APPLIED OUTCOME MEASURES IN CLINICAL ATHLETIC TRAINING: A DISSERTATION OF IMPROVED CLINICAL PRACTICE

A Dissertation

Presented in Partial Fulfillment of the Requirement for the

Degree of Doctor of Athletic Training

with a

Major in Athletic Training

in the

College of Graduate Studies

University of Idaho

by

Wendy Wheeler Dietrich

December, 2014

Major Professor: Dr. Alan Nasypany, EdD

AUTHORIZATON TO SUBMIT DISSERATION

This dissertation of Wendy Wheeler Dietrich submitted for the degree of Doctor of Athletic Training with a major in Athletic Training and titled "Applied Outcome Measures in Clinical Athletic Training; A Dissertation of Improved Clinical Practice" has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor: Date:

Dr. Alan Nasypany

Committee Members: Date:

Dr. Jeffrey Seegmiller

Date:

Dr. Paula Parker

Date:

Dr. Colleen Shotwell

Department Administrator: Date:

Dr. Philip Scruggs

Discipline's College Dean: Date:

Dr. Corinne Mantle-Bromley

Final Approval and Acceptance by the College of Graduate Studies:

Date:

Dr. Jie Chen

ABSTRACT

Outcome measures are an integral part of providing high quality athletic training healthcare services. These measures are essential for better understanding the quality and progress of a patient's recovery. Athletic Training practitioners are expected to regularly collect and evaluate outcome measures to guide decisions pertaining to treatment and rehabilitation for physically active populations. All healthcare professionals must become more proficient with the collection and analysis of patient-oriented and disease-oriented measures to improve patient care, especially considering the unique patient volume and time constraints of our treatment setting. Outcome measures offer an ideal method for assessing the effectiveness of various treatment options for hamstring injuries. The purpose of this research was to examine the current use and application of outcome measures in a clinical athletic training practice. The two-part study included a survey distributed to a sample of the National Athletic Trainers' Associations certified membership and a clinical research investigation using outcome measures collected during the application of a hamstring treatment technique.

Survey results seemed to indicate familiarity and confidence in utilizing outcome measures, including disease-oriented evidence (DOE) and patient-oriented evidence (POE), was low. College and university practitioners responded particularly low. A second clinical investigation was undertaken to demonstrate how the practicing clinician could use DOE and POE in daily practice. The administration of the box tape procedure (McConnell, 2012), combined with the traditional rehabilitation protocol was associated with clinically significant improvement in patient status. Each patient was able to return to participation in sport activity without a return of symptoms or re-injury through a 60-day follow-up period and demonstrated restoration of active range-of-motion (AROM), pain reduction, and improved function as measured on the POE outcome instruments. Although findings suggest this technique was effective, further research is needed to establish the physiological basis of the improvement in function that appears to have resulted from the treatment.

ACKNOWLEDGEMENTS

It is with immense gratitude that I acknowledge my professors, Dr. Alan Nasypany, and Dr. Jeffrey Seegmiller. They, in their infinite wisdom and with tremendous courage, saw a need for the profession of athletic training to join the ranks of healthcare practitioners and took action. Their dedication to the field of athletic training and to the advancement of clinical practice is unmatched and my patients and I are indebted to them both. My appreciation can scarcely be expressed in words for accepting me into the DAT.

I must also acknowledge my fellow "Plank Owners" who blazed a new trail in the wilderness, Dr. Rusty Baker, Jennifer Melina, David Ruiz and Julie Miller. I am indebted to your willingness to share your knowledge, and a listening ear. We shall forever be the first and it is with great admiration I stand next to you.

My good fortune has extended to my amazing colleagues, Professor John Paolini and Dr. Colleen Shotwell. They have supported, entertained and challenged me in all aspects of my career and I would not have attempted this undertaking without their approval. Also, I am so very thankful to acknowledge Dr. Paula Parker, who has graciously given her knowledge and time without asking for any return. She is a tremendous example and I am grateful for her friendship.

I owe my deepest gratitude to my family, who are the rock upon which my foundation stands. My parents, Tom and Linda Wheeler, instilled a love of learning and expectation of success in academia. Their example and dedication to their children, biological as well as the students they have touched throughout their careers, are unparalleled. I am so very grateful to have had such strong role models and owe all of my determination to them.

Few individuals are blessed enough to have the benefit of true partnership, particularly when it comes with such deep abiding love. I am so very fortunate to have my husband, Dr. Scott Dietrich, believing in me in all I do. He is truly my partner in all things: parenthood, athletic training, life and love. I strive to achieve all he believes I can.

DEDICATION

For my amazing boys, to whom every breath is devoted.

I love you Scott, Devin and Owen.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
NARRATIVE SUMMARY

Athletic Training, as a healthcare profession, is continually evolving. Initially, athletic trainers were not much more than sports coaches who knew how to wrap a bandage and rub on salve. According to the seminal text, Principles of Athletic Training (2009, p. 5), early athletic trainers had "no technical knowledge, their athletic training techniques usually consisted of a rub, the application of some type of counter-irritant, and occasionally the prescription of various home remedies and poultices". The National Athletic Trainer's Association (NATA), formed in 1950, and the Professional Education Committee, in 1970, were established to create standards by which an athletic trainer would be educated. Athletic Training was not recognized as a healthcare profession until 1990 (National Athletic Trainer's Association, 2013). Slowly, athletic trainers have begun to carve out their place in patient care. An athletic trainer is now defined as a "Healthcare professional who collaborates with physicians to optimize activity and participation of patients and clients. Athletic training encompasses the prevention, diagnosis, and intervention of emergency, acute and chronic medical conditions involving impairment, functional limitations and disabilities (National Athletic Trainer's Association, 2013, pp. http://www.nata.org/athletic-training)."

In the mid-1990s, athletic trainers were not required to graduate from an accredited degree program to become certified athletic trainers, as they are now. The internship route did not require a degree in the field of athletic training, and was an apprenticeship model in which the candidate learned through experience under supervision of a certified athletic trainer. This sets up a model in which the knowledge base is built upon personal experience instead of scientific research (Prentice & Arnheim, 2009). Formal research was introduced in my clinical practice while undertaking a Master's degree at West Virginia University in the form of evidence-based practice. Evidence-based practice (EBP) is the conscientious use of current best evidence in making decisions about the care of each patient or the delivery of health services. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research (The Cochran Collaboration, 2013).

Unidirectional evidence-based practice in which science and the scientific method of research were to inform clinical practice is a common misconception. The results of ran-

domized controlled bench trials leave many practitioners unable to relate the outcomes to the treatment of each patient in a distinct community (Woolf, 2008). Results of the controlled bench trial are often dependent on the control of variables unable to be manipulated in actual patient care. For example, controlled bench trail may depend on the patient receiving the treatment on consecutive days. Patients participating in college athletics may not be able to attend a treatment session on consecutive days due to away contests or academic work preventing attendance. Research in the field of healthcare reflects this model. Translational research is a term that describes the template for research that bridges the gap between basic and applied research (National Center for Advancing Translational Science, 2013). Translation of new knowledge, mechanisms and techniques generated by basic science into the prevention, diagnosis and treatment of disease is imperative to improving healthcare (Fontanaros & DeAngelis, 2002).

Translational research most often refers to the bench to bedside and back to bench endeavor in which a clinically identified problem distilled into a scientific research study informs clinical practice. The inverse is also true in that clinical observation can inform laboratory testing. A new method of diagnosis, therapy and prevention developed through basic science and conveyed to clinical practice is known as Phase 1 (T1) Translational Research (National Center for Advancing Translational Science, 2013). Phase 2 (T2) Translational Research results from clinical type studies that inform everyday clinical practice. The T2 translational research falls in the scope of practice of public health scientists. Those who study T2 translation facilitate application of research findings to the community (Woolf, 2008).

The model for translation of basic research into clinical practice and back again has been conceptualized as a "translational highway" (Schwarts & Vilquin, 2003, p. 394). Westfall, Mold and Fagnan, (2007) further extend the breadth of translational research to include a third type of research. Phase 3 (T3) translational research is practice-based research for investigation of scientifically developed research into day-to-day clinical care (Westfall, Mold, & Fagnan, 2007). It is important to make scientifically gained knowledge pertinent and accessible to both practitioner and patients. The T3 research is effective in this regard, as it translates knowledge into practice. Much of the research produced in healthcare, including athletic training gets lost in translation (Lenfant, 2003). While the focus of T1 and T2

translational research is taking the findings of basic research and translating them into clinical investigations, the focus of T3 research is taking the findings of clinical investigations and translating them into the healthcare at a community level. Most of the healthcare in athletic training is in local settings, including school based setting, clinics, professional sports, industrial and dance. This is where the translational highway branches into a number of smaller avenues and lanes providing ample opportunity for the knowledge vehicles to get lost (Schwarts & Vilquin, 2003). A systematic and careful look at how knowledge translates into clinical healthcare is warranted (Lenfant, 2003). Development of the advanced practitioner, who is both a clinician and a researcher, skilled in both scientific method as well as patient care, is the solution to this quandary.

The Doctorate of Athletic Training (DAT) degree produces advanced clinical practice in the field of athletic training, in essence to generate expert clinicians and translational researchers. Advanced clinical practice in athletic training incorporates the full investigation of a clinical question through the review of current literature, development of theories, application of theory-based practice, evaluation of outcomes, and dissemination of knowledge to fellow practitioners. Methods hinge on thoughtful practice in which the practitioner relies on foundational knowledge to develop the theories tested and explored.

The purpose of this dissertation was to show mastery in all the aforementioned aspects of advanced clinical practice: 1) evaluation of patient care and development of a clinical question, 2) review of current evidence for possible solutions to clinical question 3) test possible solutions through application in clinical settings, and 4) disseminate new knowledge thus informing and encouraging new laboratory study. Chapter 2 encompasses the Plan of Advanced Practice, and the analysis and improvement of personal clinical practice. Chapter 3 details the clinical outcomes gathered and methodically examined to develop theories for potential advancement of patient care quality. Chapter 4 is a review of current literature specifically about both outcome measures applicable to athletic training and current practices in care of hamstring injuries. Chapter 5 is an original two-part research study of outcome measures application in clinical athletic training and the effectiveness of outcome measures to evaluate the box tape treatment (McConnell, 2012) on hamstring injury.

The Plan of Advanced Practice (PoAP), described in chapter 2, serves as a map for the journey to becoming an expert clinician and documents the path I have previously taken.

The chapter evaluates strengths and weaknesses defined by the National Athletic Trainers Association's role delineation. The PoAP addresses weaknesses through courses and research throughout the DAT course work. For example, one category evaluation states a weakness as "Unsatisfied with current documentation techniques, would like to implement electronic patient records which include outcomes measures." This weakness was thoroughly addressed in a literature review in chapter 4 and put into practice in a research project described in chapter 5. Outcome measures use has transformed from weakness, to strength, and now a specialty. This transformation also occurred in regards to the selection, application and evaluation of the effectiveness for therapeutic interventions using the best evidence to guide those decisions (Knight & Ingersoll, 1998). During the past two years, I was able to acquire expertise in the treatment and rehabilitation of hamstring injuries and the use of outcomes measures to evaluate the effectiveness of the treatment, evidenced specifically in chapters 4 and 5.

One such method of treatment was the box tape method described by Jenny McConnell, an Australian physical therapist. In a lecture provided for Northeast Seminars, Dr. McConnell describes a method of unloading the underlying muscle tissue and shortening the injured structure through application of tape surrounding the affected area. The result of the box tape was protection of injured structures and reduction of pain, which allowed the patient to further complete rehabilitation exercises (McConnell, 2012). Chapter 2 discusses the philosophies that have evolved to guide my clinical practice; specifically the role fascia plays in the diagnosis and treatment of muscle injury. Chapter 3 documents the journey to improve clinical outcomes achieved in my personal clinical practice. Before outcomes could be appropriately incorporated a review of current literature on outcomes measures applicable to athletic training clinical practice was undertaken in Chapter 4.

Outcome measures are essential to understanding quality recovery in an active population. Collection and analysis of data is critical in healthcare professions such as athletic training (Michener, 2011). The ability to assign a meaningful value to recovery allows a clinician to quantify significant change in an injury. The two basic types of outcomes measures are clinician-oriented measures (COE) (e.g., range of motion and girth) and patient-oriented measures (POE). Evaluation of health-related quality of life and the effect of injury on the patient is the goal of patient related outcomes. Many patient outcome measures already ex-

ist, but few athletic trainers are familiar with them resulting in low implementation (Stiller-Ostrowski & Ostrowski, 2009). The use of outcomes measures allows an athletic trainer to become a scholar clinician, evaluating one's own personal practice and advancing the profession by thorough scientific inquiry.

One weakness in clinical practice is the outcomes of hamstring-injured patients. Acute and recurrent hamstring injuries are among the most common injuries reported in athletic participation, particularly in sports involving high-speed running (Chumanov, Heiderscheit, & Thelen, 2011). Hamstring injuries accounted for 16% of sports injuries reported in the 2007 International Association of Athletic Federations surveillance study (Alonso et al., 2009) and resulted in over half of the injuries reported during the National Football League's training camp. Days lost from participation ranged from 8 to 25 days with an over 33% re-injury rate within the first two weeks (Feely, Kennely, & Barnes, 2008). The frequency and duration of hamstring injuries makes them an excellent topic for clinical research. The prolific nature and resulting disability associated with hamstring strain is further illustrated in an extensive literature review of hamstring injury presented in Chapter 4. Incidence, mechanism, diagnosis and treatments of hamstring injury were all thoroughly researched for the most current evidence.

Treatment philosophies discovered through the literature review typically employed include early intervention of conservative treatment, followed by mobilization and eccentric muscle strengthening as quickly after the first 24 hours as tolerated by the patient. This treatment protocol has served as an effective method of treatment, well tolerated by the patients, and has resulted in positive clinical outcomes (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). Kilcoyne and colleagues (2011) state their protocol (reflective of the above tenets) was effective in their particular cohort of patients and collegiate athletes, and resulted in return to play in less than 2 weeks with a low risk of recurrence. The limiting factor of the patient's progress was pain as tolerated by the patient (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). Implementation of the box tape treatment (McConnell, 2012) in clinical practice revealed positive patient outcomes and hastened a return to activity as illustrated in the clinical outcomes in Chapter 3. Chapter 5 presents a research project evaluating the outcomes measures collected on hamstring injured patients treated with the box tape during pre-season. The goal of the research project was to not only improve treatment of ham-

string injuries, but to create a template for the further exploration of clinically based outcomes in effectiveness research.

The process of creating true translational research does not end with the research project. Evidence-based practice philosophy underlines importance of evaluating the effectiveness of all aspects of healthcare. There remain important links between clinical practice and research established and maintained with outcomes measures. Evidence from routine clinical application, or effectiveness data, is compared with outcomes obtained from randomized controlled-treatment trials or efficacy data. In this way, T3 translational research evaluates knowledge from T1 and T2 research applied in distinct community patient care, and results inform further T1 and T2 research; an important step in developing an effective translational research process. The process is referred to as practice-based evidence (Barkham & Mellor-Clark, 2000). The box tape method improved the outcomes of the patients with hamstring injuries, and theories explaining why can now be developed and explored scientifically. One such theory developed through the process of practice-based evidence suggests the low-grade hamstring injury involves more fascia disruption, and not true muscle damage.

In the article by Knight and Ingersoll (1998), they expound on the need for scholarship in athletic training to improve both the status of athletic training as a profession, and increase an athletic trainer's ability to improve patient outcomes. These two prominent figures define athletic training scholarship as advancement of knowledge through theory development and evaluation to find and disseminate new knowledge. The advancement of knowledge is the essence of advanced clinical practice. The most difficult aspect of the path to advanced practice is that the answers are not always clear. The advanced practitioner accepts the challenge of exploration. They are walking the line between research and practice, immersing themselves in both simultaneously, which is a difficult task. Failure to incorporate scholarship results in stagnant clinical practice. Successful implementation of scholarship improves patient care beyond current outcomes and is closer to what might be possible. Therefore, the advanced practitioner must walk the line between scientific theory and clinical application.

The purpose of undertaking the DAT and pursuing an advanced clinical practice degree was to become a scholar clinician and apply translational research to the traditional ath-

letic training setting. The goal was to produce an applicable method of clinical research that can use outcome measures to evaluate professional practice indented to further inform scientific or laboratory research. The advanced practitioner in athletic training is an expert in EBP and truly a scholar clinician.

CHAPTER 2
PLAN OF ADVANCED PRACTICE

The PoAP has served as the road map for my journey to the DAT. Achieving advanced practice requires evaluation of current practice and includes both strengths and weaknesses. Athletic training scope of this practice is defined in two professional publications: The Athletic Training Educational Competencies (National Athletic Trainer's Association, 2012) and the Role Delineation Study (Board of Certification, 2012). The combination resulted in the document *Athletic Training Guide to Services* (National Athletic Trainers' Association, 2010) that has been the basis for evaluation. The PoAP establishes a plan to address weakness and improve healthcare by filling holes in current practice and illuminated areas of specialization. The process has expanded both the breadth and depth of my clinical practice bolstering quality of patient care.

The reflective nature of the evaluation and PoAP development required an organic method of documentation and is presented as a narrative. The goals developed to address weakness outlined in the PoAP (summarized in a brief statement submitted for the DAT) are presented under the headings Spring Semester Goals and Fall Semester Goals. Goal documentation recorded progress and communicate personal reflection of athletic training clinical practice. The philosophies included in this chapter outline the thought processes in developing personal guidelines with regards to both rehabilitation as well as treating back pain. Inclusion of these philosophies illustrates the principles of thoughtful evidenced-based practice. Much of the information presented in this chapter comes directly from this documentation and reflects an informal writing style to communicate personal growth. The *Athletic Training Guide to Services* (National Athletic Trainers' Association, 2010) assisted my evaluation by providing a virtual checklist of skills need in advanced athletic training practice (Appendix 1).

IMPROVEMENT OF PRACTICE

The process of the creating the PoAP has provided an exception opportunity to address deficiencies in my current practice. As the profession of athletic training has evolved a great deal and practice of athletic training has advanced. The five domains of practice for athletic training are I) Injury/Illness Prevention and Wellness Protection, II) Clinical Evaluation and Diagnosis, III) Immediate and Emergency Care, IV) Treatment and Rehabilitation,

V) Organization and Professional Health and Well-Being (National Athletic Trainers' Association, 2010). Various educational endeavors were completed to address the missing pieces.

Under Domain I, Injury/Illness Prevention and Wellness Protection, weakness was discovered under the subheadings of "Obtain and interpret environmental and patient/client data to make appropriate recommendations for patient or client safety and continuance or suspension of activity " (Table 1.2). The NATA has provided members an opportunity to advance evidence-based practice through the best practice guidelines described in the NATA Position and Consensus Statements (National Athletic Trainers' Association, 2012). I have thoroughly reviewed the NATA Position Statements that concern heat illnesses, lightning safety, dietary supplements, sudden death in sports, managing disordered eating, head injury prevention and management, cervical spine injury management, skin disease and sport related concussion. The knowledge gained through the evaluation was used in clinical practice to create and revise many policies and procedures in my clinical practice.

Another weakness under the first domain included the assessment of patient or clients to screen for potential injury/illness or risk factors that would increase their risk (Table 1.1). Postural and Ergonomic Assessment involves assessing the human body as a function of the whole. Although I hold a bachelor's degree in Kinesiology, the study of human movement, I have not expanded on the knowledge base acquired in undergraduate education. To address this weakness I have obtained the Ergonomic Assessment Specialist Certificate (CEAS-I) through the Back School of Atlanta's online seminar. The CEAS-I course increased awareness of industrial athletic training and I gained insight into a new and expanding setting. I have also completed a certification course in the Functional Movement Screen and Selected Functional Movement Assessment. This expanded my current knowledgebase in the evaluation and treatment of postural and functional movement pathologies.

Evaluation of Domain II, Clinical Evaluation and Diagnosis, revealed weaknesses in area I had formally believed to be the strongest. Lack of formal undergraduate education indicated weaknesses in foundational knowledge in pathology, evaluation (specifically special tests) and pharmacology (Table 1.4). To address deficiencies I enrolled in the physician extender program provided by Coordinated Health Systems. The program increased my

knowledge of orthopedic evaluation including special test used to decide need for imaging or more expensive diagnostic testing. I was also exposed to the vast and ever-expanding use of pharmacological agents to treat musculoskeletal injuries. Athletic trainers are not permitted to prescribe any of these treatments, but are often asked to administer them. This includes dexamethasone in application of ionto- and phono-phoresis. I also witnessed administration of platelet rich plasma treatment, a new and emerging method of soft tissue treatment. The physician extender programs also increased my awareness of pathology of obscure injury and illness. Clinical practice often limits the ability to recognize rare pathologies and is often misdiagnosed as more typical injuries and illnesses. Observing and acquiring experiences in a different clinical setting expounded on pathologies previously unseen in my day-to-day clinical practice.

A specific course on Durable Medical Equipment (DME) was offered and undertaken through Orthopedic Associates of Allentown. By enrolling in a physician extender program I improved my skills in orthopedic appliances and DME design and use. Additional observation of Physician DME provider provided further insight in application of DME. Lack of formal undergraduate education in athletic training also resulted in weakness in therapeutic modalities, which fall under Domain IV, Treatment and Rehabilitation (Table 1.6). Modalities include therapeutic laser, electric stimulation, and ultrasound and diathermy and cryotherapy applications. Surprisingly, the review undertaken to improve this weakness revealed flawed or fragile evidence. I have found a narrowed rationale for the use of many of these modalities and have sought treatment options elsewhere. Previous experience with manual therapy was difficult to apply. Time constraints and lack of knowledge made patient outcomes poor. DAT course work, including specific research and presentation assignments have greatly expounded my clinical skills in manual therapies. I have become proficient in Muscle Energy Techniques (MET), Positional Release, and Strain Counter-Strain through various texts and presentation. Many of the traditional modalities used in athletic training are limited and less applicable than the manual therapies described in Chapter 3. My clinical practice has successfully, shown in the outcome measures described in Chapter 3, relied less on the traditional modalities.

Additional gains in alternative therapy included completion of a 150-hour yoga instructor training course. The course, offered through the NATA Evidence-based Prac-

tice Webinar, was presented by Ginger Garner MPT, ATCPYT, ERYT500 (National Athletic Trainer's Association, 2012). Adding yoga practices into clinical practice has allowed for greater understanding of fascial lines, ergonomics and the mind/body connection. The yoga practice has also provided increased application of practitioner guided breathing technique use in pain management and rehabilitation.

