)
Nerve root	5 (18.5)	3 (11.1)	2 (7.4)
Non-specific/mechanical	20 (74.1)	20 (74.1)	21 (77.8)
Not spine related	2 (7.4)	3 (11.1)	2 (7.4)

Treatment Recommendations:			
No further follow up	0	1 (3.7)	3 (11.1)
Urgent surgeon referral	1 (3.7)	1 (3.7)	2 (7.4)
Emergent surgeon referral	0	0	0
Referral to another specialist	2 (7.4)	1 (3.7)	3 (11.1)
PT Rehab	22 (81.5)	14 (51.9)	20 (74.1)
PT and Surgical Referral	2 (7.4)	2 (7.4)	0
Education and Self Manage	15 (55.6)	21 (77.8)	2 (7.4)
Refer Primary for Pharm	6 (22.2)	0	4 (14.8)
Imaging and diagnostic tests:	1 (3.7)	1 (3.7)	1 (3.7)
Lab or other	0	1 (3.7)	1 (3.7)

* determination of the source of the participant's symptoms, based on clinical examination

Level of agreement for diagnostic and management categories between each provider group is presented in Table 3. For the PT_{alone} and NP_{alone} comparisons, 'good' agreement (k=0.63) was found for diagnosis of "back problem" and management recommendation of "urgent surgical referral" (k = 0.649). 'Moderate' strength in agreement was found for "overall categorization of diagnosis" (k = 0.474). 'Slight' strength in agreement was found for diagnosis of "medical/other body part mechanical or spinal cord lesions" (k = 0.348), and "referral back to primary practitioner for pharmacology/lab or imaging" recommendations (k = 0.372). All of these were found to be statistically significant agreements with the exception of "medical/other body part mechanical or spinal cord lesions".

For the comparison between NP_{alone} and PT/NP_{team}, 85.2% agreement was found when identifying "the back" as the source of the problem. Kappa calculation was not possible in this case, as the PT/NP_{team} had zero participants identified without a back problem. Moderate agreement was found for a diagnosis of "medical/other mechanical body part or spinal cord lesion" (k = 0.43), and for "referral to other (non-surgical) specialists" (k = 0.471) but only "referral to other (non-surgical) specialists reached significance.

Comparison of PT_{alone} and PT/NP_{team} was 92.6% agreeable for back pain as the primary source of the participant's problem. Kappa cannot be calculated at this high level of agreement (i.e. > 90%).(29,30,35) Strong agreement was noted for "urgent surgical referral" (k = 0.649), and "recommendation of any PT follow up" (k = 0.664). Slight

agreement was found for "overall categorization of diagnosis" (k = 0.359).

Table 3.3 Inter-group Diagnostic and Management Recommendation Concordance

Variable	**PT_{alone} versus NP_{alone} Percent Agreement and Kappa (k)**	**NP_{alone} versus PT/NP_{team} Percent Agreement and Kappa (k)**	**PT_{alone} versus PT/NP_{team} Percent Agreement and Kappa (k)**
CBD Triage Back Problem	**92.6%, k=0.63 (p<0.00)**	**85.2%, k ***	**92.6%, k ***
Medical/Mechanical Other/Spinal Cord Lesion	81.5%, k= 0.348 (*p*=0.05)	81.5%, k= 0.43 (*p*=0.024)	70.4%, k=-0.161 (*p*=0.381)
Overall Categorization	**77.8%, k=0.474 (*p*=0.001)**	66.7%, k=0.176 (*p*=0.166)	**74.1%, k=0.359 (*p*=0.004)**
Management Recommendation No follow up	96.3%, k= *	85.2%, -0.059 (*p*=0.719)	88.9%, k= *
Urgent surgical referral	**92.6%, k=0.649 (*p*<0.00)**	88.9%, k=0.052 (*p*=0.773)	**96.3%, k=0.649 (*p*<0.00)**
Referral to another specialist	88.9%, -0.052 (*p*=0.773)	**92.6%, k=0.471 (*p*=0.004)**	81.5%, k=-0.098 (*p*=0.603)
Referral to PT	59.3%, k=0.063 (*p*=0.683)	63%, k=0.187 (*p*=0.305)	**88.9%, k=0.664 (*p*<0.00)**
Refer to primary for pharmacology/lab/ Imaging	**81.5%, k=0.372 (*p*=0.013)**	77.8%, k=0.156 (*p*=0.326)	66.7%, k=0.090 (*p*=0.639)

*unable to calculate kappa due to 0 count in cell (all 27 out of 27 participants were indicated to have back pain). **Bold indicates agreement is significantly higher than expected by chance,** with Bonferonni correction *p*=0.017.

3.5 Discussion

The purpose of this study was to investigate the concordance, or agreement, of diagnostic and management recommendations arising from three assessment groups: in-person PT_{alone}, in-person NP_{alone} and PT/NP_{team} joined over telehealth.

In the interprofessional assessment, NPs brought significant advantages to the team: history of rapport and trust with the patient, as well as knowledge of medical comorbidities and pain management approaches already tried by their patients with CBD. The consulting PT contributed consultative skills on neuromusculoskeletal assessment techniques, as well as clinical reasoning on the intricacies and management approaches for CBD.

The two PTs (PT_{alone} and PT_{team}) were trained and practiced in the same setting with similar experience in spinal triage, and were accustomed to a similar assessment format. The PT/NP_{team} went through pre-assessment interprofessional training to standardize their assessment. The NP_{alone} followed their traditional assessment approach. The NP_{alone} and NP working with the PT in a team had different practice settings and years of experience. These differences in clinical practice may have contributed to overall findings, however the most likely reason for differences is the presence of the PT on the interprofessional team.

The present study noted strong agreement between PT_{alone} and NP_{alone}, as well as PT_{alone} and PT/NP_{team} with respect to “overall diagnoses” and management decisions such as “need for urgent surgical referral” and “follow up PT”. Although concern has been expressed that elements of a conventional face-to-face physical examination require the PT to be “hands-on” with the patient (18), in the present study adapting a neuromusculoskeletal assessment to an interprofessional approach of the PT/NP_{team} resulted in similar outcomes for “overall diagnosis” and “management recommendations” as an in-person PT assessment.

PT_{alone} and NP_{alone} comparisons had ‘good’ agreement on the management recommendation for “urgent surgical referral”, and ‘moderate’ strength in agreement for “overall categorization of diagnosis”. NP_{alone} and PT/NP_{team} had 85.2% agreement for identification of “the back” as the primary source of the participant’s problem, but had lower agreement on overall diagnosis or recommendation for “urgent surgical

management". PT_{alone} and PT/NP_{team} were 92.6% in agreement that the back was the source of participants' problems, and 'strong' agreement was noted for "urgent surgical referral", and "recommendation of any PT follow up".

Participants spent a mean of 13.1 minutes with the NP_{alone}, 36 minutes with the PT_{alone}, and 31 minutes with the PT/NP_{team}. NP_{alone} assessment durations were significantly less than both PT_{alone} and $NP/PT_{team.}$ This may be an important factor in the consideration of a new model of care. The increased length of assessment durations noted with the PT/NP_{team} compared to NP_{alone} would come with increased cost for the healthcare system due to the need to pay two practitioners in the telehealth model. However, this refers only to the cost of clinician time, without any reference to travel or time cost to the patient, which are important future considerations for this model of care, since they may represent cost savings to the patient. The present study did not collect information on direct cost savings to the patient which may have been realized due to the team model, for example time and travel already noted, as well as the potential cost savings due to identification of referral needs in the case of medically complex patients, which occurred in the team model. The systematic review by Wade et al. found that medical and specialist care models using telehealth for rural outpatient services also identified studies where telehealth was determined more expensive than the control (in terms of costs of health care services).(36) To the best of our knowledge, there are no cost analyses for PT involvement in an interprofessional care model using videoconferencing.

In terms of longer assessment times on the PT/NP_{team}, there were 3 outliers out of 22 (71, 65 and 55 minutes), which may provide valuable cases to demonstrate the enhanced effectiveness of the team approach. In the three cases, the PT/NP_{team} identified complex medical concerns. In the first case, the PT/NP_{team} made referral to geriatric assessment unit for medical review, occupational therapy and PT for reconditioning and treatment for mechanical degenerative pain (of the lumbar spine). PT_{alone} recommended that individual treatment by a lone practitioner would not likely be effective, and that the patient required a team approach to care. NP_{alone} recommended return to physician for workup, and noted the importance of social connections and psychological treatments to be ongoing. With the final two cases, it appeared that the PT/NP_{team} made unique

contributions to management recommendations in comparison to those made by the PT or NP alone. In the second outlier, PT/NP_{team} recommended full cardiac, neurological and metabolic workups with the primary provider due to reported: excessive thirst, diminished bilateral foot sensation, noted dyspnea/wheeze, deconditioning, diaphoresis, history of syncope, and diminished memory. NP_{alone} recommended "referral back to primary provider" due to concerns of generalized weakness, proprioceptive and sensory difficulties. PT_{alone} recommended possible candidate for facet injection. In the third outlier case, the PT/NP_{team} reported widespread irritable capsular restrictions including bilateral hips and cervical spine and recommended PT follow-up. NP_{alone} recommended self-care with videos on posture, as well as continued exercises given by the patient's own PT. PT_{alone} had recommended PT follow-up and self-care for the lumbar pain. However, the third case was more likely indicative of osteoarthritic flare up and involved screening of hips and cervical spine to confirm; this additional screening required a greater length of time.

The present study examined a full, comprehensive neuromusculoskeletal assessment process and clinical reasoning process for the management of CBD. Previous research using telehealth for back pain has focused only on specific assessment techniques, or portions of assessments. Truter et al. determined that assessment of lumbar range of motion over telehealth was valid.(37) Palacin-Marin et al. reported strong inter and intra-rater reliability for lumbar range of motion and straight leg raise assessments. (38) No previous studies have examined the concordance, or level of agreement, of a full neuromuscular assessment and associated clinical decision-making in comparison to a reference standard of in-person PT assessment.

Reduced access to PT in rural and remote regions is a known healthcare disparity. Bath and Janzen found that patients appreciated the expertise and education provided by an in-person PT for their back pain, but that this did not solve the problem of limited rural access to PT.(15) Briggs et al. interviewed rural Australian people with CBD. They found that some of the participants expressed dissatisfaction with limited access to both interdisciplinary care and practitioners with experience managing pain. Participants raised the idea of telehealth technologies for improving care.(39) The present study demonstrates the feasibility of bringing a PT consultant to a rural team for CBD

assessments using telehealth, which could improve access to PT in rural areas. The NP/PT_{team} decisions about overall diagnosis, referral to surgeon and referral for PT showed adequate agreement with the decisions of a PT_{alone}, which means similar decisions were made through the team assessment over telehealth, as would have been made if a PT_{alone} assessed the participants.

3.5.1 Limitations

There were several limitations to this study. Participants underwent assessment by all three professional groups in one day. This format may have theoretically contributed to patient fatigue or exacerbation of pain, especially in the more compromised patients with noted comorbidities. Another limitation is that order of assessment was determined by convenience due to lack of space and availability of professionals, so randomization and sequencing to the 3 assessment scenarios was not feasible.. It is possible that although participants were instructed not to do so, they may have behaved differently or been sensitized to questioning in subsequent sessions due to learning of assessment approaches and questions. This potential effect was not counterbalanced by random presentation of conditions.

This model is based on an interprofessional team consisting of a PT and a NP. In Canada, the NP is a self-regulated professional with advanced scope of practice. NPs are able to order diagnostics, prescribe medications and perform other skills that are not within the scope of a nurse clinician. This may limit the generalizability of these findings to teams with similar health practitioner scopes of practice. For example, in other jurisdictions around the world there is not a NP role, or regulatory allowances for this role differ. In the United States for example, there is not consistency among all of the states as to what advanced roles an NP is allowed to perform with the scope of their duties.(40) The findings would not necessarily be transferable to jurisdictions without advanced scope roles such as a NP.

The diagnostic and management concordance tool for CBD is a previously used instrument with operational definitions.(41) However, it is a complex tool with many possible categories and it is possible that the practitioners could vary in their interpretations despite the operational definitions and training. For example, “education and self care” was selected a number of times by PT_{alone} and NP_{alone}, but rarely by the

PT/NP_{team}. This may indicate that the PT/NP_{team} included this information as part of the assessment and discussion with the participant, rather than considering it as a separate recommendation.

Cohen's kappa is based on comparisons of 2 raters.(30) In this study we had three groups to compare, so repeated calculations were done between pairs. Kappa cannot be utilized when one of the options had a "0" cell count, which happened when the PT/NP_{team} selected all 27 participants as having back pain as their primary problem. Both the NP_{alone} and PT/NP_{team} agreement for "back pain" diagnosis were very high (over 80% and 90% respectively) but (k) could not be calculated.

3.6 Conclusion

This is the first known study to evaluate concordance of a "team and technology" approach for CBD care with more traditional forms of single-provider in-person care for CBD. The 'team' consisted of a PT joining a NP and patient using telehealth. This study is also the first to examine full neuromusculoskeletal assessments for CBD. There was 92.6% agreement for PT/NP_{team} and PT_{alone} with respect to a back pain diagnosis, as well as 'strong' agreement for recommendations of "urgent surgical follow-up" and "referral to PT" management needs following lumbar neuromusculoskeletal assessment. The team model using telehealth was an effective model of care in this study. It is an option for integrating a PT into a care team, in comparison to PT_{alone}, that may be suitable for rural and remote primary care teams who manage CBD. Decisions of diagnosis and management are in strong agreement with those made by PT_{alone}. The addition of a team to provide care in comparison to a PT_{alone} or NP_{alone} appeared to result in unique management considerations for three complex cases with co-morbidities. This may suggest enhanced quality of care for patients with multiple co-morbidities. Future research should focus on evaluating the feasibility and effectiveness of this new model of care in a rural/ remote setting, ideally through randomized controlled trials, to compare different models of care on health and systems outcomes for patients with CBD. Future research should also include other primary practitioners working with the PT and patient – for example nurse clinicians and physicians. Focus on patient and practitioner experiences with a team and technology approach would provide additional information

about the potential value of this proposed model of care and be a valuable addition to future studies.

