An economic feasibility analysis of pulsed electromagnetic field therapy as an equine therapeutic modality

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ABSTRACT

The purpose of this thesis is to discern the economic feasibility of Pulsed Electromagnetic Field (PEMF) Therapy as an equine therapy. This is in consideration to similar equine therapeutic modalities, such as shockwave therapy, laser therapy, and salt water hydrotherapy. The objectives of this study are to evaluate the technical advantages of PEMF over others for treating the same issues in horses and conduct scenario analysis on PEMF to determine its robustness under alternative business conditions.

Primary data was used for the study, drawing on prices, time and cost estimates from professionals in the field. The constructed business model was then projected over a 10-year time frame. Revenue and expenses are based on a small mobile business model, starting off as an owner-operated business and adding an employee in Year 5 to minimize risk and increase probability of success. Vehicle and equipment purchases are financed over five years. The initial revenue model accounts for an average of 7.5 whole body treatments per day (at $60 per treatment) while working 250 days a year. Growth rate was calculated at 4 percent per year. Scenario analysis was conducted altering number of days treated, number of whole-body treatments per day, and growth rate.

The results show that PEMF therapy is the most technically and operationally feasible option of the aforementioned modalities for a mobile business model due to its variety of applications, ability for use before and after performances, reasonable startup cost and lack of veterinary oversight required. The business was determined to be economically feasible under all the alternative scenarios because the estimated Net Present

Value (NPV) was positive under the scenarios at 7.5% discount rate. Number of whole-body treatments were determined to be more critical on the financial performance of the business than the number of days within the confines of the scenario analyses conducted. The economic feasibility of the business was not affected by the growth rate because reducing it to zero still produced a positive NPV, even though it was a much lower NPV.

The next step is to use the foregoing results to develop the business plan for building a mobile equine PEMF Therapy service in a “horse-culture” region of the country. The results will guide the development of the key performance indicators and how they may be managed to ensure financial and economic success of the business. They will also allow for the development of the critical value innovations necessary for distinguishing the business from its competitors in ways that facilitate the selection of the most profitable customers.

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CHAPTER I: INTRODUCTION

How humans have used horses has depended on human needs at different periods in time. In current times, and through selective breeding, horses have become extremely specialized as to preferred breeds and lineage for various sports disciplines. While this has been attributed to horses being more athletic and trainable animals, it has also been one contributing factor in increasing performance-related issues. Breeding tendencies as well as pushing horses to perform at younger ages and/or at a high intensity have combined to result in more athletic performers but also potentially injury-prone animals.

Driven by the hope of financial gain on investments, competitions have been created for horses that promote racing and showing these animals at a young age. Large prizes added to the winnings create an atmosphere that pushes training to the earliest times possible. For race horses, this begins at a year of age as they can begin racing as two-year olds. In the western performance horse industries, training begins around two years of age so that they can be shown in futurities (events for horses that are in their first year of competition) as three-year olds. The western disciplines include barrel racing, reining, cutting, and cow horse. These events are very physical and include repetitive motions, such as hard stops and quick turns on animals that are still maturing. As a result, the horse's tendons, bones, and joints tend to deteriorate at an early age, requiring constant maintenance to sustain the desired high performance. Issues caught and treated early can reduce career ending problems as well as decrease time needed for rehabilitation.

Veterinary diagnostics have substantially advanced in recent years, allowing veterinarians to more readily diagnose issues in horses. Horse owners in turn invest significant sums of money in ensuring the health of their animals because they not only care about them but want some pecuniary return on investment through the performance of these horses. The availability of technology to diagnose problems and the willingness of owners to pay creates an opportunity for investors to invest in technologies that promise to be profitable. Therapeutic modalities, such as Pulsed Electromagnetic Field Therapy (PEMF), have become increasingly important due to a better understanding of their value and potentially better economics of utilization.

1.1 Pulsed Electromagnetic Field Therapy

Pulsed Electromagnetic Field Therapy has only been used as a therapeutic modality for horses within the United States within the last decade. Originating in Europe, there has been strong supporting research behind the methodology that agrees with its effectiveness. Large vinyl loops that produce an electromagnetic field are placed at problem areas around the horse's body, and the machine is set at a frequency appropriate for the ailment. This therapy is focused on healing at a cellular level, and the pulsing effect expands and contracts the animal's cellular membranes, creating a more permeable cell, that contribute to reduced inflammation, increased blood flow, and a healthier cell overall. It uses a pulsing magnetic field to reduce pain and inflammation. The modality has the potential to penetrate deep within the body with higher frequencies. It does not have a direct analgesic effect, and therefore patients can return to preforming without any concern of masking pain and worsening an injury (Gaynor 2018). Currently within the industry, three sessions are recommended within the time frame of a week or two for maximum benefits.

There is a vast list of debilitating issues that this therapy has proven to assist with. It ranges from tendon and ligament strains, osteoarthritis, to speeding up healing time on fractures. There are no known negative side effects from this therapy, and horses do not have to be sedated to be treated, and usually enjoy the process. As a result, a licensed veterinarian does not need to perform the modality or even be present during treatment, as is common with some of the other options such as shockwave therapy. No other equipment is needed other than the unit itself. A particular area can be treated, as with a tendon strain, or the horse can be treated as a whole unit. This equipment can also be used as a preventative therapy without any specific ailments present so that the equine athlete can be and stay in top condition. The equipment is portable, and therefore makes it easy to transport instead of having to bring equine patients to a care facility to be treated. A knowledgeable horseperson can perform the treatments, preferably with a strong understanding of equine anatomy, physiology and lameness. There is no licensing required.

Figure 1.1 Pulsed Electromagnetic Field Therapy Unit

Photo Credit: Author, 2019.

1.2 Other Therapeutic Modalities

Shockwave, cold hydrotherapy, laser therapy, and hydrotherapy are potential therapeutic modalities that could be used to treat similar ailments (such as lameness, osteoarthritis or back pain). These options all have their own strengths and weaknesses when considering their therapeutic attributes.

Cold hydrotherapy with salt water is limited to the lower limbs but is a common treatment for performance horses that are showing at a high caliber. It has the ability to address the majority of lower leg issues, including tendon, ligament, and swelling of the limbs. This therapy involves the horse standing in a (usually transportable) unit that fills with saltwater and is between 35-37 degrees Fahrenheit. The water continuously circulates for the 20 minutes that the horse is being treated. This combination reduces heat and inflammation, as well as provides temporary analgesic relief and slows degradation of tendons post injury. The addition of salt provides a hypertonic poultice that aids as a drawing agent to the limbs. No sedation is required for treatment, and therefore veterinary oversight is not required.

Laser Therapy offers a range of pain and soundness related benefits for performance horses. This treatment is applied by using a Class 4 laser. It functions by emitting a photon stream that creates vasodilation, thereby reducing inflammation and pain. It has proven to speed up wound healing as well as being well-known for treating acute and chronic pain in animals in instances such as arthritis, muscle pain, etc. It is not known to be as effective on tendon or boney lesions, or joint issues. The penetration is not near as deep as either the shockwave or PEMF therapy, but it is painless and can, therefore, be performed without sedation. It does emit a small amount of heat. However, if the probe is continuously moving this does not affect the patient. Larger areas of an animal can be treated, but it is not a very effective or even technically feasible in whole body treatment. Again, this therapy option is portable, and due to the fact that no sedation is necessary, there is no licensing necessary to preform treatment. Laser Therapy is usually per a veterinarian's recommendation but is usually performed by a technician. Number of treatments vary but are usually recommended in package of three to six treatments with the optional monthly maintenance treatment thereafter.