Domain V encompassed organization and administration of athletic training practice. My initial evaluation revealed significant deficient under this domain. Weaknesses in the "utilization of standard coding and reimbursement practices for documentation and billing" as well as "Maintenance of medial records that meet legal and regulatory standards" stood out as a significant concern (Table 8.1). Athletic trainers have not yet achieved the goal of third-party reimbursement from insurance providers including Medicare (National Athletic Trainer's Association, 2012). However, preparations to acquire billing ability have become an important need in the profession. I had previously received a National Provider Identifier (NPI) number, but was completely unfamiliar with the medical coding and billing protocol. I attended a seminar entitled, "*Coding and Billing for Therapy and Rehabilitation"*, provided by Cross Country Education to gain the knowledge necessary for when athletic trainers acquire the ability to bill for third-party reimbursement.

I have also undertaken research in current electronic patient records systems that are being used in athletic training and other healthcare settings. Few athletic trainers are experts in documentation and even fewer understand outcome measures (Mathewson, 2011). An extensive literature review revealed outcome measures used in orthopedic and rehabilitation. The method of collection of outcome measures necessitated an electronic delivery system. I have become proficient in using electronic patient records, specifically the Athletic Training Software (ATS) system, and have worked with the development team to include outcome measures, such as the Functional Movement Screen, in the patient records. Development of outcomes based electronic patient records in athletic training is paramount patient care evaluation.

GOALS FOR FUTURE PRACTICE

Goals for future practice were developed and submitted following the fall 2011 and spring 2012 semesters. The intent of the goals was to guide the development of clinical expertise and evaluate progress of the PoAP. The following have been taken directly from the-

se submissions and are written in an informal manner. The semester goals are included to show growth throughout the DAT program.

Spring Semester Goals:

One of my short-term goals was to make myself more accessible to patients who had recently suffered acute injuries. This allowed me to evaluate and document patients' treatment efficacy within a very short period of time following their injuries. I believe the physical presence of a healthcare practitioner during practices of high-risk sports is valuable. The ability to intervene on behalf of my patients who have been significantly injured during practice sessions is critical when, as has often happened, neither the coach nor the patient have realized the extent of the injury. This is most evident in concussion and heat illness, both life-threatening conditions in which early intervention is crucial. I have also found early intervention of other orthopedic injuries to improve patient outcomes, muscle injuries in particular being an example of this. This type of intervention is almost exclusive to the field of athletic training as most healthcare practitioners will not be able to treat patients as acutely as the traditional setting athletic trainer. I hope demonstrating the importance of this early intervention, through documented outcomes, will separate athletic training from other healthcare professions. Learning more evidenced-based injury management will support my ability to improve patient outcomes. Researching and becoming proficient at administration of modalities and other treatments will bolster these efforts.

My long-term goal for the future is to create an electronic patient record system to assist athletic trainers in a hectic traditional setting correctly document patient injury process, including both clinician and patient based outcomes. This system needs to be user friendly, portable, and time saving. It must also be include CPT and medical billing codes for evaluation, treatment, and rehabilitation of injuries sustained by an active population. By studying the current outcomes trends utilized in athletic training and other healthcare settings I hope to devise a comprehensive data collection and analysis system. The ultimate goal of this system will be to not only collect and organize patient records (which are important to prevent litigation), but also to provide a method of analysis, thus supporting the Clinician-Researcher. The ability to evaluate one's own practice has the potential to improve personal patient care. In addition, the opportunity to organize and share patient outcomes will serve the profession of athletic training in a profound manner. Creating a database of

athletic training generated outcomes provides proof of our value in patient care and benchmarks with which to compare and improve upon.

Fall Semester Goals:

As mentioned above, I have made a significant amount of progress on my goals created in the second semester of the DAT program, though I still have a long way to go. My goals for the next semester include the completion of the unfinished tasks listed above. The most prominent of these is the Ergonomic Assessment Specialist Certification. I believe building off the foundation the FMS has laid may make this certification more meaningful. I also look forward to completing the Yoga instructor Training course because of what I have learned so far has been extremely applicable to clinical athletic training.

Although I have successfully completed the goal of electronic patient record documentation, I look forward to expanding on this goal. This, I believe, has become the essence of my plan of advanced practice. Having the knowledge to choose appropriate clinician and patient based outcomes needed to evaluate a technique and method of treatment is paramount to improving patient care. Choosing the appropriate outcome is only the beginning. The need to accurately and realistically collect the outcomes has long been missing in documentation and evaluation. The advent of technology as it exists currently and where the future may possibly take us is thrilling. I look forward to being on the cusp of these developing technologies and truly hope my work can make choosing, gathering and assessing outcomes daily practice in athletic training.

PHILOSOPHY

Rehabilitation Philosophy:

There are four health strategies recognized by the World Health Organization: Prevention, Rehabilitation, Cure, and Support. Rehabilitation, as defined by Stucki, Cieza and Melvin (2007) is a health strategy for enabling people with health disorders facing, or likely to face, disability, to achieve and maintain optimal function within their chosen environment. My approach to rehabilitation sees the patient as a client and consumer of healthcare whose goal is simply to get better. My philosophy as it pertains to rehabilitation of the patients in my professional practice is grounded in the disablement model that incorporates patient driven definitions of better and clinician based focus on impairment and function. My goals reflect that of the patients' and combine to produce the rehabilitation plan. The

four components of the disablement model described by Vela & Denegar (2010b) include impairment, functional limitations, disability and quality of life. It is my opinion that an effective rehabilitation, which views the patient as a consumer of healthcare, addresses all four of these components.

Clinically, it is important to discuss the biometric impairments. The most common impairment is pain, followed by decreased motion and strength, and instability. These components manifest into functional limitations. For example, a patient might say, "I cannot run (functional limitation) because it is painful to bend my knee (impairment)." Functional limitations influence the patient's ability to do their identified tasks. Inability to complete a defined skill or task is called disability. An example of how impairments and limitations affect disability might be a patient reporting "I cannot play soccer (disability) because my knee is painful (impairment) when I run (functional limitation)." Subsequently, disability can lead to a decrease in the patient's perceived quality of life, for example, "My life is bad (Quality of life) since I can't play soccer (disability) because my knee is painful (impairment) when I run (functional limitation)." The process of Disablement cannot all be attributed to a one-dimensional model, because the components are not unidirectional. Functional limitations can cause impairments and quality of life certainly influences disability.

Once the pathology of the injury is identified a problem-and-goal list can then be used to address impairment, functional limitations, disability and a patient's quality-of-life. A personalized plan for rehabilitation combines patient and clinician expectations. It is important for the clinician to inform the patient of tissue healing rates and realistic steps in the exercise progression. Conversely, it is important for the patient to be honest with the clinician about symptoms they are experiencing. I find this approach well received by the patients in my practice, as they feel they are a part of their rehabilitation. Modalities support healing and treat impairments. Taping and bracing overcome functional limitation. Psychosocial interventions are used to address quality of life issues.

This approach also allows for an aggressive return to activity. Typically, patients are encouraged to take part in as much of their chosen activity as possible. For example, a patient may not be able to participate in a basketball scrimmage, but they may be able to shoot free throws and complete dribbling drills. Inclusion in the activity of choice provides an opportunity for the patient to not only support physical fitness or sport specific skills, but to

also maintain a social connection with teammates. Often, maintaining that connection allows the patient to visualize their goals and provides a measuring stick for progress.

As noted above, the multifaceted process of rehabilitation requires both the clinician and the patient to work as a team throughout the process. The athletic trainer's knowledge of the tissue healing phases and general injury specifics, combined with patient needs, should be reflected in the goals set for the patient. The Disablement theory of healthcare, with its origins in the World Health Organization (International Classificaion of Functioning, Disability and Health, 2001) and more recently translated to athletic training by Vela and Denegar (2010), provides a road map for this approach. This method keeps the patient and the clinician focused on each area as well as the goals.

Back Pain Philosophy

Traditionally, back pain in the collegiate athletics realm can only be categorized by the "recognize and refer method," check for "red flags" and refer to physician for further diagnostic testing. Although there are some athletic trainers who do a better job than others at evaluation and treatment of such injuries, low back pain is the black hole of patient care, where the symptoms are merely managed. Often incorporation of injections and spinal manipulations are used to quell pain and resolve patient complaints. I am embarrassed to admit this area of my own practice is blatantly hypocritical. The philosophy I had incorporated in my clinical practice is, embarrassingly, the "Red Flag Method," or one may describe it as "The Essentials of Athletic Training" philosophy (Prentice & Arnheim, 2009). I performed evaluations almost exclusively to rule out red flags, such as acute disc pathologies, nerve entrapment and fractures. The rehabilitation method I typically used is ineffective at best, merely treating symptoms until the issue resolves itself or physician intervention takes effect. Patients are most often left with some trace symptoms of pain and disability and are merely waiting for the next episode of pain and dysfunction. In no other aspect of my patient care would I have been so thoughtless, often arguing acceptability of such care. Sadly, up until one year ago, this was my norm and my basic method of treating back pain.

Upon the discovery of the DAT and later various methods of treating low back pain, I have slowly begun to peer into the dark. With merely a candle of light to illuminate a once dark and scary black hole of back pain, I have recently begun to see there is a path and it doesn't necessarily lead to physician intervention. Between the teaching of both Mulligan

and Mackenzie I have discovered the world of derangement and how treating a patient is not scary. In fact, making a mistake or increasing symptoms may actually be beneficial to a patients care. Mackenzie describes repetitive movements to correct derangements and often times a patient may feel worse. A thoughtful practitioner will recognize the increase in symptoms and alter the movement to correct the derangement. Mulligan's Mobilization with Movement aims to decrease the derangement, but in a more comfortable way for this practitioner, do so without pain. In his demonstration presented by Northeast seminars, Mr. Mulligan reiterates time and again the need for pain-free repetitive movements. I find the technique much more laborious as a practitioner, but much more palatable as well.

As one who holds a degree in Kinesiology and Exercise Science, I would be remiss in not incorporating biomechanics into my back evaluations and treatments. I previously often sought to correct imbalances in muscle strength and joint range of motion to reduce chances of re-injury and treat pain. I often looked to leg length discrepancies, tight hip flexors and weak abdominal muscles as the cause and of course the cure for most back pain. Only recently have I expanded this philosophy to incorporate fascial lines. Perhaps the imbalances I previously sought to correct where actually tightening and pulling in the fascia and not the joint position at all. Myofibrils in fascia, innervated by free nerve endings, are able to keep up a contraction for long periods of time (Benjamin, 2009). I have approached several recent cases with a fascial philosophy in mind. By releasing or managing fascial restrictions, Total Motion Release (TMR), Instrument Assisted Soft Tissue Mobilization (IASTM), and taping, pain, derangement, and spasm seem to dissipate. Often rehabilitation consists of participation in ones chosen activity. Once the patient is able to participate without pain, they incrementally increase activity to build stamina and muscular endurance. Several recent articles indicate load bearing ability fascia, such as Lumbar fascia to integrate proprioceptive signals (O'Sullivan & Bird, 2011). Theories suggest the slow contractile nature of the fascia may play a role in rigidity of what we consider muscle spasms, but may also play a role in increasing muscular stability (Schleip, Klinger, & Lehamnn-Horn, 2005). In support of the Mechanical Diagnosis and Treatment method, DeWitt and Venter (2009), show that repetitive movement of a specific muscle group, such as those moving the lumbar spine, can produce increase stability in the superficial and deep fascia surrounding said muscle group, thus

providing a more efficient movement pattern and allowing more power generation (DeWitt & Venter, 2009).

Although I am not tremendously confident in my ability to treat low back pain, I feel as if recent developments and new research has shown me a path of possibilities. I am interested in researching the fascial theories more extensively, specifically those in “Body Work” and apply these new ideas to my clinical practice.

CHAPTER 3
INDIVIDUAL OUTCOME SUMMARY

The evaluation of clinical practice and development of practice philosophies produced a framework for clinical practice improvement. The process uncovered shortcomings and focused attention to new methods of evaluating clinical practice and the acquisition of new modalities. The end goal filled gaps and elevates patient care in my clinical athletic training practice. Improvement of personal clinical practice requires a method of experimentation focusing on local needs. The DAT blends action learning and reflective practice into the participatory action research (PAR) method. New methods of evaluation of practice involved using both outcome measures as well as Minimal Clinically Important Differences (MCID). Incorporation of patient-oriented outcomes measures combined with clinician-oriented outcomes allowed for the quantification of healing. MCIDs provided a method to evaluate patient healing. PAR method is valuable in the evaluation of personal practice and clinician reflection is relevant to the process. A short narrative regarding each treatment method has been included to represent clinician reflection. New modalities were acquired through interaction with professors, peers and the Northeast Seminars Continuing Education and included Instrument Assisted Soft Tissue Mobilization (IASTM), Total Motion Release (TMR), McConnell's taping technique, and Mulligan's Mobilization with Movement (MWM).

In healthcare, PAR is defined as a systematic investigation to improve practice that will enhance the working environment and the working environment of those who are part of it, including practitioners, clients and patients (Koshy, Koshy, & Waterman, 2011). This type of research is increasingly used in health-related settings because it is well suited to identifying problems and developing solutions that improve practice (Meyer, 2000). Examples of PAR can currently be found in various healthcare settings, including nursing, physical and occupational therapy as well as general medical and hospital settings (Koshy, Koshy, & Waterman, 2011; Meyer, 2000). The intention of PAR is to be a disciplined approach to answering the question of "How do we see the situation and how can we improve it?" (Vellenga, Gypdonck, Hoogwerf, & Tan, 2009). The cyclical process of PAR begins and ends with reflection, followed by planning, action and observation. The entire process continues until the participants collectively are satisfied with the change (Glasson, Chang, &

Bidwell, 2008). Athletic training healthcare resembles PAR because of the steps involved; assessing, planning, implementation, and re-evaluation of various disease states. Many athletic trainers may recognize these steps in their own patient evaluations. PAR enables practitioners and consumers to participate in the development of knowledge they will use for patient care (Vellenga, Gypdonck, Hoogwerf, & Tan, 2009).

Participatory action research differs from conventional research in three distinct ways. First, PAR focuses on research that enables action. Action is attained through a reflective cycle of collecting and analyzing data; then determining what action should follow. The cycle is then repeated building upon the previous action in what is typically described as a corkscrew. Second, PAR seeks to incorporates the human condition and the line between research and researched is erased. All stakeholders are valued and the experiences they bring to the table adds to the richness of the study. Third, PAR does not remove data or participants because they do not fit the methodology. The methodology is often adjusted to include all participants. PAR aims to incorporate the researchers as active participants in the research process. (Baum, MacDougall, & Smith, 2006).

The DAT employed PAR to improve clinical practice. Outcome measures, including both patient and disease-oriented outcome measures, were collected on each patient treated with a specific modality. Results were analyzed for effectiveness and changes were made to treatment protocol to increase positive outcomes. The processes of PAR also produced an opportunity to investigate how and why modalities were or were not successful. The results are represented in Tables 3-6.

The success of each treatment method was measured through evaluation of outcome measures. Global outcome measures were used because of applicability to multiple orthopedic conditions treated in clinical athletic training. Many of the treatment methods are indicated for various areas of the body. Specific outcome measures evaluate the effect of treatment on individual body areas, such as the ankle, are not valuable in cross evaluating the treatment method on multiple pathologies. Patient-oriented as well as clinical or disease-oriented outcome measures were collected and analyzed for clinically significant changes. Patient-oriented outcomes included the Global Rating of Change (GRC), pain as evaluated through the visual analog scale, and the Disablement of the Physically Active Scale (DPA Scale). Disease-oriented outcomes included Range of Motion (ROM) goniometrical meas-

ured, clinician rated strength of 0-5, and Return to participation (RTP). Return to participation (RTP) was recorded as "no participation," "limited participation," and "full participation."

To evaluate meaningful change in patient-oriented outcome measures MCID was used. The operational definition of a MCID is the smallest difference in score of an outcome measure which patients perceive as beneficial and could potentially warrant a change in the patient's management. Mathematically MCID is the error associated with two administrations of a measure, or the change in the scores (Jaeschke, Singer, & Guyatt, 1989). For example, the Numeric Rating Scale (NRS) used to measure pain reports a change in fifteen percent or one point as the MCID. However, a change of thirty-three percent or two points were best associated with the concept of "much better" which may be a better point of reference for a significant change (Salaffi, Stancati, Silverstri, Ciapetti, & Grassi, 2004). The use of MCID provides meaningful interpretation of outcome measures, however, limitations do exist. The values are not always stable and the error values and meaningful change can vary in the amount measured. Sample of patients, type of treatment, interval of change and patient acuity can influence stability. Also, many of the measures have not accounted for the ceiling effect that occurs in an athletic population of patients (Michener, 2011). The exception to this is the DPA Scale, which determined the MCID using a strictly athletic population. The DPA Scale was found to be both sensitive and specific to this population and the healing process associated with competitive sports. The DPA Scale MCID value for an acute injury was nine points (Vela & Denegar, 2010b). The MCID for the GRC is two points in either direction (Kamper, Maher, & Mackey, 2009).

OUTCOME SYNOPSIS AND PLAN

Instrument Assisted Soft Tissue Mobilization (IASTM):

Instrument Assisted Soft Tissue Mobilization (IASTM) operates on the theory that by scraping superficial tissue a practitioner can mobilize and manipulate underlying fascial structures. A plethora of current research has investigated these claims. Scientific research indicates an increase in fibroblast production in tissues that have been treated with IASTM as well as increases in range of motion (DeWitt & Venter, 2009). The popular Graston's method of IASTM has been a popular presentation at NATA and Pennsylvania Athletic Trainer's Society (PATS) meetings. Tecnica Gavilan advanced the instrument-assisted

foundations and introduced the method of using IASTM during stretch and exercise. The technique provides an advanced treatment protocol that advances patients through the static IASTM described in the Graston's method to an endpoint of IASTM through active range of motion to end range stretch. Although the technique induces some pain initially, the instantaneous relief encourages patients to request further treatments until permanent relief is felt or function is fully restored. The pathologies that may be benefited by appropriate application of IASTM include tendonopathies, acute ligamentous injuries and muscle tears.

The PAR study applied these positive results to patients who would theoretically benefit from these increases (see Table 1). The participants were selected for inclusion based on a decrease in ROM, sub-acute to chronic presentation, and pain level. Timely yet long lasting outcomes were noted for nearly all patients treated with this technique. The results demonstrated very positive improvement trends and strong potential of an appropriate well-researched application.

Narrative:

Although I have had previous experience with the Graston's technique, the addition of the Gavilan tools and the technique, which involves instrument assisted soft tissue mobilization with movement or stretch, have greatly improved patient care. Every patient (N=7) I have utilized this technique on has improved after three or less treatments. Tightness resolved in 24 hours post 1 treatment in 71% (n=5) of the documented patients and in 7 treatments for 100% (n=7). Results were permanent in 57% (n=4) of patients. 43% (n=3) patients report continued symptoms with return to activity. MCID in DPAS score (decrease in more than 6 points for a chronic injury was observed in 57% (n=4) of patient post 1 treatment and in 100% of patients by the 3rd treatment. The results are very quick, but many times not permanent, as symptoms will often return three days post treatment or upon increase of activity. The summation of the patients treated with Gavilan is available in Table 3. Future goals for this technique are to extend the treatment to more acutely injured area when ROM is decreased. I am interested in discovering the effects on injuries with more single event mechanisms (e.g. mcl sprain), as the previous patients displayed more chronic or overuse mechanisms.

Table 1.*Outcome Measures for IASTM*

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
1. Male Track Athlete	Tightness and discomfort left posterior lower leg	Decreased ROM- < 5 degrees	1. Gavilan with stretch 2. Physical exercise 3. Active assisted stretch	1. Reported Tightness resolved in 24 hours 2. DPA Scale decrease of 10 points Day 1-Day 2 3. ROM equal bilateral
2. Female Track Athlete	Pain in Bilateral Hamstring; Shortened Stride	Decreased ROM, Hamstring Tightness	1. Gavilan with hip flexion 2. Physical exercise 3. Active assisted stretch X 2 days	1. Reported Tightness resolved within 5 days 2. DPA Scale decrease 9 points Day 1-2; decrease 5 points Day 2-3; decrease 4 points Day 3-5 (no apt day 4). 3. ROM return to reported normal
3. Female Hurdler	Tightness and discomfort in bilateral quad	Quad Tightness	1. Gavilan with hip flexion 2. Physical exercise 3. Active assisted stretch X 2 days	1. Reported tightness resolves after 24 hours, returns 3 days the resolves again 2. DPA Scale decrease 2 pts. day1; increases 4 pts. day 3; decease 6 pts. day 5 3. ROM WNL
4. Male Sprinter	Tightness and discomfort in bilateral hamstrings	Hamstring tightness	1. Gavilan with hip flexion 2. Physical exercise 3. Active assisted stretch X 4 days	1. Reported Tightness resolved in 24 hours, returns periodically but is easily treated. 2. DPA Scale decrease of 10 pts. day 1-day 2; increase of 5 pts. day 8, decreases 10 pts. day 9, decrease 2pts day 11. 3. ROM equal bilateral
5. Female Track Athlete	Pain in Left Hamstring	Decreased ROM- 10 degrees	1. Gavilan with hip flexion 2. Physical exercise 3. Active assisted stretch	1. Reported tightness resolved in 24 hours 2. DPA Scale decrease of 12 points Day 1 3. ROM equal bilateral

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
6. Male Cross Country athlete	Pain and Tightness in left lateral upper leg	IT Band tightness	1. Gavilan with stretch 2. Physical exercise 3. Active assisted stretch	1. Reported Tightness resolved in 24 hours, returns periodically but is easily treated. 2. Pain decreases 5-0 while running 3. DPA Scale decrease of 10 pts. day 1-day 2; increase of 5 pts. day 8, decreases 10 pts. day 9, decrease 2pts day 11. 4. ROM equal bilateral
7. Male Baseball Pitcher	Tightness and pain in right upper arm; decrease in velocity	Biceps tightness	1. Gavilan with elbow extension 2. Physical exercise 3. Active assisted stretch	1. Reported Tightness resolved in 7 days 2. DPA Scale decrease (5pts Day 1-2, 10 pts. Day 2-4, 6pts Day 4-6, 2 pts. Day 6-7) 3. ROM equal bilateral 4. Reported velocity WNL

Total Motion Release (TMR):

Total Motion Release (TMR) builds upon the foundation of cross education in which the body applies knowledge from one side of the body to the other side. For example, Previous research cites pain relief in phantom limbs (Carabelli & Kellerman, 1985), unilateral strengthening producing strength gains in contralateral homologous muscle group and cross-educational muscle gains (Hendy, Spittle, & Kidgell, 2012). TMR starts on the non-injured area and moves in a direction of preference as compared to traditional therapy focused on moving the injured area in the direction of restriction. TMR requires the practitioner understand and apply the rules of scientific method to assess and treat patients (TMR, 2011). The treatment method is easily evaluated in a PAR study (see Table 2). Patients were selected for inclusion based on the presentation of painful or restricted motion resulting from activities related to overuse syndromes. As a novice practitioner of TMR, the inclusions of acute injuries were not attempted. The method resulted in favorable outcomes including the decrease of pain and increase of ROM as well as the return of function.