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3.8 Declaration of Interest

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5. Transition Chapter 3 to Chapter 4

In the second Chapter, a systematic review identified gaps in the literature including few RCTs and no studies including interprofessional models of care for management of musculoskeletal disorders, and a paucity of research on participant experience with telehealth models of care for PT management of musculoskeletal disorders. Chapter 3 evaluated an interprofessional team approach to management of CBD by examining the diagnostic and management concordance of three intervention groups managing CBD: 1) in-person PT; 2) in-person NP; 3) PT joining an NP and patient utilizing secure videoconferencing. The study determined that an NP/PT_{team} made similar decisions as an in-person PT regarding overall diagnosis of back pain, whether or not urgent referral to a surgeon was needed, and whether PT follow-up was recommended. This indicated that if a PT joined an NP and patient using secure videoconferencing, the decision making about CBD diagnosis and management planning would agree with the decision made by an in-person PT.

The concordance study described in Chapter 3 occurred in an urban location, which leaves a gap in terms of the use of this model of care in a rural location and with a rural health care team. The concordance study provided a quantitative look at the diagnostic and management concordances of the PT/NP_{team} approach to care, when compared to PT_{alone} and NP_{alone} models. The participants in the subsequent study (Chapter 4) were recruited from an RCT conducted in a rural location, whereby an urban PT used secure videoconferencing to join and NP and their patients in a rural area. This is an approach similar to that used by the NP/PT_{team} described in Chapter Three. Chapter Four focuses on the experiences of both patients and practitioners involved in the NP/PT_{team} model of care and uses a qualitative, inductive thematic approach to analysis. This will address the final objective of the dissertation.

6. Chapter 4: Experience of Patients and Practitioners with a Team and technology Approach to Chronic Back Disorder Management

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This paper has not yet been submitted for publication. Stacey Lovo Grona led ethics submissions and contributed substantially to preparation of evaluation tools, assisted with marketing and recruitment of participants and monitoring participant submission of measurement tools by appropriate timelines. She was the PT on the NP/PT_{team} and therefore involved with all assessments for that team. She was the first reviewer for qualitative analysis, and met with review team for all qualitative analysis components. She drafted this manuscript and completed all edits.

4.1 Abstract

Although rural and remote residents face general challenges accessing health care in comparison to urban dwellers, care for musculoskeletal conditions like chronic back disorders (CBD) is particularly challenging for rural and remote residents due to lack of access to Physical Therapists. Telerehabilitation such as secure videoconferencing offers one solution to this disparity in rural care delivery, but incorporating the perspectives of health practitioners and patients is important when developing new sustainable care models. This study investigated the experiences of practitioners and patients during a novel interprofessional model of assessment where an urban-based Physical Therapist used videoconferencing to virtually join a rural Nurse Practitioner and a rural patient with CBD. Patient surveys and semi-structured interviews of practitioners and patients were analyzed quantitatively and qualitatively. Most patients were 'very satisfied' (62.1%) or 'satisfied' (31.6%) with the overall experience, and 'very' (63.1%) or 'somewhat (36.9%) confident' with the assessment. Thematic analysis of interviews revealed that this novel assessment method identified: access to care for CBD, effective interprofessional practice, enhanced clinical care for CBD, and technology considerations. These findings will be useful in the development of patient-centered models of care utilizing telehealth strategies.

Keywords: telemedicine, interprofessional relations, low back pain, physiotherapy, patient-centered care

4.2 Introduction

Rural and remote Canadians experience difficulties accessing healthcare that are not experienced by urban dwellers.(1–3) Travel and weather can make healthcare access very difficult.(1,2,4) In order for rural and remote patients to access care by physical therapists (PTs) who specialize in musculoskeletal care it may be necessary to travel long distances, since practitioners who specialize in these conditions are in particularly short supply in rural areas.(5) Travelling long distances for care also means time lost from work and family activities.

Rural healthcare disparities can be seen within the broader health care access literature. Most notably, Thomas and Perchansky identified several important aspects of access to care: availability, accessibility, accommodation, affordability, and acceptability to the patient.(6) In terms of availability, there are fewer health care professionals in rural than urban areas. (1,7) PTs are an example of a profession with reduced numbers in rural and remote regions. One third of Saskatchewan residents live in rural areas (8), but only 10% of PTs work in rural areas.(5) This lack of rural access has particular implications for chronic musculoskeletal disorders. One study compared experienced PTs knowledge of musculoskeletal disorders to that of physicians and specialists, and found PTs had greater knowledge about musculoskeletal management than physicians, except orthopedic surgeons (9). This helps to underscore why the inclusion of PTs on primary care teams managing CBD is important.

Due, at least in part, to the lack of PTs in rural and remote areas, physicians and nurse practitioners (NPs) are primarily involved in management of CBD in rural and remote regions. NPs are primary healthcare providers who practice autonomously in clinics where physician numbers are reduced.(10) In Saskatchewan, 55% of NPs practice in rural locations, compared to 25% of family physicians.(11) Shah et al. found that NPs may be improving primary healthcare access in some rural Saskatchewan areas, such as Kelsey Trail Health Region (the site of the present study).(12) NP's provide the first portal of entry into the health care system for many patients. Following a physical exam and appropriate investigations, the NP facilitates a referral to the appropriate health professional.(13)

The lack of appropriate access PT services is all the more acute for rural and remote residents; rural and remote Canadians are 30% more likely than urban dwellers to have CBD.(14) Salemink refers to a rural paradox, which describes the situation in which rural areas that need enhanced digital access the most, are the ones who have it the least.(15) A rural paradox is also found in the diminished PT services available to rural Canadians who are more likely than urban people to have CBD. In a Canadian study, the majority of users (64.7%) of an urban-based spinal assessment program led by PTs were from rural and remote areas, highlighting a potential need for more rural and remote CBD services.(16) Notably, patients and rural referring primary care providers of the spine triage service identified limited PT availability as a barrier to managing CBD in their region.(17) Briggs et al. studied the experiences of rural Australians with back pain (18); patients described limited resources, and particularly limited CBD-specific care. Patients reported that rural health care teams lacked pain management experience and "integrate(d) care with other non-medical practitioners" for interdisciplinary management planning.

Innovative ways to bring PTs and other professionals to rural areas to join primary healthcare teams are needed to enhance care for CBD. Patients in Australia showed optimism about using telemedicine to improve availability of pain management professionals.(18) Telehealth has been used for PT assessment of some components of spinal conditions, such as measurements of range of motion and straight leg raise.(19,20) The obvious disadvantage to PT over telehealth is the inability of the PT to directly perform physical components of the assessment. To address this, Lovo Grona et al. completed a lumbar neuromusculoskeletal assessment and management protocol for a CBD patient using remote presence robotics,(21) in which an urban PT consultant joined a NP and patient in a remote northern area. This case study was the first known *team and technology* approach to management of CBD in the literature. The NP performed all physical components of the examination, with the PT consulting. Further investigation joining PTs with rural and remote care teams using telehealth strategies to improve options for rural patient care are needed.

Enhancing access to PT in rural and remote regions could be facilitated through a *team and technology* model of care, which capitalizes on complementary

interprofessional skills sets, such as those of PTs and NPs. PTs are primary practitioners with expertise in injury and functional recovery, pain management, and movement. NPs are primary practitioners with advanced scopes of practice including completing referrals to specialists, ordering diagnostic imaging, and prescription of medication. Both practitioners have expert knowledge and skills in patient assessment. Given their complementary skills a PT/NP team approach would appear ideal, but this approach would only be successful if it were responsive to the goals of both patients and practitioners. Goldman et al. evaluated interprofessional practice protocols and discussed the importance of health professionals' opinions on development and acceptance of new models of care.(22)

Understanding the experiences of patients and practitioners is vital to designing effective service delivery strategies for new care models in rural and remote regions. In a systematic review, Kairy et al. reported limited available evidence on patient experience with telerehabilitation.(23) One study reported positive experiences among 5 patients who were cared for by a PT using telehealth,(24) and a single case study reported on the experience of a patient and NP who utilized a team and technology approach.(21) The present study will build on the case study by Lovo Grona et al., which examined the experience of one patient and one practitioner with a *team and technology* approach to care.(21)

The objective of this study was to describe the experience of healthcare providers and patients who participated in a *team and technology* model of care for management of CBD. This study will examine the experiences of the interprofessional team members and the patients who participated in the team and technology model of care for management of CBD.

4.3 Methods

4.3.1 Participants and Research Design

A randomized controlled trial (RCT) pilot study was conducted in a rural community 264 km drive from the research center. PT was not available within the community, and patients who required PT needed to travel 30 minutes to a regional center, after an approximate 6-month wait. A detailed description of participants and

research design are presented elsewhere.(25) One of the intervention groups received assessment and initial management of their CBD by a team consisting of a NP, located with the patient, and a PT, who joined them via secure videoconferencing. Prior to onset of the study, as well as once during the study and after it was completed, the PT travelled by car to the rural community to meet with the NP in person. The group who received the PT/NP_{team} approach is the only group of participants that will be described in this manuscript, and within the present study, they are not compared to the other groups in the RCT. Twenty patients participated in the NP/PT_{team} using videoconferencing group. One patient withdrew mid-study leaving 19 patients. The experiences of the participants (patients and health professionals) in the PT/NP_{team} group will be described.

The team used a laptop with VidyoDesktop Software Inc. (Vidyo Inc, Hackensack, NJ, USA). An external web camera with pan, tilt, and zoom functionalities was located at the NP and patient site; this device transmitted audio and video to the consultant urban PT. Figure 1 shows the viewpoint of the urban-based PT. A full neuromusculoskeletal assessment for the lumbar spine was completed on each patient. Patients were provided with a lay summary of assessment findings, management recommendations and education regarding expectations for treatment needs, as well as answers to any questions they had.

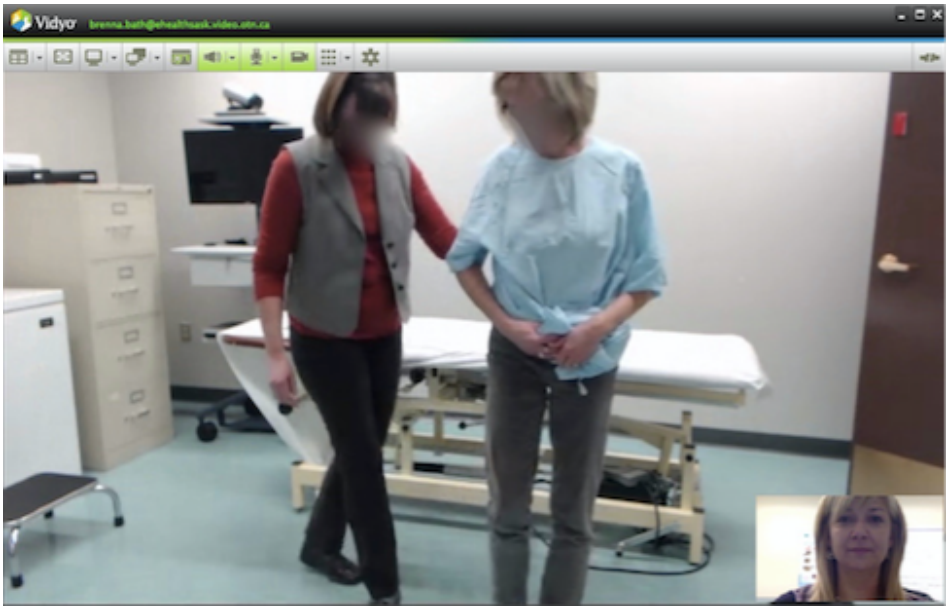

Figure 4.1. Physical Therapist (shown in inset) view of Nurse Practitioner and Model Patient, Using Vidyo secure web-based telehealth platform.

4.3.2 Measures and Data Analysis

The experience of patients in the telehealth group was measured by a modified version of a survey initially developed by Russell.(26) The modified survey used a Likert scale, whereas the original scale was graded on a line. There were 5 descriptors in the Likert scale modified version. The final modification was an open-ended question allowing participant comments. The modified survey is shown in Table 4.1 Surveys were completed by patients in the NP/PT_{team} group, 2-4 weeks after the intervention.(27) Proportions, medians and interquartile ranges (IQR) were calculated for each survey item.

Table 4.1: Patient Experience with Telehealth Assessment Survey

1. How confident were you with the videoconferencing method of a musculoskeletal assessment?	Very confident	Somewhat confident	Neither confident nor unsure	Somewhat unsure	Very unsure
2. Would you recommend this method of assessment to a friend who was unable to travel?	Yes, most definitely	Probably	Not sure	Likely not	Most definitely not
3. Do you think this method of assessment is as good as a traditional face-to-face assessment?	Yes, most definitely	Probably	Not sure	Likely not	Most definitely not
4. Could you see the physical therapist clearly at all times?	Yes, very clear	Mostly clear	Not sure	Not really clear	Not clear at all
5. Could you hear the physical therapist clearly at all times?	Yes, very clear	Mostly clear	Not sure	Not really clear	Not clear at all
6. What is your overall satisfaction with this method of assessment?	Very satisfied	Mostly satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied
7. Please add any additional comments regarding your satisfaction or experience with the telehealth/ videoconferencing assessment here.					

The PT and the NP involved in the NP/PT_{team} participated in a semi-structured interview by telephone, 2-4 weeks after the study period, about their experiences with the model of care. Six patient participants (out of a total of 19 in the group) in the NP/PT_{team} intervention arm of the RCT also completed semi-structured interviews over the phone 2-

4 weeks after their assessment. The interview guides for the participants and providers can be found in Appendix 8.4. Two researchers conducted interviewers, one interviewing the practitioners and the other interviewing the patients. Interviewers were trained and experienced in performing semi-structured interviews

Qualitative analysis involved an iterative thematic approach using open and axial coding for the open-ended patient experience survey question and the semi-structured interviews of patients and practitioners. The analysis steps included: data familiarization, code generation, identifying themes from codes, review and naming of themes, and choosing strong examples that demonstrate importance of themes to the research objectives and question.(28,29) With open coding, categories of codes were created and from there, overarching themes were generated. After open coding, axial coding allows examination of relationships between themes.(27) Two researchers (SLG & BB, both PTs) jointly developed the coding scheme and verified categories and themes independently. A third (MEO, clinical psychologist) and fourth reviewer (EH, PT) examined the coding of themes through an interprofessional lens. A final reviewer (CT), reviewed themes with a non-health care professional lens. Although there were no a priori categories, the team noted during theme review that the subthemes in one of the primary themes resembled an existing framework, the Canadian Interprofessional Health Collaborative (CIHC) National Interprofessional Competency Framework.(30) The subthemes were therefore developed in combination with a text driven-open coding method and the team's perceived alignment with the established definitions of the CIHC; some of the definitions from CIHC were used in part to describe the themes. In this way, the CIHC framework was used to help categorize some of the subthemes. It was also noted by the team that some quotes fit more than one theme. Through discussion, the reviewers refined themes and came to a final consensus.

