PRE-SURGICAL BEHAVIORAL MEDICINE EVALUATION (PBME) FOR

IMPLANTABLE DEVICES FOR PAIN MANAGEMENT:

A ONE-YEAR PROSPECTIVE STUDY

APPROVED BY SUPERVISORY COMMITTEE

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DEDICATION

To my family, friends, and fiancé for all their support

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By

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Chronic pain affects millions of individuals around the world financially, physically, psychologically, and socially. When nonoperative care does not provide adequate pain relief, surgically invasive procedures are often considered. However, poor surgical outcome affect the patient, the physician, the employer, and the insurance company. In order to reduce negative surgical outcomes, pre-surgical psychological evaluations are used in order to better predict prognosis. The current study looked at the utility of the Presurgical Behavioral

Medicine Evaluation (PBME) and revised algorithm that was described in Shocket's (2005) investigation that determines a patient's prognosis for invasive pain procedures. Patients were placed in a Green, Yellow I, Yellow II, or Red prognosis group, with Green having the best prognosis for surgery and Red having the worst prognosis. A total of 95 patients completed the PBME evaluation, with most patients being evaluated for a spinal cord stimulator or intrathecal pump. Variables, including gender, disability payment status, and involvement in pending litigation, were found to be significantly different among the groups. Analysis of data at the initial evaluation indicated that patients within the Red group endorsed significantly more physical/functional limitations, depressive symptomatology, and reported more psychological distress than the Green group. Patients were followed-up 6- and 12-months post-evaluation with both physical/functional and psychosocial measures. Analysis of the 12-month follow-up data indicated that there were significant differences among the four groups in terms of the VAS, BDI, MCS, OSW scores, and the catastrophizing scale on the CSQ. In addition, the Tukey HSD and Mann Whitney tests revealed specific significant differences among the groups. A repeated measures analysis of the initial evaluation, 6-month, and 12-month follow-up data revealed the Green and Red group was significantly different in terms of the VAS, OSW, BDI, and MCS. In addition, nonparametric analysis indicated that there were significant differences among the groups on total risk factor scores as determined by the PBME algorithm.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
BDI	Beck Depression Inventory
CI	Confidence Interval
CPT	Conventional Pain Therapy
CPQ	Confidential Pain Questionnaire
CSQ	Coping Strategies Questionnaire
df	Degrees of freedom
DPQ	Dallas Pain Questionnaire
DVS	Database Variable Sheet
F	F Ratio (test statistic)
FBSS	Failed back surgery syndrome
GCTP	Gate Control Theory of Pain
HAM-D	Hamilton Psychiatric Rating Scale for Depression
IDT	Intrathecal Drug Therapy
IT	Intrathecal
MANOVA	Multivariate analysis of variance
M	Mean
MBMD	Millon Behavioral Medicine Diagnostic
MCS	Mental Component Score (SF-36)
MDD	Major Depressive Disorder
MS	Mean Square

MMPI-2	Minnesota Multiphasic Personality Inventory – Second Edition
N	Total Sample Size
n	Subgroup Sample Size
OR	Odds Ratio
OSW	Oswestry Disability Questionnaire
p	Significance level
PBME	Presurgical Behavioral Medicine Evaluation
PCS	Physical Component Score (SF-36)
PMQ	Pain Medication Questionnaire
PPS	Presurgical Psychological Screening
PT	Physical Therapy
SCS	Spinal Cord Stimulator
SD	Standard Deviation
SF-36	Medical Outcomes Survey 36-Item Short Form Health Survey
SS	Sum of Squares
THQ	Treatment Helpfulness Questionnaire
VAS	Visual Analog Scale
WC	Workers' Compensation
χ^2	Pearson's Chi-Square

CHAPTER ONE
Introduction

Chronic pain is an epidemic in the United States affecting 35% of the general population; approximately 105 million people (Harstall, 2003). Astonishingly, Cousins (1995) reports that health care costs for chronic pain patients exceeds the combined costs of treating patients with coronary artery disease, cancer, and AIDS. Furthermore, health care costs are only a fraction of total costs related to chronic pain. The cost dramatically increases when disability compensation, lost productivity, legal fees, lost tax revenue, and treatment side effects is added to the equation. In terms of numbers, total annual costs to treat chronic pain are between 100 to 150 billion dollars (Turk & Burwinkle, 2005).

Chronic pain patients usually undergo comprehensive nonoperative treatment before more invasive treatments, such as surgery, are considered. Nonoperative care includes medication, education, stretching, and strengthening. In addition, efforts may be made to reduce the patient's weight, discontinue smoking, and equip patients with relaxation techniques, stress management skills, and coping mechanisms. However, when nonoperative care does not provide the patient with adequate pain relief, surgery may be the next treatment approach (Block, Gatchel, Deardorff, & Guyer, 2003).

The number of back surgeries in the United States exceeds 250,000 (Epker & Block, 2001). Two types of common surgical procedures include the use of implantable technologies, such as spinal cord stimulation (SCS), and intrathecal drug therapy (IDT). However, less consistent results are obtained with these more invasive procedures. For example, satisfactory pain relief is experienced 16% to 95% of the time in lumbar spine

fusions, while laminectomy or disectomy procedures result in more consistent outcomes (Epker & Block, 2001). Many studies cite that about 80%-85% of patients categorized as high risk have unfavorable outcomes following spine surgery (Epker & Block, 2001).

It is common for patients, health care providers, and insurance companies to have a mindset that surgery will provide a one-time fix for a patient's chronic pain. Additionally, patients often seek a specific cause for their pain, as well as a treatment modality that has been proven to relieve their specific pain syndromes. While health care providers would often like to accommodate such a desire expressed by the patient, and insurance companies' interests lie in limiting their expenses with a circumscribed diagnosis and treatment plan, in the long run a rush to surgical procedures may prove to be a disservice to all parties involved (Nelson, Kennington, Novy, & Squitieri, 1996).

Poor surgical outcomes affect the patient, the physician, the employer, and the insurance company to some degree. The patient may still lack adequate pain relief and may even experience greater levels of pain. Following surgery, the patient may remain disabled, be more dependent on medication, and experience an increase in emotional difficulty following poor surgical outcome. Often, the health care system is required to pay for increasingly stronger medications as well as expensive multiple treatments. Physicians may also become frustrated with difficult patients that do not respond to treatment and their increasing demands. Lastly, employers may become concerned as to the stability of a worker that appears permanently disabled (Block, 1996).

Despite meeting appropriate clinical criteria and having undergone flawless procedures, patients continue to have failing surgical outcomes for implantable modalities

(Beltrutti et al., 2004). DeBerard, Masters, Colledge, Schleusener, and Schlegel (2002) suggests that in order to improve pre-surgical psychological evaluations performed in real world clinical practice, practitioners should "include using a standardized test battery, protocols for the clinical evaluation, and a decision making algorithm" (p. 421).

CHAPTER TWO
Review of the Literature

THEORTETICAL DEVELOPMENT OF PAIN

The biomedical model of pain states that patient reports of pain are the result of disordered biology. Under this model, common accompanying features of chronic pain, such as change in mood and sleep disturbances, are reactions to the disease. Therefore, once the disordered biology is cured, the reactions to pain will subside (Turk & Monarch, 2002). Melzack and Wall (1965) introduced the gate control theory of pain (GCTP). This was the first theory to suggest that an individual's perception of pain could be described by not only physiological factors, but also psychosocial factors (Gatchel, 2005). The central feature of the GCTP is the existence of a "spinal gate" (Robinson & Riley, 1999, p. 25). The gate is located in the dorsal horn of the spinal cord and moderates the transmission of spinal cord T cells. The relative firing of large diameter and small diameter fibers, which are inhibitory and facilitative respectively, influences the T cells. The firing of these assorted fibers either opens or closes the gate, triggering the T cells and transmitting the pain impulse. In addition, descending fibers, presumably related to cognitive and affective brain systems, influence the gate and can either open or close the gate (Robinson & Riley, 1999).

In essence, the "gate" determines a patient's perception of the pain because it controls the degree of pain signals that reach the brain. Certain thoughts, feelings, and behaviors affect how open or closed an individual's gate is. On one hand, patients may implement coping strategies to manage and control their pain; ultimately closing their gate. On the other hand, patients open their gate when they fail to utilize healthy coping strategies. In addition,

a patient's perception of pain may intensify with self-defeating negative thoughts, feelings of helplessness, hopelessness, anger, stress, and tension. Furthermore, behaviors that result in inactivity, lack of adequate sleep, and poor nutrition may exacerbate symptoms of pain (Gatchel, 2005).

Finally, the biopsychosocial model explains pain as a complex and dynamic interaction between physiological, psychological, and sociological factors. This model proposes that the experience of pain cannot be broken down into physical and psychosocial components as postulated by the biomedical model. The biopsychosocial model provides an explanation as to why each individual patient will perceive and experience pain in a unique manner (Gatchel, 2005).

Turk and Monarch (2002) explain that "biological factors may initiate, maintain, and modulate physical perturbations, whereas psychological variables influence appraisals and perception of internal physiological signs and social factors shape patients' behavioral responses to the perception of their physical perturbations" (p. 7). Research demonstrates that a patient's psychopathology has the ability to influence their biology by disturbing hormone production, brain structure and processes, as well as the automatic nervous system (see Bandura, O'Leary, Taylor, Gauthier, & Gossard, 1987; Knost, Flor, Braun, & Birbaumer, 1997; Bansevicius, Westgaard, & Jensen, 1997). In addition, a patient's behaviors will influence their biology (Turk & Monarch, 2002). For example, when an individual avoids activity that may exacerbate the pain as means to reduce pain symptoms, they may actually increase the severity of their pain through deconditioning. Biological, psychological, and social factors influence the perception of pain at different levels during

the course of pain disease. For instance, during the acute phase, the pain may have a more biological component, but as pain becomes more chronic, psychosocial factors may explain a patient's symptomatology (Turk & Monarch, 2002).

IMPLANTABLE MODALITIES

After the failure of more conservative forms of pain management therapy, it has become increasingly common to implement more invasive treatment options (Williams et al., 2003). Implantable modalities, such as spinal cord stimulation (SCS) and intrathecal drug therapy (IDT) are two examples of invasive procedures commonly considered following failure of conservative treatments.

Spinal Cord Stimulation (SCS)

Shealy, Mortimer, and Rewik (1967) were pioneers of this treatment modality, being the first to stimulate the dorsal column for the treatment of intractable pain (Gatchel, 2005). Spinal cord stimulation is based on the primary tenets of the gate theory. Essentially, an SCS closes the "gate" by selectively activating the large diameter afferent fibers through electrical stimulation (Oakley & Prager, 2002). In an SCS procedure, an electrode array, or lead, is placed in the epidural space with an epidural needle (Cata et al., 2004). Next, utilizing fluoroscopic imaging, the lead is directed toward the desired anatomic location (Cata et al., 2004). The electrodes are then connected to either a passive receiving device or a battery-powered stimulator (Gatchel, 2005). The stimulating unit is usually implanted in the lower abdominal area or in the posterior superior gluteal area (Cata et al., 2004). The physician

then establishes the parameters of stimulation before allowing patients, in most cases, to control the intensity and duration of stimulation (Gatchel, 2005). The device is capable of generating a current along the electrodes, thus interrupting or masking the transmission of noxious sensations from the periphery to the brain (Turk & Burwinkle, 2005). SCS has been used to treat a variety of pain ailments, including failed back surgery syndrome, reflex sympathetic dystrophy, postamputation pain, postherpetic neuralgia, spinal cord injury dysesthesias, and multiple sclerosis (Gatchel, 2005).

A number of studies have determined the efficacy of this treatment option for chronic pain. In 1983, De la Porte and Siegfried performed a four-year follow up on 94 patients with low back pain. All 94 patients had failed at least one previous surgery prior to undergoing SCS. After four years, 60% of the patients rated their pain to have decreased at least 50% and 40% reduced their pain medication intake substantially. This study's significance is indicative in the finding that "once something goes wrong with the stimulation treatment, or the patient presents a clinical complication, his chances of having further complications increase enormously" (De la Porte & Siegfried, 1983, p. 595).

North and colleagues (1991) assessed patient and treatment characteristics in a five-year follow up of 50 patients with failed back surgery syndrome (FBSS) who had received SCS. Failed Back Surgery Syndrome (FBSS), as defined by Oaklander and North (2001), is the "persistent or recurrent, chronic pain after one or more surgical procedures on the lumbosacral spine" (p. 1540–1549). In order to control for experimenter bias, impartial third party individuals interviewed patients at mean follow-up periods of 2.2 and 5.0 years. Success was determined by at least 50% sustained relief and patient satisfaction with the

outcome. At 2.2 years, 53% of the patients were considered to have a successful outcome following SCS and at 5.0 years, 47% of patients were deemed a success (North et al., 1991).

In 1995, Turner, Loeser, and Bell provided a systematic literature synthesis of studies that treated patients with SCS. A total of 39 studies were included in the analysis to determine long-term risks and benefits of SCS for FBSS. At a mean follow-up period of 16 months, 59% of patients treated with SCS achieved at least 50% pain relief. The authors also stated that in order to determine if SCS is superior to other treatments, no treatment, or placebo, there exist a need to conduct more randomized trials (Turner, Loeser, & Bell, 1995).

Kemler et al. (2000) provided one such randomized trial. Kemler and colleagues (2000) studied pain relief in patients with chronic reflex sympathetic dystrophy who received a SCS and participated in physical therapy as compared to those who received physical therapy alone. Twenty-four patients received a SCS after successful trial stimulators and 18 patients participated solely in physical therapy. Prior to randomization, patients underwent a base-line assessment. Patents were also assessed after one, three, and six months. Each assessment period measured the intensity of pain (using the visual-analogue scale or VAS), global perceived effect, functional status, and health-related quality of life. The VAS was presented as a 0 cm to 10 cm scale where 0 cm indicated no pain and 10 cm indicated severe pain. The study found that patients who received SCS and physical therapy had a mean reduction of 2.4 cm on the VAS, while the physical therapy group had an increase of 0.2 cm. In addition, it was reported that the combined SCS and physical therapy group had 39% of patients with a score of “much improved” on the global perceived effect, while only 6% of the physical therapy group improved (Kemler et al., 2000)

Ohnmeiss and Rashbaum (2001) studied the satisfaction patients had with SCS for the treatment of chronic low back pain. Subjects included 41 patients with a mean symptom duration of 82.9 months. Follow-up questionnaires were completed by patients anywhere from 5.5 to 19 months. Sixty percent of the patients considered themselves improved from the pre-operative condition, while 40% did not. In addition, 78.1% of the subjects would recommend the surgery to someone else and 75% would have the procedure performed again if they had known their surgical outcome prior to implantation (Ohnmeiss & Rashbaum, 2001).

In a study conducted by North, Kidd, Farrokhi, and Piantadosi (2005), patients with FBSS were randomly treated with repeated lumbosacral spine surgery or SCS. Forty-five of the 50 randomized patients were available for follow-up after 6 months. Data collected at the 6-month follow-up included ratings of pain intensity, medication intake, and performance of daily activities. Patients were also able to crossover to the alternative procedure following randomization. Fourteen of the 26 patients randomized for reoperation crossed over to SCS while only 5 of the 24 SCS patients crossed over to reoperation. Additionally, long term follow-up showed 47% of patients randomized to SCS achieved at least 50% pain relief and were satisfied with the treatment. This percentage is compared to only 12% of patients randomized to reoperation who achieved the same level of pain relief. Finally, 42% of patients randomized to reoperation increased opioid medication use, while only 13% of the patients randomized to SCS required a medication increase (North et al., 2005).

Intrathecal Drug Therapy (IDT)

Direct implantation of opioids at the spinal level was proven to provide analgesic actions in a study conducted with animals in 1976 by Yaksh and Rudy. This study paved the way for researchers to further investigate intrathecal opioid injections in human subjects. One such study was conducted by Wang, Nauss, and Thomas in 1979. Wang and colleagues (1979) studied the effects of morphine injected into the spinal region of 8 patients. In the study, patients rated their pain prior to injections and after every 15 minutes for one hour following injections using the VAS (0-10). In addition, once the patients experienced pain relief from the injection, they reported at hourly intervals whether they were still experiencing pain relief. Patients received physiologic saline solution intrathecally with or without morphine. Results indicated that 2 of the 8 patients reported pain relief after both the saline solution with morphine and without morphine. However, these two patients had a mean relief duration of 15 hours following the morphine, while only a mean of 7 hours relief following the saline solution without morphine. The remaining six patients reported complete relief from pain after the morphine injections (Wang et al., 1979).

With positive results being found following injection, Coombs and colleagues (1983) treated patients with continuous intraspinal morphine delivered by an implanted continuous infusion system. Five cancer patients experiencing chronic pain and five chronic nonmalignant pain patients were implanted with the infusion devices. Patients were followed up every 3 weeks for up to 12 weeks after implantation. After 12 weeks, cancer patients experienced greater reduction in pain compared to the nonmalignant subjects. The authors explain that the difference in chronic nonmalignant pain patients report of pain is that it may

be learned, in that "with increasing chronicity, the possibility of reward for pain, in the form of financial compensation or selective attention by significant others, is augmented" (Coombs et al., 1983, p. 2339).

During an intrathecal drug delivery system procedure, a pump and a reservoir are implanted. The reservoir contains analgesic medication, in most cases opioids, providing a more potent dosage than oral administration. The pump is set on a preprogrammed schedule to deliver a steady administration of medication directly into the spinal canal (Turk & Burwinkle, 2005).

While IDT provides strong analgesic effects via spinal and supraspinal receptors, it does so without significantly affecting motor, sensory, and/or sympathetic reflexes (Winkelmuller & Winkelmuller, 1996). In addition, an IDT system "provides a more stable cerebrospinal fluid concentration of morphine, thus avoiding the fluctuations of pain relief associated with multiple bolus injections" (Tutak & Doleys, 1996, p. 295). IDT has been proven as an effective treatment modality for patients with chronic pain.

Follett, Hitchon, Piper, Kumar, Calmon, and Jones (1992) treated a total of 37 patients with intractable pain using IDT after successful trials. This study concluded that intrathecal infusion of morphine was an effective method of treating intractable pain. Thirty-five of the 37 patients had cancer-related pain and 77% of the 37 patients implanted reported good pain relief, with a pain intensity of less than 2-3 on the VAS 10-point scale (Follett et al., 1992).

In a study conducted by Tutak and Doleys (1996), 26 patients with chronic noncancer pain were treated with IDT. Patients were followed up after an average time period of 23

months and were asked to rate their pain using the VAS. Average preimplantation rating was 8.9, which decreased to an average pain rating of 5.5 at 6 months and 4.9 average pain rating at 12 months. In addition, daily functioning increased 50%. Overall results indicated that 20 of 26 patients reported good or excellent outcome (Turk & Doleys, 1996).

Winkelmuller and Winkelmuller (1996) retrospectively investigated the long term effects of IDT in 120 chronic pain patients. Patients were followed up anywhere from 6 months to 5.7 years. Throughout this follow up period, 74.2% of patients maintained benefit from IDT. In addition to these results, 92% of patients were satisfied with the therapy and 81% reported an improvement in quality of life (Winkelmuller & Winkelmuller, 1996).

In 2004, Thimineur, Kravitz, and Vodapally performed a 3 year prospective study comparing three subject groups: 1) intrathecal opioid pump recipients (PR), 2) intrathecal candidates who either had an unsuccessful trial or declined the IT treatment (NR), and 3) individuals who were recently referred (NP). NPs received conservative pain management treatment because they were less severe patients. The PRs and NRs received a baseline assessment at the entry into the study and follow ups were done every six months for a three year period. The NPs received a baseline assessment at the entry of the study and at the 3-year mark only. The study showed that the PR group and NP group had improved pain, mood, and function across the 3-year span. On the other hand, the NR group significantly worsened in terms of pain, mood, and function (Thimineur, Kravitz, & Vodapally, 2004).

Cost Effectiveness of SCS and IDT

As previous studies have determined, both SCS and IDT have shown to be effective treatments within clinical trials and some randomized control trials. However, a cost-benefit analysis is necessary in order to determine if this type of treatment is a financially sound decision for years to come. Kumar, Malik, and Demeria (2002) studied the cost-effectiveness of SCS compared with best medical treatment/conventional pain therapy (CPT) over a 5-year period. The study consisted of 104 patients, 60 of which underwent SCS, while the remaining 44 participated in CPT. Data analysis indicated that the mean cumulative cost for SCS was $29,123 per patient, while CPT cost an average of $38,029. In addition, statistics indicated that the cost of treatment was greater for the first 2.5 years of SCS compared to CPT, yet over the 5 year period, SCS proved to be less expensive on average. Lastly, 15% of the SCS returned to work during the follow-up period, while non of the individuals in the CPT were able to do so (Kumar, Malik, & Demeria, 2002).

Kemler and Furnee (2002) found similar results when they compared SCS treatment with physical therapy (PT) and PT alone. Results of a lifetime analysis of patients with chronic reflex dystrophy indicated that SCS cost $60,000 cheaper than PT alone. In addition, the authors reported that SCS patients had significantly lower pain ratings and better quality of life (Kemler & Furnee, 2002).

Kumar, Hunter, and Demeria (2002) performed a study that investigated the cost effectiveness of IDT compared to CPT. The method was similar to previous study in that patients were assessed over a 5-year period. On average, the IDT group's costs were $29,410 over a 5-year period, while the CPT groups average cost was $38,000. Again, initial costs

for IDT were higher than CPT, yet they were recovered by 28 months. The Oswestry Pain Questionnaire (Fairbank et al., 1980) was given at entry into the study and each year for the five years. Statistical analysis of the Oswestry confirmed a 27% improvement in pain for the IDT, while only a 12% improvement in the CPT group (Kumar, Hunter, & Demeria, 2002).

CONCEPT AND RATIONALE OF SURGICAL PRESCREENING METHODS

Complex interactions between physical, behavioral, cognitive, and emotional factors related to an individual's pain symptomatology, at least in part, explains the variability of success of implantable devices. The high risk of SCS and IDT failures has provoked research surrounding the factors that predict poor outcomes. Despite decades of research, many clinicians in the field of pain management still do not agree that psychological factors affect surgical outcome (Williams et al., 2003).

Long, Erickson, Campbell, and North (1981) found that patients who were not screened prior to electrical stimulation surgery had a success rate of only 33%. This percentage increased dramatically to 70% when the candidates underwent psychological screening methods. Patients excluded from surgery had serious mental or physical disabilities, psychiatric disturbances, or poor personality factors. Long and colleagues (1981) concluded that SCS and peripheral nerve stimulation are therapies for chronic pain with organic origins and "the techniques will not benefit problems which are largely behavioral or psychiatric" (p. 216).

In 1985, Daniel, Long, Hutchison and Hunter successfully predicted the surgical outcome of 80% of patients considered for deep brain stimulators or spinal cord stimulators.

They also suggested that that the primary selection criteria for SCS be psychological factors (Daniel et al., 1985). In addition, De la Porte and Van de Kelft (1993) extensively reviewed the literature and found success rates for SCS to range from 15% to 88% within the failed back surgery syndrome population. They also found that studies with good patient screening procedures had success rates of 85% initially and 60% in the long term. On the other hand, studies lacking such pre-surgical screening practices resulted in success rates of 50% immediately and 35% in the long term (De la Porte & Van de Kelft, 1993).