Shockwave therapy is a therapeutic modality that sends sound waves pulsing into injured soft tissue or boney lesions. This method uses the waves to create micro-abrasions that promote healing through attracting cellular response. The hand-held tool used to deliver the therapy must be directed to the specific point of injury, which makes treating large areas difficult or infeasible for whole-body treatment. The treatment is painful, requiring that patients must be lightly sedated, which necessitates the services of a veterinarian. The nature of shockwave therapy requires that it not be used in treating issues such as osteoarthritis, limiting its application in addressing patient needs since the operator needs to know the medical history and state of the patient to use it without associated risks.

Numerous treatments available for lameness and soreness issues in performance horses exist. Majority, such as those involving joint injections with steroids and newer biological options such as Platelet Rich Plasma (PRP), Interlukin-1 Receptor Antagonist Protein (IRAP) therapy, and ProStride (which is a combination of PRP and IRAP) require a veterinarian. These options have proven to work well along with therapies such as shockwave or PEMF, depending on the injury. Further discussion into injection options will not occur because of their veterinary specific application as well as the more direct application (joint and tendon issues only). Other solutions include chiropractic and acupuncture, which are also not discussed here because they can only be practiced by veterinarians or licensed chiropractors. Other diagnostic and therapeutic options that are available to the laymen, such as Theraplates (a vibrating plate that horses stand on) and thermal imaging are also not discussed because of the lack of credible research to uphold their claims at the present time.

The critical characteristics of the foregoing modalities are summarized in Table 1.1. It shows that of the four modalities, only shockwave therapy requires a veterinarian to be present for application. It also is the only one that requires rest period before the horse returns to performance activities. Saltwater hydrotherapy cannot be administered over the whole body of the horse while the other three can, technically, be used over whole body. However, the laser therapy is very time involved and can become impractical if using on the entire body.

Figure 1.2 Comparison of PEMF, Shockwave, Salt Water Hydrotherapy, and Laser Therapies

Therapy	Modality	Rest period required?	Administrable to whole body?	Usage	Treatment Time
PEMF	Sends pulsing electromagnetic fields through animal. Cells are rejuvenated as they gain the ability to eliminate waste	No	Yes. Assists with muscoskeletal issues, soft tissue, wounds, and fractures	Reduce body soreness and treat injuries	30-45 minutes
Shockwave	Micro abrasions are created through ultrasonic waves applied to a specific area. These abrasions draw additional cellular healing response to them.	Yes. 2-3 Days	Yes. Some areas more feasible than others. Assists with muskoskeletal pain and soft tissue injuries	Specific injuries and areas of soreness	15-20 minutes
Hydrotherapy	Uses cold salt water that circulates around lower limbs and results in a hypertonic poultice that reduces pain, heat, and inflammation through vasoconstriction	No	Legs only. Assists with tendon and ligament issues.	Used to heal injuries as well as for maintenance	30 minutes
Laser	Use of photon light therapy to increase vasodilation, reduce inflammation, and increase healing speed	No	Yes. Heals wounds, reduce osteoarthritis pain, reduce muscle soreness	Used on injuries or areas of issue	6-15 minutes on average

1.3 Research Objectives

The overall objective of this research is to determine the economic feasibility of PEMF therapy in the equine industry with the potential for developing a mobile business that services the expanding performance horse market in the U.S. and PEMF therapy's competitive advantage over other therapies, such as laser, shockwave, and salt water hydrotherapy. These therapies (except shockwave) have the business potential without the oversite of a licensed veterinarian, but also could benefit a veterinary practice and therefore have access to a patient base. The analysis will mainly focus on western states (Montana, Idaho, Wyoming, Colorado) and the potential clientele within this area. The results will support the decision to invest in a venture to provide PEMF services in the region. An analysis will assist in assessing the profitability of the investment under alternative scenarios.

The specific objectives are as follows:

1. Evaluate the technical advantages of PEMF over the other modalities available for treating the same issues in horses
2. Conduct an economic feasibility analysis to identify if PEMF therapy has economic potential
3. Conduct scenario analyses for the most profitable option to determine its robustness under alternative business conditions.

1.4 Outline of the Thesis

The rest of the thesis is presented as follows. In the next chapter, an overview of the literature on modalities for treating performance horse injuries, with a focus on PEMF is presented. Chapter 3 presents the methods used conducting the study as well as the assumptions that motivated the modeling approach. The results and discussion are presented in Chapter 4 and Chapter 5 presents the summary and conclusions emanating from the study.

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CHAPTER II: LITERATURE REVIEW

The equine athlete is subject to an array of issues regarding its soundness. Maintaining the animal so that its performance is not diminished or rehabbing injuries so that value and performance is maintained is paramount. Lameness has been widely documented as one of the most common health problems in domesticated horses, as well as one of the leading causes of loss among racehorses (McGreevy, et al. 2011). One example is in tendon injuries that continue to persist as a major cause of wastage in equine athletes. When workload is increased beyond the body's ability to adapt, these injuries result. This can be from a single instance or a prolonged accumulation of overload resulting in a tendon injury. The level of injury can vary from a molecular composition change to a disruption in the structure, both of which are major problem for the racing industry when considering both financial cost and welfare implications (Smith, et al. 1999).

The Quarter Horse is the prominent breed in western performance disciplines such as barrel racing, cutting, reining, and cow work. Many of these horses begin training as two year olds and compete in events beginning at three years of age. Quarter Horses are bred for athleticism, trainability, phenotype, and are placed in rigorous training programs to advance their knowledge quickly. Pain from the proximal metacarpus (area on the forelimb below the knee) is common among cutting horses and can range from mild to severe. Even though the lameness with these injuries can be severe, they are not necessarily considered career ending if a six month break from training as well as treatment and rehabilitation protocols (such as shockwave therapy, injections, etc.) are completed (Barrett, et al. 2018). The variety of maladies that cause lameness can be extensive, but so are the options for prevention and rehabilitation.

2.1 Pulsed Electromagnetic Field

2.1.1 History

The origin of magnetic therapy dates back to ancient Chinese texts. More recently, Albert Einstein was the first to prove electrical generation of a magnetic wave and modern electromagnetic therapy began in 1971 when direct current was used with success in healing a non-healing fracture via implanting electrodes directly into the bone (Schlachter and Lewis 2016). These electrodes developed into a non-invasive version with antennas that were studied on Beagles and developed into use on humans. Bone Growth Simulators (BGS) were derived from the previous machines in the 1980s and were a low powered version of PEMF. The 1990s resulted in a PEMF device that was designed to treat soft tissue instead of bone, and were a smaller, more manageable model. The U.S. Food and Drug Administration has since approved used of various PEMF machines for non-union fractures, post-operative pain and edema, osteoarthritis, and plantar fasciitis on humans (Gaynor 2018). Veterinarians first used PEMF to treat racehorses with fractures (Conrad 2016). Devices consist of an electrically powered machine that is easily portable, weighing anywhere from 15 to 30 pounds. Loops made of tubing connect to the machine and are placed on the animal, producing the electrical stimulation. The size of the loops depends on the area being treated – lower limbs require smaller loops, while necks and backs require larger loops.