Narrative:

The "Fab Five" have become a staple in the treatment of chronically injured patients, particularly those of whom traditional rehabilitation of failed to correct. I have also found value in the technique when applied to patients who participate in sports with traditional imbalances, such as throwing athletes. The very first patient, male baseball pitcher was extremely reluctant, but found positive outcomes. He reported increases in strength and velocity lasting the remainder of the 4-week season. Unfortunately, no COE or POE were recorded and documented results are anecdotal. Patient 2 was diagnosed with a L4-L5 herniated disc approximately three months prior to seeking treatment. He was extremely painful reporting 8/10 on NRS and was almost unable to move. Post 1 treatment of TMR, pain decreased to 2/10 and he was able to complete core-strengthening exercises followed by traction. MCID (6 points for a chronic injury) for DPA scale was recorded post initial (10 points) , 2nd (6 points) and 3rd (10 points) TMR treatments He continued this treatment protocol 4 days a week for 6 weeks. . He was discharged symptom free and has remained that way. This is certainly a departure from previous cases of herniated disc, which in some cases has progressed to the point of disability. Last two patients treated with TMR collected POE and COE consistently. Both patients recorded MCID in pain (NRS) and DPA scale post initial treatment. Patient 3, male soccer goalie, maintained POE with increase in activity. Patient 3 also experienced an improvement in COE; ROM measured in degrees of variance from unaffected returned to equal bilaterally. Patient 4, female swimmer, received treatment during her competitive season. While maintaining a high level of activity, she recorded overall decreased pain and DPA scale over 14 days. The COE of ROM side did not improve past -8 degrees of shoulder flexion.

Table 2.*Outcomes Measures for Total Motion Release*

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
1. Male Baseball Pitcher	Decreased velocity and weakness	General muscle imbalance of shoulder, back and hip	1. Total Motion Release x 3 over 5 days 2. Limited pitching	1. Reported weakness dissipates 2. Velocity returns to normal. 3. Symptoms returned periodically, but resolved with TMR over remainder of season, 4 weeks.

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
2. Male football, Offensive Line	Low back pain and decrease movement	Herniated Disc L4-L5	1. Total Motion Release 2. Core Strengthening 3. Traction x 4 days for 6 weeks	1. Pain Decrease to no more than 2 for remainder of season (6 weeks) 2. Functional ability returns and is maintained throughout season 3. DPA Scale decrease (10 pts. Day 1-2; 6 pts. Day 2-4; 10 pts. Day 5-7) ROM returned to WNL by day 3
3. Male Soccer Goalie	Decreased right shoulder flexion 5 degrees and abduction 7 degrees; posterior shoulder pain	3 months post labral repair, frozen shoulder	1. Continued Rehabilitation 2. Total Motion Release x 5 days per week 4 weeks 3. Gavilon over posterior back trapezius x 4	1. Pain decrease from 5-1 within 20 minutes and maintained from day 3-4 2. ROM returned to equal bilateral by week 2 3. DPA Scale decrease (14 pts. Day 1-2)
4. Female swimmer	Shoulder Pain while swimming	Bicep tendon impingement	1. Shoulder stabilization exercise 2. Total Motion Release x 5 over two weeks	1. Pain decrease from 5-2 after first treatment. Decrease continues (4-1 Day 2, 3-1 Day 6, 1-0 Day 8, 2-0 Day 9, 0 Day 12) 2. ROM remained unequal (-8 degrees flexion) but was not painful 3. DPA Scale decreased (12 pts. day 1-2, 1pt day 2-4, 5 pts. day 4-5, 3 pts. day 5-7, 1 pts. day 7-8, 1pt day 8-9) and remained at 4 for until discharge.

McConnell Taping Technique:

McConnell Taping Technique is an idea developed by physiotherapist Dr. Jenny McConnell. The method is based on the understanding that postural dynamics influence dynamic activities. Poor postural dynamics can result in musculoskeletal symptoms that can be relieved through unloading soft tissue. This is typically done with tape and results in imme-

diate decrease in pain and optimized effective of treatment and exercise (The McConnell Institute, 2012). The PAR for the McConnell Taping technique included patients presenting pain specifically located in the lower limb including posterior thigh, hip and Achilles tendon (see Table 3). Results indicated the tape produced clinically significant results in reduced pain and increased function. All patients treated with the McConnell method of taping prior to activity experienced and MCID in pain immediately following tape application (n=8) regardless of injury site. DPAS scores for 85.7% of patients (n=7) indicate a MCID post initial application as well. Relief of symptoms was permanent in 37.5% (n=3) patients. Tape was re-applied in 50% (n=4) of patients, whom all experienced continued resolution on symptoms with tape application. One patient continued to have symptoms of pain and disability following tape application. Symptoms in this patient decreased steadily of 3-week course of treatment and she was able to compete in the remainder of the cross-country season pain free. Hamstring injured patients results show improvement over outcomes presented in the literature and further research was warranted. The clinical study is presented in Chapter 5. Narrative:

Learning this technique has brought a great deal of joy back into my clinical practice. I have found a tremendous benefit to the patients I treat. The tape is easy to apply and I have instructed three other athletic trainers on the method and they have also found success. The tape assists patients in reducing pain and increasing functional ability, thus creating the quickest improvement in the DPA Scale of any of the techniques I have mastered yet. The majority of injuries I have found success with are muscular in nature, with the exception of one greater trochanteric bursitis, which found instant improvement. The other injuries included three hamstrings, one Achilles tendon, five anterior tibial stress syndromes. I was even able to use the philosophy of "shortening" the structures to alleviate the force to other areas of the body not demonstrated by Jenny McConnell. One such case was a female patient who participated in running hurdles diagnosed with pes anserine bursitis. By placing one strip of tape along the medial distal hamstring while applying pressure to the hamstring tendon, the patient was able to run pain free for the first time in nearly 3 months. Even after the tape was removed her pain was decreased from original and has since gone completely. The most important aspect of this method is that it allows the patient to remain active (many

times even competitively) during the treatment process whereas traditional treatments typically reduce or even eliminate sport until pain dissipates.

Table 3.*Outcomes Measures for McConnell Taping Techniques*

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
1. Female cross country	Pain in hamstring following a sprint take-off	Grade 1 hamstring strain	1. Kilcoyne hamstring protocol 2.Application of McConnell Tape	1. Strength increases from 4/5 to 5/5 2. Pain reduced from 5/10 to 1/10 3. ROM WNL 4. DPA Scale reduced 37 pts. day 1- day 3 and 4 pts. day 3- day 5 5. Normal activity resumed immediately and patient finished remainder of season w/o incident
2. Male Cross Country	Pain in hip while running	Greater Trochanteric bursitis	1. Ultrasound 2. Application of McConnell Tape 3. Exercise Modification	1. No strength deficient were presented 2. Pain was reduced from 6/10 – 0/10 3. DPA Scale reduced 25 pts. day 1-day2, 0 pts. day 2- day 6 (Tape re-applied), 6 pts. from day 6- day 7. 4. Normal activity was resumed by day 3 following progression to full workout 5. Patient finished season w/o further irritation.
3. Female High Jumper	Pulling sensation and pain following jumping	Grade 1 Hamstring strain	1. Kilcoyne hamstring protocol 2.Application of McConnell Tape 3.Reduced exercise intensity x 24 hours	1. Strength improved from 4/5 to 5/5 2. Pain reduced 6/10- 0/10 with exercise from day 1- day 2 3. ROM increase 5 degrees and WNL 4. DPA Scale reduced 28 pts. day 1- day 2, increased 2pts from day 4- day 5 (tape re-applied), decreased 2pts from day 5 on. 5. Normal activity resumed post 24 hours 6. Patient finished season w/o further irritation

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
4.Male Middle distance runner	Pain in anterior lower leg	Medial tibial stress syndrome	1. Ice message x 20 minutes 2. Application of McConnell Tape 3. Reduced exercise duration x 48 hours	1. Pain reduced from 4/10 to 1/10 post 24 hours and 1/10- 0/10 day 2-day3 2. DPA Scale reduced 5 pts. day 1-day 2 and 1 pt. day 2- day 3, score of 0 following day 3. 3. Normal activity was resumed post 48 hours. 4. Symptoms of pain 2/10 reappear day 5 tape is re-applied; Pain level returns to 0/10. 5. Patient finishes season with 3-4 reapplications of tape but w/o pain
5.Female cross country runner	Pain in anterior lower leg	Tibialis anterior strain	1. Ice message x 20 minutes 2. Application of McConnell Tape	1. Pain reduced from 5/10 to 0/10 post 24 hours. 2. DPA Scale reduced 10 pts. day 1- day2 and remains at a score of 5 for remainder of treatment 3. Normal activity resumes post 24 hours 4. Tape is reapplied throughout season, patient is able to complete season w/o pain
6. Female long distance runner	Pain in medial aspect of right knee	Pes Anserine bursitis	1. Ice message x 20 minutes 2. Ultrasound x 14 days 3. Reduction of physical exercise x 20 days 4. Application of McConnell Tape post 2 weeks	1. Pain of 6/10 reduced to 4/10 day 1- day 3; maintained 4/10 day 3- day 14 Pain of 4/10 reduced to 2/10 post tape application day 14- day 15, pain reduced from 2/10 to 0/10 day 15 through day 25. 2. DPA Scale reduced 2 pts. day 1- day 2, fluctuates 2-4 pts. for approximately 2 weeks. Reduces 10 pts. day 14- day 15, 4 pts. day 15 – day 16, and remains at 2 pts. for remainder of season 3. Patient resumes normal activity post 3 weeks and remained pain free throughout season.

atient	Chief Complaint	Diagnosis	Treatment	Outcomes
7. Male basketball	Pain and weakness in posterior right ankle; inability to preform calf raise	1 week post Achilles tendon strain	1. Application of McConnell Tape 2. Continue re-habilitation	1. Pain reduced from 4/10 to 1/10 immediately and maintained throughout next two weeks. Rising to 3/10 post competition to returning to 1/10 after ap-prox. 36 hours. 2. No DPA Scale administered 3. Patient able to compete in last 6 competitions of season w/o incident including NCAA playoffs
8.Male football	Pain and weakness fol-lowing a pulling sen-sation during running ac-tivity	Grade 1 hamstring strain	1. Kilcoyne hamstring protocol 2. Application of McConnell Tape	1. Pain reduced from 6/10 to 4/10 day 1-day2, reduced from 4/10 1/10 day 2-day3, reduced from 1/10- 0/10 day 3- day5. 2. Strength increased from 3/5 to 4/5 day 1- day3, and increased from 4/5 to 5/5 day 3- day5. 3. DPA Scale decrease 39 pts. day 1- day3, and 10 pts. day 3-day 5 4. Patient was able to resume normal activity after day 5. Day 7 tape was re-applied and pa-tient completed spring season w/o further incident.

Mobilization with Movement (MWM):

The Mobilization with Movement (MWM) manual therapy technique, produced by Brian Mulligan F.N.Z.S.P. (Hon), to address musculoskeletal disorders with pain free manual therapy. The technique relies on manually repositioning the painful joint to eliminate pain and restore normal function (Mulligan Concept, 2013). The PAR method was again used to evaluate the effectiveness of the treatment to improve outcome measures (see Table 4). Initial outcomes were poor and failed to improve patient condition. As indicated by the cyclical nature of the PAR method further investigation into Brian Mulligan's approach was initiated. After completion of the online seminar, application of MWM was modified. Second round outcome measures improved over the first round and indicated clinically significant results. MWM was well tolerated and, when properly applied, produced long lasting reductions in pain and increases in function (Mulligan Concept, 2013).

Narrative:

I continue to be optimistic of the Mulligan methods. I have watched and re-watched his presentation. Little victories have shown up here and there, but not constantly. The positive aspect, which Brian Mulligan himself has pointed out, is the practitioner can tell if the treatment is viable within the first 90 seconds. Three of the four patients treated with MWM met this criterion. Very little is lost when the mobilization is given a chance, but much is gained. I do find the utilization of some of the techniques challenging, as mobilization with very large individuals is difficult anyway. The addition of the techniques to already established rehabilitation and or stretching exercises, as mentioned before, have a significant cost-to-benefit ratio. Unfortunately, I did not do a good job of recording the failures, as I should have. The following table represents the few successful treatments. I will remedy this for future work.

Table 4.*Outcomes Measures for Mulligan's Mobilization with Movement*

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
1. Male football athlete	Pain and dysfunction in Right ankle	Lateral Ankle Sprain	1.Mulligans mobilization 2.RICE 3. Basic ROM exercises	1. No change in Pain, or ROM after Mulligans, treatment was discontinued.
2. Female swimmer	Pain in lateral left ankle, following fall from high heeled shoes	48 hours post Lateral Ankle Sprain`	1. Mulligans mobilization and tape application	1. Pain was reduced from 5/10 to 0/10 with mobilization and continued 1/10 with application of tape 2. ROM remained WNL 3. Patient was able to complete ankle strengthening exercises 4. Patient did not return for follow up treatment, but did not report further symptoms

Patient	Chief Complaint	Diagnosis	Treatment	Outcomes
3. Female Soccer athlete	Pain and dysfunction in Left lateral ankle	Grade 1 Lateral Ankle Sprain	1. Mulligans Mobilization and tape application 2. Basic ROM exercises 3. RICE	1. Pain reduced from 4/10 to 0/10 with mobilization and remained 1/10 with application of tape. 2. ROM remained WNL, but slightly painful(2/10) with lateral movements 3. Patient was able to complete rehabilitation strengthening exercises and returned to limited practice 4. Patient improved steadily for four days and returned to full activity on day 5.
4. Male football Receiver	Pain, obvious deformity and dysfunction in first finger of right hand	Dislocation	1. PIP reduced spontaneously upon palpation. Compression was applied as well as buddy tape. 2. Mulligans mobilization post 24 hour 3. rehabilitation exercises	1. Pain reduced from 5/10 to 0/10 day 1- day 3. 2. DPA Scale reduced 16pts day 1- day2 and 2 pts. day 2- day 3 and remained the same for next 5 days. (score reflected issue outside of finger injury) 3. Patient returned to full activity including catching and gripping a football day 3. He was discharge day 5 with resolution of symptoms.

Narrative Conclusion:

I have learned a great deal over the past two years. Improving patient care with the addition of new skills has been both rewarding and exciting. I have had the opportunity to learn a great deal about outcomes measures and how they apply to a multitude of healthcare settings. The application of specific measures in an active population produced and utilized by athletic trainers is a thrilling prospect. Finally, the ability to evaluate and change my own practice based on trial, error and reconnaissance is action research at its core. I am not the only athletic trainer to be frustrated and devalued. Both my successes and failures provide a data-driven blueprint for future endeavors and I look forward to what can be accomplished over time.

CHAPTER 4
REVIEW OF LITERATURE
OUTCOME MEASURES

Outcomes measures are essential to understanding quality recovery in an active population. Healthcare professionals such as athletic trainers should be well versed in the collection and validation of psychometric measures if they are to improve patient care. The ability to assign a meaningful value to recovery allows a clinician to quantify significant change in an injury. Psychometric measures are patient driven meaning the responses are from the patients' point of view rather than clinician measures. Clinician-rated measures include ROM, strength, and girth. The goal of psychometric measures is to evaluate health-related quality of life and the effect of injury on the patient. Many patient outcome measures already exist to evaluate health status and health-related quality of life, but few athletic trainers are familiar with psychometric evaluation resulting in low employ (Stiller-Ostrowski & Ostrowski, 2009). Employment of psychometrics and outcomes measures allows an athletic trainer to become a scholar clinician, evaluating their own personal practice. Improvements can be made when weaknesses are revealed. Psychometrics can also be used to reveal the effectiveness of athletic training practice to the general public.

The World Health Organization has outlined the International Classification of Function (ICF). The ICF is a framework for measuring health and disability at both individual and population Levels. The ICF was designed to fulfill the need for reliable and comparable date to determine the overall health of population, the prevalence and incidence of non-life threating health outcomes and the effectiveness of healthcare systems. The ICF names 3 levels of human function 1) The functioning at the body or body part level 2) The whole person 3) The whole person in their complete environment. Three sequential and interrelated domains exist within these levels; impairment, functional limitation and disability. The ICF classifications with regards to these three domains can be effectively used to evaluate outcomes measure that precisely target the burden of sport injury and quality recovery (International Classificaion of Functioning, Disability and Health, 2001). Outcome measures should be in line with ICF classifications and domains in order to demonstrate construct validity.

Outcome measures can be grouped into generic or specific measures. Generic measures permit a comparison across varied populations and evaluate multiple aspects of health; including, for example, physical, mental, and social aspect. Specific measures, by nature, aren't generally comparable between groups, but are more responsive in those specific groups (e.g. one could not assume a measure taken in an ankle injury group is valid in a shoulder injury group). Typically, generic measures focus on health-related quality of life or function while specific measures center on a particular disease or populations (Guyatt, Feeny, & Patrick, 1993). All of the above mentioned outcomes measures are scored numerically and allow for quantification of significant change in injury status in a statistical manner, thus validating treatment effectiveness.

Specific Measures:

Specific measures are currently used in rehabilitative therapy, and are easily adaptable to the athletic training model and are typically used to evaluate a specific injury sight. The shoulder is a widely researched and published area of outcome measures. Some examples include: Athletic Shoulder Outcome Rating Scale, Walch-Duplay Rating Sheet for anterior Instability of the Shoulder, American Shoulder and Elbow Surgeons' Shoulder evaluation Form, 12-item Shoulder Instability Questionnaire. All of these specific measures include questions evaluating both activities of daily living and athletic specific activities such as throwing, lifting and competition making them effective in an active population (Magee, 2002). Some measures are specific to the entire upper extremity rather than the individual joints. The Disabilities of the Arm, Shoulder and Hand Scoring System (DASH) is a commonly used 30-item scale which has demonstrated decent reliability, consistency and discriminant validity (Gummesson, Atroshi, & Ekdahl, 2003). The Functional Arm Scale for Throwers (FAST) extends the outcomes measures to a more active population and sport specific outcomes. The FAST correlates significantly with the DASH, but the questions asked may give more insight into a throwing population (Sauers, Dykstra, Bay, Bliven, & Snyer, 2011).

The knee is also a popular area for outcomes measures. The Cincinnati Knee Rating System is a widely used scale that specifically targets the Anterior Cruciate deficient knee (Noyer, McGinniss, & Mooar, 1984). The Knee Society Knee Score and the Activities of Daily Living (ADL) scale of the knee outcome survey also target knee pathology, but are

typically used in a relatively sedentary population. The ADL scale does have a separate evaluation for a more active population that includes questions regarding sport activity (Magee, 2002).

Like the upper extremity, the Lower Extremity Functional Scale (LEFS) examines patient perceived disability in the entire lower extremity (Michener, 2011). The lower leg also has a number of specific tests. The Foot and ankle Disability Index has been frequently used, but does not target the physical active. The Psychometrics of Ankle Self-Report Survey (PASS) evaluates a more active population and lessens the ceiling effect of the FDI (Schlitz, Evans, Regan, & Mack, 2011). Outcomes measures are not exclusive to extremities; the Oswestry Low Back Pain Disability Index (ODI) and the Roland Morris Disability questionnaire (RMDQ) evaluate disability associated with low back dysfunction. Both the ODI and the RMDQ have shown to be a valid and reliable patient reported measure of functional disability (Vela, Haladay, & Denegar, 2011).

Generic Measures:

In the interest of time and efficiency, generic psychometric measures may be appropriate in an active population. Generic measures are less sensitive to individual change in a specific injury or joint, but are better suited to evaluate the effect of the injury on the whole person. Clinicians interested in a more holistic approach or in administering fewer instruments can choose a generic measure. This type of measurement can be divided into two groups, Functional Outcomes Measures and Health-Related Quality of Life. Functional measures focus on the amount disability in a more definite location or disease. They differ from specific measures in that they ask questions regarding the ability to perform functions related to a broader spectrum. A specific measure might measure how far a person with an ankle injury feels comfortable walking, while a generic functional measure would seek to evaluate how a person with an ankle injury feels walking, and how that in/ability to walk is affecting the patient's social ability. Health-Related Quality of Life measures aim to understand how the individual is doing overall and the change in this quotient may or may not be related to an injury (Jette, Halbert, Iverson, Miceli, & Shah, 2009).

Functional Outcomes Measures:

A few general Functional Outcomes Measures have been used in the evaluation of the physically active. The Glasgow Outcome Scale (GOS) and the Glasgow Outcome Scale

Extended (GOSE) were originally intended to be an injury specific measures used to evaluate outcomes following head injury, but the GOS has been used in general injury studies as well (Linday, Wilson, Pettigrew, & Teasdale, 1998). The GOS comprises multiple aspects of the ICF, specifically activity and participation across five separate domains. The GOSE, however longer, may be better suited for an active population because it discusses a return to normal life. Both are considered valid, having good correlations (r=0.64) with other functional measure such as the Beck Depression inventory and reliable (Kw=0.92) for face- to-face interviews. It is important to note that the GOS and GOSE are interviewer gathered tests and may have answers skewed to the interviewer bias (Linday Wilson, Pettigrew, & Teasdale, 1998). As head injury is an important aspect of athletic training and because the GOS has also been used in general injury studies, these may be viable functional outcome measures for an active population. The GOSE, however, has not been used in general injury or active populations and since they have only been used to evaluate sever injuries, further testing is needed (Linday, Wilson, Pettigrew, & Teasdale, 1998).

Other functional outcomes measures have only been for severe injury and focus on descriptions in the Abbreviated Injury Scale (AIS), a threat-to-life scale. The usefulness of such measures for mild to moderate injuries may be limited. These scales include the functional Capacity Index (FCI), the Functional Independence Measures (FIM) and the Functional Assessment Measures (FAM) (MacKenzie, Sacco, & Luchter, 2002).