Kupers and colleagues (1994) described a nationwide survey undertaken by Belgian health authorities regarding incidence, indications, and efficacy of SCS. One of the three studies analyzed the psychological screening of patients seeking surgical implantation. The screening methods included a psychological interview performed by a psychiatrist with experience working with pain patients. The psychiatrist determined whether a psychiatric diagnosis was present and whether any psychosocial problems were related to the patient's complaints of pain. The psychiatrist then made one of three recommendations for surgery: 1) contraindication, 2) no firm contraindication, with some reservation, and 3) no contraindication. Six-month outcome assessment revealed that 64% of patients who received a positive recommendation were successful while only 18% of patients who had received a recommendation with some reservation were successful (Kupers et al., 1994).

A study performed by Burchiel et al. (1995) examined physical, demographic, psychosocial variables in order to predict outcome of SCS in patients suffering from chronic back and leg pain. Subjects included 40 patients, with the vast majority diagnosed with FBSS. Assessment of treatment outcome took place three months post implantation and with

a 50% reduction in the visual analogue pain scale defining success. The screening process consisted of a physical examination, a semistructured clinical interview, and administration of the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1943) and psychosocial functioning assessment instruments. Success or failure outcomes following SCS were correctly predicted in 88% of the study population (Burchiel et al., 1995).

Epker and Block (2001) stated that Presurgical Psychological Screening (PPS) serves two purposes. First, the PPS allows the evaluator to gather information regarding psychosocial and medical risk factors in order to determine a surgical outcome based on empirical data. Second, the results of the PPS used by the evaluator can serve as a means to formulate individualized treatment plans. Thus, outcome for acceptable candidates is improved, improvement in motivation with marginal candidates can take place, and those patients not recommended for surgical procedure can begin more conservative treatment modalities to help manage their pain (Epker & Block, 2001).

In a review of the literature, Williams and colleagues (2003) found that 86% of studies involving patients undergoing implantable devices in clinical trials integrated some form of psychological data. However, of the studies reviewed, 41% used no psychological data for screening. In fact, one of the major difficulties in studying the efficacy of evaluating risk factors prior to surgery is a lack of standardized assessment criteria and/or assessment tools (Williams et al, 2003).

Furthermore, Williams and colleagues (2003) stated that manufacturers of implantable devices, as well as insurance companies, often require psychological clearance before a patient receives approval for implantation due to the fact that psychological and

behavioral factors continue to demonstrate significance when predicting patient outcome. Patients and physicians alike need to understand that the psychological assessments will facilitate in determining other interventions that may work with implantable modalities. These treatment plans can work as a means to reduce pain, increase longevity of pain relief, increase functioning, address factors that may lead to suboptimal surgical outcome, as well as discussing a patient's preferences and expectations involving pain relief (Williams et al., 2003). Additionally, Gatchel (2001) states that pre-surgical psychological interventions have the ability to improve invasive procedure outcome for patients. Interventions before surgery can help reduce the patient's stress level, improve motivation, solicit family support, as well as helping the patient determine realistic expectations (Gatchel, 2001).

RESEARCH REGARDING PSYCHOLOGICAL PRESCREENING

In 1993, North, Kidd, Zahurak, James, and Long retrospectively looked at 320 patients who had been implanted with either a temporary or permanent spinal cord stimulation devices between 1972 to 1990. All patients underwent psychological evaluations prior to treatment. In their multidisciplinary treatment program, patients were excluded from surgical procedures if they presented with the following psychological and behavioral characteristics: nonphysiological or "Waddell" signs (see Waddell, 1980) at the time of evaluation, serious drug-seeking or abnormal illness behavior, and major issues of secondary gain. While detailed insight is not included regarding the reasons as to why these particular exclusion criteria were put in place, the authors do stress the importance of psychological testing in predicting SCS outcome (North et al., 1993).

In 1996, Nelson, Kennington, Novy, and Squitieri outlined psychological factors that determine SCS suitability in a conceptual manner. Nelson and colleagues (1996) list of exclusion criteria included active psychosis, current suicidal behavior, active homicidality, untreated major depression and/or other major mood disorders, somatization disorder or other somatoform disorder, serious drug or alcohol addiction problems, pain-related litigation or compensation, lack of social support, and serious cognitive deficits. They also suggest that the psychologist include unusual pain ratings, personality and interpersonal functioning, nonphysiologic signs (e.g. Waddell's signs), and psychological testing results (e.g. MMPI) as part of their evaluation repertoire in order to complement the exclusionary criteria and gain a better understanding of patients' projected surgical outcome (Nelson et al., 1996).

Neban and colleagues (1996) defined nine recommended screening criteria to be used as a means to exclude patients from SCS implantation. Gatchel (2001) summarized them to be the following:

> Active psychosis, active suicidal, active homicidality, untreated or poorly treated major mood disorders such as major depression, an unusually high level somatization or other somatoform disorder, substance abuse disorders, unresolved worker's compensation or litigation cases, lack of appropriate social support, and cognitive defects that comprise adequate reasoning and memory (p. 196).

A study conducted by Prager and Jacobs (2001) proposed that a behavioral evaluation of patients prior to an invasive procedure is essential due to the psychological issues that co-exist with chronic pain and perception of pain relief. Following the behavioral evaluation, the psychologist placed the patient into one of four categories. They defined the patient as

unsuitable if the patient had longstanding psychological disorders and intractable psychiatric symptoms, severe character pathology, high use of health care services without improvement in symptomatology, relapsing chemical dependency, serious and unstable external stress, involvement in litigation, severe regression and disability, and suspicion of malingering or factitious elements (Prager & Jacobs, 2001).

North, Kidd, Wimberly, and Edwin (1996) looked at psychological tests administered before patients received SCS, then compared them to treatment outcomes. Subjects included 58 patients with a variety of pain diagnoses. Patients were given the MMPI and measures assessing change in somatic and emotional states prior to surgery. The mean follow-up period was 3.5 years and patients filled out a questionnaire that was mailed to them. This questionnaire assessed treatment outcomes by asking about pain intensity, pain relief, medication usage, daily functioning, and overall satisfaction with the procedure. Following multivariate statistical analysis, those who displayed low anxiety on an emotional state measure were significantly more likely to receive permanent implantation of SCS. In addition, the study showed that patients who displayed an ability to experience pleasures despite discomfort were more likely to obtain good surgical outcomes (North, Kidd, Wimberly & Edwin, 1996).

EMPIRICALLY TESTED SCORECARDS

Finneson and Cooper developed the first scorecard in 1979. The scorecard consisted of seven positive factors and six negative factors that were completed by the surgeon. An example of a positive factor included “patient’s realistic self-appraisal of future life style”,

while examples of negative factors included “back pain primarily” and “poor psychological background.” These risk factors were given a prior weight and the total score predicted surgical prognosis as good, fair, marginal, or poor. Finneson and Cooper (1979) performed a 3.8 year follow up and stated that the good prognosis patients achieved far better result than the poor prognosis patients, yet no statistical analysis were performed (Block et al. 2003).

Dzioba and Doxey (1984) utilized extensive orthopedic and psychological testing to determine probable surgical outcome. The subjects of their study included 116 patients, 77 of whom were cleared for surgery. Patients were followed up with a complete reexamination 6 and 12 months following the date of surgery, or date of initial evaluation, depending on whether or not they underwent surgery. Statistical analysis indicated an 82% prognosis success rate, with the most significant predictive variables being English proficiency, nonorganic signs, back versus leg pain, the hypochondriasis (Hy) scale on the MMPI, and the pain drawing (Dzioba & Doxey, 1984).

Spengler, Ouellette, Battié, and Zeh (1990) used a scoring system to predict surgical outcome for 84 low back pain and sciatica patients. There were four major categories in the scoring system, including neurological signs, sciatic-tensions signs, psychological factors, and imaging studies. Each of these four categories was allotted a maximum of 25 points and the scoring system determined the appropriateness of each patient for elective lumbar discectomy. The most significant predictor of treatment outcome was psychological factors, which were determined by the MMPI (Spengler et al., 1990).

Another study conducted by Junge, Dvorak, and Ahrens (1995) examined 381 patients using clinical and neurologic examinations. Patients were given an indication for

disc surgery following examinations. After analysis, "outcomes were correctly predicted in 79% of the patients with a bad outcome and in 76% of the patients with a good outcome" (Junge et al., 1995, p. 467).

DEVELOPMENT OF A SPECIFIC PPS ALGORITHM

In 2001, Block and colleagues used the PPS scorecard to determine surgical outcome of 204 spine surgery candidates. The risk factors identified for poor surgical outcome were divided into two categories: medical and psychological. Psychometric testing and clinical interviews were conducted to identify these risk factors. Each risk factor was assigned an a priori weight of either high or medium risk based on preceding research. The authors utilized a 2 x 2 matrix in order to determine good, fair, or poor outcome. Results indicated that 82.3% of patients in the poor prognosis group achieved poor outcome, and only 17% of patients with a poor prognosis achieved fair or good outcomes. Analysis of scorecards involved using a hierarchical regression analysis to determine variables that significantly contributed to outcomes. The hierarchical regression analysis showed a success rate of 84.3%; only slightly more effective at predicting outcome when compared to the PPS scorecard (Block et al. 2001).

Block and colleagues (2003) later refined the original PPS scorecard into the PPS algorithm. In the algorithm, each risk factor is assigned a weight based on the extent of previous research literature. Strong risk factors are assigned a two and moderate risk factors are assigned a one. The replacement of the 2 x 2 matrix with the algorithm offers several additional features. First, considering psychosocial risk factors are most often found to be

strong predictors of surgical outcome, they are placed in the primary position, prior to medical risk factors. Second, the algorithm added adverse clinical features when considering surgical prognosis. Lastly, the paths within the algorithm lead to a set of general treatment conditions as well as surgical prognosis. The PPS algorithm is compiled of interview, testing, and medical risk factors as well as adverse clinical features (Block et al., 2003).

INTERVIEW RISK FACTORS

The PPS interview helps to accomplish three goals. First, the interview is an opportunity for the evaluator to gather information, including further details concerning risk factors. Secondly, the interview provides the patient with information concerning recovery from surgery; possibly augmenting patient recovery. Thirdly, the interview helps the evaluator to understand the patient's perception and reaction to his or her pain, therefore aiding the psychologist in developing a treatment plan and provides a prognosis for surgery (Block et al., 2003).

Job Dissatisfaction

Research shows that psychosocial aspects of employment can predict the development of spine problems. For example, Bigos and colleagues (1991) conducted a longitudinal, prospective study to identify risk factors for back pain at work. Subjects included 3,020 aircraft employees. Those employees who stated they "hardly ever" enjoyed their jobs were an astonishing 2.5 times more likely to report a back injury as compared to subjects who said they "almost always" enjoyed their jobs (Bigos et al., 1991).

In addition, studies have shown that individuals with jobs that involve heavy lifting are more likely to sustain job related injury and have poorer results following spine surgery (Block, 1996). One such study evaluated 17,000 workers in central Sweden and found that those with occupations involving heavy physical loads and high reported job strain also possessed a relative risk of 2.8 for reporting back pain when compared to those without such job conditions (Vingard et al., 2000).

While it remains unclear in the literature as to the interaction between physical and psychosocial aspects of work that may interact to influence spinal surgery recovery, there exists robust research in other areas. Studies show that individuals who enjoy their jobs, feel respected by their supervisors, do not hold employers accountable for their injury, and do not perceive their jobs as high in stress are more likely to respond favorably to invasive and noninvasive spine treatment (Block et al., 2003).

Workers' Compensation

A number of studies correlate patients within the workers' compensation system to poor results from spine surgery. In one study, Klekamp and colleagues (1998) examined 82 patients who underwent lumbar disectomy. They found that of the patients who were not involved in workers' compensation, 81% achieved good results, while only 29% of the workers' compensation patients achieved a good result (Klekamp et al., 1998). Greenough and Fraser (1989) concluded that patients receiving compensation payments report significantly more pain and have a delayed recovery from a low back injury. A meta analysis of studies involving compensation and outcome after surgery found that of the 211 studies,

175 described worse outcome in the compensation, 30 described no difference, 5 did not comment on a difference, and only 1 described a better outcome in the compensation group (Harris, Mulford, Solomon, van Gelder, & Young, 2005).

It is possible to deduce that surgical outcome for a job-injured patient is influenced more so by the economic incentives of remaining disabled rather than the effectiveness of the surgery in correcting psychopathology. However, other factors may play a role in the connection between workers' compensation and poor surgical outcome. One factor may be treatment delay patients experience due to workers' compensation regulations. Furthermore, documentation shows that the average amount a worker receives on workers' compensation rarely exceeds 85% of wages, including tax breaks (Block, 1992). Therefore, the possibility of financial stress cannot be overlooked. Patients' diverted focus on economic survival may hinder rehabilitation efforts (Block et al., 2003)

Litigation

It is common for patients to be involved in pending litigation for various reasons, including: seeking accommodation for lost income; desire for retribution against parties perceived to have caused the injury; retaining a lawyer for workers compensation benefits; and, obtaining legal representation in hopes of receiving disability payments. In 1998, Klekamp and colleagues followed up with patients 40 weeks after undergoing laminectomy/disectomy. After analysis, 73% of patients who lacked legal representation achieved good results while 17% of those with attorneys achieved the same results. Junge et

al. (1995) concluded that if patients were applying for a disability pension, they were more likely to experience poorer surgical outcomes (Block et al., 2003).

Spousal Solicitousness and Spousal Support

Fordyce (1976) suggested that pain behaviors followed by sympathetic or solicitous responses from significant others will tend to increase the probability of occurrence. In a study conducted by Block, Kremer and Gaylor (1980), twenty married chronic pain patients participated in a structured interview. Before the interview, the patients were told that either the spouse would be observing for the first half of interview and in the second half the ward clerk would be observing, or vice versa. Patients were asked to rate current and average pain levels and spouse's response to pain behavior while both the spouse and ward were observing. Results from the study indicate "that chronic pain patients systematically alter their report of pain level depending on their perception of spousal response to pain behavior and whether they believe the spouse to be observing the report" (Block et al., 1980, p. 250). Other studies found similar results indicating the affects of spousal solicitousness on pain behavior; therefore, it is likely surgical outcome will also be influenced by spousal solicitousness (Block et al., 2003).

While spousal solicitousness is associated with increased disability, pain, and reduced outcome, spousal support is linked to improved health and recovery from surgery. Rather than reinforcing disability, spousal behaviors such as bringing medication to the patient and taking care of household responsibilities, may actually be psychologically beneficial to a patient who has recently undergone surgery. When a patient perceives their spouse as

nonsupportive, it is likely that they will experience feelings of not being loved, cared for, or willingly assisted. Feelings of support are critical to surgical recovery. For example, Schade and colleagues (1999) studied 46 patients undergoing lumbar disectomy and found that social support from a spouse was a predictor of pain relief 2 years after surgery (Block et al., 2003).

Abuse and Abandonment

Rubin (2005) cited that at least 40 to 60 percent of women and at least 20 percent of men with chronic pain disorders, report a history of abuse during childhood and/or adulthood. This incidence rate indicates that the chronic pain population is two to four times more likely than the general population to report a history of abuse. Past research indicates a well-established relationship between physical and/or sexual abuse and the development of chronic pain and inferior adjustment to pain (Rubin, 2005).

In 1992, Schofferman and colleagues performed a retrospective study of 100 patients who underwent lumbar spine surgery. Chart review identified if any of five categories of traumas took place during their childhood. The categories were: physical abuse; sexual abuse; alcohol or drug abuse in a primary caregiver; abandonment; and, emotional neglect or abuse. Patient chart review also allowed for identification of surgical outcomes, and such outcomes were deemed unsuccessful if the patient underwent a repeat surgery, failed to return to work or usual housework, sought further medical testing, and/or required continued analgesics. Patients who did not experience any of the 5 childhood traumas had a 95% success rate, whereas patients with one or two of the childhood traumas experienced 73%

surgical success rate, and those who experienced three or more of the traumas experienced 15% success rate (Block et al., 2003).

Substance Abuse

Uomoto, Turner, and Herron (1988) discovered that a history of alcohol abuse was significantly correlated to diminished outcomes of laminectomy/disectomy. The extent to which a patient uses substances may give insight into the patient's sense of responsibility for symptom control and belief that pain control depends on external measures (Block, 1996). After examining spine surgery failures, Spengler, Foreman, Westbrook, and Miller (1980) found that 25 of the 30 failures were frequently abusing medication and alcohol.

Substance abuse is difficult to accurately determine in spine surgery candidates. Patients are often reluctant to disclose use of legal and especially illegal substances. In addition, the changing acceptability of chronic opioid therapy makes it difficult to clearly determine if spine surgery candidates are abusing medication. It is important for evaluators to keep in mind the criterion that render abuse. Evaluators should consider that patients who have who have violated medical contracts, have a history of substance abuse, or called for early refills may be currently abusing and thus potentially comprise surgical outcome (Block et al., 2003).

Psychological History

Kinney, Gatchel, Polatin, Fogarty, and Mayer (1993) found that almost all of the chronic low back pain subjects involved in their study met criteria for a mental health

disorder. Furthermore, results suggested that individuals with preexisting psychopathology may be at risk for remaining stuck in a cycle of chronic pain and disability (Kinney et al., 1993). The most common mental health disorders within the chronic pain population are depression, anxiety, and/or personality disorders (Block et al., 2003). Block and colleagues (2001) concluded that a history of psychological treatment prior to spine surgery significantly contributed to a regression equation predicting poor surgical outcome. In addition, Manniche et al. (1994) found "poor psychological background" as one factor that negatively contributes to spine surgery results (Block et al., 2003).

TESTING RISK FACTORS

Psychometric testing serves to aide psychologists in making objective, accurate, and standardized assessment of a patient's coping mechanisms, personality, and psychopathology. Testing within the PPS serves three main purposes: 1) allows for the psychologist to obtain a great deal of information about the patient, 2) provides a means to check clinical impressions acquired during the clinical interview; and 3) provides results that can be linked to empirically based data in the literature to facilitate the evaluator in making appropriate treatment recommendations and surgical prognoses (Block et al., 2003).

Pain sensitivity

Extensive research has been dedicated to determine connections between pre-surgical patients and the Minnesota Multiphasic Personality Inventory (MMPI), and its revision, the Minnesota Multiphasic Personality Inventory- Second Edition (MMPI-2) (MMPI-2; Butcher,

Dahlstrom, Graham, Tellegen, & Kaemmer, 1989). The two elevations that have been commonly with poor surgical outcome are the Hs (Hypochondriasis) and Hy (Hysteria) (Block et al., 2003). Elevations on these two scales may indicate a propensity toward excessive focus and sensitivity to physical symptoms and pain (Graham, 1990). Spengler and colleagues (1990) found that elevations on the Hy and Hs scale contributed 26% to a multiple regression equation, while imaging studies contributed 10% and neurological signs only 3%. This suggests that the Hs and Hy scales are strong predictors of outcome as compared to physical variables (Block et al., 2003).

In a study by Block and colleagues in 1996, patients completed an MMPI-2 prior to undergoing discography. Discography is defined as "a procedure that involves injections of radiographic contrast material into the nucleus of intervertebral discs suspected of being degenerated or disrupted" (Block et al., 2003, p. 83-84). Patients received injections at 3 lumbar disc levels where at least one was suspected to be normal. The injection of damaged discs should provoke pain, whereas injection of a normal disc is not pain provoking (Vanharanta et al., 1987). Patients who reported pain reproduction when normal disc levels were injected were more likely to have elevated Hs and Hy scores (Block et al. 2003).

Depression

A diagnosis of clinical depression among chronic pain patients is common; up to 85% in a study performed by Lindsay and Wyckoff (1981). This is not surprising considering chronic pain patients are likely to have reduced functional ability and deconditioning, thus reducing their ability to engage in enjoyable activities. Additionally, chronic pain patients

may experience feelings of hopelessness and a sense of loss control in terms of their health, money, work, and medical treatment (Block et al., 2003).

A study performed by Kremer, Block, and Atkinson (1983) showed that depressed patients were less likely to notice improvements when they occurred. Staff members observed patients in an inpatient pain unit and recorded the number of times they were seen standing, waling, sitting or reclining. While all patients showed improvement (defined by more time spent walking and standing) some patients underresponded to their improvement. The researchers found chronicity of pain reports and Beck Depression Inventory (BDI; Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961) scores were strongly correlated to underreporting of improvement. Another study, conducted by Junge and colleagues (1996) negatively correlated high scores on the BDI (Beck et al., 1961) with diminished spine surgery success (Block et al., 2003).

Block et al. (2003) note that chronic pain patients can either have a history of depression prior to the onset of pain or a patient's depression can be reactive in nature. While there is not adequate research regarding the onset of depression and surgical outcome, it would seem that patients with chronic depression would retain symptoms post-operatively (Block et al., 2003). Pre-existing symptoms of depression are common in chronic pain patients, as evident in Polatin and colleagues (1993) study, which found that of the 200 chronic pain patients evaluated, 39% displayed symptoms of pre-existing depression.

Anger

Patients may blame a number of entities for their current condition, including attorneys, insurance agencies, mental health professionals, significant others, God, employers, oneself, ect. According to Fernandez and Turk (1995), anger may have a negative impact on treatment outcome. Treatment requires mutual trust, acceptance, and co-operation between provider and patient; therefore angry feelings may inhibit therapeutic alliances. Also, anger may detract from the course and pace of treatment through non-cooperation and passive aggressive behaviors. And finally, Turk and Rudy (1990) suggested that untreated anger may result in a vicious cycle of treatment failures and increased levels of frustration and anger; thus trapping themselves in a self-perpetuating rut. Anger also can pose many indirect threats to a patient's medical health, including: hypertension, cardiovascular health, ulcers, headaches, and asthma (Fernandez & Turk, 1995).

In a study performed by Trief and colleagues (2000), spine surgery results were examined and compared to the Cook-Medley Hostility subscale on the MMPI-2. Subjects were followed up one year after spine surgery. Researchers found that the individuals who scored higher on the Cook-Medley Hostility subscale were less likely to be working and had less improvement in daily activities (Block et al., 2003).

Anxiety

Research suggests that anxiety reduces the threshold of pain perception and tolerance, increases the awareness of chronic pain, as well as increases muscle tension, and therefore leads to an increase in pain. In a review by Kiecolt-Glaser, Page, Marucha,

MacCallum, and Glaser (1998) suggests that anxiety may also negatively affect spine surgery outcome. Anxiety increases the time it takes a wound to heal by reducing the production of proinflammatory cytokines (Kiecolt-Glaser et al., 1998). Secondly, anxious individuals may need greater amounts of anesthetic and participate in negative behaviors that influence the course of surgery (Kiecolt-Glaser et al., 1998). Negative behaviors include consuming high levels of alcohol and/or overeating. Individuals who consume high levels of alcohol may require more anesthetics, while obese patients may require more time for surgery and experience more extensive tissue damage (Kiecolt-Glaser et al., 1998). Furthermore, anxiety is related to increased pain following surgery and contributes to lowering optimal immune system functioning (Block et al., 2003)

In a study conducted by Trief, Grant, and Fredrickson (2000), patients completed measures of distress prior to lumbar surgery. After one year, patients completed a functional abilities measure and questions regarding employment status. Results indicated that patients with high anxiety scores were significantly less likely to return to work or report changes in pain levels (Trief, Grant, & Fredrickson, 2000).

