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Upskilling pain relief after surgery: a scoping review of perioperative behavioral intervention efficacy and practical considerations for implementation

Beth D Darnall ,[1] Lauren Abshire,[2] Rena E Courtney,[3] Sara Davin[2]

[1]Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Stanford, California, USA
[2]Neurological Institute, Center for Spine Health, Cleveland Clinic, Cleveland, Ohio, USA
[3]PREVAIL Center for Chronic Pain, Salem VA Medical Center, Salem, Virginia, USA

Correspondence to
Dr Beth D Darnall;
bdarnall@stanford.edu

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ABSTRACT

Perioperative skills-based interventions may support non-pharmacological management of pain and opioid reduction after surgery. Such interventions may target and enhance predictors for surgical recovery and possibly reduce chronic postsurgical pain. Existing meta-analyses are limited by inclusion of studies that are either non-surgical or with outcomes occurring only in the hours after surgery. Lacking is a scoping review of studies testing perioperative skills-based interventions for postsurgical pain relief and opioid reduction in the days and months after surgery. We reviewed the efficacy of perioperative behavioral interventions; over what time frame and in which surgical populations efficacy evidence exists; and whether such interventions can prevent chronic postsurgical pain. 20 randomized trials were included, with the following intervention types: hypnosis, relaxation therapy, stress management training, mindfulness, mixed-type skills interventions (mind–body skills, preoperative pain self-management, empowered relief for surgery); cognitive behavioral–therapy (CBT); and mindfulness-based CBT. We summarize study methods, treatment specifics, and analgesic effects. No studies were designed to test intervention efficacy for preventing chronic postsurgical pain. Only two studies used active controls as the study comparator. Two studies showed positive effects on postsurgical opioid use. No studies tested whether the interventions enhanced time to pain cessation after surgery. Four studies demonstrated durable analgesic effects at 3–12 months after surgery. We describe the real-world practicality of intervention integration into the perioperative pathway and provide dissemination and implementation methodologies that may increase intervention uptake and therefore fulfill calls from national agencies to better integrate behavioral pain treatments into perioperative care.

INTRODUCTION AND BACKGROUND

Up to 50 million surgeries are performed in the USA each year, and an estimated 313 million surgeries worldwide.[1] While the relationship between surgery and chronic postsurgical pain is complex and multifactorial, high pain intensity at the surgical site on postoperative day 10 has been shown to strongly predict pain resolution, opioid cessation, and complete recovery after surgery.[2] In an era of opioid prescribing limits, interest in effective non-opioid, non-pharmacological behavioral treatments has increased for acute and chronic pain management. For instance, the US Health and Human Services National Pain Strategy,[3] the Federal Pain Research Strategy,[4] the Interagency Best Practices Pain Management Task Force[5] and the Centers for Disease Control and Prevention have called for better national integration of behavioral pain treatments across care settings to reduce the dual crises of pain and opioid harms.

In the chronic pain context, behavioral or psychological interventions have shown efficacy in reducing pain and its impacts. Such interventions involve engaging individuals in actions that downregulate cognitive, emotional and physiological stress. Behavioral interventions are commonly thought to favorably influence adjustment to the pain state. For example, Cochrane meta-analyses have shown efficacy for reducing depression but not pain intensity per se, with a noted limitation being moderate to low quality of the evidence.[6] However, individual rigorous studies have shown primary analgesic efficacy for skills-based behavioral pain treatments with significantly reduced pain intensity and pain interference reported at 3, 6, 12, and 24 months post-treatment, particularly for those with chronic low back pain.[7–10]

In the surgical context, multiple studies have demonstrated that cognitive and emotional factors predict surgical outcomes, including postsurgical chronic pain[11 12] (see also Schreiber *et al* in this special issue). Results from these studies suggest that targeting such factors in the perioperative period might improve surgical outcomes. The perioperative context presents a focused and time-bound opportunity to apply behavioral interventions for postsurgical pain management and enhanced recovery from surgery. As one example, enhanced recovery after surgery (ERAS) programs apply multimodal perioperative strategies to enhance early recovery from surgery; however, behavioral skills-based pain management is typically absent from ERAS programs. Primary issues that may contribute to this omission include (1) lack of practical guidance; (2) ambiguity in the efficacy evidence; (3) lack of funding and knowledge around reimbursement for behavioral therapies; and (4) exclusion of behavioral specialists in perioperative pain care. Key questions remain about the efficacy of various perioperative behavioral interventions; over what time frame and in which surgical populations efficacy evidence exists; whether such interventions can prevent chronic postsurgical pain; real-world practicality of intervention integration into the perioperative pathway;

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and effective dissemination and implementation methodologies that will increase the patient, provider, and healthcare system uptake of these interventions. Recognizing a need for a synthesis of the published evidence, we conducted a scoping review of perioperative randomized controlled trials involving behavioral interventions reporting postsurgical outcomes for pain or opioid use.