The NP reviewed the final draft manuscript as a form of member checking, and agreed with the presentation of themes in the analysis.

Ethical Considerations

All participants provided written consent for participation in this study. This study was approved by the University of Saskatchewan Biomedical Ethics Board (12-341).

4.4 Results/Findings

Patient demographics for the telehealth experience survey are shown in Table 6.1. Patients were ‘very satisfied’ (62.1%) or ‘satisfied’ (31.6%) with the overall experience and ‘very confident’ (63.1%) or ‘somewhat confident’ (36.9%) with the assessment. 78.9% indicated that they ‘would recommend’ telehealth to others. 42.1% found telehealth ‘comparable’ to face to face, 36.8% found it ‘somewhat comparable’, 15.8% were neutral and 5.3% said it was ‘not likely comparable’. Both audio and visual quality were rated highly, with only 5.3% rating this as ‘not sure’ or ‘not really clear’. Complete results from the telehealth experience survey questions are presented in Table 6.2.

Table 4.2 Patient Demographics (*n*=19): CBD Patients Participating in a Team and Technology Approach to Care

Variable	Participant Demographics	Proportion
Age (mean, *SD*)	50.84, 13.87	
BMI Classification	***n***	**%**
Normal	4	21.1
Overweight	7	36.8
Obesity	8	42.1
Gender		
Female	11	57.9
Male	8	42.1
Marital Status		
Married	14	73.7
Divorced/Widowed/Never Married	5	26.3

Table 4.3 Patient-reported Experiences with Telehealth Assessment (*n*=19)

Question	Very or Yes *n* (%)	Somewhat or probably *n* (%)	Neutral *n* (%)	Somewhat unsure or not likely	Very unsure or not at all

				n (%)	*n* (%)
Confidence with Assessment	12/19 (63.1)	7/19 (36.9)	0	0	0
Recommendation to Others	15/19 (78.9)	4/19 (21.1)	0	0	0
Comparison to Face to Face	8/19 (42.1)	7/19 (36.8)	3/19 (15.8)	1/19 (5.3)	0
Visual clarity	15/19 (78.9)	3/19 (15.8)	0	1/19 (5.3)	0
Audio clarity	13/19 (68.4)	5/19 (26.3)	0	1/19 (5.3)	0
Overall Satisfaction	13/19 (68.4)	6/19 (31.6)	0	0	0

Two health care providers (PT and NP), and six patients participated in semi-structured interviews following the intervention. Both health care providers were female, with 22 and 26 years of experience respectively for the PT and the NP. Four primary themes were identified: 1) access to care for CBD; 2) effective interprofessional practice; 3) enhanced clinical care for CBD; and 4) technology.

Figure 4.2 describes the relationship of the primary themes, including the area of overlap between *teams* (effective interprofessional practice), *technology* and *enhanced clinical care for CBD*, which is *access to care for CBD*

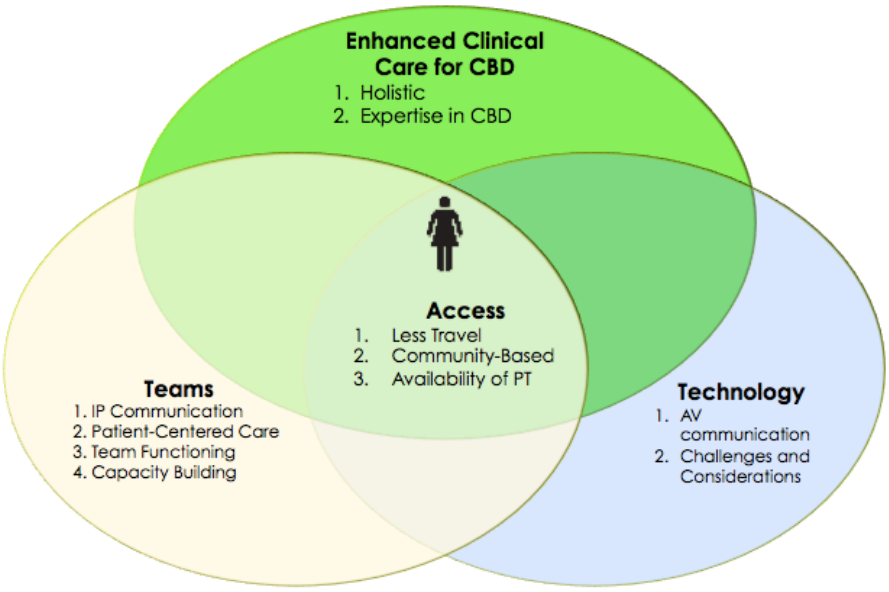

Figure 4.2. Model Describing the Relationship between Themes as Described by Participants in a Team and Technology Model of CBD Care

Access to Care for CBD:

Access to care for CBD was defined as the ability to achieve appropriate physical therapy care in the patient's own rural community for a chronic condition of the lumbar spine. Access to Care for CBD had three sub-themes: *less travel; more convenient*; *community-based care*; and *enhanced access to physical therapy care*.

a) Less Travel, More Convenient:

The subtheme of *less travel, more convenient* refers to being able to have care provided locally, without driving to an urban center. The NP stated that the team and technology model was "much more convenient for the patient", indicating "they don't have to take a day off work and drive to surrounding communities or Saskatoon". Patients reported: "it saved me an hour and a half trip" and "I think especially where we live out here it's not easy to get into the city". A patient also indicated: "[the] elderly really would benefit from the use of teleconferencing and not having to drive".

b) Community-Based Care:

The theme of *community-based care* pertains to care that is provided in the context of rural living, fitting for the rural people's lifestyles, and involving known and trusted practitioners. The PT noted: "the appreciation of the service being offered locally was much greater than I had anticipated". The NP reported "if I have a patient that's not terribly mobile or financially is a little strapped, it allows them a really great assessment and not have to leave the community". This is an important statement that comments on financial and functional ability/disability needs that may be present in a rural community. Patients were familiar with and trusted the NP. This existing relationship led to increased confidence with the new model of care: "if I saw [the NP] on a regular basis then she's kind of fully aware of what issues are going on and then they can work together to figure out a plan or whatever for me". Another patient noted "if we can bring this here and use the resources in this area, then why not" which indicated appreciation for using the space and human resources available in their own community.

c) Enhanced Access to Physical Therapy Care:

The subtheme of *enhanced access to PT care* referred to available and timely care by a PT team member. The rural NP noted that there was a delay in care in their community due to a "significant challenge with [the local rural] PT department keeping

up with the community needs". The PT reported "I can get the great majority of the information I need to help them over videoconferencing and I think it would make our in-person visits more efficient and usable". One of the patients reported: "if this works and this is something we can do, I think that would speed up some of the process (for accessing appropriate care)".

Effective Interprofessional Practice (The Team):

Effective interprofessional practice and its subthemes were defined using input from the CIHC definitions. Effective interprofessional practice was defined as "the process of developing and maintaining effective interprofessional working relationships to enable optimal health outcomes".(30) The broad theme of interprofessional practice was divided into four subthemes: *interprofessional communication, patient-centred care, team functioning, and capacity building.*

a) Interprofessional Communication:

Interprofessional communication referred to communication within the team including mutual understanding and trust.(30) The goal of *interprofessional communication* should be to improve the quality of care. The PT suggested that the relationship with the NP developed throughout the research process, and was an important factor in successful communication: "it may be more challenging if the two team members were strangers to each other or had never met or talked repeatedly by videoconferencing". This was interpreted as meaning trust and rapport had developed throughout the intervention period. Patients noted "they [NP and PT] could communicate back and forth and with me at the same time instead of having to go to the one and then a week later going to the other one" and also "so you've got a physiotherapist trained as a physiotherapist and you've got a nurse practitioner. So when they work conjoined like that it's good. It has two pairs of professional hands in one room." This appears to indicate that the patient believed the communication between the practitioners was effective when they were both located with the patient, as one team.

b) Patient-Centered Care:

For the purposes of this study, we defined *patient-centered care* as patient involvement and engagement, including sufficient patient education and listening to

patient needs. (30) *Patient-centered care* will meet a patient's goals and be high quality. The NP summarized how well this interprofessional assessment using telehealth met the needs/goals of the patient, and provided patient centered care: "I think that when a patient has a number of different practitioners working together to move them forward along the continuum of wellness I think that … it's going to ensure that everybody is on the same page" and "I think we expanded the patients' treatment options in that one visit by using the two". She explained what happens with patients who suffer from CBD without the interprofessional telehealth approach, receiving care that is instead not centered around their needs: "right now I see our patients are being sent all over the place and they're not necessarily receiving the appropriate treatment. There's a great deal expense and time and poor outcomes". One patient commented on her impression of the end result: "as far as I was concerned, as accurately diagnosed and as thoroughly diagnosed as I've ever been for my back. And it took 45 minutes. They didn't rush. They did a full, proper assessment."

c) Team Functioning:

The subtheme of *team functioning* referred to effective teamwork and processes, including respectful interactions and relationships, as defined by CIHC.(30) In this case, the team functioning occurred through the unique use of technology. The PT stated: "I felt that I was providing expertise that was not available without me so I felt that my role on the interprofessional team was very relevant". The NP felt she "was sort of an extension of the PTs arm". Patients reported "someone else was taking an interest in it [their back disorder]" and "I felt better just knowing I didn't have just one professional". This was interpreted to mean that the teamwork of the PT and the NP allowed for a smooth assessment process. The traditional method of care in that area would be for the patient to see an NP by herself, in-person. A team was created and able to be present in this case due to the model of care. The impact of the team joining over telehealth was clear for this patient: "they can't physically be here, but their skills are just as effective on that screen if they have a trained pair of hands to use".

d) Capacity Building:

Capacity building was defined using the World Health Organization (WHO) definition: "human resources, institutional and infrastructural capacity, and networks and partnerships"(31) In this case, capacity for human resources and local, rural systems were

being enhanced by this model of care. Notably, only health professionals made comments related to this theme. The health practitioners identified additional populations who might benefit from a team approach: “I think we could enhance the way that we manage pain, especially in elderly people or most urgently in elderly people by having a team approach” (PT). This may be a result of professionals being aware of the needs of other populations. For example, the NP noted: “pharmacists have a lot of input that they can offer us when we’re trying to do the best type of medication reconciliation and pain management for our patients” and the PT noted that in two cases, she consulted other professionals by phone: “It would have been helpful if the PT and exercise therapist could have communicated via videoconferencing. In another case, I engaged an academic scholar in a specialty area to provide information to the exercise therapist.”

Enhanced Clinical Care for CBD: *Enhanced clinical care* described the realization of improved clinical care for CBD than was previously available to patients in that region. It had two subthemes: holistic care and expertise in CBD.

a) Holistic Care:

Holistic care referred to recognition of the whole person’s needs. The practitioners noted that “they were able to address all of their assessment and management planning needs”, and to “provide [medication] prescriptions and consult for specialist care” when needed. A patient noted they had “a full assessment of [their] back, x-rays done, blood work, and suggestions for what [they] could do”. In uniprofessional care, all of these different treatments would not typically be provided in one primary care visit (e.g. education about CBD, diagnostics, and blood tests).

b) Expertise in CBD:

This subtheme referred to the presence of specific expertise and experience in CBD management where this was not previously available. The PT indicated: “the majority of people had not been through a conservative-care approach to their back pain”. as well as “understanding of pain management was enhanced by the team [approach]”. The NP reported “when I do an assessment of someone that comes into my clinic that is experiencing back pain, my assessments are a little bit more systematic because of course I'm comfortable doing this now.” Patient statements concurred with the PT impression

that conservative care approaches were not commonly provided previous to the *team and technology* model. Patients noted “it seems like they're working to like get you where you want to be” and “I got more feedback from [the assessment] than I did just going to my doctor’s” as well as “I've had numerous things done and still have it [back pain]. So I'm kind of excited that I've noticed a bit of difference in my back already.”

Technology:

In the context of the team and technology care model, *technology* includes those aspects of technology-enabled remote care delivery that either facilitate or inhibit clear communication and care provision. It was divided into two subthemes: *audiovisual communication* and *other challenges and considerations.*

a) Audiovisual Communication:

This subtheme described the contribution of audio and visual mechanical components to quality of the interaction between the team members and the patient. The PT reported “we had a camera that was especially clear, easy to use, and quite valuable when it came to fine details. On two occasions we lost the camera and the laptop-based camera wasn't as clear or didn't show as intricate of details so the quality of the camera was a big factor. I think that's the main thing”. The PT also noted the importance of backup planning: “we did need to add external mini speakers to improve the audio when we lost our main camera.” The NP reported “we had some glitches with our electronics. I think we have to look at that and maybe better accommodate our patients because I know our volume was a challenge for some of our people that had a bit of a hearing deficit. And it is a smaller screen size so for people that want to see (PT) I'm working with-visual I think that needs to be addressed too.” Patients reported experiencing no difficulties with communication due to technology, and accepted its use: “I like to embrace technology. It's here to stay and there's a lot of benefits to it… let's use it when we can”.

b) Other Challenges and Considerations:

This subtheme explained areas other than audiovisual components, to consider about technology when developing clinical protocols, or undertaking future research. The NP reported that the office assistant’s comfort level with technology was an important

factor in facilitating efficient patient flow: “our office manager really has kept this flowing very smoothly for me. Thank goodness because I might not be nearly as excited about this if she hadn't been able to make it work”. One challenge with technology that was expressed by patients was that they assumed “ the older people might not like it”.