Catastrophizing

"Catastrophizing has been broadly conceived as an exaggerated negative 'mental set' brought to bear during actual or anticipated pain experience" (Sullivan et al., 2001, p. 53). Literature supports the notion that a relationship exists between catastrophizing and heightened pain experience, increased pain severity, increased use of pain medication, and more interference with daily activities (Sullivan et al., 2001). Catastrophizing is a coping

mechanism that may ultimately worsen the emotional and sensory impact of spine surgery (Block et al., 2003).

Gross (1986) examined coping strategies and surgical outcomes of patients who underwent a laminectomy procedure. Fifty patients filled out the Coping Strategies Questionnaire (CSQ; Rosenstiel & Keefe, 1983) prior to surgery. Gross (1986) found that patients who scored high on "loss of control" reported more pain and poorer surgical outcome compared to patients with lower scores. "Loss of control" is determined by combining high scores on the catastrophizing scale and low scores on the pain control scale (Gross, 1986).

MEDICAL RISK FACTORS

Review of a patient's chart becomes the basis for a psychologist's assessment of medical risk factors. Prior to visiting with the patient, the psychologist may gain a vast amount of information through careful examination of the medical chart. The medical chart contains information concerning medical risk factors, including: duration of pain, surgery destructiveness, nonorganic signs, pain drawings, previous surgeries, health care utilization, smoking and obesity (Block et al., 2003).

Duration of Pain

An inverse relationship exists between duration of pain and activity. As duration of pain increases for a patient, their activity level decreases. Patients will naturally tend to avoid situations that increase their level of pain, and therefore may be at risk for developing

deconditioning syndrome. Deconditioning syndrome, as defined by Mayer and Gatchel (1988), is defined as the deterioration of a patient's general fitness due to their decreasing activity. As deconditioning progresses, a vicious cycle soon develops, whereby muscle strength declines, ligaments and tendons shorten, and the patient gains weight. As the patient's body becomes increasingly deconditioned, activity level continues to decline, and reinforces pain and disability (Block et al., 2003).

In 1987, Waddell found that the longer a patient experienced back pain, the less likely the chances were that the individual would return to work. Patients with a duration of pain of 6 months returned to work 50% of the time, those with a duration period of 12 months returned to work 25% of the time, and virtually no individuals returned to work if they had experienced pain for duration of 2 years (Waddell, 1987). Franklin and colleagues (1994) examined patients who underwent lumbar fusion and found that the duration of time from the original injury significantly increased the risk of poor surgical outcome (Block et al., 2003).

Surgery Destructiveness

A surgery is considered more destructive when greater amounts of tissue are exposed, destroyed and/or removed or, if instrumentation, such as facet screws, are inserted. Block et al. (2003) stated that when a patient experiences a destructive surgery it requires more physiological stamina and may lead to a number of secondary problems. First, a more destructive surgery frequently will prolong recovery time and pose difficulties in determining how quickly patients are able to return to normal functioning (Block et al., 2003). Next, more destructive surgeries may increase the likelihood that patient will require higher

dosages of narcotic medication (Block et al., 2003). Destructive surgeries also tend to require subsequent use of external appliances, including: back braces, canes, and/or walkers (Block et al., 2003). Finally, and perhaps most significant, is the fact that the likelihood of a return to full functionality decreases with greater surgery destructiveness (Block et al., 2003). This was evident in a study conducted by Franklin and colleagues (1994), which found that patients in the Washington State workers compensation system had worse functional outcome when a greater number of levels were fused in surgery. In addition, Turner (1992) surveyed past lumbar fusions and found that while fusion techniques varied widely within and across studies, he found that positive outcomes tend to be positively associated with single level infusions.

Nonorganic Signs

Individuals within the chronic pain management field continually attempt to conceptualize the issue of pain sensitivity, otherwise known as symptom magnification. A patient identified as pain sensitive experiences a level of pain or exhibits a level of physical disability that does not mach their identified physical pathology. While a psychologist may utilize the MMPI-2, among other measures, as a means to determine pain sensitivity through scale elevations on Hypochondriasis (HS) and Hysteria (Hy), a physician may perform a physical exam developed by Waddell et al. (1980) to determine whether a patient's pain possesses a nonorganic component (Block et al., 2003).

Dzioba and Doxey (1984) examined nonorganic components of back pain and found that when a patient scored 2 or more positives out of the 21 nonorganic signs, prognosis for

lumbar surgery was poor (Dzioba & Doxey, 1984). Furthermore, Lehmann, Russell, and Spratt (1983) found that patients displaying nonorganic signs responded less favorably to transcutaneous electrical nerve stimulation than those without nonorganic symptomatology (Block et al., 2003).

Abnormal Pain Drawings

The basic components of a pain drawing are that it displays front and back outlines of a human figure (Block et al., 2003). The patient is instructed to indicate the area of symptoms on the outlines of human figures (Takata & Hirotani, 1995). Pain drawings are widely implemented in pain management clinics due to the fact that they allow clinicians to quickly view the areas in which the patient is experiencing pain and additionally provides insight into the patient's perception of their pain (Block et al., 2003). The pain drawing can assist clinicians in determining whether the pain is functional or has psychological component (Takata & Hirotani, 1995).

When studying scorecards, Dzioba and Doxey (1984) found abnormal pain drawings to be predictive of surgical outcome. Furthermore, the pain drawing test served to complement the MMPI results, rather than displacing them. This would suggest that both pain drawings and MMPI would be beneficial during PPS (Dzioba & Doxey, 1984). Another study conducted by Uden, Astrom, and Bergenudd (1998), examined pain drawings of chronic pain patients. Patients with a pain drawing that showed poorly defined patterns with expansion into other, nonanatomical parts of the body experienced poorer outcomes following conservative treatment (Uden, Astrom, & Bergenudd, 1998).

Previous Surgeries

Oaklander and North (2001) estimated that anywhere from 10% to 40% of all spine surgeries result in FBSS. Turner and colleagues (1992) found that studies with high proportions of patients with previous back surgeries reported worse outcomes as compared to those without a surgical history. Similar findings Taylor et al.'s (2000) research confirmed that significantly worse outcomes resulted among patients with at least one prior back operation.

Health Care Utilization

Research suggests that patients are less likely to experience favorable outcomes following surgery if they possess a history of visiting health care professionals. High levels of health care utilization may reflect a patient's high sensitivity to pain and/or other physical symptoms. Patients who regularly seek medical attention may be overly distressed about symptomatology. Therefore, they may be less likely to experience relief following spine surgery. Heightened awareness of symptoms, also called hypervigilance, will only diminish one's ability to overcome pain problems. Research connects hypervigilance to many medical condtions, including fibromyalgia and irritable bowel syndrome (Block et al., 2003).

Hoffman and colleagues (1993) reviewed the literature regarding surgical outcomes for herniated lumbar discs. They found that improved outcome after surgery was generally more likely in patients who had fewer number of previous hospitalizations (Hoffman et al., 1993). Similarly, Ciol et al. (1994) discovered an increased risk of lumbar spine reoperations for subjects who had a relatively high number of prior hospitalizations (Block et al., 2003).

Smoking and Obesity

Several studies reveal that smoking generally increases one's risk of experiencing chronic low back pain. Hellsing and Bryngelsson conducted one such study in 2000. The study was a 20-year longitudinal study with soldiers enlisted in the Swedish army. Findings showed that soldiers who smoked more than 11 cigarettes a day were 1.5 times more likely to have back pain. However, the research regarding smoking and spine surgery remains relatively inconclusive. While Manniche et al. (1994) found that patients with a history of smoking achieved less favorably outcomes following discectomy, Block et al. (2001) did not find conclusive correlating smoking and clinical outcome (Block et al., 2003).

Obesity may also impact spine surgery outcome by increasing the time the surgical procedure takes physical stress on the structure of the spine in overweight patients. Block et al. (2001) defined obesity as 50% above ideal weight, and used a stepwise hierarchical regression model to determine impact. Statistical analysis showed that obesity was a significant predictor of surgical outcome, more so than chronicity, number of previous surgeries, and surgery type (Block et al., 2003).

ADVERSE CLINICAL FEATURES

Identification of adverse clinical features relies on the expertise and insight of the examiner. Adverse clinical features include inconsistency, medication seeking, staff splitting, noncompliance or minimal compliance, threatening behavior, defeatist resignation, deception, and personality disorders. Presence of these features should be taken into

consideration and possibly change treatment recommendations made by the examiner (Block et al., 2003).

PPS PROGNOSIS

As stated earlier, each risk factor is assigned an a priori weight based on the extent of research supporting the risk factor. In order to determine a prognosis for surgery, the psychologist must total the weights of identified psychosocial risk factors. The psychosocial risk factors are determined by adding up the total interview and testing risk factors. According to the PPS algorithm, patients with a poor prognosis are recommended for discharge or noninvasive treatment. On the other end of the spectrum, patients with a good prognosis are recommended for post-operative psychological treatment or no psychological treatment necessary. Furthermore, patients with a fair prognosis were recommended to work with a psychologist on compliance and motivation (Block et al., 2003).

SCHOCKET'S (2005) STUDY

Schocket (2005) examined patients who underwent Pre-surgical Behavioral Medicine Evaluations (PBME) when being considered for IDT or SCS procedures. The PBME was derived from the algorithm developed by Block and colleagues (2003). In addition, Block et al.'s (2003) nomenclature was refined and placed patients in one of five recommendation groups. Patients were placed into Green, Yellow I, Yellow II, Red I, and Red II groups based on their treatment recommendations. Patients in the Green group were cleared for surgery with no behavioral treatment, Yellow I patients were recommended for post-

operative behavioral treatment, Yellow II patients were recommended for pre-operative behavioral treatment to work on compliance and motivation, Red I patients were recommended for non-invasive treatment exclusively and Red II groups were recommended for discharge (Schocket, 2005). Schocket (2005) looked at biopsychosocial factors of patients at evaluation and 6-months post evaluation.

Schocket (2005) found interesting differences between diagnostic groups at the time of evaluation. When comparing the Green and Red groups, males were much more likely (18.7 times) to be categorized in the Green prognostic group than females. When comparing Green and Yellow II groups, males were 5.4 times more likely to be placed in the Green group. In terms of disability payments, a significantly greater number of patients receiving payments were categorized in the Red group. Furthermore, as prognosis improved, the number of patients receiving payments decreased. When considering physical and functional measures at the time of evaluation, the Green group had the greatest perceived physical functioning indicated by vocational status. Next, the Red group underwent six times more health care visits as compared to the Green group (Schocket, 2005).

Schocket also looked at psychological and social distress in patients at evaluation. The MMPI-2 was one of a number of measures utilized by the behavioral psychologist to determine prognostic group. The Yellow II and Red groups had the highest elevations on the Scale 1 (Hypochondriasis) and Scale 3 (Hysteria) on the MMPI-2. The Green group also showed significantly lower scores on measures of depressive symptomatology (Depression scale on the MMPI-2, Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), and the Hamilton Psychiatric Rating Scale for Depression (HAM-D;

Hamilton, 1960). In terms of Scale 4 on the MMPI-2, measuring anger, the Green group had the lowest scores as compared to the other groups. The Green group also scored the lowest on scales that determined anxiety and social introversion. Finally, the Red group scored highest on the CSQ Catastrophizing scale, while patients with lower scores improved their prognosis. Overall, the Green group scored favorably compared to the Red group at the initial evaluation on the MMPI-2 on scales, HAM-D, and the Catastrophizing scale of the CSQ (Schocket, 2005).

Schocket (2005) also assessed patients 6-months following the PBME evaluation. The measures used to assess follow-up outcomes were the Visual Analogue Scale (VAS) or Pain Drawing Analogue (PDA; Ransford, Cairns, & Mooney, 1976), BDI, the Medical Outcomes Survey 36-Item Short Form Health Survey (SF-36; Ware, Snow, Kosinski, & Gandek, 1993), the Oswestry Disability Questionnaire (OSW; Fairbank, Couper, Davies, & O'Brien, 1980), medication record, as well as questions regarding health care utilization, disability payments, and vocational status. Overall, the Green group displayed better biopsychosocial functioning compared to the Red group. For example, based on the SF-36/MCS, the Red group possessed the greatest amounts of mental impairment, while the Green group possessed the greatest percentage of patients using no medications.

Finally, when studying the algorithm, Schocket (2005) found the interview risk factors, psychological testing risk factors, adverse clinical features, and the medical risk factors to be significantly different between the groups; however, the least significant difference among the groups were the medication risk factors different between groups. As stated previously, medication risk factors were found to be least predictive of surgical

outcomes in Block and colleagues (2001) algorithm. Most interestingly, adverse clinical features were significant in predicting poor surgical outcome, thus suggesting that they may play a more significant role than previously thought by Block and colleagues in 2003 (Schocket, 2005).

SCOPE OF CURRENT INVESTIGATION

The current study is an extension of Schocket's (2005) investigation. As reviewed in the literature, SCS and IDT are effective modes of treatment for chronic pain, yet there seems to be more than just biological components that affect surgical outcome. The Pre-surgical Behavioral Medicine Evaluation is not only compliant with most insurance demands, but also reduces the risk of litigation and poor outcomes on part of surgeons. This study was planed to provide additional evidence for pre-surgically evaluating patients' psychosocial and medical risk factors prior to undergoing invasive procedures in order to improve surgical outcomes. This was be accomplished by further analysis of the longitudinal data collected by Schocket (2005), with the addition of follow-up evaluations at 6-months post PBME evaluation. Additionally, the current study analyzed the biopsychosocial functioning of patients 12-months post PBME evaluation. The goal was to determine the effectiveness of using the modified PBME evaluation, described in Schocket's (2005) investigation, to predict outcomes.

The PBME algorithm is a revised algorithm that provides the evaluator with different a prior weights for each risk factor as well as a different set of presurgical prognosis and recommendations to the physician. Our PBME algorithm places patients into one of five

recommendation groups: 1) Green - no recommendations, proceed with surgery; 2) Yellow I - surgery with post-operative behavioral medicine treatment recommended; 3) Yellow II - pre-operative behavioral medicine treatment focusing on compliance and motivation measures recommended; 4) Red I - non-invasive treatment recommended); and 5) Red II - discharge recommended, with no treatment of any kind. Similarly to Shocket's (2005) study, the Red I and Red II groups were merged into a single Red group in order to increase power when analyzing differences among the groups.

Data collected at the initial evaluation and 6-months and 12-months post-PBME evaluation were analyzed in order to determine differences among the groups in terms of mental and physical functioning. Group assignment was based upon the behavioral psychologist's surgical prognosis as indicated by the PBME algorithm. The following hypotheses were proposed for the current investigation.

Hypothesis One

It was hypothesized that at the initial evaluation, individuals would differ among groups in terms of disability payment status, health care utilization, pending litigation status, and vocational status. It was also hypothesized that a greater proportion of patients in the Red group compared to the other groups would be receiving disability payments, utilize health care more, and had yet to return to work. Analysis of Variance (ANOVAs), non-parametric tests, and chi-square statistical tests were used to determine the differences

Hypothesis Two

The current study investigated the risk factors for reduced surgical outcome within the algorithm. The risk factors were analyzed in order to determine differences among the groups. It was hypothesized that the risk factors would be different among the groups and the Red group would have significantly higher risk factor scores than the Green group.

Hypothesis Three

The current study investigated the effectiveness of using the PBME algorithm. It was hypothesized that the Green group would show better biopsychosocial functioning, while the Red groups would show the worst biopsychosocial functioning at intake, 6- and 12-months post pre-surgical evaluation. Therefore, biopsychosocial functioning was analyzed at the time of evaluation, as well as 6- and 12-months post pre-surgical evaluation. Statistical tests utilized for this hypothesis included ANOVAS, repeated measures ANOVA, non-parametric tests, chi-squares, and pair-wise comparisons.

CHAPTER THREE
Methodology

SUBJECTS

The Pre-surgical Behavioral Medicine Evaluation (PBME) subject group consisted of 95 patients. Patients were referred by physicians for a pre-surgical behavioral medicine evaluation in order for a behavioral psychologist to make a surgical prognosis. Patients were surgical candidates for either an electrical nerve stimulator or an intrathecal pump. Patients were evaluated during the time period from September 2003 to June 2006.

In terms of gender, 58.9% of the initial evaluation sample was female, while 41.1% were male. The average age was 54.60 years (SD = 14.85). The racial breakdown of the sample determined that 90.5% were Caucasian patients, 4.2% were African-American, 4.2% were Hispanic, and 1.1% was other races. Of the 95 patients, the majority were married (67.4%), while 12.6% were separated or divorced, 12.6% were widowed, 6.3% were single, and 1.1% was living with a significant other. Sixty percent of the patients reported that they were not receiving disability payments, leaving the remaining 40% receiving disability payments. Only 15.8% of the initial evaluation sample stated that they were involved in pending litigation related to their current pain condition. The average duration of patient's pain was 102.05 months, however this varied tremendously (SD = 105.11). Finally, the majority of patients (62.1%) were evaluated for a spinal cord stimulator. The remaining breakdown of the type of procedures is as follows: 27.4% IT pump, 4.2% deep brain stimulator, 4.2% optical nerve stimulator, 1.1% jaw stimulator, and 1.1% for the removal of

melanomas and placement of a drain in back of thigh. A summary of the initial evaluation data for the total sample is presented in Table 1.

PROCEDURE

Patients were given a packet of paperwork upon referral for a pre-surgical evaluation. The packet consisted of the following: 1) explanation of the PBME; 2) consent form for psychological assessment and treatment; and 3) questionnaires collecting pain levels, current medication usage, impact of pain on physical and emotional functioning, and general impact of pain on lifestyle. The patient filled out the paperwork prior to evaluation and brought this packet to their evaluation. Behavioral medicine psychologists conducted the pre-surgical evaluations at The Eugene McDermott Center for Pain Management at The University of Texas Southwestern Medical Center at Dallas, Texas (Center).

The evaluation included a review of available records, a semi-structured diagnostic interview, and psychological testing. The psychologist integrated the diagnostic interview, available records, and psychological testing in order to make appropriate recommendations for treatment and surgery. Missing data was mainly due to the high volume of patients seen in the Center and the large amount of testing measures utilized. Once the psychologists completed their recommendations, a summary of the results were immediately faxed to the referring physician followed by a full detailed report in the mail. The results outlined risk factors and recommendations for surgery in a succinct manner for the physician. The psychologists' recommendations fell into five categories: 1) proceed with surgery; 2) proceed with surgery and post-operative behavioral sessions; 3) pre-operative behavioral sessions

prior to surgery; 4) non-invasive therapy recommended exclusively; 5) discharge with no treatment of any kind. The treating physician discussed the recommendations with the patient. If the patient wanted to discuss the results with their psychologist, they had the opportunity to schedule an additional appointment with the psychologist.

Pre-operative treatment typically consisted of 3-4 behavioral medicine sessions with a psychologist. The goal for these sessions was to prepare patients with the tools and coping mechanisms necessary to identify and manage psychosocial factors that can influence surgical recovery. When the patient completed the suggested sessions, surgical recommendations were reassessed. Post-operative treatment consisted of anywhere between one to ten sessions with a psychologist. The goal of these sessions was to improve the patient's compliance and motivation, while helping them cope and adjust to issues that arise after surgery.

At the initial evaluation, a number of variables were collected, including gender, age, race, marital status, duration of pain, type of procedure, and whether or not the patient is receiving disability payments or involved in pending litigation. The variables can be divided into either categorical or continuous variables. Categorical variables include gender, race, marital status, type of procedure, disability payment status, and pending litigation. Continuous variables include age and duration of pain. Each of these variables was analyzed in order to determine any differences among the four prognostic groups (Green, Yellow I, Yellow II, and Red). Again, the Red group refers to the combination of the Red I and Red II groups.

Patients were followed up at 6- and 12-months post pre-surgical evaluation. Patients were asked to complete the Oswestry (OSW; Fairbank, Couper, Davies, & O'Brien, 1980), the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), and the Medical Outcomes Survey 36-Item Short Form Health Survey (SF-36; Ware, Snow, Kosinski, & Gandek, 1993). Furthermore, patients were asked to rate their current pain level from 0 to 10, with 0 being no pain and 10 being the worst possible pain. Questions concerning vocational status, healthcare utilization, litigation, disability payments, and surgical procedure were also asked. Patients were asked to complete the follow-up by phone or in person if they were still being seen at the Center. Follow-ups completed by phone took anywhere from 15 to 20 minutes. Lastly, at the 12-month follow up, each patient was asked to complete additional questionnaires. These measures were sent via mail to the patient. The measures included the Coping Strategy Questionnaire (CSQ; Rosenstiel & Keefe, 1983), the Dallas Pain Questionnaire (DPQ; Million, Haavik-Nilsen, Jayson, & Baker, 1981), and a medication list.

Instruments and Outcome Measures

Confidential Pain Questionnaire (CPQ)

The Confidential Pain Questionnaire is a self-report measure. The patient records demographic information, date and details of injury/pain condition, previous treatments for pain condition including any surgeries, employment status, education level, disability payment status, workers' compensation or personal injury litigation involvement, health care utilization, additional contact numbers, and other chronic health problems.

Visual Analogue Scale (VAS) or Pain Drawing Analogue (PDA; Ransford, Cairns, & Mooney, 1976)

This instrument is a visual analogue scale designed to rate the patient's degree of pain on a scale from 0 (no pain) to 10 (worst possible pain). The scale is a 10-centimeter horizontal line hashed at two-point intervals. The patient is asked to place an "X" on the line to represent his or her current level of pain. Empirical data supports the use of the VAS with chronic pain patients. The VAS has also demonstrated good psychometric properties (Gatchel, Mayer, Capra, Diamond, & Barnett, 1986; Rissanen, Alaranta, Sainio, & Harkonen, 1994).

Dallas Pain Questionnaire (DPQ; Million, Haavik-Nilsen, Jayson, & Baker, 1981)

The DPQ is an analogue scale comprised of 15-self report questions assessing an individual's perceived pain and disability. Subjects indicate their response to each question by marking a point on a 10-centimeter line, representing a range of possible answers from 0 to 10. The total score is comprised of all the responses added together. Scores of 0 to 39 indicate "mildly disabling" pain; 40 to 84 indicate "moderately disabling pain"; and 85 and above indicate "severely disabling pain." The Dallas Pain Questionnaire has particular utility when the self-report of pain exceeds that which would be projected given physical findings, suggesting the existence of a psychosocial component in the patient's disability (Capra, Mayer, & Gatchel, 1985).

Oswestry Disability Questionnaire (OSW; Fairbank, Couper, Davies, & O'Brien, 1980)

The Oswestry is a self-rating scale that provides an evaluation of the degree of functional impairment. The Oswestry is comprised of 10 questions assessing limitations of various activities of daily living secondary to pain. The items are scored on a 0-5 point scale, with a potential range of scores from 0 to 50. The Oswestry has demonstrated adequate reliability, with test-retest reliability found to be .99 with 24 hours between administrations; it has also shown adequate validity (Kaplan, Wurtele, & Gillis, 1996; Leclaire, Blier, Fortin, & Proulx, 1997).