2.1.2 Mechanisms of Action

Pulsed Electromagnetic Field Therapy is an offshoot of diathermy. Diathermy generates local heat through high-frequency electromagnetic waves that are produced by a coiled wire and raises the temperature of deep tissues by three to four degrees Celsius. The heating factor occurs mainly in muscle tissue. PEMF functions at a lower frequency (less than 600 pps) and a short duration. As a result, the magnetic field resonates a current within the tissue but does not heat them. (Schlachter and Lewis 2016). A variety of devices are available currently, and the technology varies depending on the shape and strength of electromagnetic waves emitted as well as the frequency and length of treatment applied. (Gaynor 2018). These include blankets, wraps, and small and large coil systems – all produce magnetic fields that vary in area and depth.

Biologically, there is still significant research to be done. What scientists do know is that these waves physically disturb by pulsing the cellular membrane and activate many cellular cascades (Rosso 2015). This causes an increased calcium ion signaling that binds with calmodulin (CaM), resulting in signaling metabolism, inflammation, apoptosis, and vascular tone pathways. Nitric Oxide (NO) production has also proven to increase with PEMF use. Nitric Oxide is a signaling molecule that influences cells in the immune and nervous system. When higher concentrations of it are produced, the results are reduced inflammation and increased vasodilation. (Gaynor 2018)

Expression of other receptors and proteins has also been studied with use of PEMF. Heat shock proteins are known for their anti-apoptotic effects, and also have been found in high quantities. Adding to the confirmation of reduction in pain and inflammation, the expression of adenosine receptors in the cell membrane is increased with this therapy. This reduces prostaglandins as well as inflammatory cytokines (Gaynor 2018). Due to PEMF working through a multitude of biological pathways, it is understandable why its effectiveness has been observed.

2.1.3 Empirical Research

Research behind the veterinary use of PEMF therapy ranges from healing fractures to pain reduction. The majority of information that is used to treat horses has been inferred from human studies. A study that involved canines that had a necrotic condition of the femoral head reduced surgical intervention and recovered fully when treated with PEMF therapy for two months. Twenty treatments for a duration of 18 minutes also significantly reduced clinical osteoarthritis in canine patients when PEMF therapy was applied. When considering wound healing, a study involving rats that had a tissue flap removed from the arterial blood supply. Although the control group's flap had nearly complete failure to re-vascularize, PEMF treated animals exhibited significant vascularization and the tissue survived (Gaynor 2018).

PEMF therapy shows a potential effectiveness for tendonopothy as well as tendon regeneration. Empirical studies have not been completed at this time, though the evidence of preclinical and in vitro studies have been effective and favor healing in this manner (Rosso 2015).

2.2 Shockwave Therapy

2.2.1 History

Shockwave therapy originated in human medicine and was designed to break up urinary stones. The therapy was first used on equines in 1996 by a German veterinarian on an equine with suspensory desmitis. General anesthesia was required for equine patients at that time (Schlachter and Lewis 2016). Devices currently weigh around 30 pounds and are transportable, powered by electricity, and have a removable probe attached to the device. Despite their portability, the therapy requires veterinarian oversight because of the need for the application of a mild sedative to prevent the patient from feeling the associated pain.

2.2.2 Mechanisms of Action

When shockwave therapy is applied to an area, the machine is creating pressure waves that travel through the tissue. These pressure waves create gas pockets within the tissue that cause micro abrasions. The trauma that is induced by these pressure waves results in increased blood flow to the area, thereby creating an inflammatory response and increase of nutrients. Caution is to be taken when rehabilitating an animal with this technology, as an analgesic effect is created. This effect maximizes at about 48 hours after treatment, thereby creating the possibility of the animal overusing the injured area (Schlachter and Lewis 2016). Low energy shockwave has been most practical in a clinical situation, as at this level it has proven to be most beneficial for enhancing cell metabolism and production (Rosso 2015). There is a limit for the wave penetration, therefore deep tissue structure such as the sacroiliac joint, are out of treatment range (Schlachter and Lewis 2016).

2.2.3 Empirical Evidence

The majority of the research has been directed towards experimentally induced tendon and ligament injuries of the forelimb and hindlimb. The results have proven significantly increased collagen and fiber in the treated area, as well as increased growth factors. The lesions healed faster and more completely and reduced visible overall lameness (Schlachter and Lewis 2016). Research also supports evidence that shockwave therapy treats and significantly benefits patellar tendinopathy, lateral elbow pain, Achilles tendinitis, and tendinitis of the shoulder in human patients (Rosso 2015).

2.3 Laser Therapy

2.3.1 History

Laser therapy has been applied to equines since the 1970s. Originally, the technology used was a class III laser – functionally it proved to be successful on some wounds, but its practicality was limited. No scientific studies showed any significant results with this laser, and ultimately this was a result of weak wattage, improper wavelengths, and improper application of therapeutic dosage (Robert J. Riegel 2012). More recently, the class IV laser has been put to use and has overcome some of these issues. The last 10 years of using this laser has allowed its wide application in the veterinary field (Schlachter and Lewis 2016). Low level lasers are very portable, weighing under ten pounds, consisting of a light wand attached by a cord to a battery-powered or electricity-powered device.

2.3.2 Mechanism of Action

Laser therapy heals tissues through a cascade of events at the cellular level. This therapy is used as a localized treatment on selected areas of the animal that are known to be causing issues. The therapy itself uses several biological pathways to create an analgesic effect on the area. It also reduces inflammation though similar pathways – these include reducing production of inflammatory prostaglandins while inducing production of vasodilatory and anti-inflammatory cascades. It also is known to stabilize the cellular membrane and enhances ATP production, which increased the cells energy production. Nitric Oxide is produced as well and stimulates microcirculation (Robert J. Riegel 2012). The combination of these events creates a healing matrix that can be applied to a range of maladies and is also known for its use on acupuncture points as stimulation without actually inserting needles.

2.3.3 Empirical Evidence

Clinically, lasers are most used in equine practices on tendon and suspensory injuries, synovitis and tenosynovitis, degenerative joint disease, osteoarthritis, back disorders, and healing wounds (Robert J. Riegel 2012). A large amount of recent research has been done on wound therapy by second intention in horses, with fair success. In other studies, significance has been reported in reduction in inflammation and edema while increasing collagen synthesis. When regarding tendon and ligament studies, a rodent study with collagenase induced Achilles tendonitis improved mobility as well as the tendon's composition. Osteoarthritis studies involved a chemically induced rabbit osteoarthritis that did significantly improve cartilage regeneration and cells that induce cartilage regeneration (Schlachter and Lewis 2016). This research is very applicable to laser therapy's use in horses. Carrie Schlachter, VMD published works on electrophysical therapies states "laser therapy is beneficial on wounds and collagen synthesis, leading to more rapid healing of the damage tissue."