4.5 Discussion

This study examined the experience of patients and health practitioners with an interprofessional model of CBD assessment using telehealth, a *team and technology* model of care for CBD. Patient participants were very or somewhat satisfied with the clinical experience overall, and satisfied with their assessment. All reported they would, or probably would, recommend this format of assessment to others. While 79% (15 out of 19) reported that the videoconferencing assessment was either comparable or probably comparable to a face-to-face assessment, it is notable that one patient participant reported that it was not comparable. The 19-person sample should not be considered an exhaustive normative and representative statement on acceptability to the whole population, but as a proof-of-concept, it is very encouraging, and suggests this is a promising avenue to pursue in future research.

Qualitative analysis of patient and practitioner interviews identified the following four main themes: *access to care for CBD,* efficient *interprofessional practice, enhanced clinical care for CBD,* and *technology considerations*. Practitioners and patients reported similar experiences, with the exception of the subtheme of *capacity building*, which due to their experience, would be something the practitioners would look for in a new model of care, but that patients may not be aware of during their interaction. The relationship between the 4 themes is important: *teams*, *technology*, and *enhanced clinical care for CBD* meet together to improve access to care for CBD for the rural patient. Patients and practitioners in this sample agreed that this model of care can provide improved access to care for CBD.

Access to care was also a theme identified in the qualitative study by Kairy et al. on the use of telehealth for PT access.(24) In the present study, diminished travel and the ability to have care delivered in their own community was appreciated by patients and the local NP, who also reported that access within their own community would enhance patients’ willingness to seek care or to follow through with care plans.

Briggs et al. interviewed patients who identified the use of telehealth to facilitate access to professionals who could provide expert care and pain management strategies for CBD in rural Australia.(18) The present study is the first we are aware of that confirms that a team and technology approach to uniting experts in CBD management with a rural primary care team is met with overall satisfaction and acceptability from participants and health providers. The health providers in the present study described mutual professional benefit, in terms of capacity building on the rural team, as well as enhanced practice due to the interprofessional team. This was also identified by practitioners who utilized remote presence robotics (another form of telehealth) to address a CBD case in remote northern Canada.(21)

Effective interprofessional practice was a primary theme identified in our study. The present study builds on the N of 1 study by Lovo Grona et al.(21) with a larger sample, different technology and a different rural community location. The CIHC identified "six competency domains of interprofessional practice: interprofessional communication, patient/client/family/community-centered care, role clarification, team functioning, collaborative leadership and interprofessional conflict resolution".(30) The 4 subthemes under our primary theme of *effective interprofessional practice* included: *interprofessional communication, patient-centered care, team functioning,* and *capacity building*. Although the interview and initial coding process did not specifically target these concepts, three of our subthemes aligned closely with the CIHC competency domains. Two of the main descriptors of *patient-centered care* within CIHC's guidelines are 'providing thorough education', and 'respectful listening'. Patient participants in this study described these aspects as being part in their experiences with the *team and technology* approach to CBD care. Trust is an important concept in interprofessional communication and team functioning, and was considered in the design of the present study. The PT travelled to the community prior to, during and after the intervention to spend time with the local healthcare team. The team provided care to a number of patients and had time to develop a relationship. These factors likely made trust and interprofessional communication easier. Trust and team building have been previously shown to be important to patient outcomes (30,32) and should be a part of any future *team and technology* applications.

Technology challenges and considerations have been identified previously in telehealth literature. Similar to the findings of Kairy et al. in their study of home telerehabilitation (33), there were no major technology barriers in the present study that affected participant experience, although minor issues may have occurred during the process. The NP was located in the room with patients in our study, which likely provided enhanced confidence for patients than if they were alone with the urban-based health care provider during the intervention. In many cases the NP had a history of rapport with these patients. The NP noted the importance of availability of an additional person who is able to facilitate the technology in order to ensure the NP's busy practice was not adversely affected. Although elderly rural residents were not specifically targeted in the study, participants thought that rural older adults may not be as interested due to technology requirements, which supports the findings by Sanders et al.(34) It is notable, however, that other participants in the present study thought technology would be helpful in diminishing travel requirements for older rural residents.

According to Trainor (35) touchstones of qualitative interview research include: 1) sufficient sample to address research questions, 2) the interviewees have adequate experience, 3) researchers have established relationships with the study participants, 4) researchers acknowledge their position with respect to the work, 5) research questions and interview questions are clearly related, 6) methodology is clearly described, 7) analysis is clearly explained, 8) new information results from the interview research. In the case of the present study, the sample size of 6 patient interviews and 2 practitioner interviews provided the identified themes. All of the health practitioners in the study were sampled. Since there were not any others, this is a practical limitation of the study. If we interviewed a larger sample of participants or patients, it is possible that new themes and subthemes could emerge.

All participants interviewed were involved directly as practitioners, or participants, of the ***team and technology*** model of care. Researchers identified themselves and their roles as practitioners (PT), and as interviewers. They reflected on how their lens may have contributed to interpretation of quotes and themes. Interview questions were designed to flesh out aspects of patient experience, and open-ended questions were provided to ensure interviewees had the ability to provide additional information.

Methods and analysis have been described to ensure transparency of the processes. Finally, the results provide novel information about the experience of a team and their patients in a *team and technology* model of care for CBD.

This study has additional limitations to consider. The experience with telehealth survey (quantitative) had a small sample with only 19 participants. The interviewer for the practitioners was not the same as the interviewer for patients. Although they followed a guide, there may have been differences in their style of questioning. There is the likelihood of overly positive appraisals of the clinical service provided by patients, which is a common problem with patient satisfaction surveys.(36) There were only 2 practitioners, who had performed 20 CBD assessments together. Their experiences would not necessarily be generalizable to other PT/NP teams, or teams who had no experience working together. This model of care was implemented in the context of a funded research study. As such, the researchers had time for technical set up, brainstorming and problem solving if technical issues arose. This may not be the case in direct patient care settings with busy patient caseloads. In order to be successful, future implementation of similar models of care would need to have adequate resources for technology support, and for building trust and team rapport.

4.6 Concluding Comments

The objective of this study was to examine the experiences of patients and practitioners who were involved in a *team and technology* model of care for the management of CBD. In this study, an urban-based consultant PT joined with a rural NP; the combination of their expertise ensured a trusted and skilled environment that facilitated successful interventions for rural CBD patients. The health practitioners provided enhanced clinical care for CBD through development of interprofessional (team-based) competencies and the use of telehealth technology. This resulted in improved access to care for rural patients with CBD. They did not have to travel to receive expert advice for their back pain, and their care was provided to them in their own community, alongside a local primary care provider.

This is a model that could be potentially adapted and implemented in other rural or remote areas. The next step would be to include other care providers who could contribute to holistic CBD management. Examples of other care providers who could

participate on a CBD team include: family physicians, medical specialists (i.e. orthopaedic or neurosurgeons, rheumatologists), pharmacists, and psychologists. Future research needs also include the evaluation of this model of care with other health conditions and evaluating the impact on short and long term health outcomes.

4.7 Acknowledgements

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4.8 Declaration of Interest

SLG received a Public Health in Agriculture and the Rural Ecosystem Fellowship and a Health Research Foundation of Canada Graduate Scholarship for her PhD work. BB and MEO received grants to support this research from the Saskatchewan Health Research Foundation, which did not have a specific role in the research. BB received a grant from the Kelsey Trail Health Region to support equipment purchase and operational expenses for the research.

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7. Chapter 5: Discussion and Conclusions

The goal of this dissertation was to examine the use of secure videoconferencing in the management of MSK disorders, and to determine whether an innovative *team and technology* model could facilitate access to enhanced primary care for CBD in rural and remote regions. This goal was addressed in 3 manuscripts: 1) a systematic review examining the use of secure videoconferencing methods by PTs to provide care for musculoskeletal disorders; 2) a concordance study which compared the agreement of a *team and technology* model of care with other more traditional models, and 3) a mixed-methods study whereby the experience of patients and practitioners participating in a *team and technology* model was examined.

The following research questions were addressed:

1. a) What is the validity and reliability of secure videoconferencing for PT management of musculoskeletal conditions (manuscript 1)?

b) What are the impacts of use of secure videoconferencing technologies on health, process, and system outcomes in musculoskeletal disorders (manuscript 1)?

2. What is the diagnostic and management concordance of an interprofessional assessment session performed through videoconferencing compared to a PT or NP only in-person assessment (manuscript 2)?

3. What was the experience of the interprofessional team members and the patients who participated in the *team and technology* model of care for management of CBD (manuscript 3)?

A synopsis of the three manuscripts will be provided here. An overall discussion will integrate the findings of the three manuscripts into contribution to research, future research considerations, and clinical and policy recommendations

5.1 Synopsis of Manuscripts

5.1.1 Systematic review: Use of videoconferencing strategies for physical therapy in people with musculoskeletal disorders: A systematic review

Manuscript 1 was a systematic review on the validity and reliability of secure videoconferencing as well as the impacts on health, process and systems outcomes of

using secure videoconferencing for PT interventions on MSK conditions. From 4 databases, 1439 articles were identified from the years 2003-2016, and following title, abstract and full texts screens, 17 manuscripts met the inclusion criteria. Six studies examined validity and reliability, one examined only validity, one examined only reliability, and nine studies examined interventions.

Low validity was found for shoulder and elbow joint assessments (1,2) nerve tests around the elbow,(2) and lumbar postural assessment.(3) Other specific measures for shoulder,(1) elbow,(4) lumbar,(3,5) lower extremity,(6) knee,(7,8) and ankle (9) demonstrated acceptable validity, as well as intra- and inter-rater reliability except for the elbow, where only evidence for intra-rater reliability was found.(4)

Intervention studies found improved health related quality of life for the telehealth group.(10–12) Improved shoulder (11) and knee (10) function were found in non-controlled studies. Tousignant found improved function in people with knee osteoarthritis in the telehealth group over the short term,(13) and Russell determined non-inferiority for knee function in the telehealth group.(14) Two studies measured patient experience (15,16) and two measured costs.(12,17) Direct cost savings were reported for travel time (patient perspective) and travel reimbursement (system perspective) in a study on knee patients (12) and travel costs (system perspective) were diminished in a second study with knee patients.(13)

Lack of improvement in the telehealth group patients over the long term may indicate the need for more supports over extended lengths of treatment.(17) Support could include combined in-person and telehealth care as suggested by Kairy et al.(18), or the presence of trained personnel located with the patient (such as an interprofessional model).(19) Interprofessional models for managing musculoskeletal disorders have not been examined in the telehealth literature.(20) Briggs et al. wondered whether telehealth would be a solution to recruiting professionals with pain expertise to rural Australia, and examination of interprofessional telehealth models of care could provide more insight into this question.(21)

More robust studies with larger sample sizes, blinding and randomization, such as the study by Tousignant,(17) would add rigor to the research in this area. Future research should also include cost analyses to ensure both health care system and patient costs are

evaluated and compared to other models of care through randomization or cluster randomization.

The systematic review identified gaps in the literature, which allowed us to identify the next steps in examining telehealth models for MSK care. We sought to investigate whether interprofessional technology-based models of care for CBD were concordant with in-person models of care. The model assessed was part of our subsequent study, which examined the diagnostic and management concordances of a telehealth model of care compared to in-person PT and in-person NP interventions. The demonstrated paucity of research related to individuals' experiences with telehealth led us to our final study, which examined patient and practitioner experiences with a PT and NP team using telehealth to manage CBD.

5.1.2 Manuscript 2: A physical therapist and nurse practitioner model of care for chronic back pain using videoconferencing: diagnostic and management concordance

The inability to perform a traditional hands-on examination is a barrier to the uptake of telehealth for PTs.(6) To address this, a *team and technology* approach was developed and evaluated. We examined the concordance, or agreement, in diagnoses and management decisions that were made in three intervention groups: PT/NP_{team} using secure videoconferencing, PT_{alone} and NP_{alone}. Twenty-seven adults with CBD participated in the study. Following the assessment, each health care provider group determined diagnostic and management recommendations according to a diagnostic classification tool.

PT_{alone} and PT/NP_{team} agreed 92.6% of the time regarding "back pain as the source" of the participant's problem (kappa could not be calculated).(22) Strong agreement (analyzed using kappa) was noted for "urgent surgical referral" and "recommendation of any PT follow up". This meant that for these decisions, a PT/NP_{team} agreed with a PT located in-person with a patient. The PT/NP_{team} group spent significantly more time with participants than the NP_{alone}. This finding may increase health care system costs due to human resource time, an issue which had been identified previously in the literature.(23) However, the human resource time may be a trade off for savings on patient and system travel costs, and potentially more comprehensive care.

Cost considerations were not addressed in this study, but would benefit from future research.

This was an urban-based participant and provider intervention, so the degree to which the findings would apply to a rural population is unknown. Therefore, the subsequent study examined a rural population's experience with a team and technology model of care.

5.1.3 Manuscript 3: Experience of Patients and Practitioners with a Team and Technology Approach to Chronic Back Disorder Management

Manuscript 3 evaluated the experiences of patients and practitioners who participated in a *team and technology* approach to CBD management. Adult participants were randomly assigned to one of three intervention groups: 1) PT_{alone}, 2) NP_{alone}, 3) urban PT joining rural NP and patient using telehealth (NP/PT_{team}). Only the experience of the NP/PT_{team} was examined in this manuscript.

Nineteen participants completed the post-test 'experience with telehealth' survey, which was modified from an earlier version published by Russell.(24) Patients were 'very satisfied' (62.1%) or 'satisfied' (31.6%) with the overall experience. Six patients and two healthcare practitioners completed a follow-up semi-structured interview. Through iterative thematic analysis, four primary themes were identified: 1) *access to care for CBD*, 2) *effective interprofessional practice*, 3) *enhanced clinical care for CBD*, and 4) *technology*. Complete definitions for these themes and additional subthemes were reported in detail in manuscript 3.

All patients were satisfied with the experience overall, as well as with their assessment. All reported they 'would' or 'probably would' recommend this form of assessment to others. *Effective interprofessional practice, enhanced clinical care for CBD* and *technology* facilitated experiences of patients and practitioners that enhanced *access to care for CBD* in that community.

The quantitative data analysis was limited by a small sample size (n=19). There were only two health practitioners and six patients who completed semi-structured interviews, which presented a practical limitation to generalizability of the findings, which positions the quantitative data as exploratory rather than definitive.