Pain Medication Questionnaire (PMQ; Adams et al., 2004)

Adams (2004) developed the PMQ as a screening instrument in order to assess the risk of opioid medication misuse among chronic pain patients. The 26 self-report items were constructed based on behavioral correlates and attitudes suggestive of opioid misuse. The PMQ was found to be psychometrically sound, with a test-retest reliability coefficient of .85, and examination of internal consistency yielded a Cronbach's alpha of .73. High-risk scores are associated with greater likelihood of substance abuse potential and/or history, higher levels of psychological distress, reduced coping, and poorer physical functioning, including higher rates of unemployment (Adams et al., 2004).

Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961)

The Beck Depression Inventory is a 21-item self-report inventory designed to assess the intensity of depressive symptomatology. Each item is scored from zero to three, with a

potential range of scores from 0 to 63. A total score of 0-9 is deemed normal; 10-15 is mild depression; 16-19 represents mild to moderate depression; 20-29 reflects moderate to severe depression; and 30+ indicates severe depression. Research using the BDI has established good psychometric properties, including internal consistency reliability coefficients exceeding .73 in non-psychiatric samples. The Hamilton Rating Scale for Depression (HAM-D 1960) and the BDI have correlations of .73, suggesting adequate validity (Beck, Steer, & Garbin, 1988).

Millon Behavioral Medicine Diagnostic (MBMD; Millon, Antoni, Millon, Meagher, & Grossman, 2001)

The MBMD is a 165-item, self-report inventory that is used to assess psychological factors that can influence the treatment course of medical patients. According to the developers, the MBMD is a substantial upgrade from their previous Millon Behavioral Health Inventory (MBHI). The MBMD generates 29 clinical scales, 3 response pattern scales, 1 validity indicator, and 6 negative health habits indicators. It is appropriate for use with adult clinical and rehabilitation patients (aged 18-85) who are undergoing medical care or surgical evaluation. The MBMD has demonstrated satisfactory reliability with an internal consistency estimate of .79, and test-retest estimates with a median value of .83 (Millon, Antoni, Millon, Meagher, & Grossman, 2001).

Minnesota Multiphasic Personality Inventory-Second Edition (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989)

The MMPI-2 is a 567-item, self-report measure of personality functioning and psychiatric symptoms. It is the most commonly applied personality test for patients with chronic pain. Individuals experiencing chronic pain demonstrate a higher prevalence of psychiatric disorders, particularly depression and personality disorders, than the general population (Deardorff, 2001). There are 10 empirically-derived clinical scales and a number of supplementary scales. Several validity scales are provided to assess the test-taking attitudes of the patient.

The MMPI-2 normative sample closely approximated 1980 census data, and demonstrated adequate internal consistency and test-retest reliability (Graham, 1990). In the assessment of chronic pain patients, the MMPI-2 is useful in identifying psychopathology as well as personality and behavioral characteristics, treatment planning, and prediction of treatment outcomes (Deardorff, 2001). A meta-analysis conducted by Parker, Hanson and Hunsley (1988) reported an average stability coefficient of .74 for the MMPI-2 test-retest reliability, and an average internal consistency correlation of .87. The MMPI was found to be effective in distinguishing between psychiatric and control groups, neurotic and psychotic groups, and depression and anxiety groups, suggesting good discriminate validity (Zalewski & Gottesman, 1991).

Medical Outcomes Survey 36-Item Short Form Health Survey (SF-36; Ware, Snow, Kosinski, & Gandek, 1993)

The SF-36 is a 36-item self-report questionnaire that assesses health-related quality of life, both physical and mental. It is widely used for routine monitoring and assessment of health-care treatment outcomes. It yields a total of eight scales, as well as two standardized summary scales called the Mental Component Scale (MCS) and the Physical Component Scale (PCS), which correspond respectively to patients' overall sense of physical and mental well-being. The availability of population-based normative data from various medical populations makes the SF-36 useful for comparative purposes as well. Several studies have reported high test-retest reliability coefficients, and examination of internal consistency has found Cronbach's alphas exceeding .70, and usually above .80 (Ware, Snow, Kosinski, & Gandek, 1993).

Coping Strategy Questionnaire (CSQ; Rosenstiel & Keefe, 1983)

The Coping Strategy Questionnaire is a 42-item self report inventory that assesses how often individuals use six cognitive coping strategies and 2 behavioral coping strategies, including diverting attention, reinterpreting pain sensations, ignoring pain, praying and hoping, coping self-statements, increasing behavioral activities, and catastrophizing. It also contains 2 additional items related to subjective ability to control and decrease pain. Patients indicate on a 6-point scale (where 0 = never do that, 3 = sometimes do that, and 6 = always do that) the activities they engage in when experiencing pain. The CSQ has demonstrated adequate to excellent internal consistency (Rosenstiel & Keefe, 1983) and test-retest

reliability (Main & Waddell, 1991). Factor scores derived from the CSQ have been shown to be associated with dimensions of pain-related adjustment and functioning (Dozois, Dobson, Wong, Hughes, & Long, 1996; Keefe, Caldwell, Queen, & Gil, 1987).

Hamilton Psychiatric Rating Scale for Depression (HAM-D; Hamilton, 1960)

The HAM-D evaluates depressive symptomatology using a structured interview format. It consists of 17 items rated on a 3- to 5-point scale, which cover multiple content areas related to depression. The higher scores represent more severe depressive symptomatology. The following cut-off scores are used to assess severity of depression: <12 (none to minimal); 12-20 (mild to moderate); 21-29 (moderate to severe); 30+ (severe). The HAM-D has been found to have a good inter-rater reliability correlation coefficient of .9 (Rush, Beck, Kovacs, & Hollon, 1977). It has also demonstrated acceptable concurrent validity of .73 with the BDI (Beck, Steer, & Garbin, 1988).

DESIGN

The current study also examined the differences among the four prognostic groups 12-months post-initial evaluation. Variables collected at the 12-month follow-up included the VAS, BDI, OSW, MCS, PCS, DPQ, CSQ, health care utilization, vocational status, and medication usage. At the conclusion of this project, 45 of the 67 patients (67.2%) were able to be contacted for a one-year follow up. These 45 patients completed the VAS, BDI, OSW, PCS, MCS, health care utilization, and vocational status. The majority of the follow-ups were completed over the phone (n = 38, 84.4%), while 7 were completed in person (15.6%).

Twenty of the 67 patients (29.9%) did not complete a 12-month follow-up. The reasons for not completing a one-year follow-up included noncompliance (n = 13, 19.4%), relocation (n = 3, 4.5%), deceased (n = 3, 4.5%), and intervening medical condition (n = 1, 1.5%). Two of the 67 (3%) patients had limited compliance because they completed the VAS, health care utilization, and vocational status over the phone before deciding they did not want to participate further.

Some of the measures in the 12-month evaluation were sent via mail and included the DPQ, CSQ, and medication sheets. These measures were completed by 12 of the 67 patients (17.9%). If medication sheets were not completed by patients, attempts were made to have them completed by the referring physician. Twelve medication sheets were completed by the patients and sent via mail and an additional 9 were completed by the referring physician. In total, medication sheets were collected from 21 of the 67 patients (31.3%). The reason for not completing medication sheets was that the referring physician was no longer treating the patient at the time of the follow-up or the patient was deceased.

An intent-to-treat statistical method was used to calculate the projected 12-month follow-up results for the 22 patients for whom data was missing. As cited in Shao and Zhong (2003), a last-observation-carried-forward approach was used. This approach replaces the missing data at the 12-month follow-up with last previous non-missing value, in this case, either six-month follow-up or initial evaluation data.

Twelve of the 67 patients (17.9%) had previously completed a six-month follow-up and consequently, the individual's six-month data was carried forward to replace their missing 12-month data. Six-month data included the VAS, BDI, OSW, PCS, MCS, health

care utilization, vocational status, and medication usage. The remaining 10 of the 67 patients (14.9%) did not complete a 6-month follow-up, and therefore the patients VAS, BDI, OSW, PCS, MCS, health care utilization, vocational status were taken from the initial evaluation.

The DPQ and CSQ were not completed at the 6-month follow-up. Therefore, the missing data at 12-months was replaced by the data at the initial evaluation, if present. Fifty five of the 67 patients (82.1%) did not complete the DPQ and CSQ at the 12-month follow-up; presumably due to non-compliance with completing and mailing the measures.

There were no significant differences between those individuals who completed the 12-month follow-up (n = 45) and those who did not (n = 22) on primary demographic variables. In addition, there were no significant differences between those individuals who completed the measures completed via mail at 12 month (n = 12) and those who did not (n = 55) on primary demographic variables.

Of those patients able to be contacted for a 12-month follow-up, 16 (35.6) had not undergone any procedures, 10 (22.2%) were currently using an SCS, 9 (20.0%) were currently using an IT pump, 3 (6.7%) underwent other pain surgeries, 4 (8.9%) had a failed SCS procedure, and 3 (6.7%) had a failed IT procedure. In terms of the Green group, 0 of the 7 (0.0%) patients not undergone any procedures, while 6 of the 8 (75%) patients in the Red group had not undergone any procedures. The breakdown of patients' surgical procedures is displayed in Table 2.

CHAPTER FOUR
Results

ANALYSIS OF INITIAL EVALUATION VARIABLES

Analysis was conducted in order to determine if any significant differences were present between the groups (Table 3). Categorical data, including gender, race, marital status, disability payment status, and litigation status were examined using the Pearson's chi-square statistical analysis. One-way ANOVAs were used to analyze the continuous variables (age and pain duration). There was a significant difference between the prognostic groups and gender, $\chi^2(3) = 8.58$, $p = .035$. The differences are most robust between the Green and Red groups, where males were 19.8 times more likely than females to fall in the Green group, $\chi^2(1) = 8.547$, $p = .003$, OR = 19.8, 95% CI: 1.944-201.626. No significant differences were found for age, race, and marital status. However, there was a significant association between the prognostic group and disability payment status $\chi^2(3) = 13.385$, $p = .004$. The Green group did not have any individuals receiving disability payments at the initial evaluation, while two-thirds of the patients in the Red group were receiving disability payments. Lastly, the chi square analysis indicated significant differences between the prognostic groups and status of pending litigation, $\chi^2(3) = 10.806$, $p = .013$. Again, the Green group did not have any individuals involved in pending litigation and the Yellow II group had the majority of individuals involved in pending litigation. No significant differences were found between the four prognostic groups and duration of pain, yet the Green group had the lowest average pain duration (92.93 months), while the Yellow I had the highest average pain duration (109.76 months). In addition, no significant differences were

found between the prognostic group and type of procedure sought. The majority of the patients in the Green, Yellow I, and Yellow II were evaluated for a spinal cord stimulator, while the majority of the Red group was evaluated for an IT pump.

THE BIOPSYCHOSICAL PROFILES OF THE FOUR PROGNOSTIC GROUPS AT INITIAL EVALUATION

A number of physical/functional and psychosocial measures were collected at the initial evaluation in order to determine each patient's physical and psychosocial functioning. The physical/functional measures that were analyzed for differences among the four prognostic groups included: the Dallas Pain Questionnaire (DPQ), the Visual Analogue Scale (VAS), the Oswestry (OSW), and the SF-36/Physical Component Score (PCS). The psychosocial measures analyzed at the initial evaluation included the Beck Depression Inventory (BDI), the Hamilton Psychiatric Rating Scale for Depression (HAM-D), the catastrophizing scale on the Coping Strategy Questionnaire (CSQ), and the SF-36/Mental Component Score (MCS). Lastly, health care utilization, vocational status, and the Physician Medication Assessment were also analyzed in order to determine if differences in healthcare utilization, vocational status, and medication intake existed among the four prognostic groups.

Shapiro-Wilk and Kolmogorov-Smirnov tests were used in order to determine normality of the measures collected at the initial evaluation (VAS, DPQ, MCS, PCS, OSW, BDI, HAM-D, and the catastrophizing scale on the CSQ). The test for normality was significant ($p < .05$) for the BDI, HAM-D, MCS, PCS, and VAS, indicating that these

measures were not normally distributed. In addition, Levene's Test was used to determine if the variances in the groups were equal. Levene's test was significant ($p < .05$) for the MCS, BDI, the catastrophizing scale on the CSQ, and VAS, indicating that the variances for these respective measures were significantly different. Nonparametric tests were used to analyze the measures in which the tests of normality or homogeneity of variance, or both, were significant. Therefore, nonparametric tests were used to analyze the BDI, MCS, PCS, VAS, and the catastrophizing scale on the CSQ, while one-way ANOVAs were used for the DPQ and OSW.

Analysis of Physical/Functional Measures

If data was normally distributed and the variances were not significantly different among the groups, ANOVAs were used to examine differences among the four prognostic groups at the initial evaluation. In addition, post-hoc tests were utilized in order to determine the specific differences among the groups. As indicated in Table 4, significant differences between the groups were found for the DPQ, $F(3, 79) = 3.107$, $p = .031$. Tukey HSD indicated that the Red group scored significantly higher on the DPQ when compared to the Green group. A significant linear trend was also found with the DPQ, $F(1, 79) = 9.046$, $p = .004$. This indicates that as prognosis worsened, groups endorsed more physical and functional limitations. Significant differences were also found between the groups with the OSW measure, $F(3, 83) = 3.447$, $p = .02$. Similar to the DPQ, the Tukey HSD indicated that the Green group scored significantly lower on the OSW compared to the Red group. As the prognosis groups worsened from the Green to the Red group, the OSW scores increased

proportionately, $F(1, 83) = 9.807$, $p = .002$. The non-parametric Kruskal-Wallis Test was used to analyze the PCS and VAS. No significant differences were found on the VAS and PCS among the four groups.

Analysis of Psychosocial Measures

The MCS and catastrophizing scale on the CSQ were two coping measures collected at the initial evaluation. The Kruskal-Wallis test was implemented in order to compare the mean scores of these measures among the four prognostic groups, as displayed in Table 5. In order to further understand the differences, Mann-Whitney Tests were used in order to compare the Green and Red groups. There were no significant differences among the four groups on the MCS. However, there was a significant difference between the Green and Red groups, $U = .50$, $p = .008$, $r = -.76$. In terms of the catastrophizing scale on the CSQ, a measure of presence of this maladaptive coping style, there was significant differences among the four groups, $H(3) = 19.511$, $p < .001$. Based on the Mann-Whitney test, the Red group scored significantly higher than the Green group, $U = .000$, $p < .001$, $r = -.84$, on a scale that determines use of catastrophizing as a coping mechanism. In addition, the Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic group worsened, the median catastrophizing scale on the CSQ score increased, $J = 1447$, $p < .001$, $z = 3.935$, $r = .45$.

The HAM-D, a clinician rated scale of depressive symptomatology, and the BDI, a self-report measure of symptoms of depression, were collected at the initial evaluation. The Kruskal-Wallis test showed significant differences among the four prognostic groups on the

HAM-D, $H(3) = 27.709$, $p < .001$ (Table 5). The Red group scored significantly higher on the HAM-D when compared to the Green group, $U = 15.50$, $p = < .001$, $r = - .69$. The Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic group worsened, the median HAM-D score increased, $J = 2244$, $p < .001$, $z = 5.401$, $r = .56$. The Kruskal-Wallis Test also revealed differences of scores on the BDI among the four prognostic groups, $H(3) = 26.088$, $p < .001$. In order to further examine differences among the four groups, the Mann-Whitney Test was utilized. The Green group had a significantly lower BDI score compared to the Red group, $U = 1.00$, $p < .001$, $r = - .985$. In addition, the Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic group worsened, the median BDI score increased, $J = 2113$, $p < .001$, $z = 4.824$, $r = .51$.

Analysis of Vocational Status, Health Care Utilization, and Medication Use

Vocational status was divided into two groups: working and not working (Table 6). Significant differences were found between the four prognostic groups and vocational status, $\chi(3) = 15.830$, $p = .001$. When comparing the Green and Red groups on vocation status, the Green group had a higher percentage (n = 10, 71.4%) of individuals who were currently working than the Red group (n = 1, 8.3%). The chi-square analysis indicated that the difference between the Green and Red group was significant, $\chi(1) = 10.539$, $p = .001$, OR = 27.5, 95% CI: 2.616-289.133, with 27.5 times more members of the Green group working at intake than the Red group. The number of health care visits for the four prognostic groups was analyzed using the Mann-Whitney test. No significant differences were found between

the four groups on health care visits or emergency room visits. The Green group had a lower average of both health care and emergency room visits compared to the Red group. However, no significant differences were found between the Green and Red group and health care utilization. Results are displayed in Table 7.

Table 8 displays the percentages of the number of individuals taking specific types of drugs within each prognostic group. The following types of drugs were considered: Narcotics, Muscle Relaxants, Benzodiazepines/Sedatives, NSAIDs, Anticonvulsants, and Antidepressants. Using the chi-square analysis, no differences were found between prognostic groups and the number of individuals taking a certain medication. In addition, no significant differences were found between the Green and Red groups when compared to one another exclusively (Table 9).

Analysis of Algorithm Scores

The algorithm scores for the PBME patients were evaluated in order to determine significant differences among the four prognostic groups. The algorithm scores analyzed included the interview risk score, testing risk score, medical risk score, and adverse clinical score (Table 10). Shapiro-Wilk and Kolmogorov-Smirnov tests were used in order to determine normality of the algorithm scores. The test for normality yielded significant evidence for non-normality of the data across all risk scores. Therefore, nonparametric tests were used to determine significant differences among the groups. In addition, Mann-Whitney tests were used in order to determine significant differences when comparing risk scores of the Red and Green groups alone.

Information during the clinical interview, including level of job satisfaction, workers' compensation status, pending litigation related to their pain, history of abuse or abandonment, substance abuse, psychological history, and the amount of spousal support and/or solicitousness, yielded information in order to determine the interview risk scores. The Kruskal-Wallis test indicated that the total interview risk scores were significantly different among the four prognostic groups, $H(3) = 26.71$, $p < .001$. The Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic groups worsened, the median interview risk scores increased, $J = 2316$, $p < .001$, $z = 5.207$, $r = .53$. In addition, Mann-Whitney tests were used to further explore this finding. The Red group had significantly higher interview risk scores than the Green group ($U = 22$, $p = .001$, $r = - .66$).

The total testing risk score was determined by psychological tests given to patients in order inform the behavioral medicine psychologist information pertaining to the patient's level of pain sensitivity, depression, anxiety, and catastrophizing. The Kruskal-Wallis test indicated that the total testing risk scores were significantly different among the four prognostic groups, $H(3) = 44.825$, $p < .001$. The Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic groups worsened, the median testing risk scores increased, $J = 2606$, $p < .001$, $z = 7.207$, $r = .74$. A Mann-Whitney test indicated that the Red group had significantly higher testing risk scores than the Green group ($U = 1$, $p < .001$, $r = - .84$).

The medical risk score included factors such as duration of pain, number and type of prior spine surgeries, nonorganic physical signs, abnormal pain drawings, smoking, and

obesity. The Kruskal-Wallis test indicated that the total medical risk score was significantly different among the four prognostic groups, $H(3) = 21.604$, $p < .001$. The Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) indicated that as the prognostic groups worsened, the median medical risk scores increased, $J = 2112$, $p = .001$, $z = 4.712$, $r = .48$. A Mann-Whitney test indicated that the Red group had significantly higher medical risk scores when compared to the Green group ($U = 14$, $p < .001$, $r = -.72$).

Lastly, adverse clinical scores included inconsistency, medication seeking, staff splitting, compliance issues, threatening, resignation, deception, and personality disorders. As with the other algorithm total scores, the Kruskal-Wallis test indicated that the total adverse risk score was significantly different among the four prognostic groups, $H(3) = 14.680$, $p = .002$. The Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) indicated that there was a trend in the data: as prognostic groups worsened, the median adverse clinical risk scores increased, $J = 2035.5$, $p < .001$, $z = 3.181$, $r = .33$. Again, a Mann-Whitney test indicated that the Red group had significantly higher adverse clinical scores when compared to the Green group ($U = 42$, $p = .031$, $r = -.57$).

12-MONTH FOLLOW-UP ANALYSIS FOR PROGNOSTIC GROUPS

Analysis of Physical/Functional and Psychosocial Measures

As displayed in Tables 11 through 14, paired sample t-tests for each measure were conducted for each of the four prognostic groups in order to compare initial evaluation and one-year follow up scores. The Green group showed improvements on five measures (OSW, VAS, PCS, BDI, MCS) at the one-year follow up, yet only significant improvements were

seen for the VAS, $t(7) = 2.887$, $p = .023$, BDI, $t(8) = 2.391$, $p = .044$, and MCS, $t(3) = -3.806$, $p = .032$. Though the Yellow I group showed improvements on the PCS, VAS, OSW, DPQ, MCS, and the catastrophizing scale on the CSQ, only the VAS showed a significant improvement from intake to one-year, $t(22) = 4.465$, $p < .001$. Additionally, within the Yellow II group, improvements were seen on all seven measures, yet only the VAS showed statistical improvements, $t(19) = 3.356$, $p = .003$. The Red group showed statistically significant improvements on the BDI, $t(9) = 2.266$, $p = .050$. The Red group also had non-significant improvements on the VAS and MCS.

Shapiro-Wilk and Kolmogorov-Smirnov tests were used in order to determine normality of the 12-month follow-up measures (VAS, BDI, MCS, PCS, OSW, DPQ, and the catastrophizing scale on the CSQ). The test for normality was not significant ($p > .05$) for the BDI, MCS, OSW, DPQ, and the catastrophizing scale on the CSQ, indicating that these measures were normally distributed. However, PCS yielded significant evidence for nonnormality of the data. In addition, Levene's Test was used to determine if the variances in the groups were equal. Levene's test was significant ($p < .05$) for the OSW and the catastrophizing scale on the CSQ, indicating that the variances for these respective measures were significantly different. Nonparametric tests were used to analyze the measures in which the tests of normality or homogeneity of variance, or both, were significant. Therefore, nonparametric tests were used to analyze the PCS, OSW, and the catastrophizing scale of the CSQ, while one-way ANOVAs were used for the DPQ, BDI, and the MCS.

The BDI was found to be statistically different among the four groups, $F(3, 63) = 9.20$, $p < .001$, with the average BDI score increasing as the prognostic group worsened

(Table 15). A significant linear trend was found, $F(1, 63) = 25.335$, $p < .001$, indicating that patients reported more depressive symptomatology proportionately as prognostic group worsened (Figure 1). The Tukey HSD indicated that the Red group scored significantly higher on the BDI compared to the Green, Yellow I, and Yellow II groups. Similar to the BDI, the MCS was found to be significantly different among the four prognostic groups, $F(3, 55) = 7.215$, $p < .001$. MCS scores decreased as prognostic group worsened, which is indicative of a significant linear trend, $F(1, 55) = 18.377$, $p < .001$ (Figure 2). Again, the Tukey HSD post hoc test found that the Red group scored significantly lower on the MCS compared to all other groups. The catastrophizing scale on the CSQ was also found to be significantly different among the four prognostic groups, $H(3) = 15.917$, $p = .001$. When comparing the Red and Green group using the Mann-Whitney test, the Green group was significantly different than the Red group, $U = .00$, $p = .001$, $r = -.84$. Lastly, the Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic group worsened, the median score on the catastrophizing scale on the CSQ increased, $J = 844.50$, $p = .008$, $z = 2.651$, $r = .34$.