There are, however, measures that focus on musculoskeletal injuries resulting in a more appropriate fit for athletic training. The Musculoskeletal Functional Assessment (MFA) and the abbreviated Short Musculoskeletal Functional Assessment (SMFA) are two such scales (Swiontkowki, Engelberg, & Martin, 1999). The MFA contains many ICF subcategories including activities, participation, body function and structure, running, and changes to participation and physical fitness aligning the MFA closely with an active population. Good correlation between physician rating and the MFA was (r=0.40-0.66), validity was established in trauma patients and reliability was (ICC= 0.7-0.92) in a self-administered test (Andrew, Gabbe, Wolfe, & Cameron, Evaluation of instruments for measuring the burden of sport and active recreation injury, 2010). The SMFA, like many other abbreviated measures, eliminates many important questions related to active populations, but has been

shown to maintain most of the reliability, validity, and responsiveness of the MFA (Swiontkowki, Engelberg, & Martin, 1999).

Health-Related Quality of Life Measures:

Health-Related Quality of Life measures are less frequent in health professions, but assess a greater number of items and focus more on how the injury is affecting the patient in function or health-related quality of life. The most commonly published generic measure is the Short form-36 (SF-36). It is a multi-item scale that assesses health-related quality of life in eight areas 1) limitations in physical activity, 2) limitations in social activities, 3) limitations in usual role activities because of physical health problems, 4) bodily pain, 5) overall mental health, 6) limitation in typical roles, 7) vitality, and 8) general health perceptions (Ware & Shelbourne, 1992). Since its inception the SF-36 has become the measuring stick by which other outcomes are measured and validated. These categories can further be grouped into a mental component score and a physical component score. Eleven different studies have used the SF-36 to evaluate active populations and injuries related to sport participation (Andrew, Gabbe, Wolfe, & Cameron, 2010). The SF-36 does not, however, ask any questions about upper extremity functional questions and has a significant ceiling effect for very active populations. Often, higher physically functioning individuals scored much higher on baseline evaluation than did a sedentary population. Other studies have created new normative data and scoring rubrics for more specific populations, (NCAA athlete values) but better measures for these specific populations may exist.

Another issue for the SF-36 is the length of the survey, which can be considered tedious. A shorter form (SF-12) has a 90% correlation with the SF-36, a considerable amount of construct validity. Unfortunately, the abbreviation was at the expense of the questions related to an active population. The results may be even less specific to an active population because it removes the questions regarding more strenuous activities. In fact, it was validated on chronic medical patients who presumably have lower physical function (Ware, Kosinski, & Keller, 1996).

The Sickness Impact Profile-136 (SIP-136) maintains the sport specific and active recreation questions that are lacking in many other studies. They include energy psychomotor, exercise tolerance, muscle and joint function and recreation participation. The SIP-136 has also demonstrated the abilities to discriminate between groups of ankle sprain patients

with little to no ceiling or floor effect and only in trauma patients (Jurkovich, Mock, & MacKenzie, 1995). The primary disadvantage to using the SIP- 136 is the length of completion time. In an effort to shorten the time frame, like the SF-36, the SIP-136 has been reduced to the SIP-68 (Debruin, Buys, & DeWitte, 1994). Like the SF-36, the reduction in the length of the survey is at the expense of the questions most relevant to physically active participation.

The majority of the generic measures are predicated on the theory that patients react to injury the same way they react to grief. Measures are taken to help predict which stage of the Kubler-Ross grieving process the patient may be in (Harris, 2003). A different model may better represent injury in an active population. Vela and Denegar have developed a theory of understanding the progression of events that follow injury specifically in a physically active population rather than a general population (Vela & Denegar, 2010b). This is imperative to eliminate the ceiling and floor effects experienced with other generic measures such as the SF-36 (Vela & Denegar, 2010a) The Disablement in the Physically Active Scale (DPA Scale) assesses the overall burden of injury in a physically active population and can identify significant changes in overall health-related quality of life as well as functional ability. The theory behind, and the intention for, this particular model was to evaluate this specific population. The DPA Scale has the potential to be much more sensitive to detecting change as it relates to response to injury in an active population (Vela & Denegar, 2010b). In a study of 368 physically active participants, twenty were excluded for not meeting the physically active requirement. Researchers found the test to be reliable (ICC = .943), valid (r= -0.714, P, .001) and responsive along the entire injury process from day one through week six (Vela & Denegar, 2010a).

One extremely basic yet very useful scale is the Global Rating of Change Scale (GRC). The GRC scale is very often used in clinical research, particularly in the musculoskeletal area (Kamper, Maher, & Mackey, 2009). The GRC scale asks the patient to assess health status, and recall that status at a previous point in time. The patient is then asked to calculate the magnitude of change that is scored on a numeric or visual analogue scale. The most typical scale is the 11-point scale that begins with a negative five and ends at a positive five. A negative calculation indicates a worsening of condition whereas a positive number correlates with improvement. The scale includes a zero number that indicates no change in

condition. This scale provides a method of obtaining patient outcomes in a manner that is efficient, flexible and reliable Test-retest reliability is ICC 0.90 with the eleven-point scale. The minimum detectable change is .45 while the minimally clinically important change is two points on the eleven-point scale. Correlations for the GRC is high (r=0.72 and r=0.90), especially correlations with patient satisfaction measures (Spearman correlation coefficients 0.56 to 0.77) indicating the scale represents meaningful change to a patient (Kamper, Maher, & Mackey, 2009).

An old business adage says we manage what we measure. As clinicians, collecting patient centered outcomes allows us the opportunity to manage our patient care, evaluating and applying throughout the injury process. The input from patients also assists the athletic trainer in administering healthcare tailored to the individual, and creates a more effective experience. Use of tools, such as DPA Scale and the GRC scale can allow an athletic trainer to demonstrate effectiveness in the management of injuries in a physically active population and elevate not only their personal practice, but also the profession as a whole.

HAMSTRING INJURY

Hamstring strains remain a significant reason for loss of athletic productivity. Few therapeutic interventions have indicated an appropriate or effective treatment. The current research involving hamstring injury is extensive yet remains mostly inconclusive. The purpose of this literature review is to investigate current concepts in hamstring strain. It will include current publications on aspects of anatomy and physiology, prevalence, diagnosis, mechanism of injury, and treatment.

Four muscle bodies comprise the hamstring complex; the short and long heads of the bicep femoris on the lateral aspect of the posterior thigh, the semimembranosus, and the semitendinosus on the medial aspect. The long head of the biceps femoris originates from the ischial tuberosity and inserts on the fibular head while the short head originates on the lateral femoral lip and inserts into the long head insertional tendon.

Semimembranosus and Semitendinosus, like the long head of the bicep femoris, also originate on the ischial tuberosity and attach on the posterior and superior aspect of the medial tibial condyle, respectively. Together these muscles are the foremost agonists to flex the knee joint (Kumazaki T, Kumazaki, Ehara, & Sakai, 2012; Marshall, Girgis, & Zelko, 1972). The muscle fibers of the long head of the bicep femoris and the semimembranosus

are hemi-pennate muscles and contain much shorter muscle fibers than those of the short head of the bicep femoris and the semitendinosus; which have a fusiform shape. The ratio of the total muscle length to the muscle fiber length is 2 to 3 times larger in the short head of the bicep femoris and the semitendinosus. This architecture leaves the long head of the bicep femoris and the semimembranosus more susceptible to injury when the knee is extended. These muscles can be overly stretched in this extended position (Kumazaki T, Kumazaki, Ehara, & Sakai, 2012).

Schache and colleagues (2012), in a study of the biomechanics of the hamstring during running, found the bicep femoris at a greater risk of injury during knee extension, specifically during terminal swing of running. Typically, the peak musculotendonous force and strain for all hamstring muscles occur around the same time. The bicep femoris exhibited the largest peak strain, and the semitendinosus showed the largest lengthening velocity. The semimembranosus created the greatest peak force and generated the most total power, thus performing the greatest amount of positive and negative work (Schache, Dorn, Blanch, Brown, & Pandy, 2012). This may indicate a greater risk of injury to the semimembranosus when the muscle fatigued.

Acute and recurrent hamstring injuries are among the most common injuries reported in athletic participation, particularly in sports involving high speed running (Chumanov, Heiderscheit, & Thelen, 2011; Alonso, et al., 2009; Feely, Kennely, & Barnes, 2008). Posterior thigh injuries accounted for sixteen percent of sports injuries reported in the 2007 International Association of Athletic Federations surveillance study (Alonso, Junge, Renstrom, Engebretsen, Mountjoy, & Dvorak, 2009) twelve percent of injuries occurring in an English Professional Football League season (Woods, Hawkins, Maltby, Hulse, Thomas, & Hodson, 2004)and resulted in over half of the injuries reported during the National Football League's (NFL) training camp (Feely, Kennely, & Barnes, 2008). Hamstring strains are common and can result in serious loss of time in athletic competition. The study of the NFL training camp reported days lost ranged from 8 to 25 with an over 33% re-injury rate within the first two weeks (Feely, Kennely, & Barnes, 2008). Petersen and colleagues (2010) described an average of 21.5 days per injury missed of competitive play for a 1-year prospective study of a Danish elite football (soccer) team. The study also demonstrated an accumulation of injuries in the first two months and then again after a winter break (Petersen, Neilsen, Homich, &

Nielsen, 2010). Yeung, Suen and Yeung (2009) followed a group of competitive sprinters and found 53% of them reported a hamstring injury in the first 100 hours of training (Yeung, Suen, & Yeung, 2009). The rate of injury within the first portion of the season suggests a de-conditioned hamstring may be more susceptible to injury

Of the three principal muscles comprising the hamstrings, the most commonly injured muscle is the bicep femoris. A study of an English professional football (Soccer) league revealed that, out of all the hamstring injuries over an entire season. Fifty-three percent of these strains occurred in the bicep femoris (Woods, Hawkins, Maltby, Hulse, Thomas, & Hodson, 2004). The proximal musculotendonous junction of the long head of the bicep femoris specifically, is reportedly the most commonly affected structure (Schneider-Kolsky , Hoving, Warren, & Connell, 2006; Koulouris, Connell, Brukner, & Schneider-Kolsky, 2007; Rettig, Meyer, & Bhadra, 2009).

The most predictive variable for hamstring injury is previous hamstring injury (van Beijsterveldt, van de Port, Vereijken, & Backx, 2012). In a study of a soccer season Engebretsen and colleagues (2010) found that athletes who had previously injured hamstrings had more than twice as high a risk of sustaining a new hamstring injury. Another predictive variable, specifically found in sprinting athletes, revealed a 17 fold increase in risk for athletes demonstrating a quadriceps peak torque ratio of less than 0.60 at an angular velocity of 180 degrees (Engebretsen, Myklebust, Holme, Engebretsen, & Bahr, 2010)

A consistent method of diagnosis is crucial to accurate management. Critical factors in diagnosis of hamstring injury are gait inspection, inspection including palpation of the muscle belly, range of motion tests, manual muscle tests and imaging (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011; Malliaropouls, et al., 2010; Reiman, Loudon, & Goode, 2013). Laboratory tests for biologic markers have proven to have an exceptionally low sensitivity and specificity and should not be used to diagnose hamstring injury until more studies can be done to increase reliability (Sorichter, Mair, Koller, Calzolari, Artner-Sworzak, & Puschendorf, 1997). Other special tests are used to rule out differential diagnosis, such as L5-S1 disc pathology. These special tests include the slump test and the straight leg raises (Hunter & Speed, 2007). Both MRI and diagnostic ultrasounds can provide insight into the nature and extent of hamstring injuries (Kerkhoffs, et al., 2013; Connell, et al., 2004). MRI and diagnostic ultrasound equally assess baseline diagnosis of a hamstring inju-

ry, but MRI is more sensitive for identifying low-grade injuries. MRI of hamstring injuries are done using fat suppressed T2 images and can best be observed 24 hours to 5 days post injury (Ekstand, Healy, Walden, Lee, English, & Hagglund, 2012). Grade 1 injuries are defined radiologically as involving less than 5% of the muscle. Grade II demonstrate 5 to 50% of muscle length and Grade III injuries are defined a complete rupture (Connell, et al., 2004). Ultrasound produces a grade 0 for a normal appearance, grade 1 for subtle findings, and grade 2 and grade 3 demonstrate a partial or complete disruption (Peetrons, 2002). Kerkhoffs and colleagues (2013), in a survey distributed to the members of the European Society of Sports Traumatology, Knee Surgery and Arthroscopy, indicated imaging should be performed within three days post-acute injury for both MRI and ultrasound (Kerkhoffs, van Es, Wieldraaijer, Sierevelt, Ekstand, & van Dijk, 2013).

Cohen et al., (2011) were able to correlate MRI diagnosis of hamstring injury to the number of games missed by patients participating in the National Football League. A grade one or two injury typically resulted in less than two games missed, while a grade three injury averaged 6.4 games missed (Cohen , et al., 2011). As the application of diagnostic ultrasound and or MRI may not be available to each patient, the clinical diagnosis of the hamstring strain must be valid and reliable without the benefit of diagnostic testing. Both Malliaropouls et al. (2010), and Kilcoyne and colleagues (2011) have evaluated and graded hamstring injuries using clinical evaluations and have reported these measures to be as effective as diagnostic testing (Malliaropouls, et al., 2010; Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). Reiman, Loudon and Goode (2013), in a systemic review, demonstrated a higher sensitivity in composite tests, but a greater specificity in the use of single special tests. Clinical evaluation includes 1) mechanism 2) ability to ambulate 3) pain 4) manual strength testing 5) range of motion deficit and 6) taking-off-the-shoe test (Reiman, Loudon, & Goode, 2013).

History remains an excellent indication of hamstring injury. Understanding potential mechanisms of injury are important in interpreting patient descriptions. Typically, a patient will describe a “pop” or sharp pain while kicking, jumping and running; running being the most prevalent (Woods, et al., 2004; Schmitt, Tim, & McHugh, 2012). Hamstring injury resulting from running can be divided into two potential mechanisms. Elizabeth Chumanov and her colleagues provide evidence that the majority of hamstring injuries occur during the

eccentric swing phase. This results in injuries closer to the ischial tuberosity affecting the tendons of the semimembranosus (Chumanov, Heiderscheit, & Thelen, 2011). While John Orchard illustrates that hamstring injuries occur during the concentric aspect of the stance phase of running, effecting long head of the biceps femoris and the proximal muscle-tendon junction (Malliaropoulos & Maffulli, 2012).

Opar et al (2012) have illustrated a theoretical outline proposing a neuromuscular inhibition of the bicep femoris specifically leading to a maladaptation and subsequent eccentric weakness. This paradigm lends itself toward atrophy of the previously injured muscles, changes in the angle of peak knee flexor torque and greater risk of re-injury. The long head of the bicep femoris was found to have lower myoelectric activity for rate of torque development and impulse when compared to uninjured subjects. It is unknown if the deficit leads to the injury or if the injury leads to the deficit (Opar D, 2012). Brockett, Morgan and Proske (2004) investigated the angle torque curve and discovered a significantly shorter muscle length in the previously injured hamstrings when compared to the uninjured side and control subjects without previous injury. Comparison to the uninjured side of the same patient indicates the injury caused the shortened muscle length (Brockett, Morgan, & Proske, 2004). The studies demonstrate patients who have previously experienced hamstring strain return to play with weakness at the end ranges of motion, thus predisposing them to further injury.

Potential shortening of the hamstring muscles themselves indicated range of motion is critical to the evaluation. Active range of motion is reduced during the acute stage of hamstring injury. Pain may be the primary reason for shortening (Kerkhoffs, van Es, Wieldraaijer, Sierevelt, Ekstand, & van Dijk, 2013). Malliaropouls et al. (2010) have found active knee range of motion deficit as on objective and accurate measurement of injury and approximate time missed. They also found the evaluation of ROM during the 90/90 Active Knee Extension Test measurement to be effective and a valid predictor of severity. Deficits of less than 10% were classified as Grade 1 and between 10% and 19% as Grade 2 Strains. The authors support that this method is even more sensitive than the diagnostic ultrasound in predicting time missed due to injury (Malliaropouls, et al., 2010). Reiman, Loudon and Goode (2013) found a sensitivity of .55(95% CI: 0.46, 0.69) for active range of motion evaluation (Reiman, Loudon, & Goode, 2013).

Reiman, Loudon and Goode (2013) states a lack of strong evidence investigating the utilization of clinical special tests for hamstring injury diagnosis exist. Only one special test was described to be sensitive in detecting hamstring injury. The study found a sensitivity of a1.0 (95% CI: 0.97, 1.0) for the Taking-off-the-Shoe Test. The specificity of 1.0(95% CI: 0.97, 1.0) for at a Composite examination including taking-off-the-shoe test, active, passive and resistive range of motion test (Reiman, Loudon, & Goode, 2013).

The limited evidence suggests the use of stretching including slump stretching, agility/trunk stability exercises, or even intramuscular injections as an effective treatment. No significant effect could be demonstrated with low-grade steroidal anti-inflammatory drugs (NSAIDS) or manipulation of the sacroiliac joint (Reurink, Goudwaard, Tol, Verhaar, Weir, & Mown, 2012). Anti-inflammatory drugs that specifically target cyclooxygenase-2 hinder skeletal muscle repair. Other biological interventions such as growth factors, can aid in the regeneration phase, but results are often short lived. Limited evidence also suggests no effect on hamstring injury resulted from manipulation of the Sacroiliac joint (Reurink, Goudwaard, Tol, Verhaar, Weir, & Mown, 2012).

The most common philosophy typically employed is early intervention of conservative treatment, followed by mobilization and eccentric muscle strengthening as quickly following the first 24 hours as tolerated by the patient. This treatment protocol has served as an effective method of treatment well tolerated by the patients resulting in good outcomes (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011; Schache, Dorn, Blanch, Brown, & Pandy, 2012). Schache and colleagues (2012) determined the use of eccentric hamstring exercises prevents hamstring injury. The study found the number needed to treat to prevent 1 hamstring injury was 13 (95% CI; 9, 23) for new or recurrent hamstrings. While the number needed to treat to prevent recurrent injury alone was 3 (95% CI; 2, 6) (Schache, Dorn, Blanch, Brown, & Pandy, 2012). Goldman and Jones (2011) in a systematic review determined insufficient evidence to judge the efficacy of interventions used to prevent hamstring injuries. The review did show promise in the use of manual therapies, but complete outcomes data need to be collected in future research (Goldman & Jones, 2011). Greenstein and colleagues (2011) used a closed chain eccentric training protocol to significantly reduce hamstring related pain in professional cheerleaders who often experience injuries resulting from overstretch (Greenstein, Bischop, Edward, & Topp, 2011).

The previous article by Kilcoyne et al (2011), states the protocol is effective in their cohort of patients (Collegiate Athletes) resulting in RTP in less than 2 weeks with a low risk of recurrence. The limiting factor of the patient's progress was pain as tolerated by the patient. The Kilcoyne et al. (2011) protocol was able to return hamstring-injured patients to play between 5-23 days post injury (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). This was similar to other studies (Ekstand, Healy, Walden, Lee, English, & Hagglund, 2012). The small sample of patients treated with the McConnell tape indicates a return to full activity at an average of three days. The reasons for the short recovery time may be a reflection of the low-grade of the hamstring strain. The patients evaluated in the pilot study all were diagnosed with grade-1 hamstring strains, meaning there was little to no disruption in the muscle tissue. Malliaropouls et al (2012) indicated hamstring injuries demonstrating less than a 20 degree deficit in range of motion, like the patients in this study, had an average RTP within 2 weeks (Malliaropouls, et al., 2010) While Kilcoyne and colleagues (2012) found an average of 7.4 days until RTP following grade-1 injury (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). This indicated the combination of McConnell tape with the Kilcoyne hamstring protocol has decreased the number of days out of activity.

CHAPTER 5
ORIGINAL RESEARCH MANUSCRIPT
"OUTCOME MEASURES USED IN CLINICAL ATHLETIC TRAINING: PART 1, SURVEY OF CURRENT PRACTICE"

Over the past decade, the National Athletic Trainers' Association (NATA) has actively pursued the advancement of evidence-based practice (EBP) in athletic training (AT). Evidence-based medicine refers to the integration of the highest quality scientific research evidence with clinical expertise and patient values to make clinical decisions (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). Thus, successful implementation of EBP is partially reliant on clinician expertise. The determination of clinical expertise, through the evaluation of patient and clinician centered outcomes, is lacking in AT (Sauers & Snyder, 2011). Continued integration of scientific research into clinical medical practice is still needed (Westfall, Mold and Fanagan, 2007). It is estimated that only 14% of bench research ever reaches clinical practice settings and it can take an average of 17 years for practitioners to apply the new knowledge. There is also some concern that many clinical trials do not accurately reflect situations that occur in authentic AT clinical practice (Sauers & Valocich-McLoed, 2012).

Multiple articles (Berwick, 2003; Schwartz & Vilquin, 2003; Sung, Crowley, & Genel, 2003) refer to how daily practice research has improved healthcare. Healthcare providers are in a position to test scientific theories on readily available patients and provide the disease-oriented and patient-oriented data necessary to evaluate the effectiveness of their practice. Practitioners, as a result of *a priori* clinical practice and collected outcomes, are also able to assess and improve their clinical effectiveness and develop expertise. Because evidence-based medicine is a recursive process, discoveries in clinical practice must be able to inform science to truly complete the circle of translational research, creating paradigm referred to as practiced-based evidence (PBE) (Pitney & Parker, 2002).

A key component to creating PBE and clinical expertise is the use of outcome measures. Outcome measures, whether disease-oriented or patient-oriented, are used to audit clinical practice and enable systematic measurement of AT practice (Dunckley, Aspinal, Addington-Hall, Hughes, & Higginson, 2005). "The assessment of outcomes involves reporting on the result of healthcare services that take the patient's preferences, and values into

account through a variety of clinician and patient-based tools" (Snyder, Valovich-McLeod, & Sauers, 2007, p. 32). Extrinsically, outcome measures aid analyses of effectiveness and provide quantitative evidence to support conclusions, providing a valuable source of PBE. Intrinsically, using outcome measures enhance communication with patients and assist in directing the plan of care by patient (Jette, Halbert, Iverson, Miceli, & Shah, 2009).

Outcome measures that target the burden of sport injury and quality recovery are best evaluated with The World Health Organization's International Classification of Function (IFC) (International Classificaion of Functioning, Disability and Health, 2001). The ICF is a useful tool in the evaluation of "mental functions, pain, neuro-musculoskeletal and movement-related functions, muscle function, mobility, community, social and civic life and environmental attitudes" (Andrew, Gabbe, Wolfe, & Cameron, 2010, p. 141). The classifications can be further divided into two distinct categories of disease or clinician-oriented and patient-oriented evidence (POE). Disease-oriented evidence (DOE) refers to outcomes that measure physiologic markers of health (e.g., blood pressure, peak flow, girth, range of motion, strength) (American Academy of Family Physicians, 2013). Objective measurement of these markers should be a routine part of AT daily practice. Improvement in objective measures, however, does not always lead to an improvement in POE or resolution of the patient's complaints (Michener, 2011).