5.2 Contribution to Research

The systematic review (manuscript 1) identified gaps in literature including: 1) absence of interprofessional teams using videoconferencing to provide MSK care, 2) limited research evaluating experiences with technology-based care, and 3) limited numbers of comparative studies on technology-based models of care. These findings influenced the novel approach described in manuscript 2 and manuscript 3. Manuscript 2 evaluated an interprofessional team (PT/NP_{team}) and patient using videoconferencing by comparing their diagnostic and management decisions with those of PT_{alone} and NP_{alone} to determine the concordance of these decisions. To our knowledge, this was the first study of its kind. Once concordance with PT_{alone} was determined, we evaluated the *team and technology* model of care in a rural location with 19 participants and the local rural NP. We further evaluated the experiences of both the practitioner team and 6 of the patients via semi structured interviews and an iterative thematic approach.

As depicted in Figure 7.1, the primary themes of the *team and technology* model of care rest on a foundation deemed to be the essential facilitators for this model. The foundational requirements are likely necessary for success of this model of care and are, therefore, important for translating this model into the clinical setting. These foundational requirements provide a map for future researchers and clinicians to follow in the development of their own *team and technology* models of care. Foundational components have been identified throughout manuscripts1-3 and include:

1. *Effective technology with local tech support.* The NP in our experience study (manuscript 3) identified the importance of having an extra person (other than the NP) dedicated and available to manage technology issues. In a busy clinical practice it would not be realistic for a clinician to have the time to cope with technical issues, as their focus should be on patient care. Health technology is advancing rapidly, and the most up-to-date technology should be evaluated to ensure teams are able to provide the best possible care. This finding was also supported by one of the recommendations of the systematic review, (manuscript 1) which was to ensure the most up-to-date and relevant technology was used.
2. *Adequate audio and visual quality.* This is a critical component to ensure effective care. Manuscript 3 identified that these factors might have been an issue during an

assessment. If a patient has difficulty hearing or seeing the consulting team member, this could have an influence on their experience and their interest or willingness to proceed with that model of care. This would be particularly relevant for an older patient population group with potentially greater challenges with hearing and vision.

3. *Availability of a backup technological communication method*: During the experience study, there was a failure of the computerized camera. In this case, the backup laptop camera was used and attachable speakers were necessary for audio quality. Implementation of any remote care model should have explicit consideration for what mode of communication will occur in the event of possible malfunction.
4. *An interprofessional team member located with the patient*: The systematic review (manuscript 1) identified no studies with an interprofessional approach in a videoconferencing model of care for MSK management. The concordance and experience studies evaluated different aspects of an interprofessional team model. The concordance study identified that the PT/NP_{team} made comparable diagnostic and management decisions as a PT_{alone}. This, along with the quantitative and qualitative findings in the experience study, supported the effectiveness of an interprofessional team in utilizing videoconferencing technology to provide care for CBD. In the case of the present studies, a self-regulated, advanced scope practitioner (NP) joined the PT. With broader implementation, the need for other interprofessional team members would be determined by patient needs and local care available.
5. *Concordance with in-person PT assessment*: Prior to developing a model of care whereby a PT joins a rural team for interprofessional assessment, dependent on the population needs it may be relevant to know whether the team's findings would agree with those of a clinician located in-person with the patient. This step helps to ensure feasibility of a new model of care.
6. *Commitment to developing a trusting team relationship*: The PT/NP_{team} in the experience study completed 20 assessments together. In addition, they had done pre-training in interprofessional care, and they met in-person three times throughout the study, to develop a relationship with and learn about each other. A trusting team relationship is a foundational component of a *team and technology* model. This concept is supported by the CIHC Framework.(25)

7. *Acceptability to patients*: The systematic review identified a paucity of information on the experience of patients with videoconferencing-based management of MSK disorders. This type of information is important to ensure patient-centered care. Patients in the rural study expressed positive experiences with the *team and technology* model, which enhanced access to care and expertise in CBD care. Health professional ethics ensure that consent occurs prior to provision of services. Technology assessments should include detailed consent processes, so that patients understand the role technology will play in their care, as well as their ability to consent or decline. The findings in manuscript 3 made a novel contribution to the understudied area of patient experiences that was identified in the systematic review.
8. *Thorough education and respectful listening*: As Pineau et al. described: "it seems essential to pay special attention to the elements that characterize the therapeutic relationship, such as communication, the clinician's behavior (degree of empathy, professionalism), medical services (evaluation, diagnosis, prescriptions, treatment, etc.), the relationship of trust between the clinician and patient, and the measures for ensuring confidentiality and privacy". (26, page ix) This is a critical part of every healthcare encounter and this does not change with technology. However, due to potential barriers with technology, this requirement may require extra focus and planning. Patient reports in manuscript 3 suggested that patients felt confident with the assessment process.
9. *Addressing patient-centered issues such as culture and age*: Participants in the experience study expressed concern about the willingness of elderly people to participate in technology-related health care services. It is important to stress that this comment was made by younger (not older) adults. Special attention should be paid to the unique needs of ***each*** patient, irrespective of age. For example, larger screens or louder audio may be required for those with hearing or visual deficits. Careful attention should be paid to follow-up needs to ensure optimal understanding, for example having written or diagrammatic educational materials available if audio or visual deficits are present. Special consideration for culturally appropriate care should be made in Indigenous communities, which are often located in rural and remote areas.(27,28)

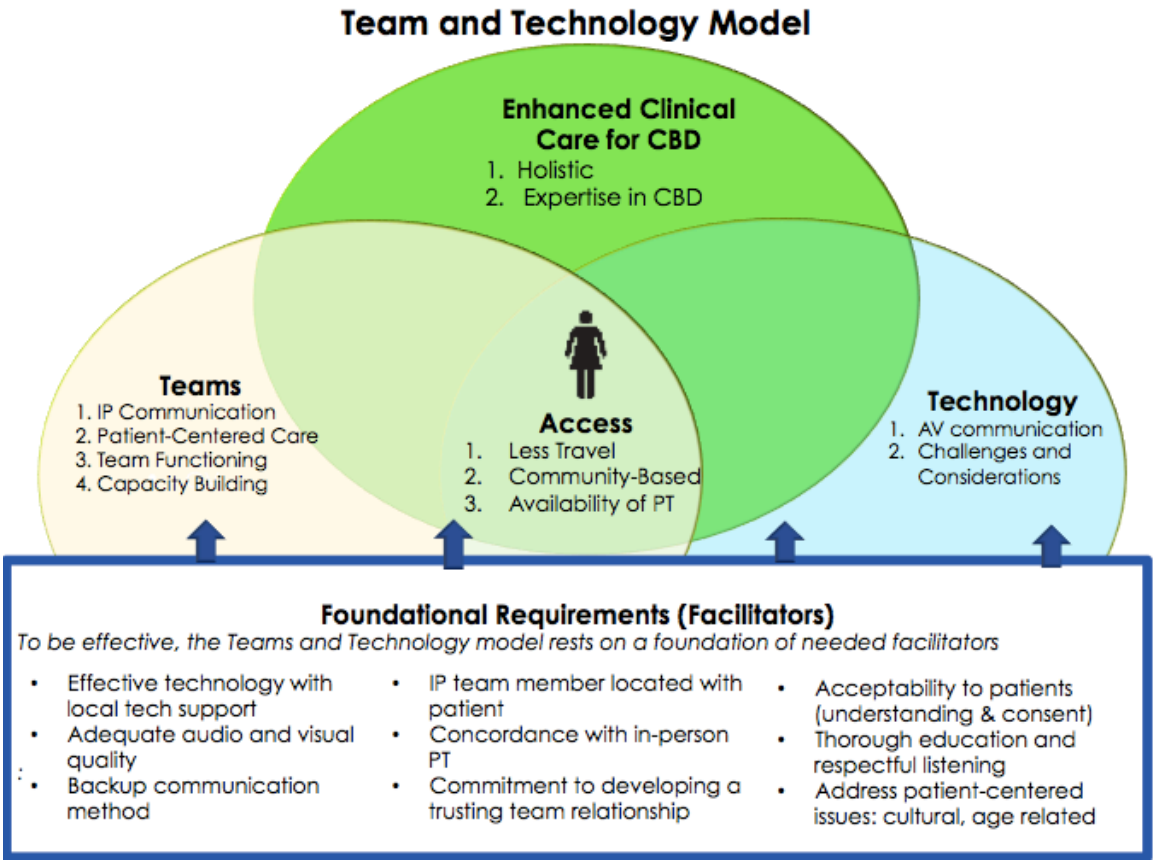

Figure 5.1 Team and Technology Model of Care: Enhanced Access to Care for Chronic Back Disorders. The main benefits described by participants in the teams and technology model sit upon a foundation of required elements or facilitators for successful implementation.

As depicted in the Figure 5.1, *access to care for CBD* is the central outcome for a patient-centered, *team and technology* model of care. Anderson and Davidson (29) described barriers and facilitators to access. Travel, costs, and professional availability can present barriers to access (30,31) and these factors were reported by patients and practitioners in manuscript 3.

Enhanced Clinical Care in CBD is a primary component of this model. Patients in manuscript 3 reported experiencing comprehensive and holistic care for their CBD due to a *team and technology* approach. Professionals with expertise in CBD and who follow a biopsychosocial approach are not always available in rural areas.(32) Manuscript 2 demonstrated that the PT/NP_{team} model resulted in diagnostic and management decisions

that were similar to those of PT_{alone}. Bath and Janzen had previously identified lack of PT services in rural communities as a barrier to effective care for CBD.(33) This series of manuscripts has demonstrated that enhanced care for CBD is possible with the *team and technology* model.

Effective interprofessional practice (team) is a main component of the *team and technology* model. The themes defined within the final study are well aligned with the interprofessional competencies defined within the CIHC framework.(25) This was an important finding, since interprofessional teams were not represented in any studies in the systematic review (manuscript 1). This gap in the literature was part of the reason that we included teams as a key issue within the study informing manuscript 2. Of importance was that we demonstrated that the PT/NP_{team} could make decisions about CBD that were similar to an in-person PT. Further examination of the interprofessional model in manuscript 3 identified effective interprofessional communication as a keystone for successful implementation of a teams and technology approach that also resulted in holistic and patient-centered care. The World Health Organization's International Classification of Functioning, Disability and Health model described a holistic approach as important to health, healthcare and wellness.(32) Evidence from manuscript 2 and 3 supported the fact that interprofessional teams are well - suited to provide care that fits within the ICF, which is an important framework for consideration with complex conditions such as CBD. Manuscript 2 demonstrated innovative decision-making from the NP/PT_{team} (in cases of complex co-morbidities) that was not found in the individual practitioner models of care.

Patients in an Australian study reported that limited availability of interprofessional care was a weakness in their local rural systems. They suggested that telemedicine may be an approach that could improve access to professionals who were knowledgeable in pain.(21) This dissertation demonstrated that it is possible to use a *team and technology* approach to care, to bring professionals to rural areas to enhance primary care for conditions such as CBD.

Technology is the final component of the *team and technology* model of care. Chipps et al. identified audiovisual issues in telehealth including variability in resolutions as well as internet issues.(34) The practitioners in the experience reported incidents

where this was the case, and a backup plan was utilized to complete the session. As reported in the systematic review, it is recommended that the most up to date technology be utilized to ensure optimal performance and results.

5.3 General Limitations

The systematic review is time sensitive. The literature search extended to the end of 2016; with the rate of advances in technology, the review will require updating soon. The concordance and experience manuscripts occurred within a research setting. This meant time to learn, problem-solve and improve technology skills was built into the research protocols. This may not be possible in a typical busy clinical setting, where health professionals are dealing with scheduling and administrative concerns in addition to their patient care. Fee-for-service healthcare environments would face an additional challenge, as billing is completely dependent on practitioner time being spent with patients. Also, salaried models of care would need to account for potential increased time requirements and impact on efficiency/volume of care. This may also limit generalizability in low-income communities, where availability of technology, human and clinical resources are even further diminished. PTs and NPs are self-regulated practitioners in Canada, and NPs have advanced scope of practice. Therefore, caution is recommended in generalizing findings to other primary care providers. Not all regions or countries have a NP role, so this may limit the use of such a model in those circumstances. Finally, these studies investigated only patients with CBD, and the findings may not be generalizable to other musculoskeletal or chronic health conditions.

The external validity of these studies is therefore limited due to the fact that these are pilot studies conducted within a research environment. Non-research clinical environments would have considerations of human resource time and health care funding which may present barriers to implementation of this model of care. Also, the specific team members of PT and NP are self-regulated professions with specific scopes of practice, which may limit the external validity of this model to those groups. The internal validity of the studies, on the other hand, is stronger than external validity as the researchers structured and controlled the research variables and study design.

5.4 Future Research Recommendations

Future research should examine the applicability of this model in other rural and remote environments, including areas with different health systems and impoverished regions. When a *team and technology* model is possible for Indigenous communities, research must begin with and include Indigenous community engagement and protocols. Involvement of Indigenous community is critical from the outset of such a project.(27,28) This will ensure that projects are truly community centered and that Indigenous values and processes lead any development for their communities.(28)

Other populations that should be evaluated include other age groups, as well as populations with other musculoskeletal and non-musculoskeletal conditions. Different populations may give rise to different research questions. Larger samples in an RCT design would provide stronger insight into effectiveness of this model of care. Manuscript 3 had only 19 participants for the quantitative analysis. Future research may include larger sample numbers or cluster RCT designs to facilitate multiple sites in the intervention.

Future research should include variations on the interventions examined in this dissertation. For example, evaluation of hybrid programming or blended programs which include videoconferencing and in-person treatment. The present studies focused on the assessment process, so evaluation of treatment provided through a team and technology model would be an important future step. This dissertation has bridged the gap from isolated tests for lumbar assessment previously described in the literature to implementation of a comprehensive neuromusculoskeletal assessment of CBD including management recommendations made by a team using telehealth. The team and technology approach should also be evaluated for used with other chronic musculoskeletal conditions to allow more in-depth and practical analysis of the use of videoconferencing technologies. Since the NP role is an advanced scope, and not all regions have a NP, analysis of this model with physician and nurse clinician team members is recommended to examine effectiveness with different team members. Other team members such as psychologists and social workers, who are also important in a biopsychosocial approach, could be included in evaluation.