The nonparametric Kruskal-Wallis Test was used to compare averages of the PCS, OSW, and VAS and the one-way ANOVA was used to compare averages of the DPQ among the four prognostic groups. No significant differences were found for the PCS and DPQ at the 12-month follow-up. The VAS was found to be significantly different among the four groups, $H(3) = 8.447$, $p = .038$. In addition, significant differences were found when comparing the Green and Red group using the Mann-Whitney test, the Green group had a significantly lower VAS score compared to the Red group, $U = 16.50$, $p = .018$, $r = -.54$.

Lastly, the Jonckheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic group worsened, the median VAS score increased, J = 1026.5, p = .006, z = 2.749, r = .34. The OSW was also found to be significantly different among the four prognostic groups, $H(3) = 13.953$, p = .003 (Figure 3). Similar to the VAS, the Mann-Whitney test indicated that Green group had a significantly lower OSW score compared to the Red group, U = 2.50, p = .002, r = -.78. The Jockheere-Terpstra test (Jonckheere, 1954; Terpstra, 1952) revealed a significant trend in the data: as prognostic group got better, the median OSW scores decreased, J = 925, p < .001, z = 3.714, r = .48. Results are displayed in Table 15.

Repeated Measures ANOVAs were conducted in order to compare the Green and Red groups, using the initial evaluation, 6-month follow up, and 12-month follow-up as the three data collection intervals. Significance was determined among the two groups and across time. Repeated measures ANOVAs were conducted for the BDI, MCS, VAS, PCS, and OSW (Tables 16 through 20). Mauchly's test tested the assumption of sphericity and, if violated, the Greenhouse-Geisser was used to correct for this.

In terms of physical/functional measures, results from a repeated measures ANOVA revealed that there were significant differences between the Green and Red groups on the VAS, $F(1, 15) = 6.243$, p = .025. In addition, there were significant differences between the Green and Red groups on the OSW, $F(1, 14) = 15.483$, p = .001 (Figure 5). There were no significant differences between the Green and Red groups on the PCS. Lastly, no significant effect was found for Time for the VAS, OSW, or PCS.

In terms of psychosocial measures, results from a repeated measures ANOVA showed that there were significant differences between the Green and Red groups on the BDI, $F(1, 17) = 25.73$, $p < .001$ (Figure 6). Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2(2) = 9.553$, $p = .008$; therefore, degrees of freedom were corrected using the Greenhouse-Geisser estimates of sphericity. A significant effect was shown for time, indicating that scores did improve over time on the BDI for the Green and Red groups, $F(1.38, 23.46) = 4.057$, $p = .044$. There were also significant differences between the Green and Red groups on the MCS, $F(1, 5) = 8.713$, $p = .006$. Similar to the BDI, a significant effect was shown for time, indicating that scores did improve over time on the MCS for the Green and Red groups, $F(2, 10) = 8.713$, $p = .006$.

Analysis of Vocational Status, Health Care Utilization, and Medication Use

Vocational status of the four prognostic groups was analyzed after placing the individuals in two groups: working and not working (Table 21). No significant differences were found between the groups using the chi-square analysis. When comparing the Green and Red groups, again no significant differences were found using the chi-square analysis. However, the Green group had a higher percentage of individuals working (n = 6, 66.7%) compared to the Red group (n = 3, 30.0%). Health care utilization within the last year was analyzed using the Kruskal-Wallis test, yet no significant differences were found between the four groups. The Green and Red groups were analyzed using the Mann-Whitney test (Table 22), yet, no significant differences between the groups were found. Despite this, the Red group had a higher average (33.30) of health care visits compared to the Green group (15.22)

and a higher average of Emergency Room visits (2.00) compared to the Green group (1.78). Similar to the analysis of the initial evaluation, no statistical differences among the groups using the chi-square analysis were found for medication intake (Table 23). When comparing the Green and Red groups exclusively, no significant differences were found. Table 24 displays the percentages of the number of individuals taking specific types of drugs within the Green and Red groups.

CHAPTER FIVE
Conclusions and Recommendations

The goal of the current study was to determine the effectiveness of a Pre-surgical Behavioral Medicine Evaluation, which utilized the PBME algorithm. As discussed earlier, the PBME algorithm is a revised algorithm that provides the evaluator with different a priori weights for each risk factor and a set of pre-surgical prognoses and recommendations to the physician. The algorithm determined the prognosis of chronic pain patients evaluated for invasive procedures. The evaluation utilizing the PBME algorithm satisfies most insurance demands for a pre-surgical evaluation. In addition, the Pre-surgical Behavioral Medicine Evaluation reduces the risk of litigation and poor surgical outcomes on part of the surgeons. A patient is placed in one of five groups, including Green, Yellow I, Yellow II, Red I and Red II. Similar to Schocket's (2005) study, the Red group refers to patients classified in either the Red I or Red II groups. Overall, the majority of patients were evaluated for spinal cord stimulators and intrathecal morphine pumps.

The following variables were analyzed in order to determine if significant differences existed between prognosis groups: gender, age, race, marital status, duration of pain, type of procedure, and whether or not the patient is receiving disability payments or involved in pending litigation. Interestingly, statistical differences were found among the four groups in terms of gender, with the Green group having the highest percentage of males (n = 9, 64.3%), and the Red group having the highest percentage of females (n = 11, 91.7%). Additionally, when comparing the Red and Green groups, males were 19.8 times (CI: 1.944-201.626) more

likely than females to fall into the Green group. Statistical analysis of other variables such as age, race, marital status, and pain duration did not yield significance.

This study hypothesized that a greater proportion of patients in the Red group compared to the other groups would be receiving disability payments, be involved in pending litigation associated with their pain, utilize health care more, and would have not returned to work. The chi-square statistical test indicated there were significant differences among the groups in terms of disability payment status. No patients in the Green group were receiving disability payments, while two-thirds of patients in the Red group were receiving disability payments. This finding is similar to previous studies (e.g. Klekamp et al., 1998; Harries, Mulford, Solomon, van Gerlder, & Young, 2005) that found that patients receiving compensation achieved poorer surgical results. In terms of pending litigation associated with the pain, there were also significant differences found among the four prognostic groups. Legal representation, similar to receiving disability payments, has been linked to poorer surgical outcome (Klekamp et al., 1998)

Analyses were also conducted in order to determine statistical differences among the groups on vocational status, healthcare utilization, and medication use. In terms of vocational status, there were significant differences found between the four prognostic groups. In addition, a significant difference was found between Green and Red group. The Green group had the highest percentage of individuals working (n = 10, 71.4%), while the Red group had the lowest percentage of individuals working (n = 1, 8.3%). No significant differences were found between the Green and Red groups on health care utilization, yet the Green group had a lower average of health care visits and emergency room visits compared

to the Red group. Hoffman and colleagues (1993) and Ciol et al. (1994) revealed that poorer surgical outcomes were found in patients who have a larger number of health care visits. Chi square analysis yielded no significant differences among the groups in terms of medication use.

In order to establish the effectiveness of using the PBME algorithm, physical/functional and psychosocial measures were analyzed in order to determine if significant differences existed among the four prognostic groups at the initial evaluation. The physical/functional measures analyzed included the VAS, PCS, DPQ, and OSW. There were significant differences among the groups in terms of DPQ at the initial evaluation. The DPQ assesses an individual's perceived pain and disability. Post hoc analysis indicated that the Red group scored significantly higher on the DPQ when compared to the Green group, indicating that the Red group had worse perceptions of their pain and disability. In addition, there was a significant linear trend, indicating that as prognosis groups worsened, scores on the DPQ rose proportionately. There were significant differences among the groups in terms of OSW scores. The OSW provides an evaluation of the degree of functional impairment. The Red group endorsed significantly more physical/functional limitations when compared to the Green group as indicated by post hoc tests. No significant differences were found among the groups when looking at VAS and PCS scores at the initial evaluation.

In terms of coping measures, statistical analysis of the catastrophizing scale on the CSQ indicated that there were significant differences among the four prognostic groups at the initial evaluation. The catastrophizing scale on the CSQ determines the frequency in which an individual uses catastrophizing as a coping strategy. Higher scores on the catastrophizing

scale indicate that the patient uses catastrophizing as a coping mechanism. A significant trend was found for catastrophizing scale, indicating that, as prognostic group worsened, the group's median score was higher on the catastrophizing scale. When comparing the Green and Red groups, the Red group scored significantly higher on the catastrophizing scale than the Green group at the initial evaluation. Block and colleagues (2003) stated that catastrophizing is a coping mechanism that may ultimately worsen the emotional and sensory impact of spine surgery. In terms of the MCS, a higher score on the MCS indicates that an individual is reporting less mental distress. The Green group scored significantly higher on the MCS than the Red group, indicating that the Green group reported less mental distress at the initial evaluation.

Kremer, Block, and Atkinson (1983) found that depressed patients were less likely to notice improvements from surgical procedures when they occurred. Therefore, it was predicted that patients in the Red group would endorse significantly more depressive symptomatology when compared to the Green group. Two mood measures collected at the initial evaluation were analyzed: the HAM-D and the BDI. Significant differences were found among the four prognosis groups for both the HAM-D and the BDI. Significant linear trends also were found for both measures, indicating that as prognostic groups worsened, the median scores on the HAM-D and BDI increased. Therefore, a greater amount of depressive symptoms were observed as prognostic group worsened. In terms of differences among the groups, the Red group scored significantly higher on the HAM-D and the BDI when compared to the Green. This indicates that the Red group experienced significantly more depressive symptomatology at the initial evaluation than the Green group.

The second hypothesis yielded further analysis of the risk factors determined by the algorithm. The risk factors included interview, testing, medical, and adverse clinical. Due to nonnormality, Kruskal-Wallis tests were used in order to determine significant differences among the four prognostic groups. The interview, testing, medical, and adverse clinical risk factors were all found to be significantly different among the four prognostic groups. In addition, Mann-Whitney tests indicated that the Red group had significantly higher interview, testing, medical, and adverse clinical risk scores than the Green group.

As stated previously, a major scope of the current study was to investigate the effectiveness of using the PBME algorithm. In order to determine if the differences continued to exist between the groups, patients completed follow up measures at 6- and 12-months post-PBME evaluation. The measures collected, including the VAS, BDI, OSW, PCS, MCS, DPQ, and catastrophizing scale on the CSQ, contributed to determining the biopsychosocial profiles of patients. It was hypothesized that the Red group, who had the worst prognosis following an invasive surgery, would display inferior biopsychosocial functioning at follow-up intervals, while the Green group would show better biopsychosocial functioning. Statistical tests utilized for this hypothesis included paired t-tests, ANOVAS, the Kruskal-Wallis Tests, repeated measures ANOVA, and the chi-square analysis.

The study utilized a last-observation-carry-forward approach, which replaced the missing data with participant's 6-month or initial evaluation data. Paired t-tests were utilized in order to assess improvements from initial evaluation and at the 12-month follow-up within each prognostic group. The Green group displayed improvements on five measures, yet only the VAS, BDI, and the MCS were significant. The Yellow I group showed improvement on

the physical/functional measures (PCS, VAS, and OSW) and the MCS, yet only the VAS was significant. In terms of the Yellow II group, improvements were found on all seven measures; yet again only the VAS was significant. The Red group did not improve on the OSW, PCS DPQ, yet improved on the VAS, BDI, and MCS with only the BDI significant. It is important to note that that the Green group showed significant improvement on three measures, while the Yellow I, Yellow II, and Red groups showed significant improvement on only one measure each.

In order to further investigate differences among the groups, ANOVAs, Kruskal Wallis tests, and Mann-Whitney tests were used to determine significant differences between the groups on all of the measures. The BDI, MCS, and DPQ were found to have a normal distribution; therefore, ANOVAS were utilized. At the 12-month follow-up, significant statistical differences were found among the four groups in terms of the BDI (Figure 1). In addition, a linear trend was found, indicating that patients reported more depressive symptomatology proportionately as prognostic group worsened. Post hoc tests indicated that Red group scored significantly higher on the BDI when compared to all three other groups (Green, Yellow I, and Yellow II) at the 12-month follow-up. The MCS was also found to be significantly different among the groups at the 12-month follow-up, with scores progressively decreasing as prognostic group worsened (Figure 2). As mentioned earlier, a lower score on the MCS indicates that an individual is reporting more mental distress. Overall, post hoc tests showed that the Red group was experiencing more mental distress and endorsing more depressive symptomatology compared to the other groups at the 12-month follow-up. Nonparametric tests were used to analyze the catastrophizing scale on the CSQ.

The catastrophizing scale was also found to be significantly different among the four prognostic groups. In addition, the Green group scored significantly lower on the catastrophizing scale than the Red group. Lastly, a significant trend was also found: as the prognostic group worsened, the median score increased. The 12-month follow-up results were similar to the results found at the initial evaluation in that the four groups were significantly different in terms of the BDI and the catastrophizing scale on both time intervals. This demonstrates the accuracy and effectiveness of the PBME algorithm.

The nonparametric Kruskal-Wallis Test was utilized to compare averages of the PCS, OSW, and VAS, while a one-way ANOVA was used to analyze the DPQ at the 12-month follow-up. In terms of the VAS, significant differences were found among the four prognostic groups. The Mann-Whitney Test indicated significant differences between the Green group and Red group on the VAS. Similar to the analysis of the initial evaluation data, significant differences were found among the four groups in terms of the OSW at the 12-month follow-up (Figure 3). In addition, the Jockheere-Tepstra test (Jonckheere, 1954, Terpstra, 1952) revealed a significant trend: as the prognostic groups got better, the median scores on the OSW and VAS decreased. This indicates that the differences in functional/physical limitations that were found at the initial evaluation were again found at a 12-month follow-up. No significant differences were found for the PCS and DPQ.

As previously stated, follow-up data were also collected 6-months post-PBME evaluation. A repeated measures ANOVA was also used to compare differences between the Green and Red groups and differences across time (initial evaluation, 6-month, and 12-month follow up). The PCS was the only measure not to have significant between subject effects

for the prognostic groups. The Green and Red groups were significantly different on the VAS, OSW (Figure 5), BDI (Figure 6), and the MCS. Only the BDI showed a significant effect for time, indicating that scores significantly improved over time for the Green and Red groups.

Differences in vocational status, health care utilization, and medication usage were analyzed in order to determine any differences among the four prognostic groups, as well as specific differences between the Green and Red groups. No significant differences existed with regard to these variables. However, the Green group did have a higher percentage of individuals working (66.7%), while only 30% of the Red group was working at the 12-month follow-up. Also, the Red group had higher average of health care visits (33.30) and emergency room visits (2.00) compared to the Green group at the 12-month follow-up.

Summary of 12-Month Outcomes

Overall, the PBME displayed strong accuracy in predicting the extent of future physical/functional and psychosocial distress for patients considered for invasive pain procedures. When compared to the Green group, the Red group rated their pain higher, was more physically/functionally limited, reported more depressive symptoms, was in more mental distress, and utilized catastrophizing as a coping mechanism more often. Even when including data across time (initial evaluation, 6- and 12-months post evaluation), the four prognostic groups differed on the MCS, BDI, OSW, and VAS. The Green group also had a higher percentage of individuals working at the 12-month follow-up, and, on average, utilized less health care.

Limitations and Directions for Future Research

There were three main limitations regarding this study. The first limitation was the number of patients who completed a one year follow-up, as more follow up completers would have yielded greater statistical power. Elderly patients were especially difficult to obtain complete compliance for the follow-up data. Often, elderly individuals had a difficult time hearing the extensive questions over the phone. Also, some of the pain patients, especially those not recommended for surgery, were still in considerable pain at the time of follow-up. It is difficult for patients to stay on the phone for a long period of time when they are in pain. At times, it was difficult to collect follow-up data from the individuals who were not recommended for surgery. These individuals were offended by the clinic because they were not able to undergo the invasive procedure after the PBME. One way to increase the number of one-year follow-ups may be to simply increase the data collection time. Another way is to improve one-year follow-up completion rates by having patients schedule an appointment to see a behavioral medicine psychologist where they could complete the measures prior to a follow-up appointment. Future research may want to look at ways to increase a patient's compliance following a recommendation of exclusion on invasive treatment.

Secondly, the distribution among the groups varied, with the majority of patients falling into the Yellow I and Yellow II groups, and a lesser number falling into either the Green or Red groups. Green and Red group membership seems to increase at a rate much smaller than membership of either Yellow groups. As a result, only by entering more participants in the study will the numbers in the Green and Red groups to increase. In

addition, with more subjects in the PBME study, differences among the Red I and Red II can be examined.

Third, follow-up data was collected over the phone. This creates concern with regards to the extent that the data is valid. The measures used in this study were created with the intention of the patient filling them out in person. As stated previously, appointments made at follow-up dates, in which the patient fills out measures in person, should be considered for future research.

Future research concerning pre-surgical screening of patients for invasive pain procedures is vital. Future research should consider following up with patients beyond the one year mark. This research technique will increase researcher's ability to determine the effectiveness of the PBME algorithm.

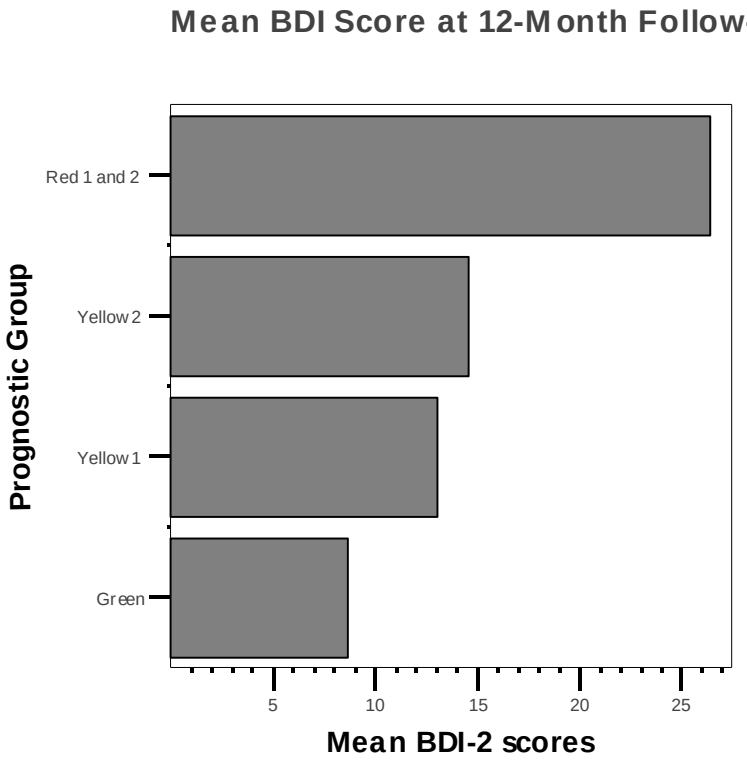
Conclusion

The current study showed the utility and accuracy of using the Pre-surgical Behavioral Medicine Evaluation and algorithm in order to determine chronic pain patient's prognosis of invasive procedures. Evidence that supports this algorithm will likely lead to more widespread use, which will benefit not only the patients undergoing the invasive surgical procedure, but also health care providers, employers, and insurance companies. An individual's pain is best conceptualized and understood biopsychosocially. Therefore, biological, psychological, and social factors should be considered when predicting whether pain procedures will yield negative or positive results. The PBME contributes to the increase of surgical success rates, as well to the understanding of risk factors that could be minimized

prior to a surgical procedure. While the development of the PBME algorithm was created out of robust research regarding surgical risk factors, it is critical to continue research on the algorithm itself. It is imperative to further understand the strengths and weaknesses of the PBME, while also determining the factors that contribute to a patients' improvement or deterioration in biopsychosocial functioning in the future.