2.4 Hydrotherapy

2.4.1 History

Since ancient times, thermal therapy applied to the skin has been a basic physical therapy modality. Cold therapy has been widely accepted for treatment of acute soft tissue injuries to reduce pain and inflammation (Schildboeck 2006). Water as a medium for this methodology has also been recognized as a mode of rehabilitation for humans for many years. Using saltwater along with cold hydrotherapy, which is the method of application that this research will concentrate on, has become a method of rehabilitation and prevention of injury for horses even though the empirical research specifically on horses is limited (McGowen 2007). The approach currently used to apply this methodology to horses consists of a portable walk-in spa with ramps and doors on each end. The machine fills up with cooled salt water to the appropriate level on the horse for the required treatment. The highest level the spa is capable to treat is upper limbs, as anything higher would cool the animal's core body temperature beyond healthy levels.

2.4.2 Mechanism of Action

Hydrotherapy functions with five principles for its mechanisms of action: buoyancy, osmolality, temperature, hydrostatic pressure, and viscosity. In this theory, buoyancy is the lifting force that reduces pressure on joints. In horses, water at elbow level can reduce weight load by 10 to 15 percent. High solute concentrations create the osmotic effect that was previously mentioned, and results in reducing inflammation while being analgesic. Hydrostatic pressure is the increased pressure that is applied to the limb when it is inserted in water. This act increases lymphatic drainage as well as venous return, resulting in less edema and a reduction in pain. When considering temperature, cooler temperatures (known as cryotherapy) that decrease the soft tissue temperature 10 to 15 degrees Celsius have proven to cause vasoconstriction – resulting in edema reduction and an analgesic effect. Viscosity refers to the increase in effort that a horse is required to use to push through the resistance that occurs in water. As water is about 12 times more viscous than air, this greatly increases the strength required to move limbs through this medium (King 2016). The combination of osmolarity, hydrostatic pressure, and cryotherapy are applied to horses that undergo salt water hydrotherapy.

2.4.3 Empirical Research

Multiple studies regarding salt water therapy have shown significance, although the majority of the research has been on human studies. In one study, two weeks of daily exercise in mineral water reduced pain in areas that humans had arthritis (King 2016). Also reported in humans, the "combined effects of massage, thermal influence and saline hydrotherapy have been described [with success]" (Schildboeck 2006). One equine study reported significant increase in healing both clinically and through ultrasound on lower limb soft tissue injuries when they stood in hypertonic cold water baths (5-9 degrees Celsius) for 10 minutes a day, 3 times a week for 4 weeks. Reports of a visual change in edema were also reported within 8 days of initial cold salt water therapy treatment (King 2016).

2.5 Economic Research

Economic feasibility studies that compare the success of the specific methodologies used in equine rehabilitation therapy are limited. While a study done by Stokes (2015) theorized that when building an equine rehabilitation center in Central Texas, investing in a higher quality facility would be most economically feasible, there was no specific research on the economic nature of the modalities used at said facility.

The USDA implemented a census in 2015 regarding the demographics of the United States equine population. When identifying the primary use of equids on an operation, 47.2 percent were used for pleasure, followed by 25 percent for farm or ranch work and around eight percent each for showing/competition and breeding (Veterinary Services Center for Epidemiology and Animal Health 2015). While horse numbers in the country increased by about one million between 1997 and 2007 from 3,020,117 to 4,028,827, those numbers declined to about 3,621,348 in 2012 (Veterinary Services - National Animal Health Monitoring System 2017). There are no more recent population figures on horses in the U.S.

The USDA also studied the percentage of operations that had resident equids with a lameness, leg, or hoof problems that could not be used for intended purposes without treatment. This percentage was 23.5 in 1998, and while dropping to 15.5% in 2005 increased to 28.0 percent in 2015 (Veterinary Services - National Animal Health Monitoring System 2017). The research presented represents an increased need for treatment of lameness issues in recent years, despite the slight decline in number of horses overall.

It is recognized that equine sports may distort the veterinarian-client relationship when third-party interests emerge as a result of increased economic value (Campbell 2013).

The serious points of ethical dilemmas are often during and between competitions when owners want their animals ready to compete and veterinarians have alternative prescriptions in the interest of the patient. Campbell argues that this is not different from what is observed in human sports. Bringing services to the event such as those presented here provide a mitigation of some of these challenges when the patient can receive effective treatment without the masking effect of medications which has led to exacerbation of injuries. Furthermore, their non-pharmacological nature implies that they may be used as safe preventative modalities that enhance performance while reducing risks (Hopster and Kastner 2015).

CHAPTER III: METHODOLOGY

This chapter presents the data used to determine appropriate costs regarding purchasing and utilizing a PEMF therapy unit, along with the costs associated with other similar therapeutic modalities (shockwave, laser, and hydrotherapy). The economic data is collected from primary data sources.

The majority of this information includes cost and profitability analysis of each of the therapeutic modalities that can be compared to PEMF Therapy. The regional location of these therapies was held constant, resulting in general pricing and cost of living being relevant to the area.

To assess this project, the long-term alternatives for the investment are considered. Discounted cash flow analysis is used by calculating Net Present Value (NPV). Accounting for the investment and cash flow through this process results in making adjustments in the value of the investment over time. This considers the alternatives had it been invested in some other project or means. Adjusting the variables determines the economic feasibility of the project. The project will assess growth scenarios over the time period that will discern the minimum requirements for this project to be feasible.

3.1 Methodology and Theory

Multiple analytical tools are used to determine the investment's potential. The results include Cost-Benefit Analysis, that accounts for potential costs and revenues of the project based on the framework of purchasing a PEMF machine with a business based off of its applications. The project will either be determined to be beneficial to the company or not through these analytics. Cost-Benefit Analysis involves accounting for all costs and benefits associated with the project (direct, indirect, tangible, intangible, and real) and comparing results to assess if the benefits outperform the costs. These costs and benefits are discounted to account for the cost of funds.

3.1.1 Net Present Value Conceptual Model and Methodology

"In project management, the time value of money concept is a foundational element to performing a financial analysis on a project… The risk of a situation must be assessed and considered, and then compared to a project with a similar level of risk" (Heerkens 2006). The time and money concept directly affect the valuation of a project, as it influences the valuation of a dollar today. This method accounts for present versus future consumption rates, monetary inflation, and risk. The time value of money also accounts for the opportunity cost (or the cost of investing in one project and comparing it to what would be earned in interest on that dollar).

Future and present value are concepts are considered the foundation for the time value of money concept, and lead to the process underlying net present value. Future value is the calculated value of an investment based on an assumed rate of interest paid at the end of an assumed value of time. Present value is similar but takes the opposite view and is therefore the value today of a future cash flow (Heerkens 2006). Present value considers a discount factor, that accounts for the missed option of investing in another opportunity of equal risk. Another factor includes cash flow, that includes the initial outflow of cash (initial investment) and then maintains the inflow of cash over a time period. When the present value is calculated considering cash flow over time, the basic concepts of Net Present Value (NPV) are present.

The success of economic feasibility for this model is through the determination of NPV. NPV is a capital budgeting tool that has the ability to determine the potential profitability of an investment. It results from accounting for the cash inflows and outflows and includes cash flow, initial investment, the discount rate, and duration of investment. Net present value is the result of the required investment subtracted from the initial cost of the project. The equation for NPV is as follows:

$$NPV = -C + \frac{R_1}{(1+d)} + \frac{R_2}{(1+d)^2} + \frac{R_3}{(1+d)^3} + \ldots + \frac{R_T}{(1+d)^T} = -C + \sum_{t=1}^{T} \frac{R_t}{(1+d)^t}$$

In this equation, C stands for the initial investment, d represents the discount rate (of which accounts for opportunity cost, risk etc.), t alludes to the time period and R_t is the cash flow. A positive NPV is desirable, as it adds value and results in net profitability. Increasing the investment or discount rate will decrease the NPV, resulting in adverse effects on the economic feasibility of the PEMF therapy project. Alternately, increasing the time periods and cash flow positively influences the feasibility of the project. Holding the time periods and discount rates constant through all scenarios will place a comparable valuation on these projects.