Functional ability (i.e., the ability to perform a desired task) is often considered the most important outcome of healthcare from patient and societal perspectives, but is not considered from a DOE perspective (Deyo & Patrich, 1989). Considering this type of outcome measure is critical to providing expert patient care and its importance demonstrates the need for POE to be included in daily practice (Deyo & Patrich, 1989). This type of evidence, POE, is subjective and evaluates the patient's perception of their health status. Examples of POE include pain, symptoms, and functional status. Questions or surveys are often used to evaluate POE (Snyder, Valovich-McLeod, & Sauers, 2007) and these outcome measures should be a routine part of any physical evaluation (Michener, 2011). Jette et al. (2009) indicated clinicians were interested in learning about outcome measures, but most did not collect or use them. When examining the clinical practice of physical therapists, more than 90% believed outcomes were valuable, but over half did not utilize outcome measures in their practice. The reason for low use most frequently reported involved perceived lack of time

for completion by patients and analysis by clinicians (Jette et al., 2009) The level of awareness and use of outcome measures in AT clinical practice remains unknown, but anecdotal evidence suggests few ATs consistently use DOE or POE to evaluate patients or their practice, despite reported benefits (Evans & Lam, 2011). The purpose of this investigation was to explore the familiarity and confidence of Certified ATs who were members of the NATA with utilizing outcomes measure (i.e., DOE and POE) in clinical practice. The 11-question survey was distributed anonymously to Certified AT members of the NATA actively involved in patient care.

Research Questions:

1. Are Certified AT members of the NATA actively involved in patient care familiar with outcome measures?
2. Are Certified AT Members of the NATA familiar with application of DOE and POE?
3. Are Certified AT members of the NATA actively involved in patient care confident in utilizing outcome measures in their practice?

METHODS

Participants

The participants in the study were 1000 randomly selected members of the NATA either actively involved in patient care or education. These settings include college/University, 2-year institution, secondary school, clinic, hospital, and industrial/occupational setting. The NATA currently serves approximately 18,200 regular certified members in the target employment setting. (National Athletic Trainers' Association, 2013) As a free service to students engaged in research, the NATA will distribute approved surveys to 1000 participants for no cost (http://www.nata.org/content/research-survey-request). A response number of 392 was needed to reach a confidence level of .05 and 100 responses for confidence of .10.

Study Design

A cross-sectional survey research design was used to gage perceived familiarity and utilization of outcome measures, both patient- and disease-oriented, in clinical athletic training practice. Data was acquired through the distribution of the web-based survey to the described participants.

Survey Instrument

The 11-question survey (Appendix 2) design was a combination of closed-ended questions followed by open-ended questions. Brevity was important to decrease completion time and increase response rate. Demographic questions (n=2) including participant's primary practice setting and years of practice were captured. The closed ended questions assessed the participant's perceived familiarity and confidence with outcome measures. A four-point unipolar scalar model was selected to represent the continuum of responses but still limit the respondent to a positive or negative affirmation. The use of four-point scales has been demonstrated to be more reliable and valid while maintaining a meaningful distinction between choices (Dillman, Smyth, & Christian, 2008). The open-ended questions were used to identify specific outcomes measures utilized and confirm appropriate familiarity patient- and disease-oriented outcome measures. Open-ended responses would provide an opportunity for researchers to rule out confounding responses of familiarity and utilization. Respondents indicating they are familiar with and/or utilize outcome measures should be able to identify specific measures. Responses to open-ended questions were optional since some may not have been applicable to each participant.

A panel of five ATs, actively involved in patient care and whom hold advanced or terminal degrees in the fields of AT and AT Education, evaluated the instrument for face validity. The panel indicated which items were unclear or confusing and changes to the survey instrument (Appendix 2) were made based on the feedback. A detailed literature review of related healthcare practitioners' attitudes toward and use of, outcome measures supported the instruments content validity and terminology. The instrument's original term of "Clinical Oriented Evidence" was changed to "Disease-Oriented Evidenced" because reviewers found the original term indistinguishable from general outcome measures as the terms are often used interchangeably within healthcare research (Jette, Halbert, Iverson, Miceli, & Shah, 2009).

Procedures

Participants were recruited through e-mail invitation delivered by the NATA to complete the survey. Institutional review board approved the study and participants implied consent by accessing the survey. An introductory statement describing the goal of the study was provided. Terms were not defined for participants because recognition of terms was a

dependent variable regarding familiarity. A follow-up email was sent to participants two weeks following the original distribution to improve response rate (Pitney & Parker, 2002).

Data Analysis

The primary dependent variables were perceived familiarity and confidence in utilization of POE and DOE. Likert-style questions were classified as endorsed as positive when participants selected "Very familiar", "Somewhat familiar", "Very confident", or "Somewhat confident". Data are reported as percentage endorsed (%). Spearman correlations (r_s) were used to determine the relationship between clinician practice setting and whether or not they were familiar with or utilized outcome measures. Correlation coefficients were described as little or no relationship (0-0.25), fair relationship (0.26-0.50), good relationship (0.51-0.75) and excellent relationship (0.76 and higher). Other dependent variable included names of specific measures reported by respondents. These were collected in an effort to list specific outcome measures and to confirm or confound familiarity and utilization responses.

RESULTS

E-mail invitations were sent to 1000 ATs in the described clinical setting, none of which were returned as undeliverable. All of the 148 respondents who initiated the survey completed it. The surveys response rate of 14.8% is seemingly low. However, the response rate is acceptable because there is little variance in the responses and a rate of 14% is consistent with industry standards (NATA, 2013). The survey is valid as a trend indicator as it is reflective of industry segment sample and results are homogeneous. Respondents with the work setting of "Clinic" all also indicated "Secondary School" so one category of "Clinic/Secondary school" was used to describe this population of participants. The overwhelming majority (117, 79%) of respondents are employed in traditional school based settings (i.e., Secondary School [41.8%] or Collegiate Athletics [33.6]) involving direct patient care as described in Figure 1. The mean "years of work experience" was 13.05 years, with a median of 10 years and a range of 1 to 43 years as demonstrated in Figure 2.

Figure 1.*Percentage of Reported Employment Setting*

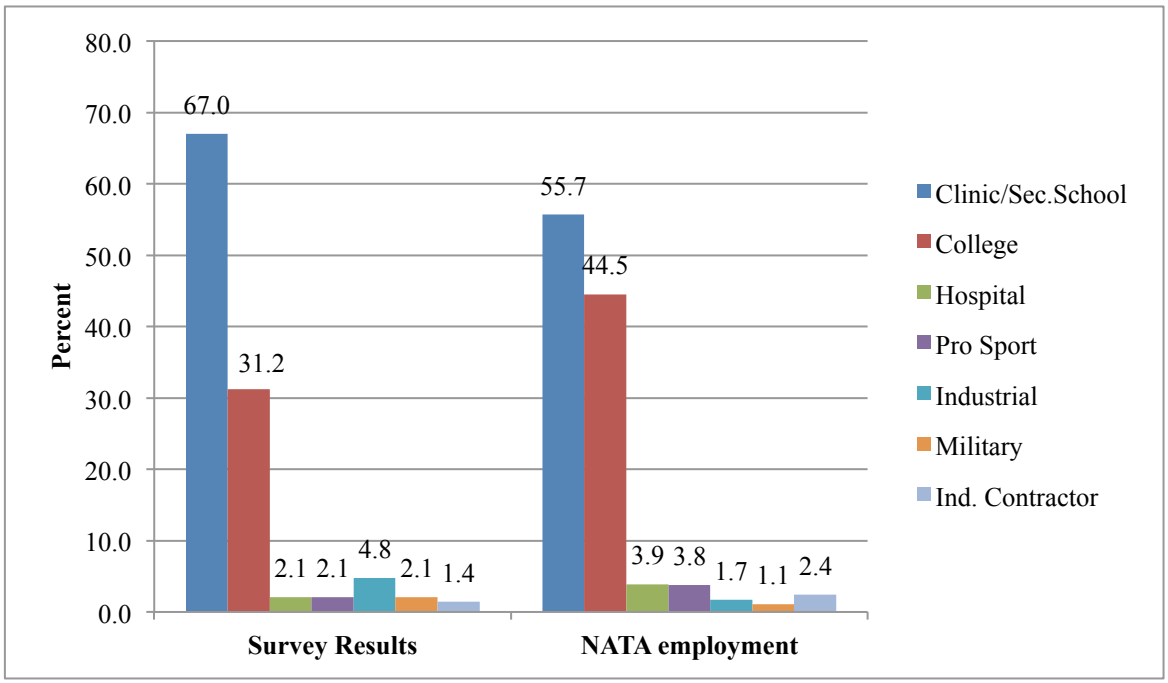
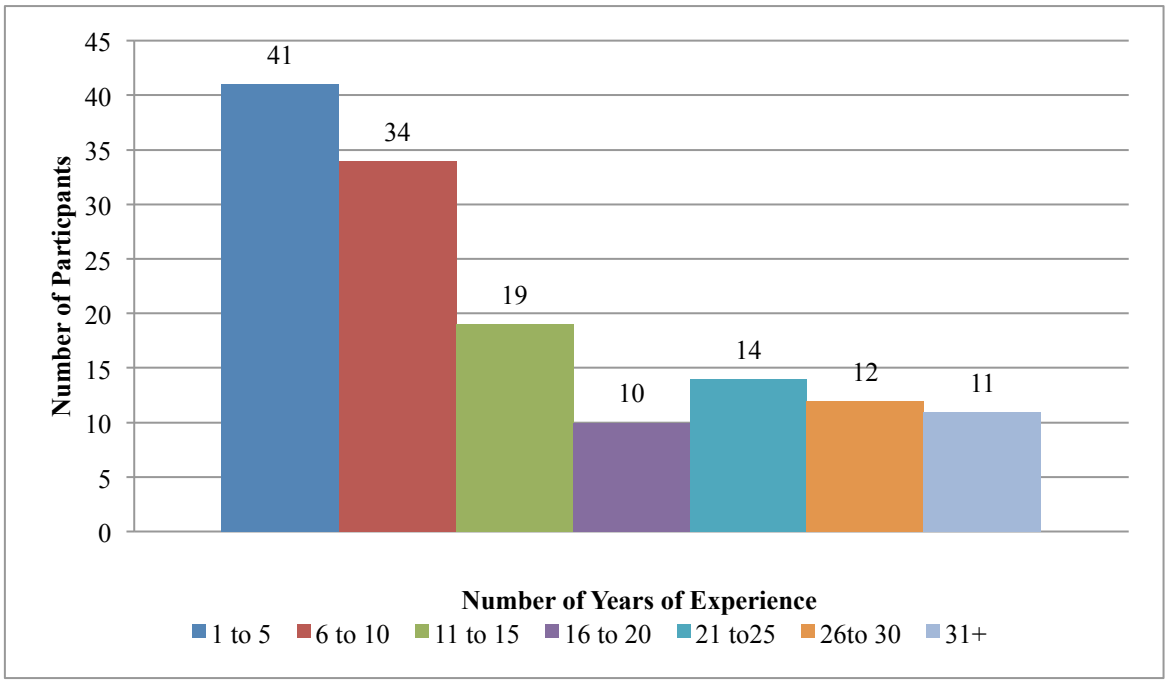


Figure 2.*Number of Years in Current Employment Setting*



Of the 137 responses 53.9% (n=71) responded to the affirmative they were "Somewhat" or "Very" familiar with outcome measures, while 46.1% (n=66) reported being either "Not at all" or "Not too" familiar with outcome measures. Spearman Correlation for primary practice setting was .105 indicating no relationship. Familiarity with specific out-

come measurement reported by respondents was 6.6% (n=7) affirmative for DOE (Table 6) and 28% (n=32) affirmative for POE (Table 7). Spearman Correlation for primary practice setting was .001 for DOE and .135 for POE indicating no relationship between responses and primary practice setting.

Of the 146 respondents, 51.3% indicated they were either "Very Confident" (n=8) or "Somewhat Confident"(n=63) in the utilization of outcome measures. Of the total respondents, 34% indicated they were "Not too confident" with outcome measures and 17% indicated they were "Not at all" confident with outcome measures.

Table 5. *Familiarity with Outcome Measures in Athletic Training*

	College/ University Involving patient care	College/ University Education only	Secondary Schools	All Settings Total
Not at all Familiar	14% (7)	0% (0)	22.4% (15)	16.8% (23)
Not too familiar	36% (18)	26.7% (4)	31.3% (21)	31.4% (43)
Somewhat Familiar	48% (24)	40% (6)	38.8% (26)	41.6% (57)
Very Familiar	2% (1)	33.3% (5)	7.5% (5)	10.2% (14)
Answered Question	50	15	67	137

- Parentheses' equal actual response number (n).

The majority of ATs who identified their primary setting as College/ University involving patient care (n=48), reported being "Somewhat familiar" (47.9%) with outcome measures and were "Somewhat confident" (37.5%) in utilizing outcomes (see Table 5). The majority (46.2%) stated they were "Not at all familiar" with POE and only one respondent stated they actually utilized any patient-oriented outcomes in their practice (Table 6). Even more (56.8%) of the College/University ATs were "Not at all familiar" with DOE (Table 7). None of the College/University (0%) ATs selected "Very confident" with utilizing DOE. The majority (92%) of respondents indicated they were either "Not at all familiar" or "Not too familiar" with DOE Only 8% responded to being either "Somewhat familiar" or "Very familiar" with DOE.

Table 6. *Familiarity with Patient-Oriented Outcomes*

	College/ University Involving patient care	College/ University Education only	Secondary Schools	All Settings Total
Not at all Familiar	46.3% (19)	15.4% (2)	50% (29)	44.7% (51)
Not too Familiar	24.4% (10)	15.4% (2)	25.9% (15)	27.2% (31)
Somewhat Familiar	26.8% (11)	46.2% (6)	20.7% (12)	23.7% (27)
Very Familiar	2.4% (1)	23.3% (5)	3.4% (2)	4.4% (5)
Answered Question	41	13	58	114

Table 7.*Familiarity with Disease-Oriented Outcomes*

	College/ University Involving patient care	College/ University Education only	Secondary Schools	All Settings Total
Not at all Familiar	59.0% (23)	38.5% (5)	73.1% (38)	65.1% (69)
Not too Familiar	33.3% (13)	23.1% (3)	23.1% (12)	28.3% (30)
Somewhat Familiar	7.7% (3)	30.8% (4)	1.9% (1)	4.7% (5)
Very Familiar	0.0% (0)	7.7% (1)	1.9% (1)	1.9% (2)
Answered Question	39	13	52	106

DISCUSSION

The purpose of this study was to evaluate the familiarity with outcome measures, specifically POE and DOE, and clinician's confidence with utilizing outcome measures in clinical athletic training practice. The results of the survey appear to indicate inadequate utilization of outcome measures by the certified members of the NATA actively involved in patient care. In previous studies, the common reasons for not using outcome measures included: unfamiliarity with the measures, the belief that utilizing such measures would take

too much time to complete and score, and clinician's inability to interpret scores (Michener, 2011; Jetta, 2006; Verhoef, Mulkins, Kania, Findlay-Reece, & Mior, 2010). Analyses of results also appear to indicate a knowledge deficit of outcome measures and insufficient utilization of DOE and POE. The results are also suggestive of publications and educational material on outcome measures having not reached a large portion of the NATA membership. While respondents indicated being somewhat familiar (41.6%) or very familiar with outcome measures (10.2%), when asked specifically about which patient-oriented or disease-oriented outcomes they know or use, only 7.8% of respondents were able to name actual measures. The inability to name outcome measures suggests that respondents were either not as familiar with outcome measures as they previously indicated or did not recognize terminology. An inability to recognize the two distinctions in outcome measures was also present which also indicates that respondents were not proficient at the use of outcome measures. The few respondents who provided specific examples either represented specific populations (e.g., independent contractors) or were incorrect with their responses (i.e., named measures that do not exist).

Of the total respondents, 29% (n=41) had only been in the profession for 1-5 years and few (26.8%; n=18) were somewhat or very familiar with outcome measures in any capacity. A natural conclusion for these results is that instruction on utilization of outcome measures may not be adequately emphasized in AT professional education programs. A follow-up survey of those enrolled in AT professional education programs to examine student understanding of outcome measures is certainly warranted and could further elucidate potential problems in this area.

Although outside the scope of this study, perceived lack of time has been identified as a barrier to the utilization of outcome measures (Deyo & Patrich, 1989). Jette et al. (2009) explored this barrier in rehabilitative patient care and learned the length of time for patients to complete the instrument and the time necessary for clinicians to analyze data were both contributory factors. Sauers and Snyder (2011), however, indicated that the cost-to-benefit ratio might be well worth the additional time. Reponses to our survey indicate high interest among practicing athletic trainers to learn more about outcome measures with the majority "Somewhat interested" (56.8%) and "Very interested" (35.1%) in learning about outcome

measures. Based on the results, one may infer that process of learning and utilizing outcomes measures may be something NATA membership is open to participating in.

Limitations:

As a cross-sectional convenience sample, this study does have limitations. The most efficient way of reaching the largest number of certified ATs working in a variety of settings was by accessing the NATA membership directory. Therefore, only those who were active members of the NATA were surveyed. The method of delivery (i.e., email) provided another challenge as one cannot assume all certified ATs have equal access to email. Further limitations include the small sample size. The NATA provides the survey to 1000 members for no charge to students. A response rate at 146 (14.8%) was below the 392 responses needed to reach a confidence level of 0.05.

Conclusions:

Survey results indicated familiarity and confidence in utilizing outcome measures, including DOE and POE, was low overall, and particularly low in the College and University Setting. Further research is needed to determine reasons for this poor utilization despite efforts by the NATA to incorporate outcomes into clinical practice. Additional research that examines how to best facilitate incorporation of outcome measures into standard practice is warranted. Sauers and Snyder (2011) have suggested, in sports related rehabilitation, that new therapies often stem from innovative clinicians. This would suggest clinicians share an equal responsibility with researchers and educators in determining the most effective treatments for particular patients and subsets of patients. A component of completing this process is to test the effect of these interventions on patients across DOE and POE. The results of the survey indicate clinicians are simply not currently taking part in the development of clinical evidence. Barriers in the utilization of outcome measures and effectiveness research in other healthcare professions include lack of education and perceived lack of time.

A second clinical investigation was undertaken to demonstrate how the practicing clinician can use DOE and POE in daily practice. A common clinical issue in the collegiate AT setting (i.e., hamstring strain) was chosen to add relevance to clinicians. The effectiveness of a “Box Tape” (McConnell, 2012) strategy to improve outcomes in patients with injured hamstrings was investigated retrospectively.

"OUTCOME MEASURES USED IN CLINICAL ATHLETIC TRAINING: PART 2, THE EFFECT OF BOX TAPE ON OUTCOME MEASURES IN HAMSTRING INJURED PATIENTS"

Evidence-based practice (EBP) refers to the integration of the highest quality scientific research evidence with clinical expertise and patient values to make clinical decisions (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). The collection of disease and patient based outcome measures provides evidence of clinical decision making which incorporates patient values. Disease-oriented evidence (DOE) provides outcomes from a physiologic perspective, while Patient-oriented evidence (POE) provides insight of the injury process from the patient's perspective (American Academy of Family Physicians, 2013). Outcome measures collected during routine AT practice may constitute evidence of informed patient-centered healthcare and provide a means of evaluating the effectiveness of EBP (Evans & Lam, 2011). A number of authors have illustrated how healthcare may be improved by evaluating the effectiveness of EBP through the study of application (Berwick, 2003; Schwartz & Vilquin, 2003; Sung, Crowley, & Genel, 2003; Evans & Lam, 2011).

Currently, the majority of evidence that ATs use to inform clinical decisions is derived from clinical trials and controlled studies which fail to measure outcomes in day to day clinical practice (Sauers & Snyder, 2011). Results of the survey presented in "Part 1: Outcome Measures in Clinical Athletic Training," confirm both a lack of understanding and use of outcome measures. The results were particularly poor in the collegiate athletics setting, which is alarming since these settings accounts for nearly 24% of NATA membership. Suggested barriers to the use of outcome measures in physical medicine include lack of knowledge of outcome measures and a perceived lack of time to administer and analyze the data of clinical practice (Evans & Lam, 2011). Overcoming the barriers to collecting and using outcome measures and employing both DOE and POE in everyday AT practice has the potential to improve the management of difficult or prolific injuries both local and the global AT community (Evans & Lam, 2011).

One such prolific injury, which remains a significant question in AT, is the hamstring injury. Acute and recurrent hamstring injuries are among the most common injuries reported in athletic participation, particularly in sports involving high speed running (Chumanov, Heiderscheit, & Thelen, 2011). Posterior thigh injuries accounted for 16% of

sports injuries reported in the 2007 International Association of Athletic Federations surveillance study (Alonso, Junge, Renstrom, Engebretsen, Mountjoy, & Dvorak, 2009) and resulted in over half of the injuries reported during the National Football League's (NFL) training camp. Days lost from participation ranged from 8 to 25 days with a 33% re-injury rate within the first two weeks (Feely, Kennely, & Barnes, 2008). The protocol typically employed to treat hamstring injury is early intervention of conservative treatment including rest and immobilization for 24 hours post injury, followed by eccentric muscle strengthening as quickly as tolerated by the patient. This treatment protocol has served as an effective method of treatment well tolerated by the patients resulting in expedited RTP (11.9 days) and low re-injury rates (6.2%) (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011).

Jenny McConnell, a physical therapist from Australia, whose patellar taping is widely published and critiqued in physical medicine, developed a tape application to alleviate pain and dysfunction associated with hamstring injury. Her purpose for the tape application was to "shorten the structures" underneath the superficial tape application. The tape facilitates recovery by decreasing pain and increasing functional ability. The purpose of this investigation was to assess the effectiveness of the box taping technique for the treatment of hamstring pathology across disease and patient-oriented evidence in a collegiate AT clinic setting. A protocol that combined the McConnell technique with the common hamstring rehabilitation protocol was utilized. All of the patients were evaluated with the same process and all treatments followed the designed protocol.

METHODS:

Study Design

Outcome measures collected on patients diagnosed with a low-grade hamstring strain were analyzed retrospectively to evaluate the effectiveness of the box tape on patient health. Data was obtained during patient interaction with athletic trainer from time of diagnosis until discharge.

Participants

The retrospective outcome measures were collected at a National Collegiate Athletics Association (NCAA) Division II University, on varsity athletes (N=10) diagnosed with low-grade hamstring injury while participating in pre-season athletics including soccer, football, field hockey, volleyball, and cross-country. This time frame was chosen due to the

high incidence of hamstring injury reported during pre-season, especially the first 100 hours of training (Feely, Kennely, & Barnes, 2008).