Additional outcomes should be measured for this model, including health outcomes as well as systems outcomes such as cost analyses. Studies including cost-benefit analysis and cost-efficiency comparisons of different treatment models should be conducted in order to provide information on the impact of this *team and technology* model on health systems. These studies should take a broader perspective to include patient costs (financial as well as personal time) in addition to health system costs.

With respect to time, health technologies are advancing rapidly. The systematic review should be repeated in 2-3 years. For the intervention studies, as new technologies emerge and become more user-friendly, new and innovative research will be necessary.

5.5 Clinical and Policy Implications

It is essential to the health of rural residents with CBD that we continue to investigate ways of enhancing access to care for CBD in patients' home communities. The proposed *team and technology* model of care may be a way to address this issue in rural Saskatchewan.

The Saskatchewan Ministry of Health's 2011 Human Resources Plan included a focus on interprofessional healthcare practices. The *team and technology* model fits with this plan. Interprofessional care enhances quality of patient care and this dissertation demonstrates that this model provided positive experiences for patients, and was consistent with in-person PT in defining diagnoses and management plans for people with CBD.

Funding models for team-based care and use of health technologies will be important now, to ensure that these research findings can translate into clinical care. Translation of technology into practice will be delayed without the ability to bill for service provision.(35) Adequate funding is needed for health professional time, onsite technical support, and administrative oversight for a technology-based model of clinical care. We saw in manuscript 2 that cases with multiple co-morbidities benefited from a team approach in that unique problem - solving and recommendations resulted from the collaborative efforts of the PT/NP_{team}. The increase in provider time noted for the team in manuscript 2 (due to the fact that there were two professionals present) may be offset by benefits to patient costs and quality of care. Further research on the interprofessional team approach to MSK care in patients with multiple comorbidities should be considered.

To improve health system implementation for provision of MSK PT using a *team and technology* approach, critical components must be ensured for success:

1) Legislation must keep pace with technology in health care, in order to ensure optimal uptake. Recently in Saskatchewan, the regulatory body for PTs (Saskatchewan College of Physical Therapists) released a Standards of Practice Guideline for Telerehabilitation after 2 years of preparation.(36) This will ensure safe and effective use of telehealth technologies by PTs in Saskatchewan, and therefore facilitate technology uptake.

2) Availability of support for clinicians to use technology will be important. Support for these situations will allow expert clinicians to focus on their patients.(37) This may be more difficult in privately - funded industry.

3) Regular testing and updating of audio and visual components, as well as a secured backup plan, are critical to ensure patient safety and quality of care.

4) A team member located with a patient will enhance patient experience, and may facilitate patient confidence in a new process, especially if rapport and trust have already been developed between the patient and the local team member.

5) Continued emphasis on development of team relationships will enhance trust and communication for the team members.

6) Careful and thorough education on the technology-based model of care, as well as adaptation of consent to include the use of technology, will be critical in ensuring patient comfort and acceptability.

In addition to the above components, which are foundational requirements for a *team and technology* model of care, there are additional 'must-haves' to ensure success:

7) Collaboration with e-health branches of health authorities will facilitate clinical processes and ensure clinicians are kept up to date with the quickly changing environment of health technology.

8) Development of policies and procedures to confirm privacy, confidentiality, and regulatory body requirements are met and communicated to patients will ease transition into a new model of care.

9) Appropriate and thorough education at the end of technology sessions will be necessary to ensure patients and team members understand next steps and have an opportunity to engage the team with questions.

5.6 Conclusion

This dissertation has demonstrated that it is feasible to join an urban PT with a rural NP and patient for an interprofessional assessment of CBD, and that the decisions made by a PT/NP_{team} regarding diagnosis and management are similar those made by an in-person PT. This is an important finding as a *team and technology* model may be a viable option to enhancing access to expertise in CBD management in rural areas, and would diminish the need for patients or practitioners to drive long distances for care. This dissertation has demonstrated that patients and practitioners in rural areas experience improved access to care for CBD through development of interprofessional teams, expertise in CBD, and the use of technology (a *team and technology* approach to care). There are foundational components, which must be met in order to ensure success of this model; without these, the model may not be successful.

Concordance of the PT/NP_{team} with in-person PT is the first study of its kind to compare a full neuromusculoskeletal assessment for CBD to traditional models of care. The experience of patients and practitioners with a team and technology model builds on a single case study design previously published, and provided a larger sample, within the context of a different community, and utilized different technology. Together, these studies will form a strong base for ongoing research into the use of telehealth technologies to enhance access to PT care in rural and remote regions.

5.7 References

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8. List of Appendices

Appendix A Systematic Review Search Strategy

1. telemedicine.mp.
2. tele-medicine.mp.
3. Telemedicine/
4. telehealth.mp.
5. tele-health.mp.
6. electronic health.mp.
7. e-health.mp.
8. ehealth.mp.
9. mobile health.mp.
10. m-health.mp.
11. mhealth.mp.
12. telecommunication.mp.
13. tele-communication.mp.
14. telerehabilitation.mp.
15. tele-rehabilitation.mp.
16. teletreatment.mp.
17. tele-treatment.mp.
18. televideo.mp.
19. tele-video.mp.
20. teletechnology.mp.
21. webbased.mp.
22. web-based.mp.
23. online communicat*.mp
24. telecare.mp.
25. tele-care.mp.
26. telehomecare.mp.

27. tele-homecare.mp.
28. cybermed*.mp
29. e-consult.mp.
30. ecare.mp.
31. e-care.mp.
32. 1 or 2 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31

33. physical therap*.mp.
34. physiotherap*.mp.
35. exp Physical Therapy Modalities/
36. exp Physical Therapy Specialty/
37. 33 or 34 or 35 or 36
38. 32 and 37
39. limit 38 to (English language and yr="2003 -Current")

Appendix B Participant Questionnaire

Thank you for agreeing to participate in this study. Please answer the following questions to the best of your knowledge. To ensure confidentiality, please do not put your name on any of the following pages. If you have any questions about the questionnaires, please ask to speak to the study coordinator.

About You:

1. Age: _____
2. Gender:
   Male
   Female
3. Current Marital Status:
   Married
   Separated
   Divorced
   Widowed
   Never Married
4. Height: _____
5. Weight: _____
6. Postal Code: _____
7. Please check your main form of work
   Paid work-full time
   Paid work-part time
   Unemployed
   Housework
   Disabled
   Student
   Retired
8. If employed, what is your occupation: _____
9. If you are <u>not</u> working, is this because of your low back problem?
   Yes No

10. Please check any of the following medical conditions that you may have or have had:

Headaches

Lung or breathing problems

Heart problems

Stomach or digestive problems

Other bone and joint problems

Please list where you have bone or joint problems: _____

_____

Other health issues: _____

11. Please indicate your smoking status:

Never smoked

Used to smoke, not a smoker now

Smoker

About your low back problem:

12. How long have you had problems with your low back (please indicate in days, months or years)?

_____

13. When did your current low back episode begin (please indicate in days, months or years)?

_____

Pain Drawing

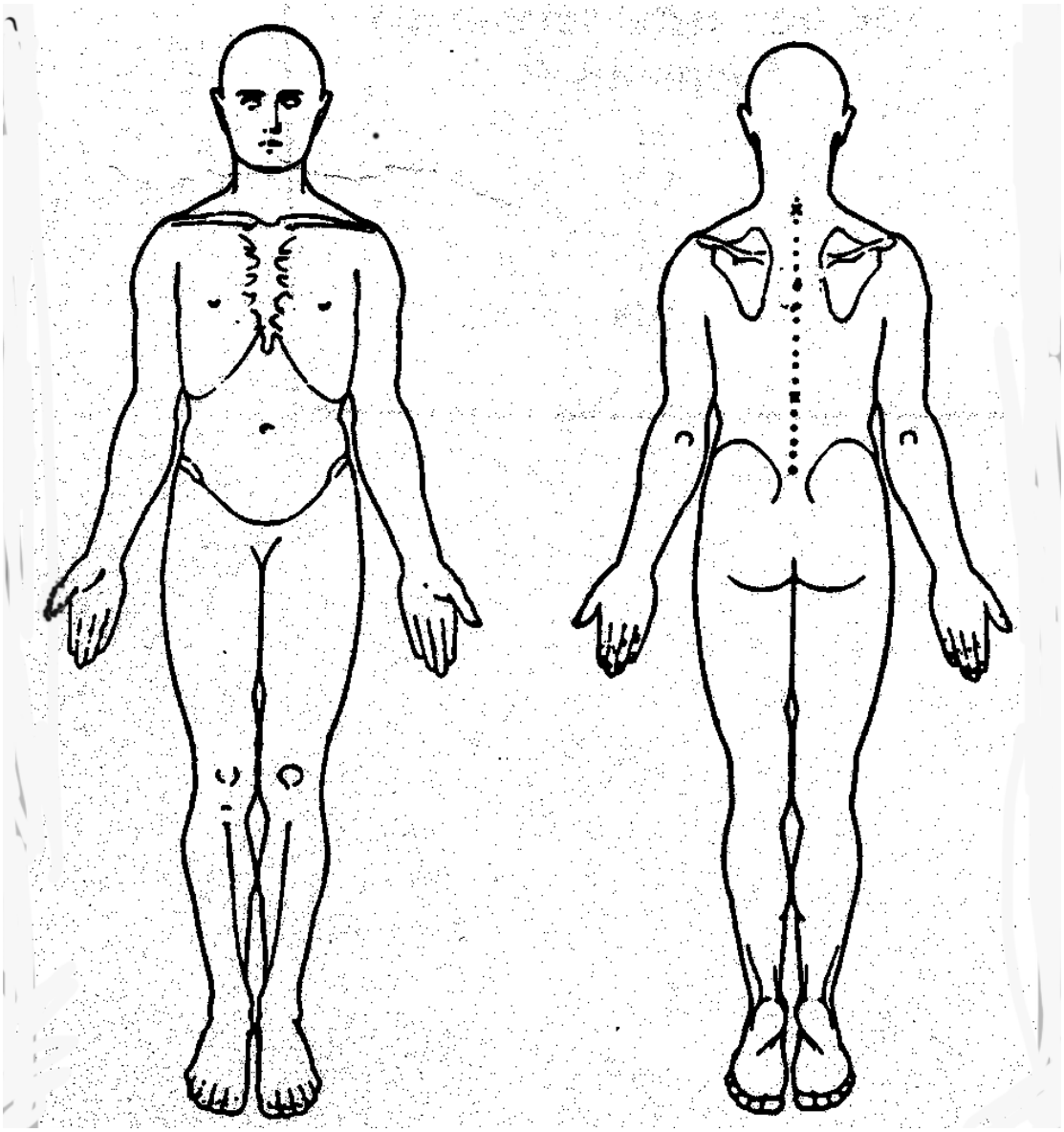
Instructions: Please indicate on the diagram below where you are experiencing symptoms. Use the following symbols to indicate the type of problems you are experiencing:

// . . . pain

O . . . pins and needles

X . . . ache

= . . . numbness



Numeric Pain Rating Scale

For the following questions, please consider the amount of pain you have experienced in the **past 24 hours only.**

Current Pain: On a scale of 0-10, with 0=no pain and 10=pain as bad as it could be, how much pain do you feel ***right now***? Please pick only one number.

0 1 2 3 4 5 6 7 8 9 10

Worst Pain: On the same scale of 0-10, how much pain did you feel when it was ***at it's worst***? Please pick only one number.

0 1 2 3 4 5 6 7 8 9 10

Least Pain. On the same scale of 0-10, how much pain did you feel when it was ***at it's best or least*****?** Please pick only one number.

0 1 2 3 4 5 6 7 8 9 10

Modified Oswestry Disability Questionnaire[2,3]

This questionnaire has been designed to give us information as to how your back or leg pain is affecting your ability to manage in everyday life. Please answer by checking **one box in each section** for the statement which best applies to you. We realize you may consider that two or more statements in any one section apply but please just shade out the spot that indicates the statement **which most clearly describes your problem.**

1: Pain Intensity

I have no pain at the moment

The pain is very mild at the moment

The pain is moderate at the moment

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[2] Fairbank JCT & Pynsent, PB (2000) The Oswestry Disability Index. *Spine*, 25(22):2940-2953.

[3]Fritz JM, Irrgang JJ. A comparison of a modified Oswestry Low Back Disability Questionnaire and the Quebec Back Pain Disability Scale. Physical Therapy 2001;81:776–88.

The pain is fairly severe at the moment

The pain is very severe at the moment

The pain is the worst imaginable at the moment

2: Personal Care (eg. washing, dressing)

I can look after myself normally without causing extra pain

I can look after myself normally but it causes extra pain

It is painful to look after myself and I am slow and careful

I need some help but can manage most of my personal care

I need help every day in most aspects of self-care

I do not get dressed, wash with difficulty and stay in bed

3: Lifting

I can lift heavy weights without extra pain

I can lift heavy weights but it gives me extra pain

Pain prevents me lifting heavy weights off the floor but I can manage if they are conveniently placed eg. on a table

Pain prevents me lifting heavy weights but I can manage light to medium weights if they are conveniently positioned

I can only lift very light weights

I cannot lift or carry anything

4: Walking

Pain does not prevent me walking any distance

Pain prevents me from walking more than 2 kilometers

Pain prevents me from walking more than 1 kilometer

Pain prevents me from walking more than 500 meters

I can only walk using a stick or crutches

I am in bed most of the time

5: Sitting

I can sit in any chair as long as I like

I can only sit in my favorite chair as long as I like

Pain prevents me sitting more than one hour

Pain prevents me from sitting more than 30 minutes

Pain prevents me from sitting more than 10 minutes

Pain prevents me from sitting at all

6: Standing

I can stand as long as I want without extra pain

I can stand as long as I want but it gives me extra pain

Pain prevents me from standing for more than 1 hour

Pain prevents me from standing for more than 30 minutes

Pain prevents me from standing for more than 10 minutes

Pain prevents me from standing at all

7: Sleeping

My sleep is never disturbed by pain

My sleep is occasionally disturbed by pain

Because of pain I have less than 6 hours sleep

Because of pain I have less than 4 hours sleep

Because of pain I have less than 2 hours sleep

Pain prevents me from sleeping at all

8: Social Life

My social life is normal and gives me no extra pain

My social life is normal but increases the degree of pain

Pain has no significant effect on my social life apart from limiting my more energetic interests (e.g. sport)

Pain has restricted my social life and I do not go out as often

Pain has restricted my social life to my home

I have no social life because of pain

9: Traveling

I can travel anywhere without pain

I can travel anywhere but it gives me extra pain

Pain is bad but I manage journeys over two hours

Pain restricts me to journeys of less than one hour

Pain restricts me to short necessary journeys under 30 minutes

Pain prevents me from traveling except to receive treatment

10: Employment/ Homemaking

My normal homemaking/job activities do not cause pain

My normal homemaking/job activities increase my pain, but I can still perform all that is required of me

I can perform most of my homemaking/job duties, but pain prevents me from performing more physically stressful activities (eg, lifting, vacuuming).