3.2 Pulsed Electromagnetic Field Variables

The initial startup cost of this machine is estimated to be $21,000. Treatments vary in price but range from $40 to $120 and average about $1.00 per minute (with treatment times being variable but averaging 30 to 45 minutes). The mobility of the machine allows practitioners to travel to the location of the patients, therefore allowing for the average cost of transportation data to be needed. The benefit allows the machine to be set up at horse shows where there is a high concentration of horses available that would benefit from the therapy, and as there is no inhibiting effects the treatments can be applied before or after performance. It can be used as a preventative, and treatments can be applied either on the occasion or in groups of two to three sessions per week.

3.3 Laser Therapy Variables

In assessing the profitability of applying equine laser therapy, the initial investment is between $12,000 and $30,000. Technically, there is no certification necessary to run the equipment. Cost for a treatment varies, from $30-$40 per treatment of 6-8 minute on the low end and $125 to $175 for a 25-30 minute treatment. Table 3.1 shows average costs based on average treatment time and anatomical area. On average, six treatment sessions are recommended per ailment. Customers can return if the issue re-occurs. This machine is mobile but is usually only applied to horses to treat an issue, not as a preventative. Transportation costs are those associated with the use of a small vehicle.

Table 3.1 Average Cost and Time to Treat Various Anatomical Areas on a Horse with Laser Therapy

Anatomical Area	Avg. Treatment Time (minutes)	Average Charge ($)
Carpus	6 to 8	30 to 40
Fetlock	5 to 6	25 to 30
Foot	6 to 8	30 to 40
Back	25 to 30	125 to 175
Stifle	8 to 10	40 to 50
Hock	6 to 8	30 to 40

3.4 Hydrotherapy Variables

Salt water hydrotherapy is simplistic in that all treatments are the same. Limbs are the only anatomical part of the horse that can be treated, as submerging the entire horse would cause for body temperature to be lowered to dangerous levels. Treatment cost averages $50 per therapy and can be repeated once daily as needed. Acquisition of a portable salt water hydrotherapy spa has an initial investment of $85,000. Maintenance per year averages around $2500.00. Treatments usually take about a half an hour per horse. This unit requires a truck and trailer to make it mobile, and therefore does result in increased transportation costs. Preventative and maintenance treatments are applicable.

3.5 Shockwave Therapy Variables

Initial investment in a shockwave system in around $40,000. Refurbishing probes costs around $1000 per year. Also, the additional cost of a veterinarian needs to be accounted for as patients need to be sedated. When considering potential income, treatments average around $300 per therapy, with a course of 3 or more treatments to heal an injury (with about 2 weeks in between therapies). Time on treating an area depends on the location and severity of the issue, but usually takes around 15-20 minutes per treatment. This machine is easily mobile but requires an injury and is less commonly used as a preventative treatment.

Figure 3.1 Pricing and Cost Comparison of Equine Therapeutic Modalities

Therapy	Initial Investment	Maintainance Costs	Price per Treatment (on Average)
PEMF	$21,000	Minimal	$60
Shockwave	$40,000	$1,000	$300
Hydrotherapy	$85,000	$2,500	$50
Laser	$25,000	Minimal	$30-40

CHAPTER IV. ANALYSIS, RESULTS AND DISCUSSION

PEMF Therapy is the most economically feasible of the therapeutic modalities in comparison with laser therapy, shockwave therapy, and hydrotherapy as it is the most versatile in its application. This results from the knowledge that it is the modality that can be used in maintenance or as a preventative for performance horses while they are under the rigors of physical activity. PEMF also has the capability to treat issues that result from high levels of performance (soft tissue, osteoarthritis, etc.). Its versatility provides a variety of potential markets while also providing opportunity to treat the entire horse (not just limbs or specific injured areas). None of the other modalities entertain this potential when considering feasibility, time, and potential markets. Therefore, PEMF Therapy is the modality that the analysis is based on.

4.1 PEMF Financial Analysis

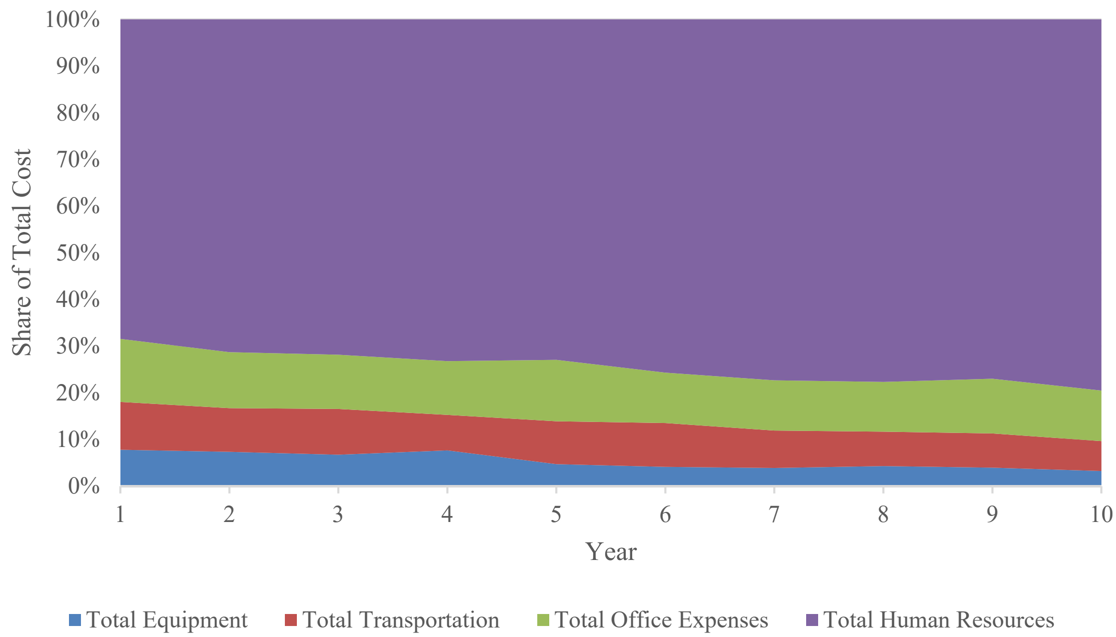
Revenue and expenses over a 10-year time frame are considered in this model. The investment of the PEMF machine as well as the purchase of a vehicle for a mobile practice were financed over 5 years at a rate of 5% interest. Other expenses include costs associated with driving and maintaining a vehicle, business expenses, and a single employee payroll with associated expenses. Fuel expenses are estimated and include costs of increased fuel rates with an average of 24,000 miles per year per vehicle. One additional employee is added in Year 5 (as well as a lease on another vehicle and PEMF machine for that additional employee). Also, a part time employee salary is included to account for scheduling and office management (including administrative duties such as billing, customer service, etc.). Appropriate rates for growth of expenses are accounted for in these estimations, and the total estimated expenses for the base scenario are summarized in Table 4.1, with a full table presented in Appendix A.