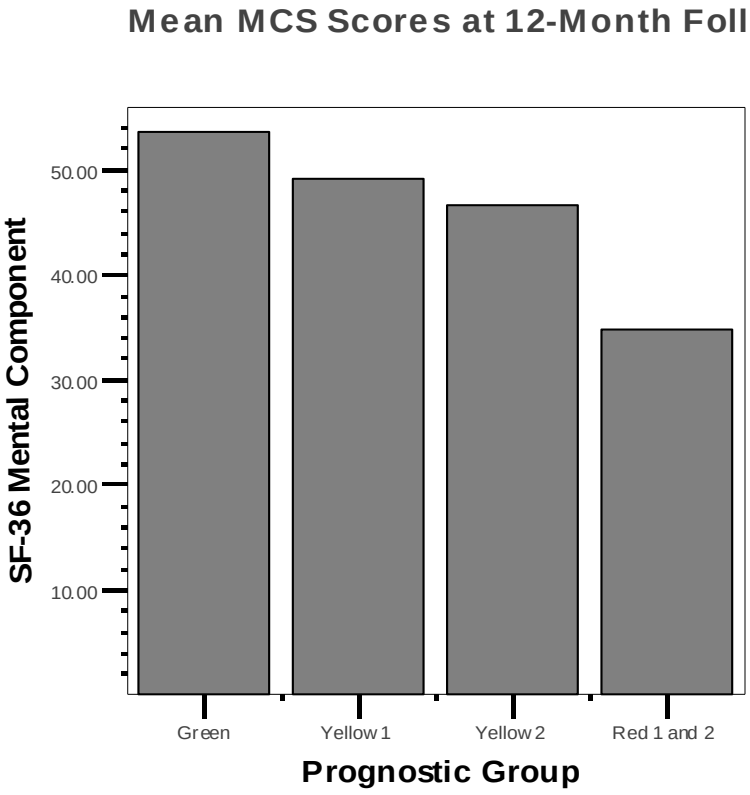
APPENDIX A
Figures

FIGURE 1:



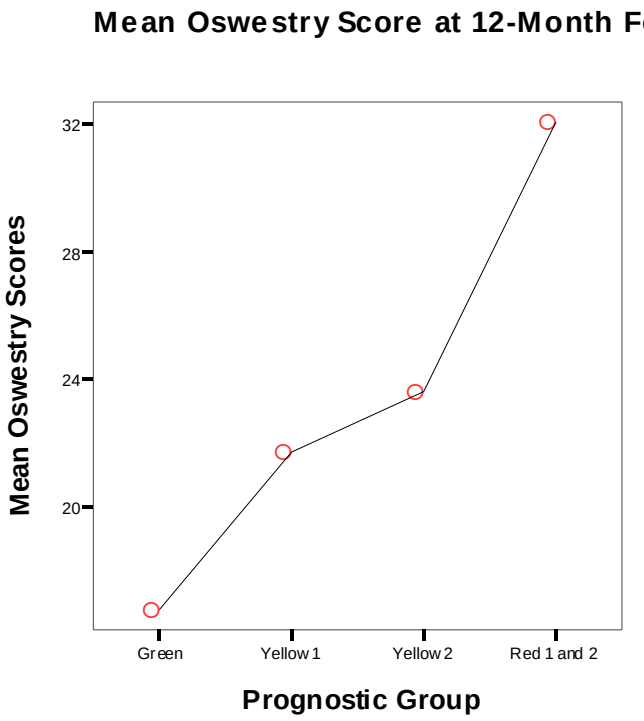
* $F(3, 63) = 9.20$, $p < .001$

FIGURE 2:



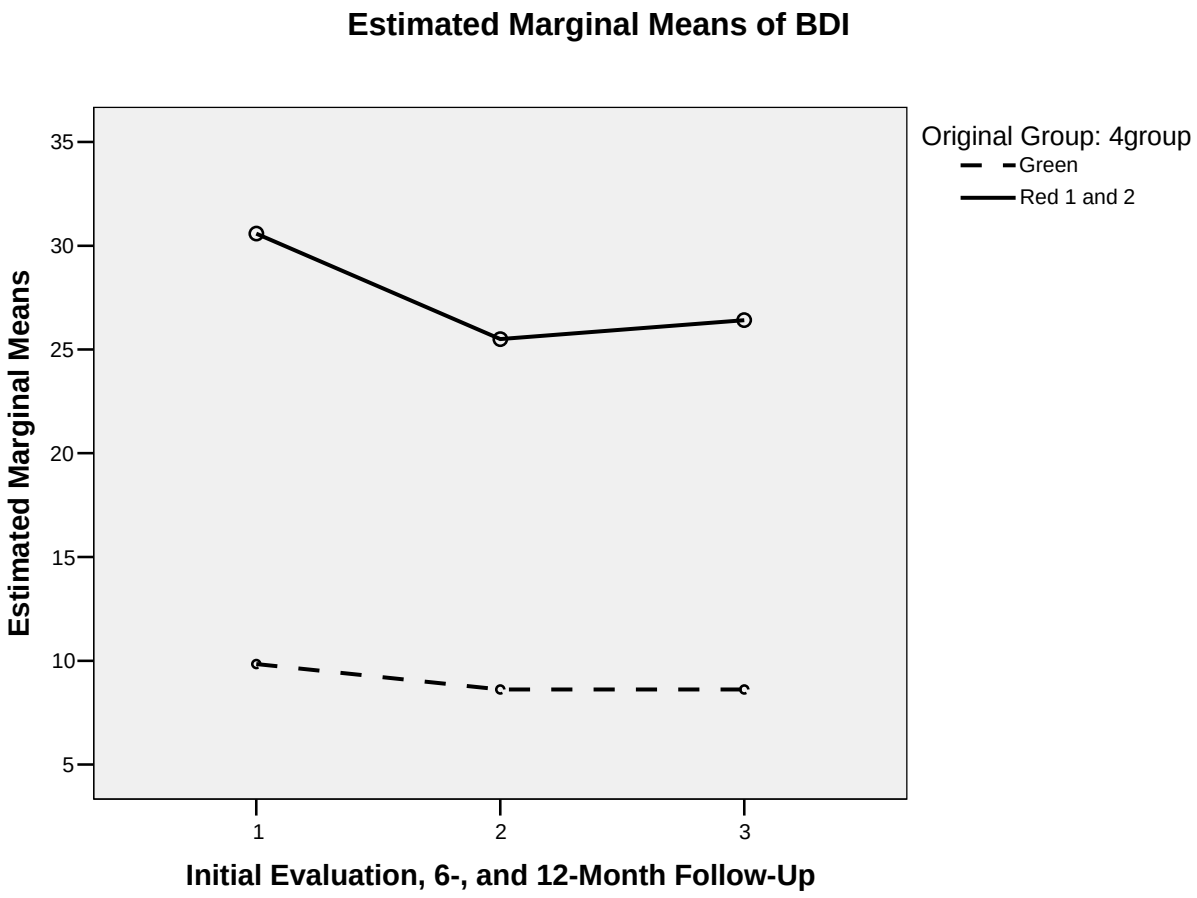
*$F(3, 55) = 7.215$, $p < .001$

FIGURE 3:



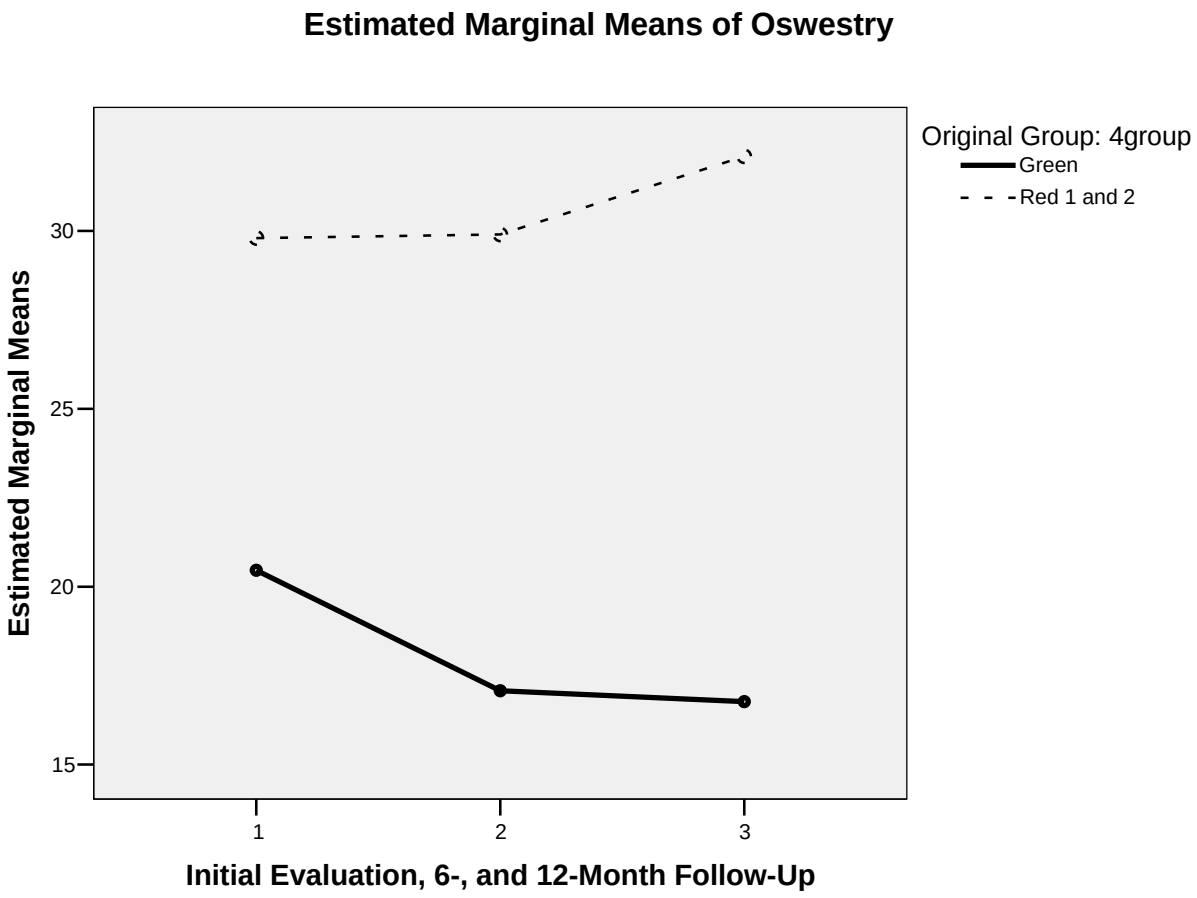
*$H(3) = 13.953$, $p = .003$

FIGURE 4:



*Group Effect: $F(1, 17) = 25.73$, $p = <.001$
*Time Effect: $F(1.38, 23.46) = 4.057$, $p = .044$

FIGURE 5:



*Group Effect: $F(1, 14) = 15.483$, $p = .001$

APPENDIX B
Tables

TABLE 1

Initial Evaluation Data for Total Sample

Variables	Total Sample (N = 95)
Gender (%)	
Male	39 (41.1)
Female	56 (58.9)
Age (years)	
Mean (SD)	54.60 (14.85)
Minimum	21
Maximum	90
Race (%)	
Caucasian	86 (90.5)
African-American	4 (4.2)
Hispanic	4 (4.2)
Other	1 (1.1)
Marital Status (%)	
Married	64 (67.4)
Single	6 (6.3)
Separated/Divorced	12 (12.6)
Widowed	12 (12.6)
Living with significant other	1 (1.1)
Disability Payments (%)	
Yes	38 (40.0)
No	57 (60.0)
Pending Litigation (%)	
Yes	15 (15.8)
No	80 (84.2)
Duration of Pain (months)	
Mean (SD)	102.05 (105.11)

TABLE 1 (CONTINUED)

Initial Evaluation Data for Total Sample

Variables	Total Sample (N = 95)
Type of Procedure (%)	
SCS	59 (62.1)
IT Pump	26 (27.4)
Deep Brain Stimulator	4 (4.2)
Occipital nerve Stimulator	4 (4.2)
Jaw Stimulator	1 (1.1)
Place Drain in Back of Thigh	1 (1.1)

TABLE 2

Procedures Relative to Prognostic Group at 12-Month Follow-Up

Type of Procedure	Total Sample N = 45 n (%)	Green n = 7 n (%)	Yellow I n = 17 n (%)	Yellow II n = 13 n (%)	Red n = 8 n (%)
SCS - Current	10 (22.2)	1 (7.1)	5 (29.4)	4 (30.8)	0 (0.0)
IT Pump - Current	9 (20.0)	3 (42.9)	3 (17.6)	2 (15.4)	1 (12.5)
Other Pain Surgery	3 (6.7)	2 (28.6)	0 (0.0)	1 (7.7)	0 (0.0)
SCS – Past	4 (8.9)	0 (0.0)	2 (11.8)	1 (7.7)	1 (12.5)
IT Pump - Past	3 (6.7)	1 (14.3)	1 (2.9)	1 (7.7)	0 (0.0)
No Procedures	16 (35.6)	0 (0.0)	6 (35.3)	4 (30.8)	6 (75.0)

TABLE 3

Initial Evaluation Data for Prognostic Groups

Variables	Green (n = 14)	Yellow I (n = 34)	Yellow II (n = 35)	Red (n = 12)	Statistic
Gender (%)					$\chi(3) = 8.58$,
Male	9 (64.3)	15 (44.1)	14 (40.0)	1 (8.3)	$p = .035$*†
Female	5 (35.7)	19 (55.9)	21 (60.0)	11 (91.7)	
Age (years)					$F(3, 91) = 1.77$,
Mean	61.43	55.94	51.71	51.25	$p = .159$†
SD	18.44	14.97	12.69	14.45	
Minimum	21	31	24	30	
Maximum	82	90	78	86	
Race (%)					$\chi(9) = 14.4$,
Caucasian	14 (100.0)	33 (97.1)	29 (82.9)	10 (83.3)	$p = .109$†
African-American	0 (0.0)	0 (0.0)	3 (8.6)	1 (8.3)	
Hispanic	0 (0.0)	1 (2.9)	3 (8.6)	0 (0.0)	
Other	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)	
Marital Status (%)					$\chi(12) = 4.70$,
Married	9 (64.3)	25 (73.5)	22 (62.9)	8 (66.7)	$p = .967$†
Single	1 (7.1)	1 (2.9)	3 (8.6)	1 (8.3)	
Separated/ Divorced	1 (7.1)	4 (11.8)	5 (14.3)	2 (16.7)	
Widowed	3 (21.4)	4 (11.8)	4 (11.4)	1 (8.3)	
Living w/ sig. other	0 (0.0)	0 (0.0)	1 (2.9)	0 (0.0)	

* Significant at .05

† Odds Ratio (OR) not calculated due to more than two subdivisions of the variable

TABLE 3 (CONTINUED)

Initial Evaluation Data for Prognostic Groups

Variables	Green (n = 14)	Yellow I (n = 34)	Yellow II (n = 35)	Red (n = 12)	Statistic
Disability Payments (%)					$\chi(3) = 13.385$, $p = .004$*†
Yes	0 (0.0)	14 (41.2)	16 (45.7)	8 (66.7)	
No	14 (100.0)	20 (58.8)	19 (54.3)	4 (33.3)	
Pending Litigation (%)					$\chi(3) = 10.81$, $p = .013$ ♦†
Yes	0 (0.0)	3 (8.8)	11 (31.4)	1 (8.3)	
No	14 (100.0)	31 (91.2)	24 (68.6)	11 (91.7)	
Duration of Pain (months)					$F(3) = .107$, $p = .956$†
Mean	92.93	109.76	98.17	102.83	
SD	124.16	118.44	99.96	56.2	
Type of Procedure (%)					$\chi(15) = 21.70$, $p = .131$†
SCS	10 (71.4)	20 (58.8)	24 (68.6)	5 (41.7)	
IT Pump	3 (21.4)	9 (26.5)	8 (22.9)	6 (50.0)	
Deep Brain Stimulator	0 (0.0)	2 (5.9)	2 (5.7)	0 (0.0)	
Occipital Nerve Stimulator	0 (0.0)	3 (8.8)	1 (2.9)	0 (0.0)	
Jaw Stimulator	1 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)	
Place Drain in Back of Thigh	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)	

* Significant at .01
♦ Significant at .05
† Odds Ratio (OR) not calculated due to more than two subdivisions of the variable

TABLE 4

Analysis of the Physical/Functional Measures at Initial Evaluation among the Four Prognostic Groups

Measure	Green n mean SD	Yellow I n mean SD	Yellow II n mean SD	Red n mean SD	Statistic
DPQ	11 78.95 27.71	31 91.47 19.73	31 96.81 22.77	10 106.7 19.78	$F(3, 79) = 3.107$, $p = .031$*
OSW	13 20.46 7.07	31 23.87 6.58	33 26.24 8.57	10 29.80 7.27	$F(3, 83) = 3.447$, $p = .020$*
VAS	13 7.85 1.52	32 8.53 1.22	31 8.35 1.45	11 8.45 1.92	$H(3) = 2.344$, $p = .504$
PCS	8 25.20 7.84	15 24.73 8.46	16 22.62 4.60	4 27.50 13.30	$H(3) = 1.433$, $p = .698$

* Significant at .05

TABLE 5

Analysis of the Psychosocial Measures at Initial Evaluation among the Four Prognostic Groups

Measure	Green n mean SD	Yellow I n mean SD	Yellow II n mean SD	Red n mean SD	Statistic
MCS	8 47.91 6.73	15 47.13 10.34	16 41.12 14.17	4 27.25 11.61	$H(3) = 7.051$, $p = .070$
CSQ-Cat.	11 7.73 4.29	28 14.29 6.93	29 16.14 9.86	9 25.78 7.78	$H(3) = 19.511$, $p < .001$*
HAM-D	14 11.43 4.72	33 13.27 5.17	33 18.42 5.91	12 24.75 7.23	$H(3) = 27.709$, $p < .001$*
BDI	13 9.85 3.98	33 12.64 6.26	33 16.52 9.11	12 30.58 13.64	$H(3) = 26.088$, $p < .001$*

* Significant at .001

TABLE 6

Analysis of Vocational Status at Initial Evaluation

Vocational Status	Green n (%)	Yellow I n (%)	Yellow II n (%)	Red n (%)	Statistic
Working	10 (71.4)	19 (55.9)	10 (28.6)	1 (8.3)	$\chi(3) = 15.830$,
Not Working	4 (28.6)	15 (44.1)	25 (71.4)	11 (91.7)	$p = .001$*†
Working	10 (71.4)			1 (8.3)	$\chi(1) = 10.539$,
Not Working	4 (28.6)			11 (91.7)	$p = .001$, 27.500 (2.616-289.133)* ‡

* Significant at .001
† Odds Ratio (OR) not calculated due to more than two subdivisions of the variable
‡ χ^2 (df) = χ^2 statistic, p value, Odds Ratio (95% Confidence Intervals)

TABLE 7

Analysis of Healthcare Utilization Six Months Prior to Initial Evaluation

Health Care Utilization	**Green** **n** **mean** **SD**	**Yellow I** **n** **mean** **SD**	**Yellow II** **n** **mean** **SD**	**Red** **n** **mean** **SD**	**Statistics**
Health Care Visits	11 5.55 3.73	25 5.76 6.18	22 8.27 8.83	4 24.50 24.04	$H(3) = 3.106$, $p = .376$
Emergency Room Visits	11 .18 .41	25 .92 2.02	26 .81 2.10	6 .67 1.63	$H(3) = .633$, $p = .889$
Health Care Visits	11 5.55 3.73			4 24.50 24.04	$U(13.50)$, $p = .264$
Emergency Room Visits	11 .18 .41			6 .67 1.63	$U(32.50)$, $p = .940$

TABLE 8

Medication Usage of Individuals at Initial Evaluation

Medication	Green N = 13 n (%)	Yellow I N = 33 n (%)	Yellow II N = 35 n (%)	Red N = 10 N (%)	Statistic
Narcotic	10 (76.9)	25 (75.8)	30 (85.7)	8 (80.0)	$\chi(3) = 1.169$, $p = .760$†
NSAID	2 (15.4)	3 (9.1)	2 (5.7)	1 (10.0)	$\chi(3) = 1.140$, $p = .767$†
Anti-Convulsant	6 (46.2)	9 (27.3)	12 (34.3)	5 (50.0)	$\chi(3) = 2.567$, $p = .463$†
Muscle Relaxant	1 (7.7)	7 (21.2)	11 (31.4)	1 (10.0)	$\chi(3) = 4.218$, $p = .239$†
Benzodiazepine/ Sedative	2 (15.4)	7 (21.2)	8 (22.9)	3 (30.0)	$\chi(3) = .732$, $p = .866$†
Anti-Depressant	4 (30.8)	10 (30.3)	17 (48.6)	7 (70.0)	$\chi(3) = 6.374$, $p = .095$†

† Odds Ratio (OR) not calculated due to more than two subdivisions of the variable

TABLE 9

Comparison of the Green and Red Group on Medication Usage at Initial Evaluation

Medication	**Green N = 13 n (%)**	**Red N = 10 n (%)**	**Statistic**
Narcotic	10 (76.9)	8 (80.0)	$\chi(1) = .031$, $p = .859$, OR = 1.200, 95% CI: .160 – 9.013
NSAID	2 (15.4)	1 (10.0)	$\chi(1) = .144$, $p = .704$, OR = .611, 95% CI: .047 – 7.882
Anti-Convulsant	6 (46.2)	5 (50.0)	$\chi(1) = .034$, $p = .855$, OR = 1.167, 95% CI: .224 – 6.081
Muscle Relaxant	1 (7.7)	1 (10.0)	$\chi(1) = .038$, $p = .846$, OR = 1.33, 95% CI: .073 – 24.315
Benzodiazepine/ Sedative	2 (15.4)	3 (30.0)	$\chi(1) = .710$, $p = .400$, OR = 2.357, 95% CI: .311 – 17.852
Anti-Depressant	4 (30.8)	7 (70.0)	$\chi(1) = 3.486$, $p = .062$, OR = 5.250, 95% CI: .874 – 31.553

TABLE 10

Analysis of Risk Scores among the Four Prognostic Groups

Risk Score	Green n mean SD	Yellow I n mean SD	Yellow II n mean SD	Red n mean SD	Statistic
Interview	14 0 .43 0 .76	34 0.76 0 .86	35 2.03 1.45	12 2.58 1.88	$H(3) = 26.71$, $p < .001$*
Testing	14 2.29 1.38	34 4.50 1.66	35 6.66 2.69	12 9.0 2.66	$H(3) = 44.825$, $p < .001$*
Medical	14 4.21 1.25	34 4.56 1.66	35 4.83 1.87	12 6.50 1.17	$H(3) = 14.68$, $p = .002$♦
Adverse Clinical	14 0.00 0.00	34 0.12 0.41	35 0.74 1.01	12 2.08 2.71	$H(3) = 21.604$, $p < .001$*

* Significant at the .001 level
♦ Significant at the .01 level

TABLE 11

Paired Samples t-tests for Green Group: Initial Evaluation to 12-Month Follow-Up

Measure	Initial Evaluation n (Mean, SD)	12-Month F/U n (Mean, SD)	Statistic
OSW	8 (18.75, 7.56)	8 (15.25, 5.06)	$t(7) = 2.021$, $p = .083$
VAS	8 (7.25, 1.58)	8 (4.75, 2.12)	$t(7) = 2.887$, $p = .023$*
PCS	4 (27.75, 34.25)	4 (34.25, 13.65)	$t(3) = -1.053$, $p = .370$
DPQ	7 (74.86, 31.23)	7 (79.14, 31.58)	$t(6) = -1.310$, $p = .238$
CSQ – Cat.	8 (7.88, 4.64)	8 (8.38, 6.12)	$t(7) = -.424$, $p = .685$
BDI	9 (9.67, 4.77)	9 (7.11, 3.33)	$t(8) = 2.391$, $p = .044$*
MCS	4 (44.75, 7.93)	4 (54.50, 5.07)	$t(3) = -3.806$, $p = .032$*

* Significant at .05

TABLE 12

Paired Samples t-tests for Yellow I Group: Initial Evaluation to 12-Month Follow-Up

Measure	Initial Evaluation n (Mean, SD)	12-Month F/U n (Mean, SD)	Statistic
OSW	22 (22.64, 6.62)	22 (20.0, 9.90)	$t(21) = 1.239$, $p = .229$
VAS	23 (8.70, 1.19)	23 (5.96, 2.62)	$t(22) = 4.465$, $p < .001$*
PCS	9 (23.56, 9.86)	9 (31.11, 11.55)	$t(8) = -1.984$, $p = .083$
DPQ	22 (89.64, 18.43)	22 (88.91, 19.01)	$t(21) = .689$, $p = .498$
CSQ – Cat.	22 (14.91, 6.76)	22 (14.05, 6.34)	$t(21) = .888$, $p = .384$
BDI	25 (12.16, 5.33)	25 (13.12, 7.19)	$t(24) = -.687$, $p = .499$
MCS	9 (52.44, 6.39)	9 (52.89, 13.52)	$t(8) = -.123$, $p = .905$

* Significant at .001

TABLE 13

Paired Samples t-tests for Yellow II Group: Initial Evaluation to 12-Month Follow-Up

Measure	Initial Evaluation n (Mean, SD)	12-Month F/U n (Mean, SD)	Statistic
OSW	21 (26.81, 8.69)	21 (25.00, 8.39)	$t(20) = 1.251$, $p = .225$
VAS	20 (8.40, 1.35)	20 (6.50, 2.14)	$t(19) = 3.356$, $p = .003$*
PCS	8 (21.14, 5.43)	8 (25.0, 8.07)	$t(7) = -2.001$, $p = .085$
DPQ	20 (97.10, 22.79)	20 (96.55, 23.75)	$t(19) = .428$, $p = .673$
CSQ –Cat.	21 (14.38, 10.11)	21 (13.0, 10.27)	$t(20) = 1.621$, $p = .121$
BDI	23 (17.30, 9.67)	23 (14.96, 9.50)	$t(22) = 1.224$, $p = .234$
MCS	8 (45.36, 14.77)	8 (48.88, 11.61)	$t(7) = -.524$, $p = .617$