Evaluation and diagnosis of hamstring injuries consisted of four clinical signs accepted for clinical diagnosis in the literature: palpation to determine muscle injured, strength impairment, ROM deficit, and differential examination (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). Strength was assessed through manual resistance of a prone hamstring curl consistent with a bilateral comparison. Range of Motion deficit was assessed through bilateral 90/90 Active Knee Extension Test (Heiderscheit, Sherry , Silder, Chumanov, & Thelen, 2010). A differential examination, which included the Slump Test, was completed to rule out neural tension dysfunction as the primary injury (Lew & Briggs, 1997). A summary of each patient's presentation is provided in Table 8.

The patients were collegiate student-athletes who complained of acute posterior thigh pain and dysfunction (i.e., ROM limitation on 90/90 active knee extension test, tenderness to palpation of a hamstring muscle, and strength deficits during manual muscle testing of the hamstring group), without signs of a lumbar spine or leg injury. In all cases, the hamstring strains occurred while running. Exclusionary criteria included history of surgery, bleeding disorders, use of anticoagulant medication, diffuse pain syndrome (e.g., fibromyalgia), corticosteroid injection, or previous injury within the previous 30 days. During the period of data collection, 13 patients met the initial inclusion criteria to participate in the study, 3 were excluded due to not meeting the injury classification of our study. Variables, such as location of injury (i.e. semi-tendinosis/ semi-membranous and biceps femoris), degree of injury, sport, gender of patient, or age were not found in the Kilcoyne study to be significantly associated with time to return to sport ($p>0.05$) and were not utilized in this study (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011)

Table 8. *Hamstring Patient Data*

Patient #	Date of Eval.	Date of Injury	Muscle	Strength	ROM Deficit	Differential diagnosis	Mechanism
1	8/8/12	8/8/12	bicep femoris	5/5	-15	-	running
2	8/10/12	8/10/12	bicep femoris	5/5	-10	negative	running
3	8/11/12	8/01/12	semi- membranosis/ tendinosis	4/5	0	negative	running
4	8/12/12	8/12/12	bicep femoris	4/5	-15	negative	running
5	8/13/12	8/13/12	bicep femoris	4/5	0	negative	running
6	8/14/12	7/31/12	bicep femoris	4/5	0	negative	running
7	8/16/12	8/14/12	bicep femoris	5/5	-10	negative	running
8	8/15/12	8/15/12	semi- membranosis/ tendinosis	4/5	0	negative	running
9	8/20/12	8/20/12	bicep femoris	5/5	0	negative	running
10	9/20/12	9/20/12	bicep femoris	4/5	10	negative	running

Procedures

Data recorded on patients treated for low-grade hamstring strain during pre-season sport participation in Fall 2012 was collected and de-identified from review of electronic patient records. Outcome measures are routinely recorded on patients receiving treatment using the Athletic Trainer Systems (ATS) injury tracking system developed by Keffer Development Systems (Grove City, PA). The DPA Scale was transcribed to a Google Drive Survey and was administered via Apple iPad 2 ® (Apple Computer, Inc.) with Wi-Fi capability during evaluation or treatment session. Data was included through the end of the semester to determine the re-injury rate within a 3-month time frame. Data on all patients, including outcome measures, were recorded during appointments with one of three licensed AT staff.

Included outcome measures were collected on adult patients, diagnosed with low-grade hamstring strains through physical examination by licensed ATs, and were treated us-

ing the box tape combined with the traditional rehabilitation protocol (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). The validity of the box tape as a method of treating hamstring injury was demonstrated in the positive effect on outcome measures by patients previously treated in athletic training clinical practice identified in the study. The box tape was applied by the same clinician following a prescribed protocol on every patient to improve reliability. Once evaluated and diagnosed, the area of pain was determined through palpation and measured for both length and width. Skin of posterior thigh was prepared through hair removal, if necessary, and application of aerosol tape adhesive. Once the skin was prepared, the vertical strips then horizontal strips were applied pulling with the intention to shorten the structures beneath. Tape strips were long enough to surround painful approximately one inch out from the area identified by the patient on all four sides. The goal was to create an "orange peel" effect in which the epidermis appears gathered and lifted at the site of injury (Figure 4). The result was a box surrounding the area of pain (McConnell, 2012)

Figure 3. *Box Tape Applied to Posterior Thigh*

Data Analysis:

Six general outcomes were identified through an extensive review of literature as both important and applicable to the elite athlete patient population by the principal investigator. General outcome measures of DOE and POE were used. The DOE utilized included ROM, strength, and return-to-participation (RTP). Range of motion was recorded as degree of deficit as measured using a goniometer marked in 1-degree increments during the 90/90 Active Knee Extension Test (Kerkhoffs, et al., 2013; Malliaropouls, et al., 2010). Strength was also measured through bilateral comparison of a manual muscle test and was scored by the clinician on the 0-5 Oxford Scale; 0= no contraction, 1= flicker, 2= weak, 3= fair with

movement, 4= good with movement, 5= strong with movement (Porter, 2013). Return-to-participation (RTP) was determined by date at which the patient was released to full participation in sport. The POE utilized was pain at worst and best (0-10) on Numerical Rating Scale (NRS), the Global Rating of Change (GRC), and the Disablement of the Physically Active Scale (DPA Scale).

The DPA Scale is a global outcome scale designed to be utilized in settings treating physically active patients. Vela and Denegar (2010a) found this short 16 question patient generated survey to be sensitive to detecting change as it relates to response to injury in an active population (Vela & Denegar, 2010a; Vela & Denegar, 2010b) The GRC scale is often used in musculoskeletal clinical research (Kamper, Maher, & Mackey, 2009). The GRC consists of a single question to rate the improvement a patient has experienced overtime (Michener, 2011). Patients were asked to rate on an 11 point scale (i.e.,-5 to +5) how their condition has changed in the past 24 hours. A negative response would indicate the patient felt worse, a positive response indicates the patient felt better than the previous day, and a score of 0 denoted no change in condition (Michener, 2011; Kamper, Maher, & Mackey, 2009). Test-retest reliability is ICC 0.90 with the eleven-point scale. The minimum detectable change is .45 while the minimally clinically important change is two points on the eleven-point scale (Kamper, Maher, & Mackey, 2009).

To evaluate meaningful change in POE, a minimally clinically important difference (MCID) was utilized for each outcome measure. The operational definition of a MCID is the smallest difference in score of an outcome measure which patients perceive as beneficial and could potentially warrant a change in the patient's management (Jaeschke, Singer, & Guyatt, 1989). Mathematically, the MCID is the error associated with two administrations of a measure, or the change in the scores (Jaeschke, Singer, & Guyatt, 1989). For example, the NRS has been found to have a change in 15% or one point representative of a MCID. However, a change of 33% or two points were best associated with the concept of “much better” which may be a better point of reference for a significant change (Salaffi, Stancati, Silverstri, Ciapetti, & Grassi, 2004). The use of MCIDs provides meaningful interpretation of outcome measures; however, limitations do exist. The values are not always stable and the error values and meaningful change can vary. Sample of patients, type of treatment, interval of change and patient acuity can influence stability. Also, many of the measures have

not accounted for the ceiling effect which occurs in an athletic population of patients (Michener, 2011). The exception to this is the DPA Scale, which determined the MCID using a strictly athletic population. The DPA Scale was found to be both sensitive and specific to this population and the healing process associated with competitive sports. The DPA Scale MCID value for an acute injury was nine points (Vela & Denegar, 2010b), while the MCID for the GRC is two points in either direction (Kamper, Maher, & Mackey, 2009).

RESULTS

Ten patients met the inclusion criteria for this study. Fifty four separate entries of outcomes measures were mined on the ten patients from Athletic Training Software (ATS), with a mean entry of 5.4 entries per patient. All reported a mechanism of running and the Bicep Femoris muscle belly was the most injured muscle group (78%) (Table 9). Previous research relied heavily on RTP as a primary clinical outcome (Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). The current study incorporates POE along with RTP and other DOE to provide a richer picture of healing (Jette, Halbert, Iverson, Miceli, & Shah, 2009). The mean number of days out of participation was 5.9 with a standard error of 1.29. The minimum number of days missed was 0 while the maximum was 16. Patient #3 returned to participation on day sixteen post injury, but did not seek care for ten days following initial injury. Patient #3 returned to participation six day post initial treatment. Patient #7 returned to participation eight days post injury and six days post initial treatment. Patient #7 had an initial injury date two days prior to initial treatment. No re-injuries were reported within 60 days of initial injury.

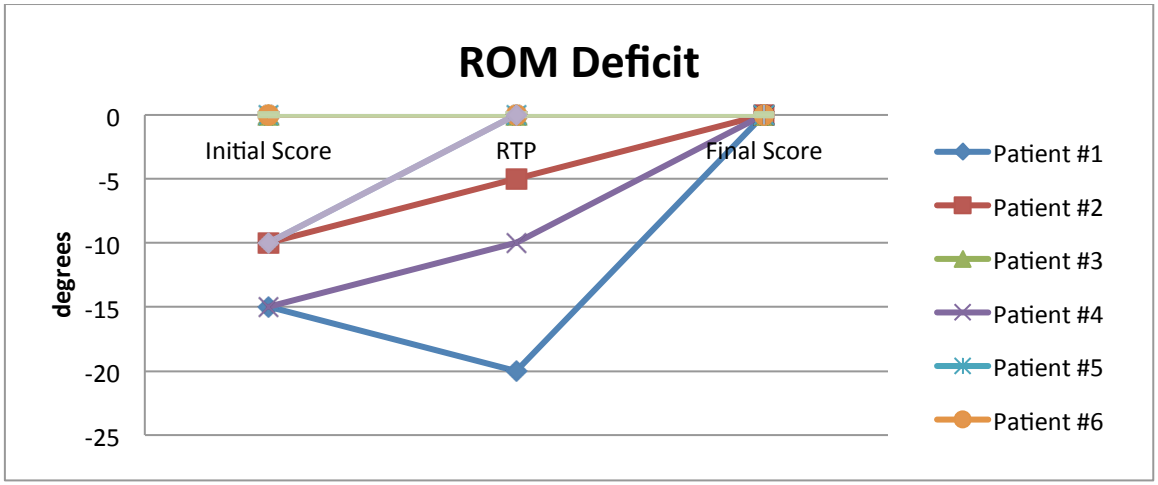
Five of the ten patients had initial deficits in ROM, evaluated with the 90/90 Active Knee Extension test, compared to unaffected leg. Patient #1 had a recorded deficit of 15 degrees which resolved to equal bilateral by five days post injury. Patient #2 had an initial recorded deficit of 10 degrees which improved to 5 degrees one day post tape. ROM had returned to equal bilateral by day five, but worsened to a deficit of 20 degrees on day seven. The decrease in ROM was temporary and retuned to equal bilateral the following day (day eight). Patient #4 had a recorded initial deficit of 10 degrees which resolved to equal bilateral on day six. Patient #10 also had an initial deficit of 10 degrees that resolved in 24 hours.

Table 9. *Hamstring Treatment Outcome Measures*

Patient #	Days Until RTP	Strength initial	Strength final	ROM initial	ROM final	Pain worst initial	Pain worst final	DPA Scale initial	DPA Scale final	Mean GRC
1	6	5/5	5/5	-15	0	4/10	2/10*	14	12	1.00
2	10	5/5	5/5	-10	0	4/10	6/10	40	15*	0.44
3	16	4/5	5/5	0	0	6/10	2/10*	13	6	3.00
4	11	4/5	5/5	-15	0	6/10	2/10*	35	3*	1.00
5	1	4/5	-	0	-	4/10	0/10*	16	0*	1.00
6	2	5/5	5/5	0	0	5/10	4/10	12	20	1.66
7	8	5/5	5/5	-10	0	3/10	3/10	20	25	2.30
8	2	4/5	5/5	0	0	5/10	4/10	27	18*	1.50
9	2	5/5	-	0	-	5/10	0/10*	10	0*	-
10	1	4/5	-	-10	-	6/10	0/10*	15	0*	-

- MCID achieved for POE score

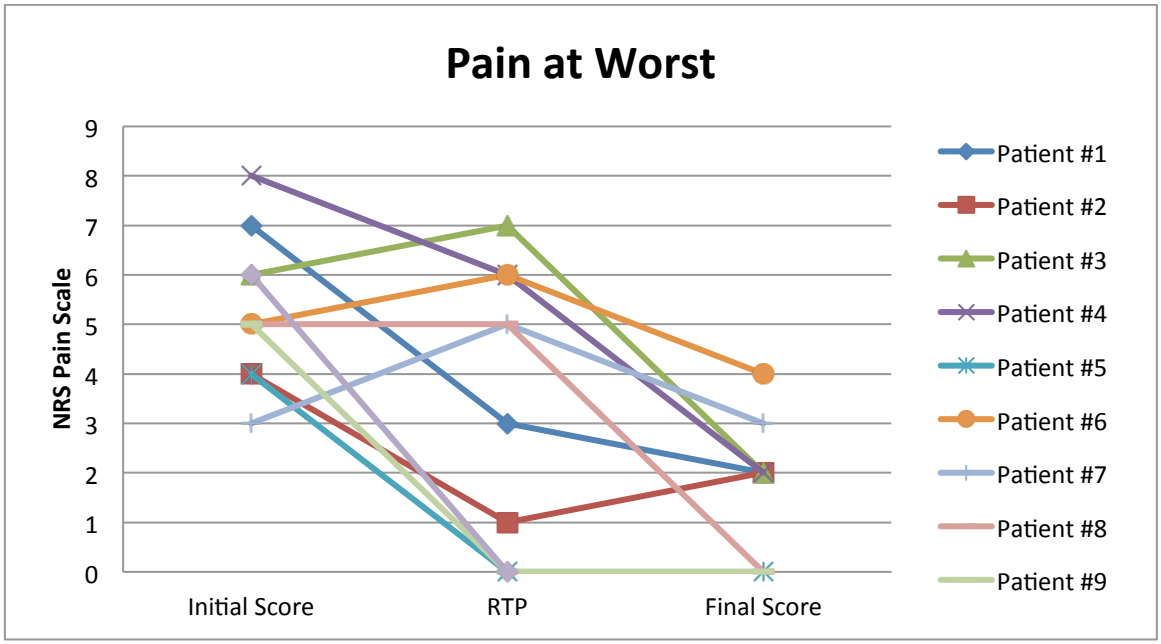
Figure 4.*ROM Deficit*



Patients #3, #4, #5, #8 and #10 all had strength of 4/5 recorded for initial evaluation as manually tested by clinician. All patients' strength deficits resolved before RTP. Patient #3 and #8 returned to strength of 5/5 two days post injury. Patient #4 returned to strength of 5/5 one day post injury. Patient #5 and #10 did not have a second record of strength evaluation following the initial evaluation. Patients, #5 and #10, returned to play without further incident one day post injury.

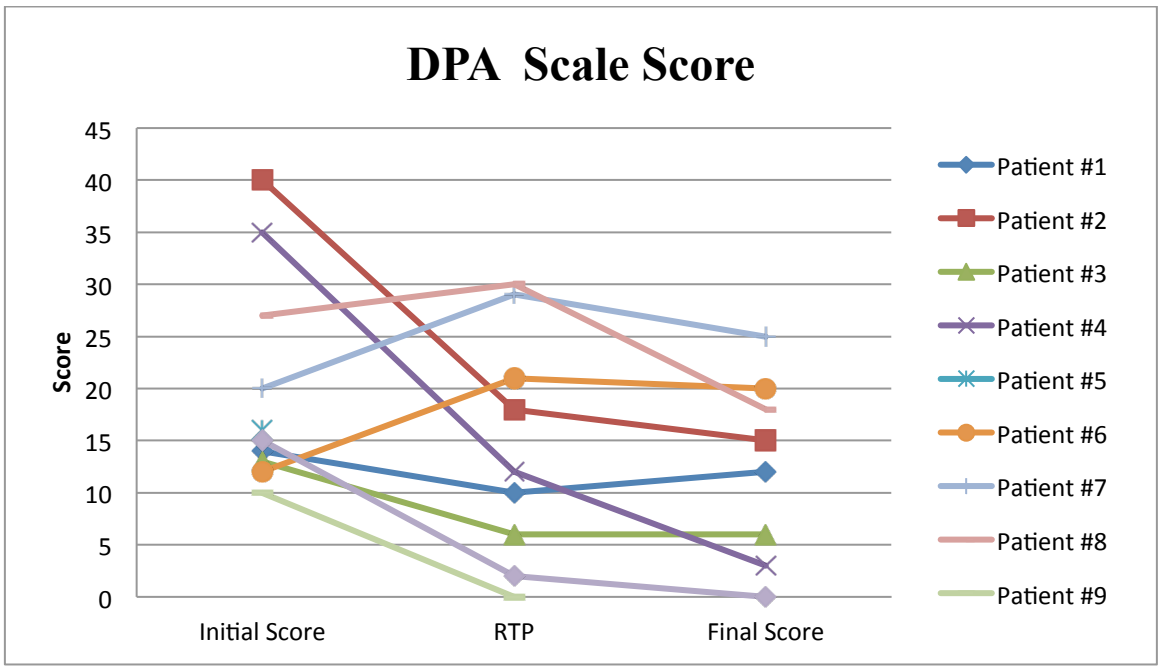
Pain, DPA Scale and GRC were recorded as POE. Patients #1, #2, #4, #5, #9 and #10 all had recorded MCID for pain at worst post-application of tape. Patients #3, #6, and #7 had a recorded increase in pain at worst post application of tape. All three patients, #3, #6, and #7, were injured at least 48 hours prior to initial treatment. Patient #3, however, had a record of obtaining MCID on four days post initial treatment reducing pain at worst from 6 to 2.

Figure 5.*Pain at Worst*



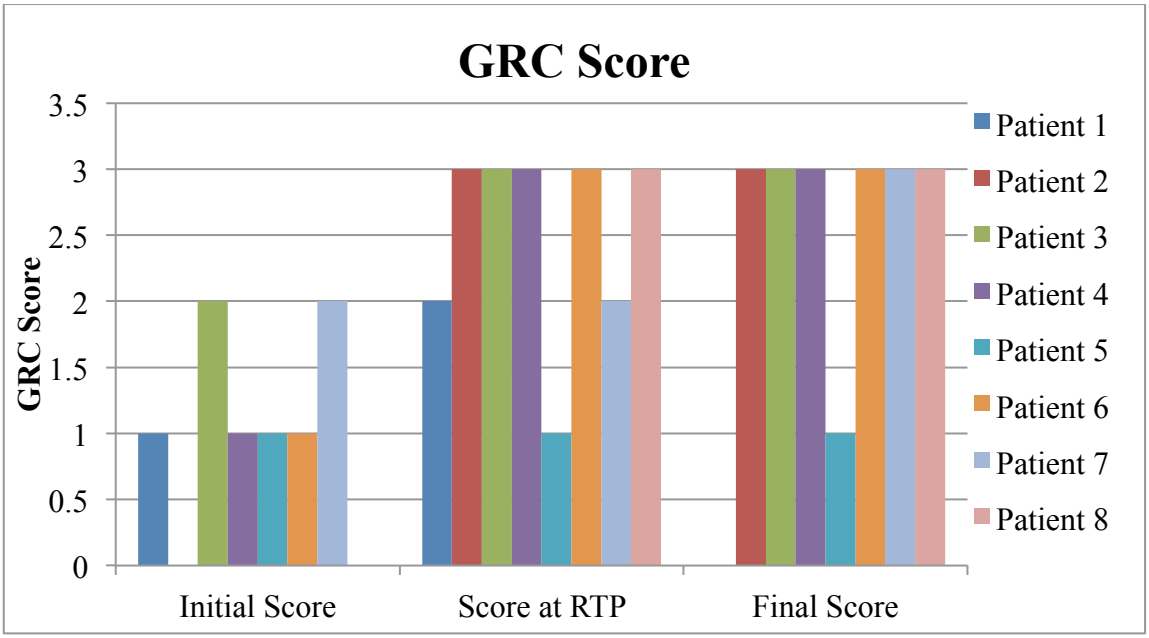
The DPA Scale was also used as POE and an MCID for acute injury, such as hamstring strain, is 9 points. Patient #2, #4, #5, #8, #9, and #10 all achieved MCID for the DPA scale score from initial measurement to final measurement. Patients #1, #6, and #7 did not record a MCID in the reduction of the DPA Scale score. (Figure 6)

Figure 6.*DPA Scale Score*



Patient #1, #4, #5, and #6 recorded a GRC of +1, and Patient #3, and #7 recorded a MCID of +2 post initial treatments indicating a positive improvement. Patient #1, #2, #3, #4, #6, #7 and #8 all reported a positive MCID on the GRC before RTP. Patient #2, #3, #4, #6, and #7 recorded a positive MCID on GRC of +3 on final score. Patient #9 and #10 did not have a record of GRC, but RTP within 48 hours post injury. (Figure 7)

Figure 7. *GRC Score*



DISCUSSION:

The purpose of this investigation was to assess the effectiveness of the box taping technique for the treatment of hamstring pathology across disease and patient-oriented evidence in a collegiate AT clinic setting. The disease-oriented outcome measures used to evaluate clinical effectiveness included strength (as assessed through manual muscle testing) and ROM deficit present with the 90/90 Active Knee Extension Test (as measured with a goniometer). The measurements were recorded as the deficit between affected and unaffected limbs. Both these measures are routinely used in the clinical evaluation and clinical trials of hamstring injury treatments (Heiderscheit, Sherry , Silder, Chumanov, & Thelen, 2010). RTP was also used to as an objective measure of the clinical effectiveness of the box tape intervention. The mean number of days restricted from participation by the patients in the current study was 5.9, which is a shorter period of time than has been previously reported in the literature. A study of hamstring injuries suffered during NFL training camp, which described a pre-season time frame, reported days lost ranged from 8 to 25 days (Feely, Kennely, & Barnes, 2008). Kilcoyne et al. (2011), utilizing a similar aggressive protocol excluding the box tape, reported days from injury to RTP as 11.9 (range 5- 23 days) with a 6.2% re-injury rate. The results of the current study demonstrate a decrease in the number of days out of participation and a reduced re-injury rate within 3 months of initial injury.

Few previous hamstring injury studies demonstrate any POE other than a general measure of pain. Previous literature evaluating hamstring injury focus on RTP and number of days missed of participation (Malliaropoulos & Maffulli, 2012; Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011). These outcomes focus the endpoint of treatment but fail to evaluate the process and landmarks crucial to patient care (Sauers & Valocich-McLoed, 2012).