Table 4.1 PEMF Expenses for Years 0-10

	Year 1	Year 5	Year 10	Total
Fixed Costs and Equipment				
PEMF Machine & Accessories	$ 5,774	$ 5,774	$ 5,774	
Annual Maintanance	$ 1,000	$ 2,000	$ 2,000	
PEMF Machine Accessory Replacement				
Antiseptic cost	$ 240	$ 400	$ 400	
Total Equipment	**$ 7,014**	**$ 8,174**	**$ 8,174**	**$ 81,604**
Transportation				
Vehicles	$10,394	$ 10,394	$ 18,478	
Vehicle Maintainance	$ 280	$ 560	$ 560	
Replacement Tires				
Miscellaneous Repairs	$ 500	$ 1,000	$ 1,000	
Vehicle Insurance & License	$ 2,700	$ 4,471	$ 4,050	
Fuel	$ 4,235	$ 8,471	$ 8,471	
Hotel	$ 1,500	$ 1,500	$ 2,000	
Total Transportation	**$ 9,215**	**$ 16,002**	**$ 16,081**	**$ 138,951**
Business expenses				
Computer & Software	$ 1,200	$ 2,600		
Printer/Ink	$ 500	$ 563	$ 652	
Advertising	$ 2,000	$ 2,165	$ 2,390	
Business cards	$ 100	$ 200	$ 200	
Office Supplies	$ 500	$ 541	$ 598	
Business/Personal Insurance	$ 1,200	$ 2,488	$ 6,192	
Credit Card/Billing System	$ 5,625	$ 13,161	$ 16,012	
Accounting Fees	$ 1,000	$ 1,126	$ 1,305	
Total Office Expenses	**$12,125**	**$ 22,844**	**$ 27,349**	**$ 195,303**
Human Resources				
Initial Employee Payroll	$35,000	$ 55,000	$ 90,000	
Additional Employee Payroll	$ -	$ 35,000	$ 60,000	
Billing and Office Support	$22,000	$ 26,741	$ 34,129	
Fringe	$ 3,500	$ 9,000	$ 15,000	
Continuing education	$ 1,000	$ 1,000	$ 1,000	
Total Human Resources	**$61,500**	**$ 126,741**	**$200,129**	**$1,287,714**
Totals	**$89,855**	**$ 173,761**	**$251,733**	**$1,703,572**

Figure 4.1 graphs the trends of each expense component over the estimated time frame. The large portion of Human Resource expenses is evident and remains to account for approximately 75 percent of the associated expenses for this model. Office expenses and transportation expenses remain steady throughout the model, while total equipment expenses tend to decrease over time.

Figure 4.1 Cost Trend by Component Over 10 Years

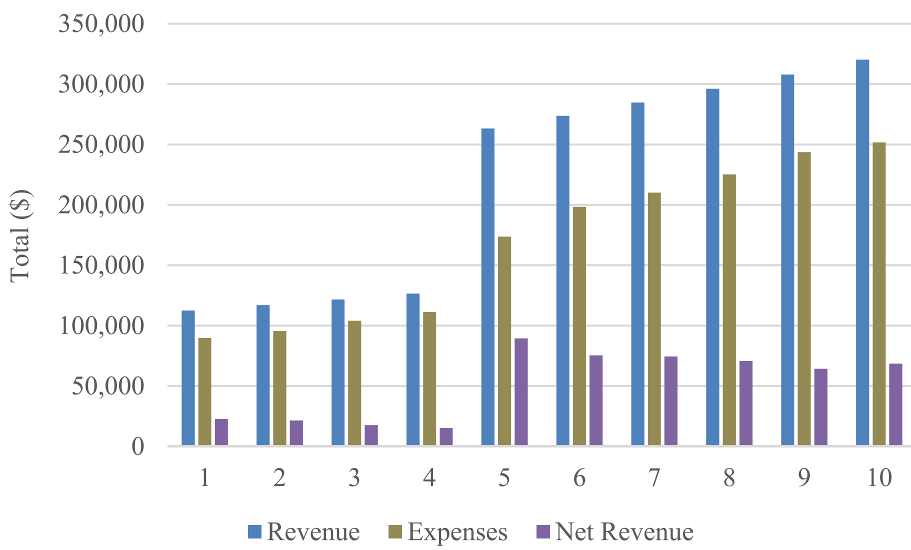


Revenue is calculated considering number of treatments per day, with one treatment covering the entire body of a horse. Growth rate per year, number of days worked per year, and number of treatments per day are variable and are analyzed in the sensitivity analysis. The discount rate is assumed at 7.5% which accounts for the moderate risk of this investment and the inflation of value over the 10 year time frame.

In the base scenario, it is expected that an average of 7.5 whole body treatments will be completed in a day, with each treatment priced at $60.00 per session, and is associated with the time it takes to complete a treatment. For context, these assumptions about treatments and days worked translate into 1,875 whole body treatments per year absent growth when working 250 days per year. That would be equivalent to 625 individual horses being treated based on the assumption that each horse receives three sessions per treatment. If we assume that each horse receives three treatments per year, then we are only looking at working with only about 210 horses per year. This reveals the operational feasibility of the assumptions underlying the foregoing economic analysis.

The number of treatments is assumed to grow at 4% per annum. It was also assumed that 250 days would be a feasible number of working days per year. The estimated income, expenses, and profit for Years 1 through 10 are displayed in Figure 4.2 under the afore mentioned conditions.

Figure 4.2 Revenue, Expenses and Profit for 10 Year PEMF Therapy Analysis by Year



4.2 Sensitivity Analysis

Sensitivity analysis was performed on variables including number of days worked, growth rates, and number of whole body treatments performed. Net Present Value is assessed in each of these models. As a result, feasibility of profitability can be estimated.

4.2.1 Sensitivity for Number of Days Worked

Initial estimations were made with 250 days worked per year. Sensitivity analysis were conducted holding an average of 7.5 treatments per day as well as holding all other previous estimated growth and expenses constant. Net Present Value was assessed at 10 day increments at 210 days through 260 days. At 250 days, NPV results in a positive value at all these rates. With these estimations, the net revenue over 10 years is positive as is the NPV, resulting in this potentially being a promising venture at any of these estimations, but increasingly more positive as the number of days worked increases.

Table 4.2 NPV Analysis on Net Revenue of PEMF Therapy when Number of Days Worked is Varied

Days	210	220	230	240	250	260
NPV	$ 113,104	$166,795	$220,487	$274,178	$327,870	$381,561
Net Revenue	$ 182,081	$266,579	$351,078	$435,577	$520,075	$604,574

4.2.2 Sensitivity for Number of Treatments per Day

Initially, NPV was assessed with a set value of 7.5 full body treatments for each day of work. Growth rate was held constant, while number of days worked was reduced to 240. Sensitivity analysis is conducted at half treatment increments, with the first feasible NPV value at 6 treatments with an NPV of $16,459. This value is low and does not leave much room for error. Anything less than a daily average of 6 treatments, NPV is negative and technically infeasible. NPV feasibility consistently increases as the number of average treatments per day increases up to 8.5 treatments per day. This is evident in Table 4.3.