With these information gaps in mind, the current report had two main goals:

1. To conduct a scoping review on perioperative behavioral skills-based pain management intervention studies with outcomes >3 days after surgery.
2. To discuss practical feasibility of interventions studied, and adoption and implementation considerations, viewed through the lens of two major healthcare centers that have uniquely moved beyond the research context and are applying evidence-based behavioral pain interventions as standard perioperative care for different types of surgery.

METHODS

Search

The literature review of previous reviews was conducted in June 2024 and involved a search of PubMed using the following search terms: (1) type of article: "Reviews", "Systematic Reviews", "Meta-analyses"; (2) Intervention targets: "Pain", "Opioids"; (3) Intervention type: "Behavioral", "Hypnosis", "Mindfulness", "Cognitive", "Virtual Reality", "CBT", "Relaxation", "Management", "Skills"; (4) Context: "Perioperative", "Surgical", "Surgery", "Post-surgical Intervention." A subsequent search of PubMed was conducted using the aforementioned intervention type, intervention target, and context terms, but adding "randomized clinical trial" as the type of article.

Eligibility criteria

The authors applied the following inclusion criteria for studies: (1) randomized trials; (2) involving adult patients; (3) receiving surgery of any type; (4) the study design tested a behavioral or psychological intervention; and (5) authors of the study reported pain or opioid outcomes. The authors excluded studies that involved (1) scopes, excisions or non-surgical procedures (eg, wound dressing changes); (2) integrated treatments that included physical movement or rehabilitative components; (3) children; and (4) final study outcomes occurring less than 3 days after surgery.

Study selection, data extraction, and risk of bias

While this scoping review was not registered, the authors met to review inclusion and exclusion criteria (ie, protocol) prior to the screening phase to increase consistency between reviewers. The first author (BDD) reviewed all studies in duplicate that were included to ensure eligibility criteria were met to reduce the risk of bias. The list of variables of interest (surgical population, N, author, year, treatment modality, intervention description, number of sessions, session duration, pain and opioid outcomes) were developed prior to the search except for the type of interventions, which was developed iteratively based on consultation among the study team (ie, context experts).

Study selection occurred in three rounds followed by data extraction: title screen, abstract screen, and full-text screen. No software was used to facilitate title and abstract screens. Data extraction was completed independently by each member of the research team based on the protocol.

Data analysis

The category definitions were based on the intervention descriptions listed in the results section. Descriptive statistics were calculated based on the total number of studies included.

RESULTS

Summary of findings from search of reviews

The authors identified 10 topically relevant reviews involving behavioral pain management treatments, with several being systematic reviews and meta-analyses.[13–22] Notably, there was a high degree of overlap in content between these reviews, along with wide heterogeneity in the studies included. For instance, no reviews focused on perioperative interventions only, the topic of the current report. Rather, behavioral interventions for general non-surgical procedures were included in the existing reviews and meta-analyses. Meta-analyses contained other study types that fell outside our inclusion criteria (eg, final outcomes data were collected in the postanesthesia care unit). As such, synthesized meta-analyses were not included and instead report results for individual studies that aligned with the inclusion and exclusion criteria.

Summary of findings from search of RCTs

In total, 20 studies met the inclusion and exclusion criteria. Results are presented in table 1, organized alphabetically by behavioral treatment type, with details on the study surgical population, the treatment type, description, and modality delivered, the number of sessions involved in each treatment, and the general study outcomes. Note that unless specified otherwise, the comparator condition is usual care (surgery only). Only two perioperative studies compared a behavioral pain management intervention to an active health education control.[23 24]The duration of final outcomes assessment ranged from 3 days to 12 months after surgery. Below is a summary of efficacy findings. Specific details for surgical population and treatment specifics including delivery modality, treatment burden, and follow-up duration are omitted in the summary and provided in table 1.

Summary of findings by treatment type

Hypnosis: Hypnosis is a behavioral intervention that can be a stand-alone treatment or adjunctive treatment with other modalities. Clinical hypnosis has been practiced in the context of pain for centuries and involves preparing the individual for suggestions (ie, induction), specific suggestions to promote changes in sensation, cognition, emotion, or behavior, and then reorientating the individual back to the present moment (ie, deinduction).[25] Perioperative studies of hypnosis suggested possible short-term analgesic benefits: one study (N=40) reported reductions in pain 1 week following surgery and the other demonstrated no analgesic benefits at months 1 and 4 postsurgery (N=68).