Pain prevents me from doing anything but light duties

Pain prevents me from doing even light duties.

Pain prevents me from performing any job or homemaking chores.

Appendix C Diagnostic and Management Concordance Tool

- Completed by assessing PT and/ or NP
- Each provider had a unique login and identification number to access a password-protected website with the online questionnaire.
- Responses were linked to each unique participant number

Diagnostic Classification and Management:

Diagnosis:

Based on the clinical findings (i.e. history, symptom behavior /location, physical exam findings and imaging findings (if available)), please answer the following questions:

1. What is this client's presenting symptoms most likely due to?

a) A problem in the back?

¨ Yes ¨ No

b) Is it likely a medical problem (e.g. GU, systemic)?

¨ Yes ¨ No

c) Is it likely a mechanical/ degenerative problem from elsewhere (e.g. hip, knee)?

¨ Yes ¨ No

- List: _____

2. Is there likely a spinal cord or cauda equina lesion?

¨ Yes ¨ No

Back pain diagnostic triage*:*

3. Indicate which category best fits the clinical presentation:

a) Possible serious spinal pathology

¨ Yes ¨ No

b) Nerve root problem

¨ Yes ¨ No

c) Non-specific back pain

¨ Yes ¨ No

d) Alternate diagnosis

¨ Yes ¨ No

Define: _____

4. Indicate what the likely source of the nerve root problem is:

a) None ¨ Yes ¨ No

b) Discogenic ¨ Yes ¨ No

c) Stenosis ¨ Yes ¨ No

Management Recommendations

5. Indicate what your recommended treatment plan is (check all that apply)

a) No further follow-up ¨ Yes ¨ No

b) Urgent surgical consult ¨ Yes ¨ No

c) Emergency surgical consult ¨ Yes ¨ No

d) Referral to another specialist ¨ Yes ¨ No

List: _____

e) PT/rehabilitation (with or without PT consultant review)

¨ Yes ¨ No

f) PT treatment and surgical referral ¨ Yes ¨ No

g) Education, initial self-care recommendations/treatment ¨ Yes ¨ No

h) Recommendation to primary practitioner for possible pharmacological management

¨ Yes ¨ No

i) Advanced Imaging (i.e. CT or MRI) ¨ Yes ¨ No

j) Laboratory, urinalysis or other tests ¨ Yes ¨ No

k) Other: _____

6. If applicable, please provide an alternative diagnosis/hypothesis that was not captured about for this participant's problem:

_____

Diagnostic Triage Explanatory Notes:

1. What is the back pain most likely due to?

a*) A problem in the back*

Clinical presentation (i.e. history, symptom behavior and location, physical examination findings fit with a problem arising mainly from the lumbar spine region)

b) ***A problem elsewhere***

-Clinical presentation (i.e. history, symptom behavior and location, physical examination findings do not fit with a problem arising mainly from the lumbar spine region)

i) Is it likely a medical problem (e.g. GU, systemic)?

- Clinical presentation does not fit with a lumbar spine region problem and there are associated signs or symptoms that may indicate a medical and/or systemic problem

ii) Is it likely a mechanical/ degenerative problem from elsewhere (e.g. hip)?

-Clinical evidence of degenerative peripheral joint disease (i.e. radiological evidence, capsular pattern of restriction, symptom presentation etc.) causing referral to low back region

2. Is there likely a spinal cord or cauda equina lesion?

-Presence of signs and symptoms of indicative of either spinal cord or cauda equina lesions (ie. gait disturbance, saddle anesthesia, hyperreflexia, clonus, Babinski sign, Hoffman sign, difficulty with micturition, loss of anal sphincter tone or fecal incontinence)

Diagnostic triage categories:

- Serious spinal pathology:

- May present with back pain or nerve root pain
- Clinical presentation, diagnosis and management concern the underlying pathology
- Presence of “red flags” (usually a combination of factors may be present)
- ***Red flags:***

-age <20 or >55 years

-significant trauma

-thoracic pain

-non-mechanical pain

-past medical history of: carcinoma, systemic steroids, drug abuse, HIV

- systemically unwell
- significant weight loss
- lumbar flexion severely limited
- widespread neurological deficits
- structural deformity
- erythrocyte sedimentation rate (ESR) >25
- x-ray- shows vertebral collapse of bone destruction

- Nerve root pain:

- Unilateral leg pain is worse than back pain
- Pain generally radiates to foot or toes
- Numbness or paresthesia in the same distribution
- Nerve irritation signs
    - reduced straight leg raising which reproduces leg pain
- Motor, sensory, or reflex changes
    - limited to one nerve root

- Non-specific/ mechanical low back pain:

- Clinical presentation usually age 20-55 years
- Pain is present in lumbosacral region, buttocks and thighs
- Pain is mechanical in nature
    -varies with physical activity
    -varies with time
- Patient is “well”

4. Indicate what the likely source of the nerve root problem is:

a) Discogenic

- age usually 20-55
- typical pattern of symptoms is increased symptoms with flexion activities (ie. sitting, bending) and relieved with extension (walking, standing)
- radiological evidence on CT or MRI (if available) that fits with the remainder of the clinical picture

- signs of nerve root irritation (e.g.. positive straight leg raise, slump or prone knee bend) and/or altered nerve conduction (i.e. fatigable weakness of key muscles, reduced or absent deep tendon reflexes, reduced or absence sensation in a dermatomal pattern)

b) Stenosis

- age of onset usually > 50 years
- typical symptom pattern is leg symptoms worse with extension activities (i.e. walking or standing) and relieved by flexion (i.e. sitting or bending)
- radiological evidence of foraminal or central canal narrowing that fits with the remainder of the clinical picture

Appendix D Semi-Structured Interviews (2-4 weeks Post-Assessment):

1. Semi-Structured Interview (Practitioners)

Thank you so much for agreeing to participate in our study. We will be recording our conversation if that is okay with you.

The purpose of this interview is to examine the experiences of Physical Therapists and Nurse Practitioners using videoconferencing to assess clients with chronic back pain. The objective is to determine perceptions of Nurse Practitioners and Physical Therapists following utilization of videoconferencing for interprofessional assessment and management of people with chronic back pain.

I want to remind you that your participation is voluntary. You can take a break if you need one. Do you have any questions before we begin?

a. How confident were you using videoconferencing for healthcare delivery to patients with chronic back pain? Why or why not?

1) Not confident at all
2) A little confident
3) Neutral
4) Moderately confident
5) Extremely confident

b. How confident were you with your role in an interprofessional team delivering healthcare to patients with back pain? Why or why not?

c. Did you feel like you were able to address all of your client's needs regarding their back pain using this method of care? Why or why not?

d. With ongoing availability of videoconferencing and a Physical Therapist /Nurse Practitioner (this question depends on who is being surveyed) colleague for this purpose, would your role change due to the new method of care?

e. Are you doing anything now that you did NOT do prior to this new method of care?

f. Could you communicate well throughout the assessment with the patient and other health care practitioner? Why or why not?

g. Were there any other challenges of this method of care and could please give examples?

h. What were the strengths of this method of care and could you please give examples?

i. What do you think are the observed or expected impacts of using videoconferencing for this type of care on people with chronic back pain?

j. What do you think are the observed or expected impacts of using interprofessional teamwork for this type of care on people with chronic back pain?

k. How could other members of the health care team be integrated into this method of care? Which team members? What would be the strengths or challenges of adding team members?

l. Would you use videoconferencing again or recommend it to a colleague for a similar clinical situation? Why or why not?

m. Is there anything else you want to tell us that we have not covered today?

2. Semi – Structured Interview (Participants)

Thinking back to your assessment appointment, can you tell me about your experience of having your back problem assessed by a Nurse Practitioner and Physical Therapist through videoconferencing?

a. How comfortable were you with the Nurse Practitioner using videoconferencing for your back assessment? Why or why not?

b. Could you communicate adequately throughout the assessment with both the Nurse Practitioner and the Physical Therapist? Why or why not?

c. Were there any challenges with the assessment due to the videoconferencing format? Why or why not?

d. Could you see any challenges with using videoconferencing for this type of ongoing health care? What were they?

e. Could you see any benefits to you in using videoconferencing for this type of assessment? What would they be?

f. Would you attend a health care appointment in the future if you knew that videoconferencing was being used? Why or why not? Would you recommend it to a friend? Why or why not?

Now I'd like to ask you about your experience of being assessed by a team of health care providers…

a. Have you had any previous experience being assessed by a team of two (or more) health care providers working together? *(Need some prompts here to illustrate)*. If yes, please describe the past experience:

b. Please tell us what you thought about having both a nurse practitioner and a physical therapist see you at the same time for your back problem.

c. Did you feel your concerns about your back problem were being addressed? If yes, how so? If not, why not?

d. What other types of health care providers have you seen in the past regarding your back problem (e.g. physical therapy, chiropractic, massage, Family Dr, specialist etc…) How did this experience compare to any health care visits you have had in the past for your back problem (e.g. by an nurse practitioner, GP or physical therapist) ? Prompt: How detailed was this visit compared to others?

e. Is there anything else you would like to share with us about your experience with using a team to assess your back problem using videoconferencing?

Appendix E Themes and Quotations from Semi-structured Interviews

1. Access to Care for CBD

	Less Travel, More Convenient	Community Based Care	Enhanced Access to Physical Therapy Care
PT	I expected the people would appreciate not having to travel but I don't think I got how much that would mean to them. I'm comparing to my prior clinical experience when people from these communities would travel quite a distance. It was quite apparent to me that they had had to take a lot of time out of their day, work life, family life to come for a visit. And those additional stresses were placed on them when they would travel three and a half hours for treatment. I didn't get any sense of those stresses for a one-hour appointment in their own hometown.	The appreciation of the service being offered locally was much greater than I had anticipated.	Prefer to use this with rural patients that are travelling to see us in an urban center. The reason is I can get the great majority of the information I need to help them over videoconferencing and I think it would make our in person visits much more efficient and usable. So it expedited a number of pieces of the health care system that would have otherwise happened more slowly. I was really happy that we could add physical therapy to a community that didn't have it in place
NP	-Much more convenient for the patient. They don't have to take a day off work and drive to the surrounding communities or Saskatoon	From my experience people that have to go outside of the community have a tendency to put it off and not follow through. So when it's right here on their back doorstep they're a little more eager to do it and more willing. I would use (VC) to get a second opinion. If I have a patient that's not terribly mobile or financially is a little strapped, it allows them a really great assessment and not have to leave the community And I also think that because it's right here in the community people are more willing to actually participate in the care and do the exercises and stretches that they've been given It's always easier to receive care from someone that you have	-There has been quite a significant challenge with our PT department keeping up with the community needs. So there is a delay in care.

		established a comfortable working relationship with already. If it's a patient that I know then it's much easier to do a holistic approach because I know their history. There is a certain rapport between a primary practitioner and their patient.	
1	You have to travel so far it's very nice to be able to have another opinion. We're so rural and we don't have very good healthcare here so if we can get anything better we're pretty happy.* It's not like we lived in a city and you have the option of going to anybody you want but still maybe the person you want to see is another province away and they do video link		
2	I think it would help, yes. One thing it would save us from having to run to Saskatoon.		
3	I think especially where we live out here it's not easy to get into the city or	And if I saw the nurse practitioner on a regular basis then she's kind of fully aware of what issues are going on and then they can work together to figure out a plan or whatever for me. I think that's a good avenue for people who live in a rural community.	I think especially where we live out here it's not easy to get into the city or even at some of the places that are closer to get into the physical therapist in a timely manner. Even at some of the places that are closer to get into the physical therapist in a timely manner. So if this works and if this is something we can do I think that would speed up some of the process.
4	Well one I didn't have to drive Elderly who really would benefit from the use of teleconferencing and not having to drive because getting to and from say Saskatoon appointments or distance appointments becomes and issue for our elderly.*	Elderly who really would benefit from the use of teleconferencing and not having to drive because getting to and from say Saskatoon appointments or distance appointments becomes and issue for our elderly.*	
5	it saved me an hour and a half trip! It did! At least! Because if there's anything more invasive then I have to go to Saskatoon and I know that. And I think we go to Saskatoon more	If we can bring this here and use the resources in our area, well then why not?	

	often than we need to;		
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* these quotations appear in more than 1 subtheme

2. Effective Interprofessional Practice

	IP Communication	Patient Centered Care	Team Functioning	Capacity Building due to Interprofessional Collaboration
PT	…if these were one-off assessments perhaps the comfort level of communication wouldn't have been as good. It may be more challenging if two team members were strangers to each other or had never met or talked repeatedly by videoconferencing.	It was very useful to have a NP so that it was a team-based approach to care. Why [was I] extremely confident? The nurse practitioner on the other side. The fact that it was a team assessment meant that I didn't have to worry that I was missing any important physical signs. If I could travel to the community on occasion for sort of team building and skill building sessions between us, I think that would help both of us. Example: I could provide more information to the NP about assessment of the back, hip, pelvis, knee for example normal movement at those joints and how to facilitate movement (assessment) there so that we could get a more detailed idea of what was going on As we did more and more assessments in XXXX I felt that I could enhance the assessment by demonstrating some techniques to the NP; so some fine-tuning for assessment. It [team assessment] was beneficial in terms of the understanding of medical	The trips we made to XXXX were important in team building situations. I felt that I was providing expertise that was not available without me so I felt that my role on the interprofessional team was very relevant And I felt that I benefitted in my understanding of the patient because of the nurse practitioner role that was played in the cases of both nurse practitioners. As we did more and more assessments in XXX I felt that I could enhance the assessment by demonstrating some techniques to the NP; so some fine-tuning for assessment.	Re: Other Members: It would have been helpful if the PT and Exercise therapist could have communicated via videoconferencing. In another case, I engaged an academic scholar in a specialty area to provide information to the ET. In some case a pain management specialist would have been awesome to have on the line I'm more concerned (after this approach) about the way that we manage- 'we' meaning our general healthcare system- the way that we manage chronic pain and pain in the elderly. I'm concerned now that there are more gaps in the management of that type of problem than I had thought there were. So I think we could enhance the way that we manage pain especially in elderly people or most urgently in elderly people by having a team approach.