Table 4.3 NPV with Varied Number of Average Whole Body Treatments per Day

Treatments	6	6.5	7	7.5	8	8.5
NPV	$ 16,459	$102,366	$188,272	$274,178	$360,085	$445,991
Net Revenue	$ 29,983	$165,181	$300,379	$435,577	$570,774	$705,972

4.2.3 Sensitivity for Growth Rate

Growth rate of the project is another consideration when valuing this model. The constant considered in other scenarios was 4 percent, and for this sensitivity analysis increments of a half a percent was assessed. NPV initially with these results at a rate of 3 percent growth is $264,903. Net Revenue is also promising at a total of $410, 889. These results conclude that this growth rate is feasible even at the lower end. Increasing growth rate above 4 percent results in an economically feasible project as well, with NPV increasing steadily as proposed in Table 4.4.

Table 4.4 NPV for PEMF Therapy with Varying Growth Rates per Year Considering Net Revenue

Growth Rate	3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%
NPV	$264,903	$295,971	$ 327,870	$ 360,621	$394,247	$428,768	$464,209
Net Revenue	$410,890	$464,724	$ 520,075	$ 576,984	$635,491	$695,638	$757,468

4.2.4 Comparing Base Scenarios to Best and Worst Case

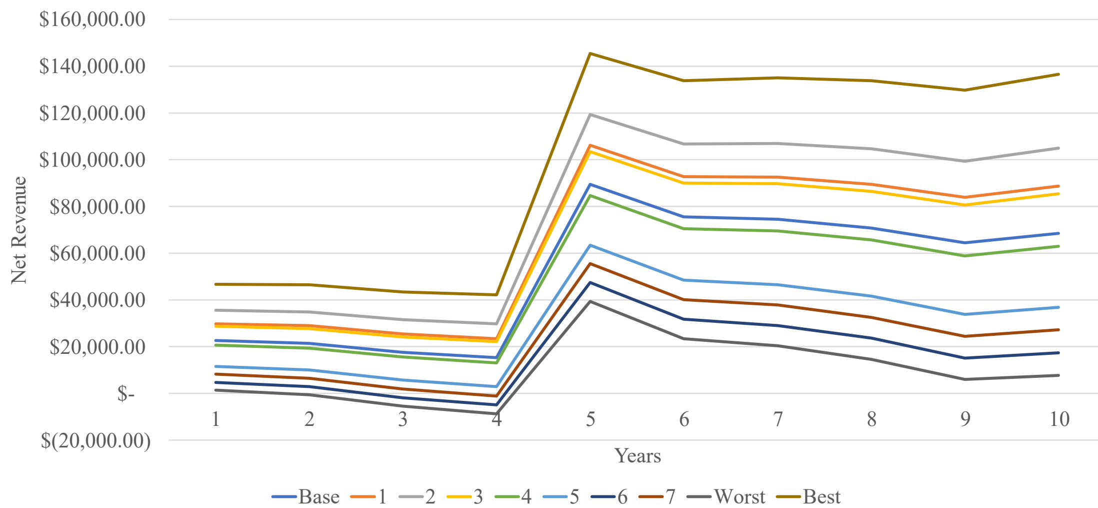
In the base scenario, NPV was calculated from an average of 250 days of work with an average of 7.5 whole body treatments per day. Table 4.5 shows the variables that were subjected to sensitivity analysis and their values under various scenarios. Results were estimated using a number of intermediate values between the best- and worst-case scenarios and combinations of these values, arguing that these changes in parameters do not occur in isolation and must be explored together.

Table 4.5 Alternate PEMF Therapy Scenarios Based on Number of Treatment Days and Number of Treatments, Including Best and Worst Case Scenario with NPV

Scenario	Base	1	2	3	4	5	6	7	Worst	Best
Treatments	7.5	10	10	9	8	7	6	6	6	8.5
Days	250	200	210	220	230	240	260	270	250	270
NPV	$327,870	$417,356	$488,944	$ 403,038	$302,814	$188,272	$102,366	$145,319	$59,412	$628,542

In the base scenario, NPV was promising at $327,869. Fluctuation can occur in these numbers, and therefore a best- and worst-case scenario was assessed. The worst-case scenario is based on a 6 treatment per day average while working 250 days a year. This would result in an NPV of $59,412. This situation would be feasible even if the average number of treatments was decreased to 6 per working day, but anything below that average would have the potential to result in a negative NPV and a business that would not be a wise investment. Figure 4.3 compares this scenario to other potential occurrences and enhances the possibility that if net revenue is based on this scenario, there will be years that the business will not profit.

Figure 4.3 Scenario Analysis Based on Net Revenue from Year 1 to Year 10, Including Worst and Best Case Scenario



The best case scenario was assessed at working 270 days with an average of 8.5 full body treatments per day. The analysis for this option far exceeded other scenario expectations, especially after year 5 where net revenue fluctuates around $130,000 per year. Even in the first few years of acquisition, the business remains to produce above

$40,000 per year in net revenue. NPV as well shows this potential, as it calculates to $628,542.

Other scenario analysis were developed based on alternate days worked and average whole body treatments per day. This analysis was calculated as the number of treatments increased, the number of days worked decreased and vice versa. The scenarios with the highest NPV were the options with the higher number of whole body treatments per day and the number of days worked decreasing. This is represented as well when considering net revenue and is depicted in Figure 4.3 as Scenarios 1,2,3 and 4. Scenarios 5,6 and 7 have a higher number of days worked but lower number of overall treatments, resulting in decreased NPV's (Table 4.5) as well as lower net revenue per year (Figure 4.3). Scenario analysis that added in fluctuations in growth rate were not assessed as reducing growth to 0 percent still resulted in a positive NPV although it was significantly lower.

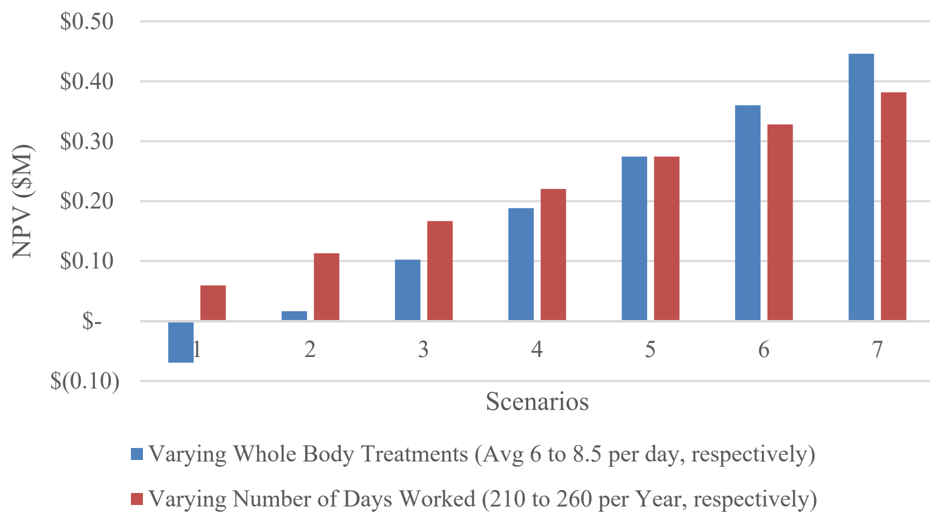
CHAPTER V. SUMMARY AND CONCLUSION

This paper evaluates the economic feasibility of a business based on Pulsed Electromagnetic Field Therapy (PEMF) and treating equine patients in the greater Wyoming, Montana, and Idaho area. Evaluation of other similar therapeutic modalities is considered as well, including shockwave, laser and salt water hydrotherapy. PEMF can be used both in an injury setting as well as a maintenance therapy for performance horses. The capability of this therapy to be performed before or after a horse competes opens the possibility for travel to large horse events, resulting in a large variety of potential clientele within a close vicinity. No veterinary oversight is needed either, providing more applications than other modalities mentioned and therefore potentially more profitability, leading to the success of this business.