The results of this study may indicate physical activity in the sub-acute time frame may be critical to the improvement in function and the decrease in disability. The box tape may support reduction in pain and early return to activity, suggesting a possible fascial dysfunction rather than muscle damage (O'Sullivan & Bird, 2011). The intention of box tape as described by McConnell is to “unload” the underlying structures (McConnell, 2012). The box tape creates convolutions in the skin theorized to increase the interstitial space between fascial sheets. Unloading fascia may reduce the mechanical stress placed on the fascia and

subsequently the free nerve endings resulting in an increase in function and reduction of pain (O'Sullivan & Bird, 2011; Schleip, Zorn, & Klinger, 2010). Theories suggest the slow contractile nature of the fascia may play a role in the rigidity of what we now consider muscle spasms, but may also play a role in increasing muscular stability (Schleip, Klinger, & Lehamnn-Horn, 2005). Further research is needed to investigate this theory further. Additional research utilizing outcome measures, specifically POE, in day to day clinical practice are needed to provide comparison data for the effect of any treatment is also warranted.

Limitations:

Limitations of this study include the lack of comparison of outcomes measurements obtained through clinical practice. Few studies are available utilizing retrospective outcome measures of day to day clinical AT practice. Most data collection occurs as a result of clinical trials in which many variables are tightly controlled. Limitations also include lack of a comparison group who did not receive the box tape or received a sham taping technique. Lack of control is inherent in this study as the aim was to study what occurred in day to day clinical patient care. The small number of patients who met the criteria to be included is also a limitation. Given the retrospective design and a setting which required equal care to all patients, a control group was not established.

Conclusion:

The administration of the box tape combined with the traditional rehabilitation protocol was associated with clinically significant improvement in patient status in regards to DOE and POE measures. Each patient was able to return to participation in sport activity without a return of disability or re-injury through a 60 day follow-up period. Each of the patients demonstrated restoration of AROM, pain reduction, and improved function measured on the POE outcome instruments. Athletic training clinicians operating in day to day clinical practice are concerned with the effect of the treatment on a patient's well-being as well as the physiologic effect typically reported in previous controlled studies (Malliaropoulos & Maffulli, 2012; Kilcoyne, Dickens, Keblish, Rue, & Chronister, 2011; Heiderscheit, Sherry, Silder, Chumanov, & Thelen, 2010). Although our findings suggest this technique was effective, further research is needed to establish the physiological basis of the improvement in function that appears to result from the treatment.

REFERENCES

1. *American Academy of Family Physicians*. (2013, 03 1). Retrieved from http://www.aafp.org/online/en/home/publications/journals/afp/ebmtoolkit/ebmglossary/afppoems.html

2. Aicher, B., Peil , H., Peil, B., & Diener, H. (2010). Pain Measurement: Visual Analoge Scale (VAS) in Clinical Trails with OTC Analgesic in Headache. *Cephalalgia* , 185.

3. Albohm, M., & Wilkerson, G. (1999). An Outcomes Assessment of Care Provided by Certified Athletic Trainers. *Journal of Rehabilitation Outcomes Measurement* , 51-56.

4. Alderman, C. (1993). Kurt Lewin and the Origins of Action Research. *Educational Action Research* , 7-24.

5. Alonso, J., Junge, A., Renstrom, P., Engebretsen, L., Mountjoy, M., & Dvorak, J. (2009). Sport Injuries Surveillance During the 2007 IAAF World Athletic Championship. *Clinical Journal of Sports Medicine* , 26-32.

6. Andrew, N., Gabbe, B., Wolfe, R., & Cameron, P. (2010). Evaluation of instruments for measuring the burden of sport and active recreation injury. *Sports Medicine* , 141-161.

7. Andrew, N., Gabbe, B., Wolfe, R., & Cameron, P. (2010). Evaluation of Instuments for Measureing the Burden of Sport and Active Recreation Injury. *Sports Med* , 141-161.

8. Barkham, M., & Mellor-Clark, J. (2000). Rigour and Relevance: Practice-based Evidence in Psychological Therapies. *Evidence-based counseling and psychological therapies* , 127-144.

9. Baron, S. (2009). Evaluatating the Patient Journey Approach to Ensure Healthcare is Centered on Patients. *Nursing Times* , 22.

10. Baum, F., MacDougall, C., & Smith, D. (2006). Participatory Action Research. *Journal of Epidemiology and Community Health* , 854-857.

11. Benjamin, M. (2009). The Fascia of the Limbs and Back; a Review. *Journal of Anatomy* , 214-218.

12. Berwick, D. (2003). Disseminating Innovations in Health Care. *JAMA* , 1969-75.

13. Board of Certification. (2012, 08 12). *bocatc.org*. Retrieved from http://www.bocatc.org/component/rokecwid/?view=ecwid#!/~/product/category=290025&id=893373

14. Brockett, C., Morgan, D., & Proske, U. (2004). Predicting Hamstring strain injury in elite athletes. *Medicine and Science in Sports and Exercise* , 379-387.

15. Brodeur, V., Dennet, S., & Griffin, L. (1989). Exertional Hyperthermia, Ice Baths, and Emergency Care at the Falmouth Road Race. *Journal of Emergency Nursing* , 304-312.

16. Busanich, B., & Verscheure, S. (2006). Does McKenzie Therapy Improve Outcomes for Back Pain. *Journal of Athletic Training* , 117.

17. Carabelli, R., & Kellerman, W. (1985). Phantom limb pain: relief by application of TENS to contralateral extremity. *Archives of Physical Medicine and Rehabiliation* , 466-7.

18. *Center for Clinical and Translational Research*. (2013, 02 16). Retrieved from http://ccts.uth.tmc.edu/what-is-translational-research

19. Chumanov, E., Heiderscheit, B., & Thelen, D. (2011). Hamstring Musculotendon Dynamics During Stance and Swing Phases of High Speed Running. *Medicine and Science in Sport Exercise* , 525-532.

20. Cohen , S., Towers, J., Zoga, A., Irrgang, j., Makda, J., Deluca, P., et al. (2011). Hamstring injuries in professional football players: magnetic resonance imaging correlation with return to play. *Sports Health* , 423-430.

21. Connell, D., Schneider-Kolsky, M., Hoving, J., Malara, F., Buchbinder, R., Koulouris, G., et al. (2004). Longitudinal Study Comparing Sonographic and MRI Assessments of Acute and Healing Hamstring Injuries. *American Journal of Roentgenology Diagnostic Imaging and Related Science* , 975-984.

22. Debruin, A., Buys, M., & DeWitte, L. (1994). The Sickness Impact Profile: SIP 68. A Short Generic Version; First Evaluation of the Reliability and Reproducibility. *Clinical Epidemiology* , 863-71.

23. DeWitt, B., & Venter, R. (2009). The "Bunkie" Test: Assessing Functional Strength to Restore Function through Fasical Manipulation. *Journal of Bodywork and Movement Therapy* , 81-8.

24. Deyo, R., & Patrich, D. (1989). Barriers to the Use of Health Status Measures in Clinical Invesitgation, Patient Care and Policy Research. *Medical Care* , 254-268.

25. Dillman, D., Smyth, J., & Christian, L. (2009). *Mail And Internet Surveys: The Tailored Design Method.* Hoboken, NJ: John Wiley & Sons.

26. Dunckley, M., Aspinal, F., Addington-Hall, J., Hughes, R., & Higginson, I. (2005). A Research Study to Identify Facilitators and Barriers to Outcome Measure Implementation. *Interantional Journal of Palliative Nursing* , 218-225.

27. Ekstand, J., Healy, J., Walden, M., Lee, J., English, B., & Hagglund, M. (2012). Hamstring Muscle Injuries in Professional Football: The Correlation of MRI Findings with Return to Play. *British Journal of Sports Medicine* , 112-117.

28. Engebretsen, A., Myklebust, G., Holme, I., Engebretsen, L., & Bahr, R. (2010). Intrinsic risk factors for hamstring injuries in professional football: The correlation of MRI findings with return to play. *The American Journal of Sports Medicine* , 1147-1153.

29. Evans, T., & Lam, K. (2011). Clinical outcomes assessment in sport rehabilitation. *Journal of Sports Rehabiliation* , 8-16.

30. Feely, B., Kennely, S., & Barnes, R. (2008). Epidemiology of National Football League Training Camp Injuries from 1998-2007. *American Journal of Sports Medicine* , 1597-1603.

31. Feldman, A. (2008). Does Academic Culture Support Translational Research? *Clinical and Translational Science* , 87-88.

32. Fontanaros, P., & DeAngelis, C. (2002). Basic Science and Translational Research in JAMA. *Journal of the American Medical Association* , 1728.

33. Glasson, J., Chang, E., & Bidwell, M. (2008). The Value of Participatory Action Research in Clinical Nursing Practice. *International Journal of Nursing Practice* , 34-39.

34. Goldman, E., & Jones, D. (2011). Interventions for preventing hamstring injuries. *Physiotherapy* , 91-99.

35. Greenstein, J., Bischop, B., Edward, J., & Topp, R. (2011). The effects of a closed-chain, eccentric training program on hamstring injuries of a professional football cheerleading team. *Journal of Manuplative and Physiological Theraputics* , 195-200.

36. Gummesson, C., Atroshi, I., & Ekdahl, C. (2003). The Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Questionnaire: Longitudinal Construct Validity and Measuring Self-Rated Health Change after Surgery. *BMC Musculosketelal Disorders* .

37. Guyatt, F., Feeny, D., & Patrick, D. (1993). Measuring Health Related Quality of Life. *Annals of Internal Medcine* , 622-9.

38. Harris, L. (2003). Integrating and Analyzing Psycholosocial and Stage Theory to Challenge the Development of the Injured Collegiate Athletes. *Journal of Athletic Training* , 75-82.

39. Heiderscheit, B., Sherry , M., Silder, A., Chumanov, E., & Thelen, D. (2010). Hamstring Strain Injuries: Recommendation for diagnosis rehabiliation and injury prevention. *Journal of Orthopedic Sports Physical Therapy* , 67-81.

40. Hendy, A., Spittle, M., & Kidgell, D. (2012). Cross education and immobilisation: mechanisms and implications for injury rehabilitation. *Journal of Science and Medicine in Sport* , 94-101.

41. Hunter, D., & Speed, C. (2007). The assessment and management of chronic hamstring/posterior thigh pain. *Best Practice & Research Clinical Rheumatology* , 261-277.

42. (2001). *International Classificaion of Functioning, Disability and Health.* Geneva: World Health Organization.

43. Israel, B., Schulz, A., Parker, E., & Becker, A. (1998). A community-based reserach: Assessing partnership approoaches to improve public health. *Annual Review of Public Health* , 173-202.

44. Jaeschke, R., Singer, J., & Guyatt, F. (1989). Measurement of health status. Ascertaining the minimal clinically important difference. *Controlled Clinical Trials* , 407-15.

45. Jetta, A. (2006). Disablement models: toward a common language for function, disability, and health. *Physical Therapy* , 726–734.

46. Jette, D., Halbert, J., Iverson, C., Miceli, E., & Shah, P. (2009). Use of standardized outcomes measures in physical therapy practice: perceptions and application. *Physical Therapy* , 125-135.

47. Jurkovich, G., Mock, C., & MacKenzie, E. (1995). The sickness impact profile as a tool to evaluation outcomes in trauma patients. *Journal of Trauma* , 625-31.

48. Kamper, S., Maher, C., & Mackey, G. (2009). Global Rating of change scale: a review of strengths and weaknessess and consideration for design. *The Journal of Manual and Manipulative Therapy* , 163-170.

49. Kerkhoffs, G., van Es, N., Wieldraaijer, T., Sierevelt, I., Ekstand, J., & van Dijk, C. (2013). Diagnosis and prognosis of acute hamstring injuries in athletes. *Knee Surgery, Sports Traumatology, Arthroscopy* , 500-509.

50. Kilcoyne, K., Dickens, J., Keblish, D., Rue, J., & Chronister, R. (2011). Outcomes of grade I and II hamstring injuries in intercollegiate athletics: a novel rehabilitation protocol. *Sports Health* , 528-533.

51. Knight, K., & Ingersoll, C. (1998). Developing scholarship in athletic training. *Journal of Athletic Training* , 271-274.

52. Knight, K., Casa, D., McClung, J., Caldwell, K., Gilmer, A., Meenana, P., et al. (2000). Assessing if two tempanic temperature instruments are valid predictors of core temperature in hyperthermic runers and does drying the ear canal help. *Journal of Athletic Training* , S21.

53. Koshy, E., Koshy, V., & Waterman, H. (2011). *Action research in healthcare.* London: SAGE Publishing Ltd.

54. Koshy, V. (2010). *Action research for improving educational practice: a step-by-step guide.* London: SAGE Publishing Ltd.

55. Koulouris, G., Connell, D., Brukner, P., & Schneider-Kolsky, M. (2007). Magnetic Resonance Imaging Parameters for Assessing Risk of Recurrent Hamstring Injuries in Elite Athletes. *The American Journal of Sports Medicine* , 1500-1506.

56. Kumazaki T, E. Y., Kumazaki, T., Ehara, Y., & Sakai, T. (2012). Anatomy and Physiology of Hamstring Injury. *International Journal of Sports Medicine* , 950-954.

57. Lenfant, C. (2003). Clinical research to clinical practice: lost in translation. *New England Journal of Medicine* , 868-74.

58. Lew, P., & Briggs, C. (1997). Relationship between the cervical component of the slump test and change in hamstring muscle tension. *Manual Therapy* , 98-105.

59. Linday Wilson, J., Pettigrew, L., & Teasdale, G. (1998). Structured interviews for the Glasgow Outcome Scale and the Extended Glasgow Outcome Scale: guidelines for their use. *Journal of Neurotrauma* , 573-585.

60. Machado, I., Maher, C., Herbert, R., Clare, H., & McCauley, J. (2010). The effectiveness of the McKenzie method in addition to first-line care for acute low back pain: a randomized controlled trial. *Bio Med Central Medicine* , 1-10.

61. MacKenzie, E., Sacco, W., & Luchter, S. (2002). Validating the functional capacity index as a measure of outcome following blunt trauma. *Quality of Life Research* , 797-808.

62. Magee, D. (2002). *Orthopedic Physical Assessment.* Philadelphia PA: Saunders.

63. Malliaropoulos, N., & Maffulli, N. (2012). Hamstring Issue in sports: still a major clinical and research challenge. *British Journal of Sports Medicine* , 79-80.

64. Malliaropouls, N., Papacostas, E., Kiritsi, O., Rad, P., Paplada, A., Gougoulias, N., et al. (2010). Posterior thigh muscle injuries in elite track and field athletes. *American Journal of Sports Medicine* , 1831.

65. Marshall, J., Girgis, F., & Zelko, R. (1972). The Biceps Femoris Tendon and Its Functional Significance. *Journal of Bone and Joint Surgery* , 1444-1450.

66. Mathewson, C. (2011). Documentation: What, Why & How? *NATA News* , 58.

67. McConnell, J. (2012, 01 21). *www.neseminars.com*. Retrieved from Managing Challenging Lower Limb Injuries: http://www.neseminars.com/more-info.asp?product=244

68. McGlynn, E., Asch, S., & Adams, J. (2003). The quality of health care delivered to adults in the United States. *New England Journal of Medicine* , 2635-3645.

69. Meyer, J. (2000). Using qualitative methods in health related action research. *British Medical Journal* , 178-81.

70. Michener, L. (2011). Patient-and Clinician-Rated Outcome Measures for clinical decision making in rehabilitation. *Journal of Sports Rehabiliation* , 37-45.

71. Mill, J., & Ogilvie, L. (2003). Establishing methodological rigor in international qualitative nursing research: a case study from Ghana. *Journal of Advanced Nursing* , 80-87.

72. Mulligan Concept. (2013, 02 18). *bmulligan.com*. Retrieved from http://www.bmulligan.com/about-us/founders-profile-history/

73. National Athletic Trainer's Association. (2010, 01). *Athletic Training Services: An overview of skills and services performed by certified athletic trainers.* Retrieved from http://www.nata.org/sites/default/files/GuideToAthleticTrainingServices.pdf

74. National Athletic Trainer's Association. (2012, 08 08). *NATA*. Retrieved from Athletic Training: http://www.nata.org/athletic-training

75. National Athletic Trainer's Association. (2013, 03 01). *NATA Membership Statistics*. Retrieved from www.Nata.org: http://members.nata.org/members1/documents/membstats/2011EOY-stats.htm

76. National Athletic Trainers' Association. (2013, 03 01). *NATA Membership Statistics*. Retrieved from www.Nata.org: http://members.nata.org/members1/documents/membstats/2011EOY-stats.htm

77. National Athletic Trainer's Association. (2012, 08 12). *NATA.org.* Retrieved from Educational Resources: http://www.nata.org/sites/default/files/5th_Edition_Competencies.pdf

78. National Center for Advancing Translational Science. (2013, 01 04). *National Center for Advancing Translational Science*. Retrieved from http://www.ncats.nih.gov/research/cts/ctsa/ctsa.html

79. Noyer, F., McGinniss, A., & Mooar, L. (1984). Functional Disability of the Anterior Cruciate Insufficient Knee Syndrome. *Sports Medicine* , 287-288.

80. Opar D, W. M. (2012). Hamstring Strains Injuries: Factors that Lead to injury and re-injury. *Sports Medicine* , 209-226.

81. O'Sullivan, D., & Bird, S. (2011). Utilization of Kinesio Taping for Fascia Unloading. *International Journal of Athletic Therapy and Training* , 21-27.

82. Peetrons, P. (2002). Ultrasound of Muscle. *European Radiology* , 35-43.

83. Petersen, J., Neilsen, N., Homich, P., & Nielsen, M. (2010). Acute hamstring injuries in Danish elite football: A 12-month prospective registration study among 374 players. *Scandinavian Journal of Medicine and Science in Sport* , 588-592.

84. Pitney, W., & Parker, J. (2002). Qualitative Research Applications in Athletic Training. *Journal of Athletic Training* , s168-s173.

85. Porter, S. (2013). *Tidy's Physiotherapy (15th Ed.).* Edinburgh: Churchill Livingstone Elsevier.

86. Prentice, W., & Arnheim, D. (2009). *Arnheim's Essentials of Athletic Training: A Competency-base Approach.* St. Louis, MO: McGraw-Hill.

87. Prentice, W., & Arnheim, D. (2009). *Essentials of Athletic Training.* St. Louis, MO: McGraw-Hill.

88. Reiman, M., Loudon, J., & Goode, A. (2013). Diagnostic accuracy of clinical tests for assessment of hamstring injury: a systematic review. *The Journal of Orthopaedic and Sports Physical Therapy* , 103-109.

89. Rettig, A., Meyer, S., & Bhadra, A. (2009). Evaluation of Hamstring Injuries: The Role of Magnetic Resonance Imaging. *Operative Techniques in Sports Medicine* , 215-218.

90. Reurink, G., Goudwaard, G., Tol, J., Verhaar, J., Weir, A., & Mown, M. (2012). Therapeutic interventions for acute hamstring injuries: a systematic review. *British Journal of Sports Medicine* , 103-109.

91. Roberts, W. (1994). Assessing core temperature in collapsed athletes: what's the best method? *Physician and Sportsmedicine* , 49-55.

92. Rolfe, G. (1996). Going to extremes: Action research, grounded practice and the theory–practice gap in nursing. *Journal of Advanced Nursing* , 1315-1320.

93. Sackett, D., Rosenberg, W., Gray, J., Haynes, R., & Richardson, W. (1996). Evidence based medicine: what it is and what it isn't. *British Medical Journal* , 71-72.

94. Salaffi, F., Stancati, A., Silverstri, C., Ciapetti, A., & Grassi, W. (2004). Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. *European Journal of Pain* , 283-291.

95. Sauers, E., & Snyder, A. (2011). A team approach: demonstrating sport rehabilitation's effectiveness and enhancing patient care through clinical outcomes assessment. *Journal of Sports Rehabiliation* , 3-7.

96. Sauers, E., & Valocich-McLoed, T. (2012). Practice-Based Research networks, Part I: Clinical Laboratories to generate and translate research findings into effective patient care. *Journal of Athletic Training* , 549-556.

97. Sauers, E., Dykstra, D., Bay, C., Bliven, K., & Snyer, A. (2011). Upper Extremity Injury History, current pain rating and Health Related Quality of Life in female softball pitchers. *Journal of Sports Rehabiliation* , 100-114.

98. Schache, A., Dorn, T., Blanch, P., Brown, N., & Pandy, M. (2012). Mechanics of the human hamstring muschel during sprinting. *Medicine and Science in Sport and Exercise* , 647-658.

99. Schechter, A. (1998). The crisis in clinical research. *Journal of the American Medical Association* , 1440.

100. Schleip, R., Klinger, W., & Lehamnn-Horn, T. (2005). Active fascial contractility: Fascia may be able to contract in a smooth muscle like manner and thereby influence musculoskeletal dynamics. *Medical Hypotheses* , 273-277.

101. Schleip, R., Zorn, A., & Klinger, W. (2010). Biomechanical properties of fascial tissues and their role as pain generators. *Journal of Musculoskeletal Pain* , 393-395.

102. Schlitz, E., Evans, T., Regan, B., & Mack, M. (2011). Psychometirics of ankle self-report survey (PASS). *NATA National Symposium* (p. Poster Presentation). St. Louis, MO: NATA.

103. Schmitt, B., Tim, T., & McHugh, M. (2012). Hamstring injury rehabilitation and prevention of reinjury using lengthened state eccentric training: a new concept. *International Journal of Sports Physical Therapy* , 333-341.

104. Schneider-Kolsky , M., Hoving, J., Warren, P., & Connell, D. (2006). A Comparison Between Clinical Assessment and Magnetic Resonance Imaging of Acute Hamstring Injuries. *The American Journal of Sports Medicine* , 1008-1015.

105. Schneider-Kolsky, M., Hoving, J., Warren, P., & Connell, D. (2006). A Comparison between Clinical Assessment and Magnetic Resonance Imaging of Acute Hamstring Injuries. *American Journal of Sports Medicin* , 1008.

106. Schwarts, K., & Vilquin, j. (2003). Building the translational highway: toward new partnerships between academia and the private sector. *Natural Medicine* , 493-495.

107. Snyder, A., Valovich-McLeod, T., & Sauers, E. (2007). Defining, Valuing, and Teaching Clinical Outcomes Assessment in Professional and Post-Professional AthleticTraining Education Programs. *Athletic Training Education Journal* , 31-41.

108. Sorichter, S., Mair, J., Koller, A., Calzolari, C., Artner-Sworzak, E., & Puschendorf, B. (1997). Skeletal troponin I as a marker of exercise-induced muscle damage. *Journal of Applied Physiology* , 1076-1082.