Relaxation training: Relaxation training involves teaching patients on the use of techniques to increase parasympathetic nervous system activity to the point that there is greater activation in the parasympathetic system as compared with the sympathetic system.[26] Two perioperative studies reported no reductions in pain and anxiety at ten days and three months after surgery (N=105, N=70). One study noted significant benefits for reducing depression and fatigue 10 days after surgery (N=70).

Mindfulness-Based Interventions: The most commonly used definition for mindfulness is "the awareness that emerges through paying attention in a particular way: on purpose, in the

Table 1 Randomized controlled trials of perioperative behavioral interventions*

Hypnosis interventions					
Treatment	**Surgical population; N**	**Author, year**	**Modality; intervention description**	**# Sessions and duration**	**Outcomes**
Self-hypnosis	Double-lung transplantation; N=68	Michel-Cherqui *et al*[36]	In-person, individual+independent practice with audio file	Two 20 min training+home practice with recording prior to surgery	No significant differences in pain, anxiety and QOL at month 1 and 4 months
Hypnosis	Breast cancer surgery; N=40	Moreno Hernández *et al*[37]	Audiofile with hypnotic script with indirect suggestions to reduce pain 1 week provided before the surgery; immediately after recovering from anesthesia/postoperative given another audio hypnotic script of 11 min in duration and instructed to listen to at home	One week before surgery; in hospital after surgery; home practice as needed	Significant pain reduction at 1-week postoperative

Relaxation Interventions					
Treatment	**Surgical population; N**	**Author, year**	**Modality; Intervention Description**	**# Sessions and duration**	**Outcomes**
Relaxation Therapy	Abdominal and urological 1-day surgery; N=105	Hansen[38]	Audio file+video application; Audio relaxation technique, music intervention, nature video application with music, nature video application without music	Twice daily for 15 min 4 days prior to and 5 days postsurgery;	No significant difference in postoperative pain or anxiety from immediately following surgery to postoperative day 10
Stress management training	Breast; N=70	Garssen *et al*[39]	Individual (in hospital)+audio file; meditation, guided imagery	4 60 min sessions on presurgery day 5 and day 1, postoperative day 2 and 30; CD for home practice	No differences for pain, anxiety, and sleep at postoperative day 90; Lowered depression and fatigue; measured from day 6 and day 1 presurgery, and day 2, 5, 30 and 90 postsurgery

Mindfulness interventions					
Treatment	**Surgical population; N**	**Author, year**	**Modality; Intervention Description**	**# Sessions and duration**	**Outcomes**
Mindfulness techniques	Total joint arthroplasty of knee or hip; N=118	Hanley *et al*[28]	Modality (individual vs group) not reported but patients were provided with an audio file for home practice; Preoperative mindfulness of breath, mindfulness of pain (MoP), or cognitive-behavioral pain psychoeducation (CB) intervention	One 20 min session 3 weeks prior to surgery	Lowered postoperative pain and opioid use; second, 3rd, 7th, 14th, 21st, and 28th postoperative days MoP resulted in lower pain intensity. Mindfulness decreased postoperative opioid use relative to CB
Mindfulness-Based Stress Reduction (MBSR)	Lumbar surgery; N=48	Chavez *et al*[40]	Preoperative online MSBR course; content includes broad experiential mindfulness mediation practice, enhancing flexibility, recognizing unhealthy patterns, changing perception, interpersonal mindfulness. Available at: https://product.soundstrue.com/mbsr/video/	Patients completed 1–8 sessions of online MSBR course (additional online sessions encouraged)	At 3 months, lower disability, higher physical functioning, lower pain interference, no difference in back or leg pain. At 12 months, lower pain interference and no difference in pain, functioning, or disability