With the use of NPV to best compare a project's worthiness, I assess the potential economic feasibility of this endeavor. The assessment of predicted expenses and revenue with 7.5 treatments performed daily while working 250 days a year produced positive results. Growth rate was set at a 4 percent increase per year, resulting in an NPV of $327,869. This calculation enhances that this business has the potential to be profitable when within the assumptions.

The sensitivity analysis provides the information of alternate scenarios in the case that growth rate, number of days worked, or the number of treatments performed are different then the results that are expected. NPV analysis was used in these scenarios as well to compare results across possible circumstances. Alternate average whole body treatment per day NPV is positive at an average of 6 treatments per day, but barely so at $16, 459 when at 240 days worked per year. Any number of average treatments per day less than this results in a negative NPV which makes it not feasible. NPV at 6.5 treatments per day and above looks promising, with an NPV of $102,365 and increasing by around $85,000 with each half treatment increment. The alternate scenario of less than 250 days worked a year had a promising outlook, considering 7.5 treatments were completed per day and a growth rate of 4 percent was maintained. NPV values were positive from 210 days worked and up. Figure 5.1 displays the NPV value trends of varying the number of days worked as well as number of whole body treatments completed.

Figure 5.1 Comparing Trends in NPV Varying Days Worked and Whole Body Treatments at 4% Growth Rate



Growth rate changes prove to be feasible as well. Analysis was done down to 3 percent growth per year, which still provided a promising NPV of $264,903. As increments increased by a half a percent of growth per year, NPV values also increased by around $30,000. The results of the scenario analysis conclude that even if performance is not the results that are initially predicted, there is potential for this business to still be successful. Any one of the areas of sensitivity analysis can underperform, although other areas of analysis will need to achieve to expected potential (depending on the severity of the underperformance).

The alternate scenario analysis presented with the effect of number of days worked versus number of treatments per day. This suggested that increasing number of treatments per day had more value than increasing the number of days worked, as scenarios with increased treatments also had higher NPV. Analysis of the best and worst case scenarios revealed that a minimum of 6 treatments per day needs to be maintained when basing success of the business on NPV. Any potential outcomes that result in more than 6 treatments per day while working 250 days or more increase the potential NPV drastically.

5.1 Future Outlook

Given the results, the proposition of this business model would be a feasible investment. Alternate expense sensitivities were not explored, such as increasing mileage or other costs associated with this business venture. It is recommended that these be considered before investing in this model, as further exploration will result in a well-versed assessment and prepare the investor for other scenarios of which may be debilitating.

Net revenue estimates continue to grow with the addition of another employee. This allows for the possibility that additional therapy practitioners could be employed to maximize the profits available to this industry. Expansion farther into the surrounding states is also a possibility if a larger radius is needed for additional employees. The number of horses that could benefit from this therapy is limited only by the model’s access to them, therefore expansion via employees is a possibility to consider in the future.

This analysis forms a financial and economic base upon which a business in this region based on PEMF therapy could be built. The next step in this endeavor would be to build a mobile practice in the Western states, based out of Wyoming. This model is to be used as a guide with days worked, number of treatments per day, etc. to be used as performance indicators so that this business may have success. It also provides insight as potential expenses associated with the plan. As this market is fairly horse saturated, development of innovations to separate this business from competitors will be a necessity. The most profitable customers will have to be established, with this either being repeat customers in a radius within the practice or maximizing on certain show circuits and the people and horses that frequent them. There may also be some potential to subcontract this business to veterinary clinics, as there would be a plethora of horses that have maladies which could benefit from this therapy.

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APPENDIX A

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Fixed Costs and Equipment											
PEMF Machine & Accessories	5.77	5.77	5.77	5.77	5.77	5.77	5.77	5.77	5.77	5.77	
Annual Maintanance	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	
PEMF Machine Accessory Replacement				1.50				1.50	1.50		
Antiseptic cost	0.24	0.24	0.24	0.24	0.40	0.40	0.40	0.40	0.40	0.40	
Total Equipment	**7.01**	**7.01**	**7.01**	**8.51**	**8.17**	**8.17**	**8.17**	**9.67**	**9.67**	**8.17**	**81.60**
Transportation											
Vehicles	10.39	10.39	10.39	10.39	10.39	18.48	18.48	18.48	18.48	18.48	
Vehicle Maintainance	0.28	0.28	0.28	0.28	0.56	0.56	0.56	0.56	0.56	0.56	
Replacement Tires			1.50			1.50			1.50		
Miscellaneous Repairs	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	
Vehicle Insurance & License	2.70	2.43	2.19	1.97	4.47	5.13	4.86	4.59	4.32	4.05	
Fuel	4.24	4.24	4.24	4.24	8.47	8.47	8.47	8.47	8.47	8.47	
Hotel	1.50	1.50	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	
Total Transportation	**9.22**	**8.95**	**10.20**	**8.48**	**16.00**	**18.66**	**16.89**	**16.62**	**17.85**	**16.08**	**138.95**
Business expenses											
Computer & Software	1.20				2.60				3.00		
Printer/Ink	0.50	0.52	0.53	0.55	0.56	0.58	0.60	0.61	0.63	0.65	
Advertising	2.00	2.04	2.08	2.12	2.16	2.21	2.25	2.30	2.34	2.39	
Business cards	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.20	0.20	
Office Supplies	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.59	0.60	
Business/Personal Insurance	1.20	1.44	1.73	2.07	2.49	2.99	3.58	4.30	5.16	6.19	
Credit Card/Billing System	5.63	5.85	6.08	6.33	13.16	13.69	14.23	14.80	15.40	16.01	
Accounting Fees	1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30	
Total Office Expenses	**12.13**	**11.49**	**12.10**	**12.79**	**22.84**	**21.37**	**22.62**	**24.02**	**28.59**	**27.35**	**195.30**
Human Resources											
Initial Employee Payroll	35.00	40.00	45.00	50.00	55.00	70.00	75.00	80.00	85.00	90.00	
Additional Employee Payroll	0.00	0.00	0.00	0.00	35.00	40.00	45.00	50.00	55.00	60.00	
Billing and Office Support	22.00	23.10	24.26	25.47	26.74	28.08	29.48	30.96	32.50	34.13	
Fringe	3.50	4.00	4.50	5.00	9.00	11.00	12.00	13.00	14.00	15.00	
Continuing education	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Total Human Resources	**61.50**	**68.10**	**74.76**	**81.47**	**126.74**	**150.08**	**162.48**	**174.96**	**187.50**	**200.13**	**1,287.71**
Totals	**89.85**	**95.54**	**104.08**	**111.26**	**173.76**	**198.29**	**210.17**	**225.27**	**243.61**	**251.73**	**1,703.57**

*In Thousands of Dollars