* Significant at .01

TABLE 14

Paired Samples t-tests for Red Group: Initial Evaluation to 12-Month Follow-Up

Measure	Initial Evaluation n (Mean, SD)	12-Month F/U n (Mean, SD)	Statistic
OSW	8 (30.38, 7.58)	8 (32.38, 9.74)	$t(7) = -.730$, $p = .489$
VAS	9 (8.67, 1.94)	9 (7.89, 3.59)	$t(8) = .642$, $p = .539$
PCS	3 (29.0, 15.87)	3 (25.33, 11.68)	$t(2) = 1.344$, $p = .311$
DPQ	8 (105.0, 21.19)	8 (105.75, 20.13)	$t(7) = -1.00$, $p = .351$
CSQ –Cat.	8 (26.75, 7.70)	8 (26.75, 7.70)	N.A.†
BDI	10 (31.70, 14.43)	10 (26.70, 11.96)	$t(9) = 2.266$, $p = .050$*
MCS	3 (26.0, 13.89)	3 (29.33, 10.69)	$t(3) = -1.644$, $p = .242$

† Could not be computed because the standard error of the difference is 0
* Significant at .05

TABLE 15

Analysis of Psychosocial and Physical/Functional Measures at 12-Month Follow-up among the Four Prognostic Groups

Measure	Green n mean SD	Yellow I n mean SD	Yellow II n mean SD	Red n mean SD	Statistic
BDI	9 7.11 3.33	25 13.12 7.19	23 14.96 9.50	10 26.70 11.96	$F(3, 63) = 9.20$, $p < .001$*
MCS	9 55.67 5.57	23 51.00 12.17	18 48.78 10.69	9 33.00 14.07	$F(3, 55) = 7.215$, $p < .001$*
CSQ – Cat.	8 8.38 6.12	24 13.54 6.72	21 13.0 10.27	8 26.75 7.70	$H(3) = 15.917$, $p = .001$*
PCS	9 32.33 12.35	23 28.61 11.93	18 25.78 9.21	9 25.0 7.76	$H(3) = 1.975$, $p = .578$
DPQ	7 79.14 31.58	24 88.21 19.11	20 96.55 23.75	8 105.75 20.13	$F(3, 55) = 2.245$, $p = .903$
VAS	9 4.67 2.00	25 5.88 2.52	23 6.39 2.11	10 7.90 3.38	$H(3) = 8.447$, $p = .038$♦
OSW	8 15.25 5.06	24 20.33 9.89	21 25.0 8.39	8 32.38 9.74	$H(3) = 13.953$, $p = .003$†

* Significant at the .001 level
† Significant at the .01 level
♦ Significant at the .05 level

TABLE 16

Visual Analogue Scale (VAS): Repeated Measures Analysis of Variance for Initial Evaluation, 6-Month, and 12-Month Follow-Up by Group and Time

Prognostic Group (n)	Initial Eval. (Mean, SD)	6 Month F/U (Mean, SD)	12-Month F/U (Mean, SD)
Green (8)	7.25, 1.58	5.75, 2.49	4.75, 2.12
Red (9)	8.67, 1.936	8.33, 3.20	7.89, 3.59

VAS	SS†	MS‡	Statistic
Group Effect	71.949	71.949	$F(1, 15) = 6.243$, $p = .025$*
Error	172.80	11.52	
Time Effect	22.86	11.43	$F(2, 30) = 2.548$, $p = .095$
Error	134.59	4.486	

† Sum of Squares
‡ Mean Squares
* Significant at .05

TABLE 17

Oswestry (OSW): Repeated Measures Analysis of Variance for Initial Evaluation, 6-Month, and 12-Month Follow-Up by Group and Time

Prognostic Group (n)	Initial Eval. (Mean, SD)	6 Month F/U (Mean, SD)	12-Month F/U (Mean, SD)
Green (8)	18.75, 7.55	15.75, 6.04	15.25, 5.06
Red (8)	30.38, 7.58	29.63, 11.65	32.38, 9.74

OSW	SS†	MS‡	Statistic
Group Effect	2422.52	2422.52	$F(1, 14) = 15.483$, $p = .001$*
Error	2190.46	156.46	
Time Effect	28.50	14.25	$F(2, 28) = .605$, $p = .553$
Error	659.67	23.56	

† Sum of Squares
‡ Mean Squares
* Significant at .001

TABLE 18

Physical Component Scale (PCS): Repeated Measures Analysis of Variance for Initial Evaluation, 6-Month, and 12-Month Follow-Up by Group and Time

Prognostic Group (n)	Initial Eval. (Mean, SD)	6 Month F/U (Mean, SD)	12-Month F/U (Mean, SD)
Green (4)	27.75, 6.40	32.00, 2.00	34.25, 13.64
Red (3)	29.00, 15.87	28.00, 11.36	25.33, 11.68

PCS	SS†	MS‡	Statistic
Group Effect	77.78	77.78	$F(1, 5) = .302$, $p = .606$
Error	1288.89	257.78	
Time Effect	10.72	5.36	$F(2, 10) = .122$, $p = .886$
Error	439.28	43.93	

† Sum of Squares
‡ Mean Squares

TABLE 19

Beck Depression Inventory (BDI): Repeated Measures Analysis of Variance for Initial Evaluation, 6-Month, and 12-Month Follow-Up by Group and Time

Prognostic Group (n)	Initial Eval. (Mean, SD)	6 Month F/U (Mean, SD)	12-Month F/U (Mean, SD)
Green (9)	9.67, 4.77	7.11, 3.10	7.11, 3.33
Red (10)	31.70, 14.43	25.60, 11.26	26.70, 11.96

BDI	SS†	MS‡	Statistic
Group Effect	5705.28	5705.28	$F(1, 17) = 25.73$, $p = <.001$*
Error	3768.96	221.704	
Time Effect	210.34	152.45	$F(1.38, 23.46) = 4.06$,
Error	881.42	37.58	$p = .044$▪♦

† Sum of Squares
‡ Mean Squares
▪ Due to the significance of Mauchly's Test, the Greenhouse-Geisser correction was used
*Significant at .001
♦Significant at .05

TABLE 20

Mental Component Score (MCS): Repeated Measures Analysis of Variance for Initial Evaluation, 6-Month, and 12-Month Follow-Up by Group and Time

Prognostic Group (n)	Initial Eval. (Mean, SD)	6 Month F/U (Mean, SD)	12-Month F/U (Mean, SD)
Green (4)	44.75, 7.93	52.50, 8.39	54.50, 5.07
Red (3)	26.00, 13.89	26.67, 10.41	29.33, 10.69

MCS	SS†	MS‡	Statistic
Group Effect	2780.04	2780.04	$F(1, 5) = 11.38$, $p = .020$♦
Error	1221.58	244.32	
Time Effect	150.74	75.37	$F(2, 10) = 8.71$, $p = .006$*
Error	86.50	8.65	

† Sum of Squares
‡ Mean Squares
* Significant at .01
♦Significant at .05

TABLE 21

Analysis of Vocational Status at 12-Month Follow-Up

Vocational Status	Green n (%)	Yellow I n (%)	Yellow II n (%)	Red n (%)	Statistic
Working	6 (66.7)	16 (64.0)	9 (39.1)	3 (30.00	$\chi(3) = 5.633$, $p = .131$†
Not Working	3 (33.3)	9 (36.0)	14 (60.9)	7 (70.0)	
Working	6 (66.7)			3 (30.0)	$\chi(1) = 2.554$, $p = .110$,
Not Working	3 (33.3)			7 (70.0)	4.667 (.673 – 32.360)‡

† Odds Ratio (OR) not calculated due to more than two subdivisions of the variable
‡ χ^2 (df) = χ^2 statistic, p value, Odds Ratio (95% Confidence Intervals)

TABLE 22

Analysis of Healthcare Utilization in the Past Year at 12-Month Follow-Up

Health Care Utilization	**Green** **n** **mean** **SD**	**Yellow I** **n** **mean** **SD**	**Yellow II** **n** **mean** **SD**	**Red** **n** **mean** **SD**	**Statistics**
Health Care Visits	9 15.22 16.48	13 10.15 5.66	10 15.80 9.57	10 33.30 41.99	$H(3) = 3.606$, $p = .307$
Emergency Room Visits	9 1.78 3.23	25 .84 1.86	22 1.23 2.45	10 2.0 2.16	$H(3) = 3.885$, $p = .274$
Health Care Visits	9 15.22 16.48			10 33.30 41.99	$U(29.00)$, $p = .188$
Emergency Room Visits	9 1.78 3.23			10 2.0 2.16	$U(38.00)$, $p = .550$

TABLE 23

Medication Usage of Individuals at 12-Month Follow-Up

Medication	Green N = 9 n (%)	Yellow I N =25 n (%)	Yellow II N = 23 N (%)	Red N = 9 n (%)	Statistic
Narcotic	8 (88.9)	12 (48.0)	15 (65.2)	7 (77.8)	$\chi(3) = 5.92$, $p = .115$†
NSAID	1 (11.1)	4 (16.0)	4 (17.4)	1 (11.1)	$\chi(3) = .332$, $p = .954$†
Anti-Convulsant	1 (11.1)	7 (28.0)	6 (26.1)	4 (44.4)	$\chi(3) = 2.55$, $p = .467$†
Muscle Relaxant	2 (22.2)	6 (24.0)	3 (13.0)	2 (22.2)	$\chi(3) = 1.01$, $p = .779$†
Benzodiazepine/ Sedative	2 (22.2)	9 (36.0)	4 (17.4)	3 (33.3)	$\chi(3) = 2.38$, $p = .498$†
Anti-Depressant	3 (33.3)	10 (40.0)	11 (47.8)	3 (33.3)	$\chi(3) = .89$, $p = .828$†

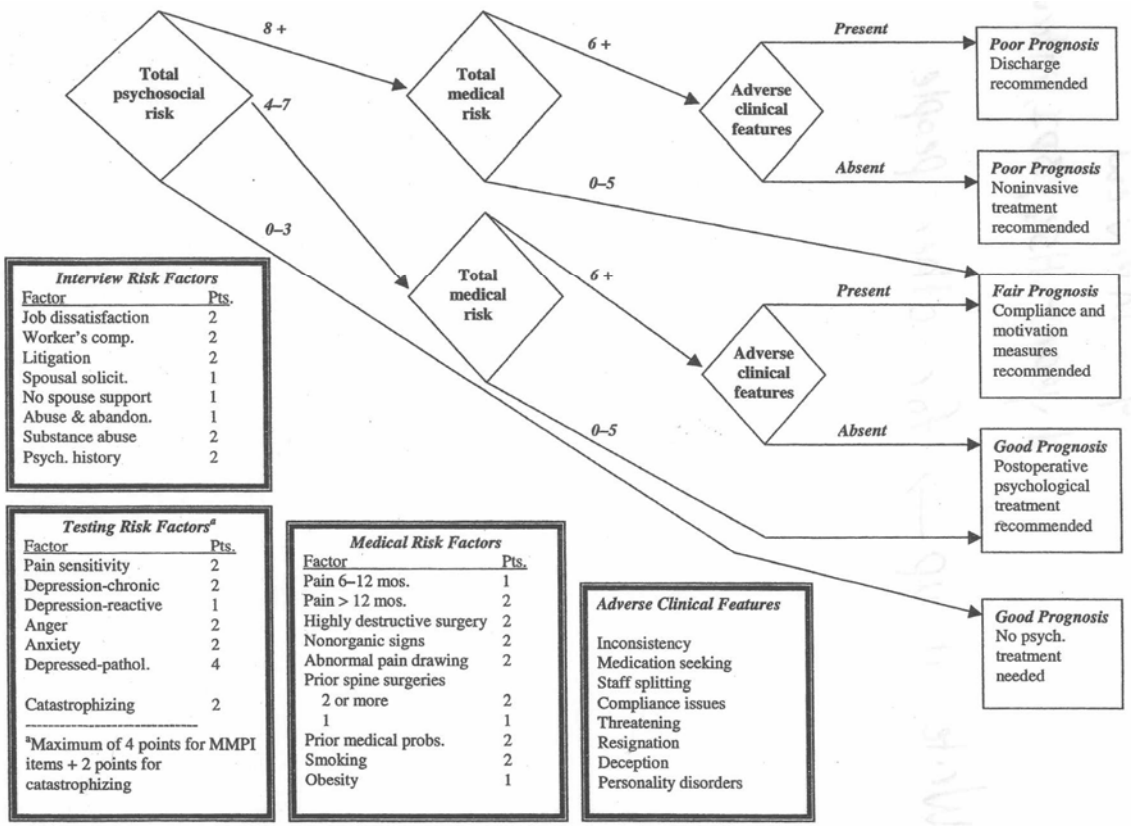
† Odds Ratio (OR) not calculated due to more than two subdivisions of the variable

TABLE 24

Comparison of the Green and Red Group on Medication Usage at 12-Month Follow-Up

Medication	Green N = 9 n (%)	Red N = 9 n (%)	Statistic
Narcotic	8 (88.9)	7 (77.8)	$\chi(1) = .400$ $p = .527$, OR = .438, 95% CI: .032 – 5.926
NSAID	1 (11.1)	1 (11.1)	$\chi(1) = .000$, $p = 1.000$, OR = 1.000, 95% CI: .053 – 18.915
Anti-Convulsant	1 (11.1)	4 (44.4)	$\chi(1) = 2.492$, $p = .144$, OR = 6.400, 95% CI: .547 – 74.891
Muscle Relaxant	2 (22.2)	2 (22.2)	$\chi(1) = .000$, $p = 1.000$, OR = 1.000, 95% CI: .108 – 9.229
Benzodiazepine/ Sedative	2 (22.2)	3 (33.3)	$\chi(1) = .277$, $p = .599$, OR = 1.750, 95% CI: .215 – 14.224
Anti-Depressant	3 (33.3)	3 (33.3)	$\chi(1) = .000$, $p = 1.000$, OR = 1.000, 95% CI: .141 – 7.099

APPENDIX C
Algorithm



Block, A. R., Gatchel, R. J., Deardorff, W., & Guyer, R. D. (2003). *The psychology of spine surgery*. Washington: American Psychological Association.

APPENDIX D
Materials

Coping Strategy Questionnaire

Individuals who experience pain have developed a number of ways to cope, or deal with, their pain. These include saying things to themselves when they experience pain, or engaging in different activities. Below is a list of things that patients have reported doing when they feel pain. For each activity, I want you to indicate, using the scale below, how much you engage in that activity when you feel pain, where a 0 indicates you never do that when you are experiencing pain, a 3 indicates you sometimes do that when you are experiencing pain, and a 6 indicates you always do it when you are experiencing pain. Remember, you can use any
point along the scale.

0	1	2	3	4	5	6
Never do that			Sometimes do that			Always do that

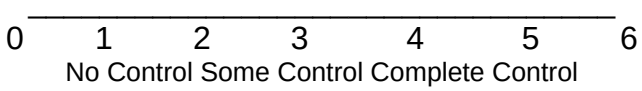
When I feel pain…

____ 1. I try to feel distant from the pain, almost as if the pain was in somebody else's body.
____ 2. I leave the house and do something, such as going to the movies or shopping.
____ 3. I try to think of something pleasant.
____ 4. I don't think of it as pain but rather as a dull or warm feeling.
____ 5. It is terrible and I feel it is never going to get any better.
____ 6. I tell myself to be brave and carry on despite the pain.
____ 7. I read.
____ 8. I tell myself that I can overcome the pain.
____ 9. I count numbers in my head or run a song through my mind.
____ 10. I just think of it as some other sensation, such as numbness.
____ 11. It is awful and I feel that it overwhelms me.
____ 12. I play mental games with myself to keep my mind off the pain.
____ 13. I feel my life isn't worth living.
____ 14. I know someday someone will be here to help me and it will go away for awhile.
____ 15. I pray to God it won't last long.
____ 16. I try not to think of it as my body, but rather as something separate from me.
____ 17. I don't think about the pain.
____ 18. I try to think about years ahead, what everything will be like after I've gotten rid of the pain.
____ 19. I tell myself it doesn't hurt
____ 20. I tell myself I can't let the pain stand in the way of what I have to do.
____ 21. I don't pay any attention to it.
____ 22. I have faith in doctors that someday there will be a cure for my pain.
____ 23. No matter how bad it gets, I know I can handle it.
____ 24. I pretend it is not there.
____ 25. I worry all the time about whether it will end.
____ 26. I replay in my mind the pleasant experiences in the past.

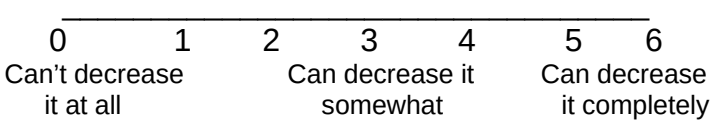
____ 27. I think of people I enjoy doing things with.
____ 28. I pray for the pain to stop.
____ 29. I imagine that the pain is outside of my body.

When I feel pain….
____ 30. I just go on as if nothing happened.
____ 31. I see it as a challenge and don't let it bother me.
____ 32. Although it hurts, I just keep on going.
____ 33. I feel I can't stand it anymore.
____ 34. I try to be around other people.
____ 35. I ignore it.
____ 36. I rely on my faith in God.
____ 37. I feel like I can't go on.
____ 38. I think of things that I enjoy doing.
____ 39. I do anything to get my mind off the pain.
____ 40. I do something I enjoy, such as watching TV or listening to music.
____ 41. I pretend it is not a part of me.
____ 42. I do something active, like household chores or projects.

Based on all the things you do to cope, or deal with, your pain, on an average day, how much control do you feel you have over it? Please circle the appropriate number. Remember, you can circle any number along the scale.



Based on all of the things you do to cope, or deal with, your pain, on an average day, how much are you able to decrease it? Please circle the appropriate number. Remember, you can circle any number along the scale.



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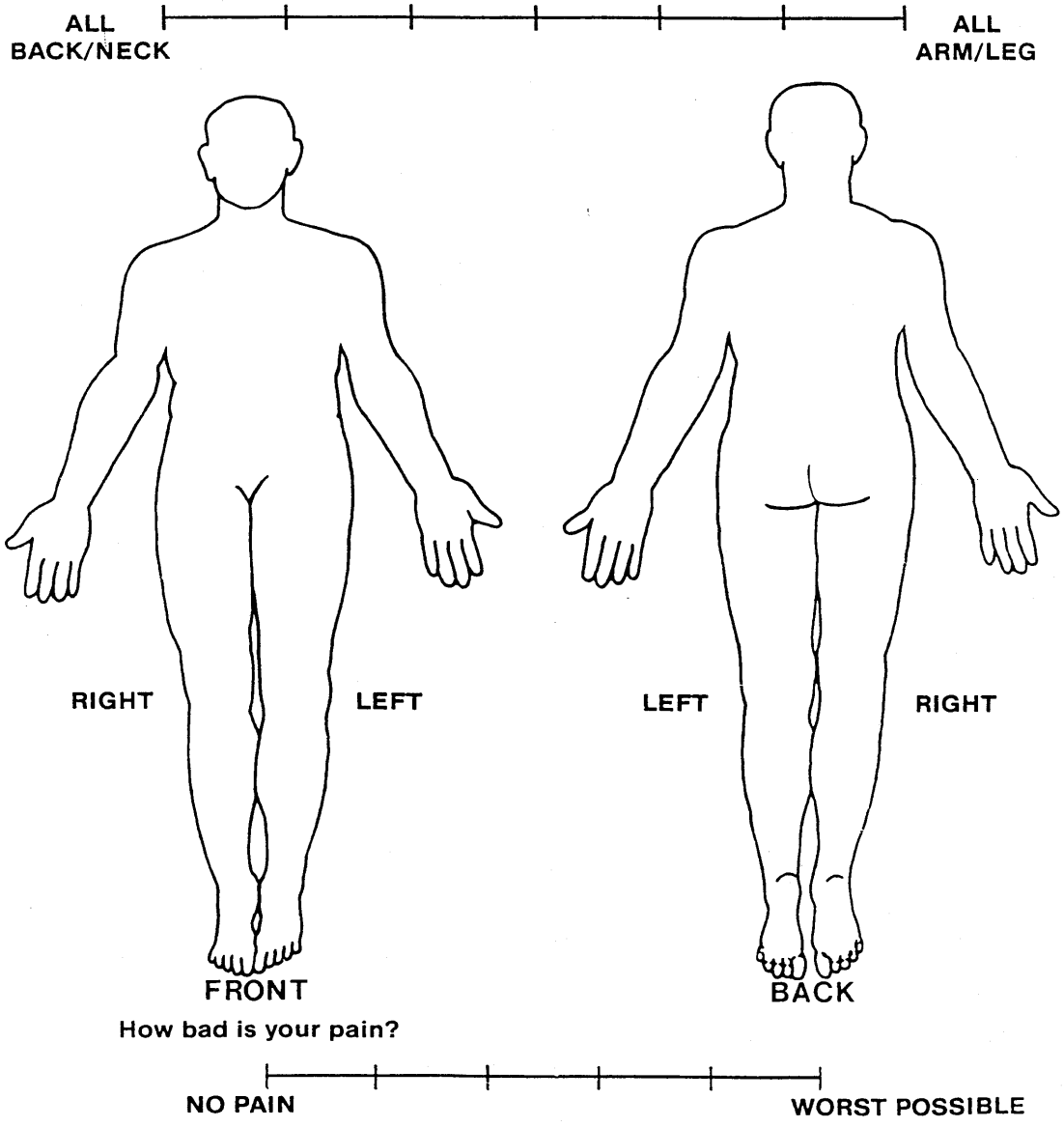
DALLAS PAIN QUESTIONNAIRE

PAIN DRAWING GRID ASSESSMENT

Draw the location of your pain on the body outlines and mark whether it is all back/neck or all arm/leg.



NAME: _____ **DATE:** _____

PLEASE MAKE AN "X" ALONG THE LINE TO SHOW HOW FAR FROM NORMAL TOWARD THE WORST POSSIBLE SITUATION YOUR PAIN PROBLEM HAS TAKEN YOU.