		and social history of the patient and in terms of numerous comorbidities I think I've put the back dysfunction into a more holistic picture than I had prior.		
NP	As far as open communication between her and the patient and myself … it was a very comfortable approach and the patient didn't appear to be intimidated at all.	I think that when a patient has a number of different practitioners working together to move them forward along the continuum of wellness I think that … it's going to ensure that everybody is on the same page. I'm a firm believer in interprofessional relationships and using the right person to do the right job. So this just cemented that further for me. I really believe it's a very effective way to offer patient care. I think not only does it (VC team assessment) enhance our assessment and improve access to the patient, but I think then the treatment portion of it will then result in the patient seeing the right person and receiving the right treatment. Because right now I see our patients are being sent all over the place and they're not necessarily receiving the appropriate treatment. There's a great deal expense and time and poor outcomes. Ordinarily I guess if they just saw the physiotherapist they may not have had the option of leaving with a prescription for some sort of analgesic at the	For me I was sort of an extension of (PTs) arm. But I think that one of the benefits of my prior (NP) training is that I knew how to do a physical assessment already so it wasn't that she had to teach me from ground zero up.	Re other team members: pharmacists have a lot of input that they can offer us when we're trying to do the best type of medication reconciliation and pain management for our patients. If it's a functional problem I think having an occupational therapist and maybe physio has a skillset too. If it's a senior … I think a homecare nurse would be a real asset. For someone that's obese and has low back problems, …having a dietician or a nutritionist there to guide them through the steps in weight reduction would be an awesome way in the perfect world to approach this.

		same time. But I think we expanded the patients' treatment options in that one visit by using the two I think it was a more holistic approach so we definitely looked at their additional needs over and above just the back pain. We ordered serologies and additional x-rays and looking for different inflammatory things that could be also influencing some of the pain they were experiencing. So we definitely addressed more than just the back pain itself. With this approach we went through their medications. We talked about their issues at home and not only their back pain but a multitude of other things as well. So I do think for the patient it's a much better approach. * It's nice to have someone kind of pulling all this information together and sort of directing that patient to wherever they need to be next. So it's not disjointed. It does make care much more cohesive Continuity of care is definitely going to be improved on.		
1		-But I mean she told her exactly what she was feeling and she felt okay with it. And I trusted Louise so -I wouldn't have probably ever had this	Well I thought it was a good idea because it was somebody else taking an interest in it.\ I wouldn't have probably ever had	

		chance if it wasn't for this. When you have these problems you don't know where to go.	this chance if it wasn't for this. When you have these problems you don't know where to go. Maybe even like Louise- I'm not even sure if she would be qualified to know all there is to know like the physio people would.	
2	Went okay. I thought it seemed to be able to get through to each other and found a lot out. It helped me anyway I think. I thought they got along all right. The nurse practitioner would kind of explained to her what I had- my problems- and the lady in Saskatoon asked questions on it that seemed to work good as far as I was concerned anyway First I was wondering about it like what was going on, what would happen? But I think it was alright. It turned out okay. They could communicate back and forth and helped everybody. Not really. Just like I said before that I felt that with the two of them there they could communicate back and forth and with me at the same time instead of having to go to the one and then a week later going to the other one sort of thing. Everything seems to be there. They could			

	communicate and figure out things right there.			
3	I thought it was actually a good thing. And if I saw the nurse practitioner on a regular basis then she's kind of fully aware of what issues are going on and then they can work together to figure out a plan or whatever for me.	The nurse practitioner was there to like move me or whatever if they needed to. Yeah, I though it was well executed. I thought it was actually a good thing. And if I saw the nurse practitioner on a regular basis then she's kind of fully aware of what issues are going on and then they can work together to figure out a plan or whatever for me		
4	There was one thing that Louise had forgot to do and the physiotherapist picked up on it right away and said, "Oh you should do" and she's, "Oh yes, yes," and she did it. And I don't think anything was missed.	I'm comfortable with Louise and I think she understands issues really well and is participating really well in this program.		
5	I thought it was a fulfilling experience. I thought maybe not having – I was kind of wondering, 'It's teleconference? And the person isn't in the room.' But the nurse practitioner did the physical stuff that she needed to do physically on me. Like the lady on the screen would tell her, "I need you to do this. Get her to do that." So it was fine. It was a good experience. And that's what the nurse practitioner is and someone to bounce the ideas off of. So you've got a	As far as I was concerned- especially being a nurse- as accurately diagnosed and as thoroughly diagnosed as I've ever been for my back. And it took 45 minutes. They didn't rush. They did a full, proper assessment	So I felt better just knowing I didn't have just one professional. I had two. I would consider this for anyone if they did make this thing happen. Yes because it brings a trained professional. They can't physically be here but their skills are still just as effective on that screen if they have a trained pair of hands to use No but I was comfortable with her because: one, I know she's a physiotherapist so I	

	physiotherapist trained as a physiotherapist and you've got a nurse practitioner. So when they work conjoined like that it's good. It has two pairs of professional hands in one room. multiple disciplines. No. That was quite refreshing So that was the physiotherapist that said that. So I had her right in the room! I didn't have to go from Louise to the physiotherapist, right?.		know that she's – you know confidentiality, all those things are implied with having that degree and training. So I didn't feel uncomfortable disrobing or anything like that. Knowing that you're getting help helps too. Yes because it brings a trained professional. They can't physically be here but their skills are still just as effective on that screen if they have a trained pair of hands to use	
6	Well because there was the lady on the screen and then there was a physical person there it was like having two people in the room so I don't really see any problems or challenges for younger people, children, or whatever. So long as the two people doing the interview or whatever explained everything and I think they did a really good job. I don't think somebody younger would find that weird		Well just with my experience with the doctors in town, how they didn't really know anything. They just prescribed drugs and had me bend this way, that way. "That hurt?" Well where one wasn't sure the other had maybe more experience, you know? Like the physical therapist maybe knew the muscles more maybe, something like that. Kind of knew what to ask.	

3. Enhanced Clinical Care for CBD

	Holistic Care	Expertise in CBD
PT	I felt that I could do an adequate assessment We were able to tell everything we needed in terms of diagnosis and management planning	They (the patients) seemed grateful for any information. It was really apparent to me that the majority of people had not been through a conservative care approach to their back pain

	from a videoconferencing style of assessment. It was quite easy and reasonable to transfer lumbar triage assessment to that model of care. I was able to address all of their assessment and management planning needs…but then there would be a recommended hands-on approach to add to the patient care.	that was so long. Without fail, they seemed very pleased and grateful for any input that we gave. I actually found that I learned more during that than I had by myself in many situations with chronic comorbidities. Understanding of pain management (re medication use and history of management)- that was quite enhanced because of the presence of the team versus when I do assessments on my own. I think I've put the back dysfunction into a more holistic picture than I had prior. The team setting…. has changed the way I look at management of chronic pain. The way I question pain is different (from prior to participating in this new approach to care). I listen more carefully for the impact of medications on their pain. I've learned more about that. I understand more than I used to about the other things that have been tried for their pain other than hands on conservative types of treatment.
NP	Re Physical Exam: I was comfortable with it. And (PT) was very good at explaining our findings on the assessment and what type of treatment plan was going to be implemented. * There were some prescriptions that were written for pain management. We even did an additional consult for another specialist over and above the physical therapy part.* I found it to be a very efficient use of my time and the patients'. Once again as I said I think that they got a more holistic approach and probably in the end got a bigger bang for their buck.	When I do an assessment of someone that comes into my clinic that is experiencing back pain my assessments are a little bit more systematic because of course I'm conformable doing this now. I've done it enough times. And I've always referred to physio but I think now I'm more aware of what types of physio may be offered and maybe a little bit more when I do ask a physiotherapist to see my patients I may be a little more specific about the type of care that I want them to provide.
1		We're so rural and we don't have very good healthcare here so if we can get anything better we're pretty happy* I'm just happy that somebody's got some answers, because I have gone to physio for different reasons in the past, and all I've ever hap - you go through all the exercises and stuff and you notice very, very little and the muscles will get so sore and you're not getting better. Like I have plantar fasciitis in both my feet and I've had numerous things done and still have it.

		So I'm kind of excited that I've noticed a bit of difference in my back already. So do you feel that your concerns about your back problems were adequately addressed then? P: I think so, yeah. Better. Way better! I feel way better. I mean they were all very good and very interested. Sometimes you go to the doctor and they'll go, "Well try this, try this, try this," and you try these things and they don't work and you go, "They don't know anything." And you're taking Tylenols and anti-inflammatories and icing and putting heat on and things like that and you only get just a bit of relief. It just seems like they're just trying to pacify you to try something and it's not really the answers. Where here I think it seems like they're working to like get you where you want to be.
2		
3	I felt it was thorough and that they could see what they needed to see. Things were explained very clearly. I appreciated that. I didn't feel rushed. You go in sometimes and it's like you got to get in, you got to get out and I didn't have that feeling. I felt I could sit there and ask the questions that needed to be asked and they asked me things they needed to clarify. So that was good.	
4	(The NP) of course was sitting right next to me in the chair and if I had any questions I could direct them directly to her.	
5	I thought it was a fulfilling experience. Well what she did was she did a full assessment of my back. So I had x-rays done, multiple x-rays done. And I had blood work to rule out or include rheumatoid arthritis, whatever else might be in my blood. She gave me suggestions as well for what I could do. Yes, to continue with the yoga stretches. Yes, to focus on those two in particular. The physical therapist did that. So I left there feeling confident with my prescription and took my prescription and have been to my regular doctor to see her for not for follow up for that, for something else. I told her what I was doing with the study. And she is confident leaving it in Louise's hands for my back at this time.	
6	I got way more feedback than I ever have from going to my doctors in town. Whether the feedback was great or not, I just got more feedback.	I got more feedback from that than I did just going to my doctor's. So yeah, I kind of felt it was a little bit more addressed I guess

	Oh well I found it was very positive and like I said I thought it was very helpful. So yeah, I was very, very glad to be in it.	

4. Technology

	AV & Communication	Other Challenges and Considerations
PT	We had a camera that was especially clear, easy to use, and quite valuable when it came to fine details. On two occasions we lost the camera and the laptop-based camera wasn't as clear or didn't show as intricate of details so the quality of the camera was a big factor. I think that's the main thing. There were two situations where we lost our camera so we relied on the laptop camera, which was fine. But we did need to add external mini speakers to improve the audio when we lost our main camera.	Fortunately they had those little speakers in XXXXX. We hadn't predicted for that. So I think that I would put that as a part of an ongoing protocol to ensure a backup because we can't always plan for hardware or internet failures. I think there was certainly a learning curve with the technology and we had the opportunity because this was a research study. It would be tricky to add a clinical person to the mix if they weren't already highly efficient with technology or if they didn't have support. Some of the problem solving we did would have been more difficult if not impossible during a clinical setting,
NP	We did have challenges where we couldn't get the eye to follow us so we had a bit of a difficulty really getting a good volume and moving the screen around. But in spite of all that it still worked. We just sort of found ways to make it work. The volume was a bit of a challenge at times so we sat our patient closer to the computer so they could hear a little better. Our screen froze up on two or three occasions on it. The only real problem with communication other than the technical part was just not being able to clearly hear her. We had some glitches with our electronics. I think we have to look at that and maybe better accommodate our patients because I know our volume was a challenge for some of our people that had a bit of a hearing deficit. And it is a smaller screen size so for people that want to see (PT) I'm working with- visual I think that needs to be addressed too. We want to make sure our technology's working and everybody is kind of on board with it. Because it is a bit of a challenge if you get your patient in the office and then suddenly you can't get anything to work.	Our office manager really has kept this flowing very smoothly for me. Thank goodness because I might not be nearly as excited about this if XXXXX hadn't been able to make it work. She was on the line with I.T. when things weren't working and she was trying to make sure that everything was in place for us. It is critical. Because I mean I have a very busy clinic. If I would have had to have taken half an hour or an hour out of my day to get everything set up and to figure out why stuff isn't working then I might be somewhat disgruntled about the process. We made it work with really very little.

	Really what I needed from her is for her to be able to see what I was doing and then give us some recommendations or guidance. And it appeared that in spite of our technical difficulties she still could see what she needed to see.	
1		
2		
3	And if she couldn't see more or something we just adjusted but I could hear and see her all the time. I guess it would kind of depend on the technology aspect of it because sometimes videoconferencing doesn't always work because there's something wrong with the internet or whatever. I think just the technology I could foresee a problem there sometimes.	
4	I could see the physiotherapist very well. I could hear her. There was nothing I sort of missed when she spoke I like to embrace technology. It's here to stay and there's a lot of benefits to it and like let's use it when we can. Our younger generation, they Skype and Face Time all the time; they will embrace it with no problem.	…elderly. But technology somewhat scares them I think. Like I say, I think we're going to struggle with our seniors only because they're unfamiliar with it.
5	We use videoconferencing out here for like Telehealth all the time so I'm already familiar with the media.	It's really no different than when you go to the doctor. You're still in a room. You've just got that extra screen there and the other person is providing their expertise from that end. So I don't really see a downside, just maybe a transition. Just a transition period for older people I guess. Younger people are going to be fine. It's older people that may not like it.
6	Communicate adequately throughout the assessment with both of the nurse practitioner and the physical therapist? P: Yes I could.	It was a little awkward but it was okay. Challenges? Not that I can really think about. No, I think it went really good.