109. Stevens, R., & Hootman, J. (2004). Evidence-based medicine: what is it and how does it apply to athletic training? *Journal of Athletic Training* , 83.

110. Stiller-Ostrowski, J., & Ostrowski, J. (2009). Recently certified athletic trainers' undergraduate educational preperation in psychosocial intervention and referal. *Journal of Athletic Training* , 67-75.

111. Strafford, D., & Spandoni, G. (2001). The reliability consistency and clinical application of a numeric pain rating scale. *Physiotherapy Canada* , 88-91.

112. Stucki, G., Cieza, A., & Melvin, J. (2007). The International Classification of Functioning, Disability and Health (ICF): a unifying model for the conceptual description of the rehabilitation strategy. *Journal of Rehabiliation Medicine* , 279-85.

113. Sung, N., Crowley, W., & Genel, M. (2003). Central challenges facing the national clinical research enterprise. *Journal of the American Medical Association* , 1278-87.

114. Swiontkowki, M., Engelberg, R., & Martin, D. (1999). Short Musculoskeletal Functional Assessment Questionnaire: Validity, Reliability, and Responsiveness. *Journal of Bone and Joint Surgury America* , 1245-60.

115. *The Cochran Collaboration*. (2013, 03 16). Retrieved from http://www.cochrane.org/about-us/evidence-based-health-care

116. The McConnell Institute. (2012, 01 21). *McConnell Insitute.com*. Retrieved from http://www.mcconnell-institute.com/

117. Thomasek, J., Gabbiani, G., Hinz, B., Cahponnier, C., & Brown, R. (2002). Myofibroblasts and mechano-regulation of connective tissue remodeling. *National Review of Molecular Cell Biology* , 349-63.

118. Tidball, J. (2005). Inflammatory processes in muscle injury and repair. *American Journal of Physiology- Regulatory, Integrative and Comparative Physiology* , r245-r353.

119. Total Motion Release. (2011, 7 20). *totalmotionrelease.com*. Retrieved from http://www.totalmotionrelease.com

120. van Beijsterveldt, A., van de Port, I., Vereijken, A., & Backx, F. (2012). Risk Factors for Hamstring Injuries in Male Soccer Players: A Systematic Review of Prospective Studie. *Scandinavian Journal of Medicine and Science in Sport* , 253-262.

121. Vela, L., & Denegar, C. (2010a). The Disablement in the Physically Active Scale, Part II: The Psychometric Properties of an Outcomes Scale for Musculoskeletal Injuries. *Journal of Athletic Training* , 630-641.

122. Vela, L., & Denegar, C. (2010b). The Disablement in the Physically Active Scale, Part II: The Psychometric Properties of an Outcomes Scale for Musculoskeletal Injuries. *Journal of Athletic Training* , 630-641.

123. Vela, L., & Denegar, C. (2010a). Transient Disablement in the Physically Active with Musculoskeletal Injuries, Part I: A Descriptive Model. *Journal of Athletic Training* , 615-629.

124. Vela, L., & Denegar, C. (2010b). Transient Disablement in the Physically Active with Musculoskeletal Injuries, Part I: A Descriptive Model. *Journal of Athletic Training* , 615-629.

125. Vela, L., Haladay, D., & Denegar, C. (2011). Clinical assessment of low-back-pain treatment outcomes in athletes. *Journal of Sport Rehabilitation* , 74-88.

126. Vellenga, D., Gypdonck, M., Hoogwerf, L., & Tan, F. (2009). Action Research, what, why and how? *Acta neurologica belgica* , 81-90.

127. Verhoef, M., Mulkins, A., Kania, A., Findlay-Reece, I., & Mior, S. (2010). Identifying the barriers to conducting outcomes research in integrative health care clinic settings-a qualitative study. *Biomed Central Health Services Research* , 14.

128. Ware, J., & Shelbourne, C. (1992). The MOS 36-item Short-Form Health Survey (SF-36) I. Conceptual framework and item selection. *Medical Care* , 473-83.

129. Ware, J., Kosinski, M., & Keller, S. (1996). A 12-item Short-Form Health Survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care* , 220-33.

130. Waterman, H. (1998). Embracing ambiguities and valuing ourselves: issues of validity in action research. *Journal of Advanced Nursing* , 101-105.

131. Westfall, J., Mold, J., & Fagnan, S. (2007). Practice-Based Research-"Blue Highways" on the NIH Roadmap. *Journal of the American Medical Association* , 403-406.

132. Wilson, J., Pettigrew, L., & Teasdale, G. (2000). Emotional and cognitive consequences of head injury in relation to the GOS. *Journal of Neurology* , 204-209.

133. Woods, C., Hawkins, R., Maltby, S., Hulse, M., Thomas, A., & Hodson, A. (2004). The Football Association Medical Research Programme: an audit of injuries in professional football--analysis of hamstring injuries. *British Journal of Sports Medicine* , 36-41.

134. Woolf, S. (2008). The meaning of translational research and why it matters. *Journal of the American Medical Association* , 211-213.

135. Yanos, P., & Ziedonis, D. (2006). The patient-oriented clinician-researcher: advantages and challenges of being a double agent. *Psychiatric Services* , 249.

136. Yeung, S., Suen, A., & Yeung, E. (2009). A prospective cohort study of hamstring injuries in competitive sprinters: preseason muscle imbalance as a possible risk factor. *British Journal of Sports Medicine* , 589-594.

137. Zerhouni, E. (2003). Medicine. The NIH Roadmap. *Science* , 63-72.

138. Zerhouni, E. (2005). Translational and Clinical Science- Time for a New Vision. *New England Journal of Medicine* , 1621-1623.

APPENDIX 1

EVAULATION OF CLINCIAL PRACTICE

Initial Evaluation of Clinical Practice

Domain	Skill Set	Strength	Weakness
I.	Assess patient or clients to screen for potential injuries/illness or risk factors that would increase their risk of injury/illness.	Collegiate Athletics setting 1. Pre-screen over 700 athletes per year. 2. Review current procedures and requirements yearly, including NCAA and NATA recommendations 3. NSCA Certified Strength and Conditioning background 4. Routinely perform body composition, fitness, flexibility and strength and endurance assessments	2.Postural and ergonomic assessment 3.Functional Movement Assessment
I.	Design and implement conditioning programs (Flexibility, strength, cardiovascular fitness) to reduce the risk of injury and illness.	3. NSCA Certified Strength and Conditioning Specialist 4. Experienced Personal Fitness Trainer-5 years	
I.	Design and implement emergency action plans to ensure medical personnel are prepared in an emergency situation.	4. Have designed and implemented emergency action plan 5. Routinely Evaluate Plans for practice 6. Serve on local committee to design and evaluate emergency action plans for various public groups such as high school athletics and recreation groups	

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
I.	Obtain and interpret environmental and patient/client data to make appropriate recommendations for patient or client safety and the continuance or suspension of activity	7.Designed and implemented heat index, cold weather, and lightning policies for current personal practice 8.Routinely evaluate plans for personal practice.	8. Uncomfortable with current best practice guidelines for management of heat illnesses.
I.	Educate patients or clients, coaches, parents on the importance of acclimatization and fluid and electrolyte balance in the prevention of heat illness.	8.Excellent communication skills 9.Student and Colleague of Sandy Folk Godac on Hydration 10.Attended multiple continuing education classes regarding acclimatization, hydration and heat illness	
I.	Inspect facilities to ensure they are free of hazards, are sanitary, and that equipment is maintained properly	9. Routinely evaluate practice facilities/ locker room and other athletic facilities. 10. Work in conjunction with University facilities department	12.Not proficient with current medical facility codes of operation
1.	Select, apply, evaluate and modify prophylactic and protective equipment and other custom devices for patients/ clients to minimize the risk of injury or re-injury	2.Provide both prescription and off the shelf orthopedic devices for a multitude of patients, including prophylactic bracing 3.Design and create orthoplast and fibroform orthosis	

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
II.	Obtaining a thorough medical history, including an assessment of underlying systemic disease and consideration of its potential contributions to the current disorder.	3. Proficient at collecting Medical History 4. Performed over 75 separate evaluations throughout fall semester 5. Excellent patient-oriented listening skills	
II.	Conducting a physical examination, including (as relevant) observation of the patient/client performing functional tasks (such as walking, reaching, running, throwing); observation and palpation for any detectable changes; joint and muscle function assessment; review of systems; stress testing; joint play; assessments for neurological and vascular abnormalities; and special tests designed to detect selective tissue or organ involvement.	8. Proficient at physical examination-performed over 75 separate evaluations throughout fall semester	8.Not proficient with many special tests.
II.	Arriving at a differential diagnosis (including those conditions that cannot be ruled out based on the exam), determine functional deficits and understanding the impact of the condition on the patient/client's life	9. Correctly diagnosed majority of patients seen throughout fall semester, including 1 rare navicular fracture with insidious mechanism.	4. Not proficient with obscure injuries or illness

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
II.	Recognizing the role of medications in the management of orthopedic injuries and medical illnesses.	Completed classes in Pharmacology Routinely coordinate with team physician and University Health Center in the prescription of necessary medications for patients	Have not kept up with new technologies as well as I would like to. Including various injectable medications and treatments
II.	Identifying disordered eating and nutritional disorders and intervene and refer accordingly	1. Successful counseled and/or referred two separate patients struggling with disorders	
II.	Create a treatment plan based on the findings of the initial examination, subsequent examinations and the needs of the patient or client that assists with functional recovery	1. Proficient in creating a treatment plan based on the disablement model illustrated by the world health organization, which describes how the active conditions correlates with the impairment and functional limitation resulting in Disability and how these affect the patients quality of life.	
II.	Communicate the nature of the examination and resulting treatment plan to the patient or client and other involved healthcare personnel, while respecting the privacy of the patient/client	1. Excellent communication skills with experience in patient based care	

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
III.	1. Perform an initial assessment determine level of consciousness and the severity of the condition. 2. Implement appropriate emergency management strategies following a pre-established emergency action plan	1. AAOS First Aid/CPR/AED Instructor 2. Associate of Greg Moyer Foundation aimed at putting AEDs in every public school in the United States 3. Successfully performed CPR with the use of an AED	
III.	Perform a secondary assessment and employ the appropriate management strategies for non-life threatening injuries, or illnesses.	1. Confident with First aid of Non-life threatening injuries, or illnesses.	1.
III.	Formulate a differential diagnosis based on the results of the initial and/or secondary assessment(s)	1. Confident in ability to properly diagnose non-life threatening emergency conditions	
III.	Communicate the nature of the injury or illness and the resulting treatment plan to the patient/client and other involved healthcare personnel, respecting the privacy of the patient/client	1. Excellent communication skills with experience in patient based care	1.
IV.	Select, apply, and evaluate the effectiveness of therapeutic interventions using best evidence to guide those decisions.	1. Familiar with application of therapeutic modalities	1. Knowledge is outdated and would like to spend more time studying evidenced based therapies

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
IV.	Manual therapy	1. Proficient at joint mobilization and massage techniques 2. Proficient with proprioceptive techniques	1. Familiar with but not proficient at muscle energy techniques 2. Would like to learn more with Positional Release and Strain /Counterstrain
IV.	Techniques to restore joint range of motion and muscle extensibility	1. Proficient in variety of stretching techniques and the theory behind it 2. Proficient in IASTM Grastons and gaining experience in Gavilon	1. Have completed 50 hours of yoga instruction training, but would like to complete 100 hour instructor training course to better instruct patients on yoga techniques
IV.	Exercise to improve strength, endurance, speed and power, Agility training, cardiorespiratory fitness	1. NSCA Certified Strength and Conditioning Specialist 2. Employed as Fitness Trainer for over five years 3. Routinely designed Conditioning programs for a variety of clients	
IV.	Agility training, Sports specific and/or functional exercises	1. NSCA Certified Strength and Conditioning Specialist 2. Employed as Fitness Trainer for over five years 3. Routinely designed Conditioning programs for a variety of clients	

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
IV.	Modalities	1. Proficient in application of heat/cold, electrical stimulation, therapeutic ultrasound, traction and biofeedback and generally understand theory	1. Familiar with therapeutic laser but not proficient. 2. Would like to better understand the current evidence for therapeutic modalities as they pertain to specific injuries.
IV.	Recommend, fit and apply braces, splints and assistive devices to facilitate the patient/client's recovery	1. Exceptionally proficient in brace selection and fitting. as well as casting and bracing and splinting	1. Would like to become certified in Durable Medical Equipment
IV.	Assess the patient's or client's functional status, interpret the results and determine the patient's or client's ability to return to his or her desired activity	1. Successfully return patients to athletic activity on a daily basis 2. Familiar with Ergonomics	1. Not familiar with work hardening or work conditioning 2. Would like to learn more about Ergonomics
IV.	Recognize the role of medications in the recovery process	1. Completed classes in Pharmacology 2. Routinely coordinate with team physician and University Health Center in the prescription of necessary medications for patients	1. Not familiar with newer techniques such as platelet rich plasma injections. 2. Would like to learn more evidenced based therapies such as efficacy of ionto/phono phoresis.

Initial Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
IV.	Provide patient or client education necessary to facilitate recovery. This includes instruction in self-treatment and education about the condition and its expected course	1. Excellent communication skills with experience in patient based care	
V	Use best evidence and the needs of the patient/client to guide their practice	1.	1. Not satisfied with current evidenced based practice knowledge
V	Ensure compliance with state and federal law and accrediting agencies' policies related to the delivery of healthcare	1. Very familiar with State Practice Act as well as Brand New Licensure Act 2. Familiar with HIPPA and FERPA 3. Personally created University MRSA policy as well as Infectious Disease Policy.	1. Unfamiliar with administering programs appropriately per the accrediting agencies for healthcare facilities
V	Utilize standard coding and reimbursement practices for documentation and billing	1. Possess NPI number	1. Completely unfamiliar with medical coding and billing
V	Maintain medical records that meet legal and regulatory standards, including complete and accurate documentation, accepted abbreviations and correct medical terminology	1.	1. Unsatisfied with current documentation techniques, would like to institute electronic patient records which include outcomes measures
V.	Abide by federal, state, and local regulations for the proper storage, transportation, dispensing and documentation of commonly used medications.	1. Familiar with drug regulations for the state of Pennsylvania	

Final Evaluation of Clinical Practice

Domain	Skill Set	Strength	Weakness
I.	Inspect facilities to ensure they are free of hazards, are sanitary, and that equipment is maintained properly	1. Routinely evaluate practice facilities/ locker room and other athletic facilities. 2. Often work with University facilities department to remedy problems 3. Health Center compliance course completed online	1.
IV.	Select, apply, and evaluate the effectiveness of therapeutic interventions using best evidence to guide those decisions.	1. Familiar with application of therapeutic modalities 2. Acquisition of new manual therapy modalities (TMR, Mulligan, McKenzie, PRT, PRRT, FMS, SFMA)	1.
IV.	Techniques to restore joint range of motion and muscle extensibility	1. Proficient in variety of stretching techniques and the theory behind it 2. Proficient in IASTM Grastons and gaining experience in Gavilon 3. Completed 30 hours of special population and pre-natal yoga instruction course	1. Have completed 80 hours of yoga instruction training, but would like to complete 100 hour instructor training course to better instruct patients on yoga techniques
IV.	Assess the patient's or client's functional status, interpret the results and determine the patient's or client's ability to return to his or her desired activity	1. Successfully return patients to athletic activity on a daily basis 2. Familiar with Ergonomics	1. Not familiar with work hardening or work conditioning

Final Evaluation of Clinical Practice Continued

Domain	Skill Set	Strength	Weakness
V	Use best evidence and the needs of the patient/client to guide their practice	1. Literature Review and design of setting based research projects to determine evidence-based practice in school based athletic training setting	1.
V	Ensure compliance with state and federal law and accrediting agencies' policies related to the delivery of healthcare:	1. Very familiar with State Practice Act as well as Brand New Licensure Act 2. Familiar with HIPPA and FERPA 3. Personally created University MRSA policy as well as Infectious Disease Policy 4. Health center compliance course completed online	1.
V	Utilize standard coding and reimbursement practices for documentation and billing	1. Possess NPI number 2. Completed online certification course in CPT-10 codes. 3. Applied to present information on CPT-10 codes applicable to athletic trainers	1.
V	Maintain medical records that meet legal and regulatory standards, including complete and accurate documentation, accepted abbreviations and correct medical terminology	1. Successful design and implementation of electronic patient outcomes measures including DPA Scale, GRC, NRS	1.

APPENDIX 2

SURVEY QUESTIONS

Dear Fellow Certified Athletic Trainer:

I am a Doctoral Candidate at the University of Idaho, and I am requesting your help to complete part of my dissertation. Please follow the link at the end of this letter to an online survey titled: Outcomes measures in Athletic Training Clinical Practice?

This questionnaire consists of just 2 generic demographic questions, 5 Likert Scale questions on a four point scale, and 4 open ended questions. It will take approximately 10 minutes to complete.

One thousand randomly selected certified NATA members in a varied of clinical setting with a listed email address are being asked to submit this questionnaire, but you have the right to choose not to participate. The University of Idaho Institutional Review Board has approved this study for the Protection of Human Subjects.

This is a completely anonymous questionnaire and upon submission, neither your name nor email address will be attached to your answers. Your information will be kept strictly confidential. This student survey is not approved or endorsed by NATA. It is being sent to you because of NATA's commitment to athletic training education and research.

As a fellow certified athletic trainer, you knowledge and opinions regarding this topic makes your input invaluable. Please take a few minutes of your precious time to fill out the anonymous questionnaire you will find by clicking on this link and submit by (DATE):

WEb link attached.

Thank you for your time and consideration.

Sincerely,

Wendy Wheeler Dietrich, MS ATC LAT CSCS
University of Idaho
whee0670@vandals.uidaho.edu

Participants for this survey were selected at random from the NATA membership database according to the selection criteria provided by the student doing the survey. This student survey is not approved or endorsed by the NATA. It is being sent to you because of the NATA's commitment to athletic training education and research.

Figure 1.1

Survey Questions:

Question: Are outcomes measure used in athletic training clinical practice?

1. What do you consider your primary practice setting?
    a. Clinic
    b. High School only
    c. Clinic Outreach
    d. College/University Athletics
    e. Teaching/Education
    f. Professional Sports
    g. Industrial
    h. Dance/Arts
    i. Other: Please specify _____
2. How many years have you been practicing as a certified athletic trainer? (please round up to the nearest year) _____
3. How familiar are you with Outcomes Measures used in athletic training?
    a. Not at all familiar
    b. Not too familiar
    c. Somewhat familiar
    d. Very familiar
4. How confident do you feel about utilizing outcomes measures into your clinical practice?
    1. Not at all confident
    2. Not too confident
    3. Somewhat confident
    4. Very confident

Figure 1. 2

Survey Questions Continued:

1. How familiar are you with patient-oriented evidence?
    a. Not at all familiar
    b. Not too familiar
    c. Somewhat familiar
    d. Very familiar
6. Please enter the names or abbreviations for the patient-oriented evidence you are familiar with:

    _____

7. Which of these, if any, do you utilize in your current clinical practice?

    _____

8. How familiar are you with disease-oriented evidence?
    a. Not at all familiar
    b. Not too familiar
    c. Somewhat familiar
    d. Very familiar
1. Please enter the names or abbreviations for the disease-oriented evidence you are familiar with:

    _____

2. Which of these, if any, do you utilize in your current clinical practice?

    _____

3. How interested are you in learning more about the use of outcomes measures in athletic training practice?
    a. Not interested
    b. Not too interested
    c. Somewhat interested
    d. Very interested

APPENDIX 3
PROTOCOL APPROVAL

1. University of Idaho

University of Idaho

March 8, 2013

Office of Research Assurances
Institutional Review Board
PO Box 443010
Moscow ID 83844-3010

Phone: 208-885-6162
Fax: 208-885-5752
irb@uidaho.edu

To: Nasypany, Alan
Cc: Wheeler Dietrich, Wendy

From: Traci Craig, PhD
Chair, University of Idaho Institutional Review Board
University Research Office
Moscow, ID 83844-3010

Title: 'Outcomes Measure Used in Athletic Training Clinical Practice'

Project: 13-053
Approved: 03/06/13
Expires: 03/05/14

On behalf of the Institutional Review Board at the University of Idaho, I am pleased to inform you that the protocol for the above-named research project is approved as offering no significant risk to human subjects.

This approval is valid for one year from the date of this memo. Should there be significant changes in the protocol for this project, it will be necessary for you to resubmit the protocol for review by the Committee.

Traci Craig

2. East Stroudsburg University

200 Prospect Street
East Stroudsburg, PA
18301-2999

East Stroudsburg University Institutional Review Board
Human Research Review
Protocol # **ESU-IRB-028-1213**

Date: **February 8, 2013**
To: **Wendy Dietrich**
From: **Shala E. Davis, Ph.D., IRB Chair**
Proposal Title: **"The Efficacy of the Box Tape on Grade 1 and 2 Hamstring Injuries"**

Review Requested:	Exempted **X**	Expedited	Full Review
Review Approved:	Exempted **X**	Expedited	Full Review

FULL RESEARCH

____ Your full review research proposal has been approved by the University IRB (12 months). Please provide the University IRB a copy of your Final Report at the completion of your research. (Extension granted)

____ Your full review research proposal has been approved with recommendations by the University IRB. Please review recommendations provided by the reviewers and **submit necessary documentation for full approval.**

____ Your full review research proposal has not been approved by the University IRB. Please review recommendations provided by the reviewers and resubmit.

EXEMPTED RESEARCH

__X_ Your exempted review research proposal has been approved by the University IRB (12 months). Please provide the University IRB a copy of your Final Report at the completion of your research.

____ Your exempted review research proposal has been approved with recommendations by the University IRB. Please review recommendations provided by the reviewers and **submit necessary documentation for full approval.**

____ Your exempted review research proposal has not been approved by the University IRB. Please review recommendations provided by the reviewers and resubmit, if appropriate.

EXPEDITED RESEARCH

____ Your expedited review research proposal has been approved by the University IRB (12 months). Please provide the University IRB a copy of your Final Report at the completion of your research.

____ Your expedited review research proposal has been approved with recommendations by the University IRB. Please review recommendations provided by the reviewers and **submit necessary documentation for full approval.**

____ Your expedited review research proposal has not been approved by the University IRB. Please review recommendations provided by the reviewers and resubmit, if appropriate.

Please revise or submit the following:

East Stroudsburg University of Pennsylvania
A Member of Pennsylvania's State System of Higher Education
An Equal Opportunity/Affirmative Action Employer

APPENDIX 4

NIH CERTIFICATE OF COMPELETION