1. **How bad is your pain?**

no pain — worst possible

2. **How bad is the pain at night?**

no pain — worst possible

3. **Does the pain interfere with your lifestyle?**

no problem — total change in lifestyle

4. **How good are pain killers for your pain?**

complete relief — no relief

5. **How stiff is your back?**

no stiffness — worst possible stiffness

6. **Does your pain interfere with walking?**

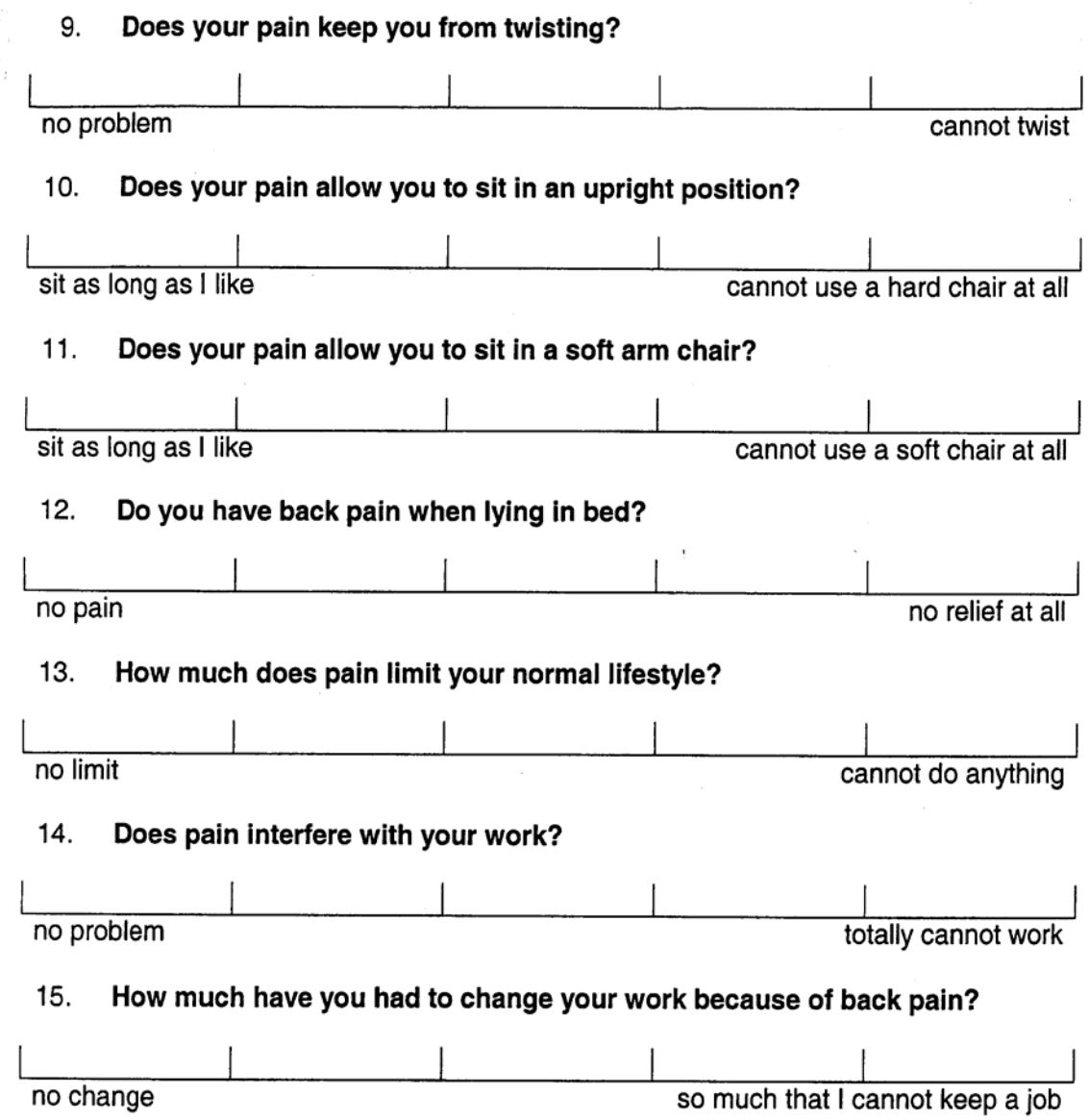
no problem — cannot walk

7. **Do you hurt when walking?**

no pain — worst possible pain

8. **Does your pain keep you from standing still?**

can stand still as long as I want — cannot stand still at all



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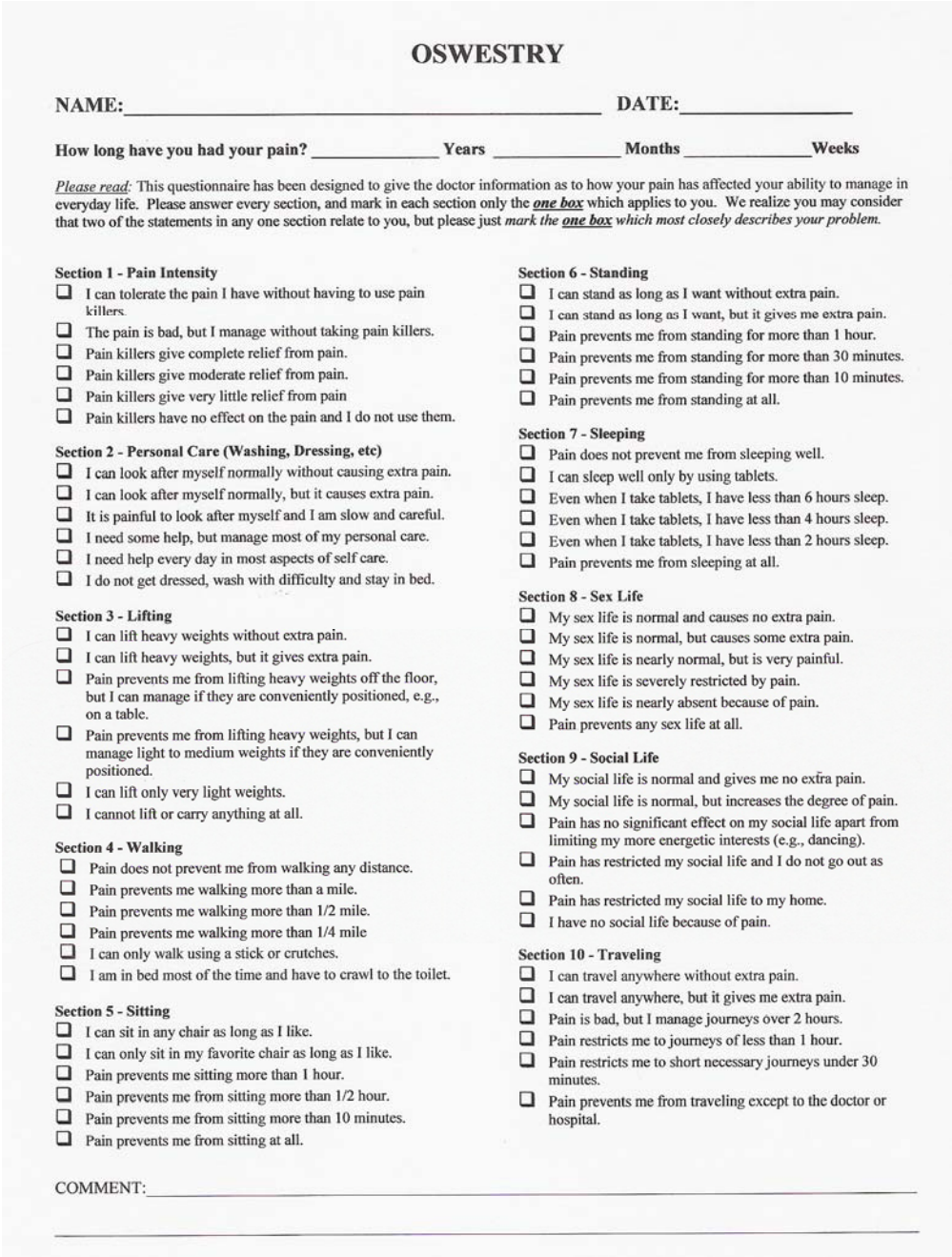


OSWESTRY

NAME:_____ **DATE:**_____

How long have you had your pain? _____ **Years** _____ **Months** _____**Weeks**

Please read: This questionnaire has been designed to give the doctor information as to how your pain has affected your ability to manage in everyday life. Please answer every section, and mark in each section only the ***one box*** which applies to you. We realize you may consider that two of the statements in any one section relate to you, but please just *mark the* ***one box*** *which most closely describes your problem.*

Section 1 - Pain Intensity

- ☐ I can tolerate the pain I have without having to use pain killers.
- ☐ The pain is bad, but I manage without taking pain killers.
- ☐ Pain killers give complete relief from pain.
- ☐ Pain killers give moderate relief from pain.
- ☐ Pain killers give very little relief from pain
- ☐ Pain killers have no effect on the pain and I do not use them.

Section 2 - Personal Care (Washing, Dressing, etc)

- ☐ I can look after myself normally without causing extra pain.
- ☐ I can look after myself normally, but it causes extra pain.
- ☐ It is painful to look after myself and I am slow and careful.
- ☐ I need some help, but manage most of my personal care.
- ☐ I need help every day in most aspects of self care.
- ☐ I do not get dressed, wash with difficulty and stay in bed.

Section 3 - Lifting

- ☐ I can lift heavy weights without extra pain.
- ☐ I can lift heavy weights, but it gives extra pain.
- ☐ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, e.g., on a table.
- ☐ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
- ☐ I can lift only very light weights.
- ☐ I cannot lift or carry anything at all.

Section 4 - Walking

- ☐ Pain does not prevent me from walking any distance.
- ☐ Pain prevents me walking more than a mile.
- ☐ Pain prevents me walking more than 1/2 mile.
- ☐ Pain prevents me walking more than 1/4 mile
- ☐ I can only walk using a stick or crutches.
- ☐ I am in bed most of the time and have to crawl to the toilet.

Section 5 - Sitting

- ☐ I can sit in any chair as long as I like.
- ☐ I can only sit in my favorite chair as long as I like.
- ☐ Pain prevents me sitting more than 1 hour.
- ☐ Pain prevents me from sitting more than 1/2 hour.
- ☐ Pain prevents me from sitting more than 10 minutes.
- ☐ Pain prevents me from sitting at all.

Section 6 - Standing

- ☐ I can stand as long as I want without extra pain.
- ☐ I can stand as long as I want, but it gives me extra pain.
- ☐ Pain prevents me from standing for more than 1 hour.
- ☐ Pain prevents me from standing for more than 30 minutes.
- ☐ Pain prevents me from standing for more than 10 minutes.
- ☐ Pain prevents me from standing at all.

Section 7 - Sleeping

- ☐ Pain does not prevent me from sleeping well.
- ☐ I can sleep well only by using tablets.
- ☐ Even when I take tablets, I have less than 6 hours sleep.
- ☐ Even when I take tablets, I have less than 4 hours sleep.
- ☐ Even when I take tablets, I have less than 2 hours sleep.
- ☐ Pain prevents me from sleeping at all.

Section 8 - Sex Life

- ☐ My sex life is normal and causes no extra pain.
- ☐ My sex life is normal, but causes some extra pain.
- ☐ My sex life is nearly normal, but is very painful.
- ☐ My sex life is severely restricted by pain.
- ☐ My sex life is nearly absent because of pain.
- ☐ Pain prevents any sex life at all.

Section 9 - Social Life

- ☐ My social life is normal and gives me no extra pain.
- ☐ My social life is normal, but increases the degree of pain.
- ☐ Pain has no significant effect on my social life apart from limiting my more energetic interests (e.g., dancing).
- ☐ Pain has restricted my social life and I do not go out as often.
- ☐ Pain has restricted my social life to my home.
- ☐ I have no social life because of pain.

Section 10 - Traveling

- ☐ I can travel anywhere without extra pain.
- ☐ I can travel anywhere, but it gives me extra pain.
- ☐ Pain is bad, but I manage journeys over 2 hours.
- ☐ Pain restricts me to journeys of less than 1 hour.
- ☐ Pain restricts me to short necessary journeys under 30 minutes.
- ☐ Pain prevents me from traveling except to the doctor or hospital.

COMMENT:_____

_____

Fairbank, J. C., Couper, J., Davies, J. B., & O'Brien, J. P. (1980). The oswestry low back pain disability questionnaire. *Physiotherapy, 66*, 271-273.

PMQ PAIN MEDICATION QUESTIONNAIRE

NAME: _____

In order to develop the best treatment plan for you, we want to understand your thoughts, needs and experiences related to pain medication. Please read each statement below and indicate how much it applies to you by marking your response with an "X" anywhere on the line below it.

1) I believe I am receiving enough medication to relieve my pain.

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

2) My doctor spends enough time talking to me about my pain medication during appointments.

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

3) I believe I would feel better with a higher dosage of my pain medication.

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

4) In the past, I have had some difficulty getting the medication I need from my doctor(s).

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

5) I wouldn't mind quitting my current pain medication and trying a new one, if my doctor recommends it.

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

6) I have clear preferences about the type of pain medication I need.

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

7) Family members seem to think that I may be too dependent on my pain medication.

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

8) It is important to me to try ways of managing my pain in addition to the medication *(such as relaxation, biofeedback, physical therapy, TENS unit, etc.)*

Disagree — Somewhat Disagree — Neutral — Somewhat Agree — Agree

(Please continue on the next page)

PMQ PAIN MEDICATION QUESTIONNAIRE

9) At times, I take pain medication when I feel anxious and sad, or when I need help sleeping.

Never Occasionally Sometimes Often Always

10) At times, I drink alcohol to help control my pain.

Never Occasionally Sometimes Often Always

11) My pain medication makes it hard for me to think clearly sometimes.

Never Occasionally Sometimes Often Always

12) I find it necessary to go to the emergency room to get treatment for my pain.

Never Occasionally Sometimes Often Always

13) My pain medication makes me nauseated and constipated sometimes.

Never Occasionally Sometimes Often Always

14) At times, I need to borrow pain medication from friends or family to get relief.

Never Occasionally Sometimes Often Always

15) I get pain medication from more than one doctor in order to have enough medication for my pain.

Never Occasionally Sometimes Often Always

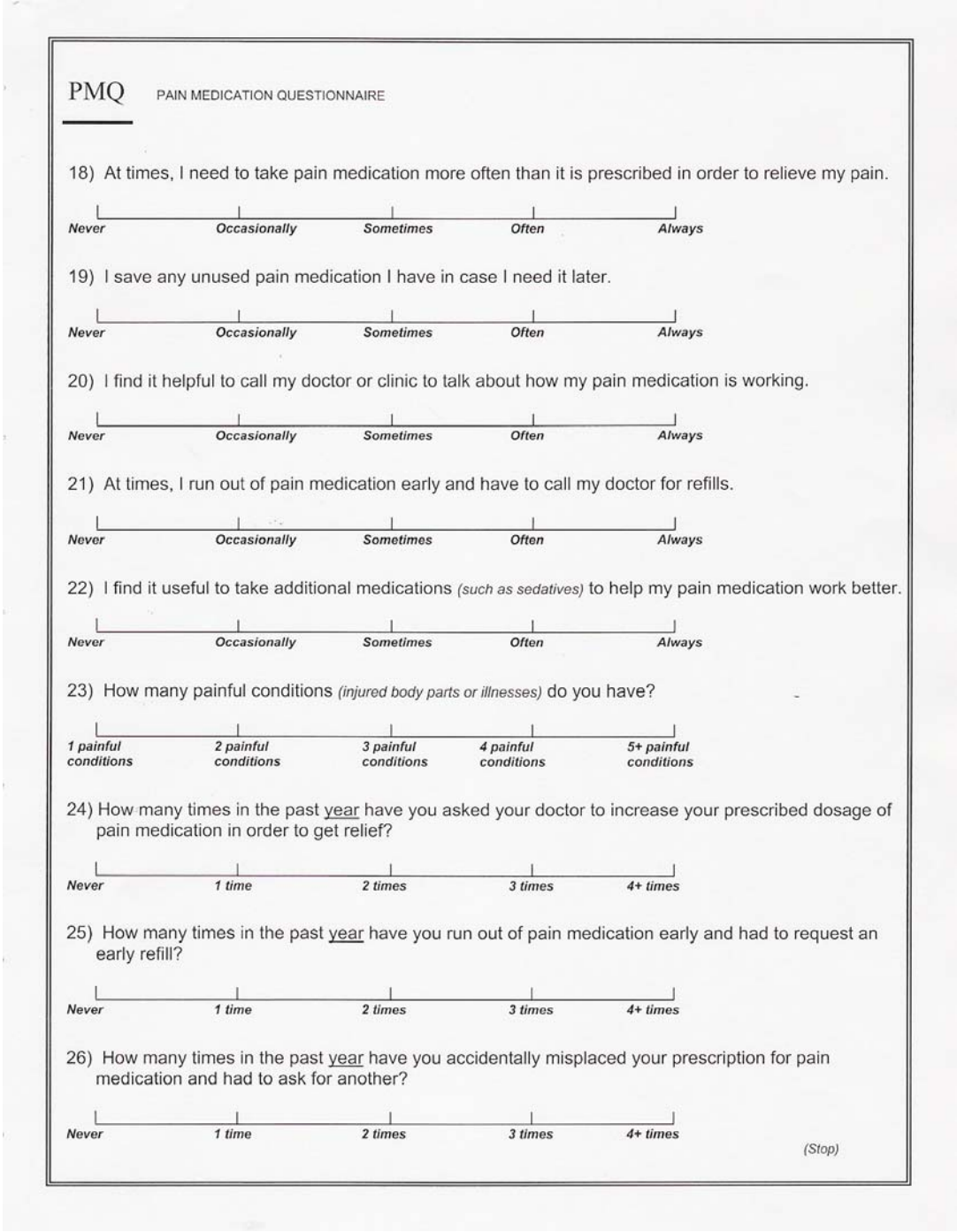
16) At times, I think I may be too dependent on my pain medication.

Never Occasionally Sometimes Often Always

17) To help me out, family members have obtained pain medications for me from their own doctors.

Never Occasionally Sometimes Often Always

(Please continue on the next page)



PMQ PAIN MEDICATION QUESTIONNAIRE

18) At times, I need to take pain medication more often than it is prescribed in order to relieve my pain.

Never | Occasionally | Sometimes | Often | Always

19) I save any unused pain medication I have in case I need it later.

Never | Occasionally | Sometimes | Often | Always

20) I find it helpful to call my doctor or clinic to talk about how my pain medication is working.

Never | Occasionally | Sometimes | Often | Always

21) At times, I run out of pain medication early and have to call my doctor for refills.

Never | Occasionally | Sometimes | Often | Always

22) I find it useful to take additional medications *(such as sedatives)* to help my pain medication work better.

Never | Occasionally | Sometimes | Often | Always

23) How many painful conditions *(injured body parts or illnesses)* do you have?

1 painful conditions | 2 painful conditions | 3 painful conditions | 4 painful conditions | 5+ painful conditions

24) How many times in the past year have you asked your doctor to increase your prescribed dosage of pain medication in order to get relief?

Never | 1 time | 2 times | 3 times | 4+ times

25) How many times in the past year have you run out of pain medication early and had to request an early refill?

Never | 1 time | 2 times | 3 times | 4+ times

26) How many times in the past year have you accidentally misplaced your prescription for pain medication and had to ask for another?

Never | 1 time | 2 times | 3 times | 4+ times

(Stop)

Adams, L. L., Gatchel, R. J., Robinson, R. C., Polatin, P. P., Gajraj, N., Deschner, M., et al. (2004). Development of a self-report screening instrument for assessing potential opioid medication misuse in chronic pain patients. *Journal of Pain and Symptom Management, 27*(5), 440-459.

Pt. Name: _____ Whitworth / Lou (circle) Date: _____

Stage: Pre-Trial / Trial / Post-Trial / Procedure / Post-Procedure (circle) Duration of Trial (# days) _____
Method of Trial: Bolus / Continuous Infusion / Stimulator (circle) Type of Stimulator _____
Please Include total daily dose (DD) or infusion rate (IR) [e.g. 30mg Oxycontin tid = 90mg Oxycontin, etc.]

Opioid **Dosage (DD/IR)**

Long-Acting
- Duragesic (Fentanyl)
- Methadone (Dolophine) _____
- Morphine Sulphate (Avinza) _____

Short-Acting
- Codeine _____
- Tramadol (Ultram) _____
- Hydrocodone (Lortab, Vicodin) _____
- Meperidine (Demerol) _____
- Morphine _____
- Oxycodone (Percodan) _____
- Oxycontin (Oxycodone HCl) _____
- Pentazocine (Talwin) _____
- Actiq (Fentanyl) _____
- Other _____

NSAID
- Diclofenac (Voltaren) _____
- Etodolac (Lodine) _____
- Fenoprofen (Nalfon) _____
- Flurbiprofen (Ansaid) _____
- Ibuprofin (Motrin, Advil) _____
- Indomethacin (Indocin) _____
- Ketoprofen (Orudis, Oruvail) _____
- Ketorolac (Toradol) _____
- Meclofenamate (Meclomen) _____
- Mefenamic acid (Ponstel) _____
- Naproxen sodium (Anaprox) _____
- Naproxyn (Naprosyn) _____
- Piroxicam (Feldene) _____
- Tolmetin (Tolectin) _____
- Other _____

Anticonvulsant
- Clonazepam (Klonipin) _____
- Keppra (Levetiracetam) _____
- Neurontin (Gabapentin) _____
- Topamax (Topiramate) _____
- Zonegran (Zonisamide) _____
- Other _____

Muscle Relaxants
- Baclofen (Lioresal) _____
- Carisoprodol (Soma) _____
- Chlorzoxazone (Parafon Forte) _____
- Cyclobenzapine (Flexeril) _____
- Methocarbamol (Robaxin) _____
- Orphenadrine (Norflex) _____
- Zanaflex (Tizanadine) _____
- Metaxelone (Skelaxin) _____
- Other _____

Antianxiety
- Benzodiazepine
  - Alprazolam (Xanax) _____
  - Clordiazepoxide (Librium) _____
  - Diazepam (Valium) _____
  - Lorazepam (Ativan) _____
  - Oxazepam (Serax) _____
- Other (Antianxiety) **Dosage (DD/IR)**
  - Antihistamines _____
  - Buspirone (BuSpar) _____
  - Other _____

Sedative / hypnotic
- Benzopdiazepines
  - Flurazepam (Dalmane) _____
  - Temazepam (Restoril) _____
  - Triazolam (Halcion) _____
- Barbiturates _____
- Chloral derivatives _____
- Zolpidem (Ambien) _____
- Sonata (Zaleplon) _____
- Other _____

Neuroleptic
- Chlorpromazine (Thorazine) _____
- Clozapine (Clozaril) _____
- Fluphenazine (Prolixin) _____
- Haloperidol (Haldol) _____
- Loxapine (Loxitane) _____
- Molindone (Moban) _____
- Perphenazine (Trilafon) _____
- Risperidone (Risperdal) _____
- Thioridazine (Mellaril) _____
- Thiothixene (Navane) _____
- Trifluoperazine (Stelazine) _____
- Olanzapine (Zyprexa) _____
- Other _____

Lithium _____

Antidepressant
- **SSRI**
  - Citalopram (Celexa) _____
  - Clomipramine (Anafranil) _____
  - Escitalopram (Lexapro) _____
  - Fluvoxamine (Luvox) _____
  - Fluoxetine (Prozac) _____
  - Paroxetine (Paxil) _____
  - Sertraline (Zoloft) _____
- **Tricyclic**
  - Amitriptyline (Elavil) _____
  - Amoxapine (Asendin) _____
  - Desipramine (Norpramin) _____
  - Doxipin (Sinequan) _____
  - Imipramine (Tofranil) _____
  - Nortriptyline (Pamelor) _____
- **MAOI**
  - Isocarboxazid (Marplan) _____
  - Phenelzine (Nardil) _____
  - Tranylcypromine (Parnate) _____
- **Other**
  - Trazadone (Desyrel) _____
  - Nefazodone (Serzone) _____
  - Venlafaxine (Effexor) _____
  - Buproprion (Wellbutrin) _____
  - Maprotiline (Ludiomil) _____

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VITAE

David Robert Heckler was born on October 29, 1981 in Austin, Texas. He was raised by his parents Dave and Jane Heckler and has three sisters, Jessica, Maggie, and Kate. He graduated from St. Michael's Academy in 2000 and then attended Austin College in Sherman, Texas for his undergraduate. David earned a Bachelor of Arts degree in both Psychology and Business Administration. Following graduation, David attended the Graduate School of Biomedical Sciences at the University of Texas Southwestern Medical Center at Dallas to pursue a master's degree in Rehabilitation Counseling Psychology. Following graduation, David is pursuing a doctoral degree in Clinical Psychology at Texas Tech University and is getting married in December to Wendy Kreisle.