Mixed-type interventions					
Treatment	**Surgical population; N**	**Author, year**	**Modality; Intervention Description**	**# Sessions and duration**	**Outcomes**
Mind-body techniques: Self Care Toolkit	Breast; N=74	Stoerkel *et al*[41]	7 audio files for home practice and antinausea wristbands; Guided mind–body techniques (breathing, progressive muscle relaxation, meditation, guided imagery, and self-hypnosis) and acupressure (antinausea wristbands)	Encouraged to listen to each audio file during 2 weeks presurgery and 2 weeks postoperative; instructed to wear wristbands during surgery	Decreased pain, fatigue, and inflammatory cytokine secretion from baseline to day 14 postoperative
Preoperative pain self-management (PePs)	General surgery, orthopedic surgery, urological surgery; N=100	Hadlandsmyth *et al*[29]	Individually received telehealth; relaxation training, pain education, cognitive restructuring and the use of coping thoughts, and goal-setting	Four sessions ranging from 20 to 24 min	Reduced pain and opioid use at 3 months postoperative compared with baseline and day 7 postoperative
Preoperative pain coping skills training vs arthritis education vs usual care (3-arm RCT)	Total knee arthroplasty; N=402	Riddle *et al*[42]	Individual, in-person (session 1), phone (sessions 2–7); delivered by a physical therapist; psychoeducation, cognitive restructuring, and skills for enhancing maintenance of gain following treatment	Eight 50 min sessions preop and ending 6 weeks postoperative	No difference in pain at 2, 6 and 12 months postoperative
Pain Relief Skills ("My Surgical Success"; "Empowered Relief for Surgery")	Breast cancer surgery; N=68	Darnall *et al*[24]	Video (online, on-demand); relaxation, thought reframing, and behaviors that modulate attention and counteract helplessness about pain	80 min, self-paced	Enhanced time to opioid cessation relative to active health education control at day 14 postoperative; no pain differences
Pain Relief Skills ("My Surgical Success"; "Empowered Relief for Surgery")	Orthopedic Trauma surgery; N=84	Ziadni *et al*[23]	Video (online, on-demand); relaxation, thought reframing, and behaviors that modulate attention and counteract helplessness about pain	45 min, self-paced	Reduced pain at 3 months postoperative relative to an active health education control

CBT Interventions					
Treatment	**Surgical population; N**	**Author, year**	**Modality; Intervention Description**	**# Sessions and duration**	**Outcomes**
CBT	Orthopedic trauma surgery	Gouveia *et al*[32]	In person; emotional processing, psychoeducation cognitive-behavioral and biopsychosocial models, cognitive and behavioral strategies (eg, mindfulness and acceptance), optimizing functioning, and preparing and managing for the future.	Six 1-hour sessions over 6 weeks	Trial ended prematurely due to infeasibility
Preoperative CBT+postoperative booster	Total knee arthroplasty; N=80	Buvanendran *et al*[43]	Individual, telehealth; based on program guide developed by Beverly Thorne. Content includes gate control theory, stress response, stress appraisals, working with negative thoughts and core beliefs	Four 1-hour CBT sessions over 1 month; booster at 3 weeks postoperative	Decreased pain catastrophizing at 3 months postoperative; no changes in pain

Continued

Table 1 Continued

CBT Interventions					
Treatment	**Surgical population; N**	**Author, year**	**Modality; Intervention Description**	**# Sessions and duration**	**Outcomes**
CBT	Total knee arthroplasty; N=60	Birch *et al*[44]	Individual; psychoeducation, cognitive and behavioral coping skills, training on how to apply skills in real-life situations	6–7 sessions×45 min, 3 preoperative and 3–4 postoperative	No reductions in pain at 3 and 12 months postoperative
CBT	Total knee arthroplasty; N=80	Sun *et al*[45]	Individual; psychoeducation on CBT and biopsychosocial models, coping skills (relaxation exercises, pleasant imagery, attention shifting), teaching how to apply skills to challenging situations	3 preoperative and 3 postoperative sessions×30 min	Reduced pain during activity from postoperative day 5–3 months, no change in pain during rest, ROM at baseline, 2, 3, 5, 6, 14 days, 3 and 12 months
CBT	Total knee arthroplasty in patients 70 and older; N=83	Chen *et al*[46]	In hospital : content includes the pain process, CBT model, strengthen habitual positive cognitive behavior thinking patterns, development of individualized discharge CBT plans	Five sessions×30 min by doctors/nurse trained by psychologist and PT	No difference in pain at 3 months postoperative; Reduced anxiety 1 and 2 weeks postoperative and depression 3 months postoperative
CBT	Total knee arthroplasty; N=50	das Nair *et al*[47]	In home or hospital; psychoeducation on the relationship between mood and pain, values-based goal-setting, self-management and behavioral activation, relaxation and mindful breathing, cognitive restructuring, and postsurgical planning	2–8 sessions×1 hour, scheduled to fit within the expected waiting time for surgery (maximum 18 weeks), held once or twice weekly	6 months follow-up improvement of mood, pain, and physical function
CBT	Lumbar fusion; N=39	Reichart *et al*[31]	Inpatient; brief intervention targeting self-efficacy and fear avoidance beliefs	Two sessions (1 pre, 1 postoperative)×30 min by psychologist	Significant reductions in highest pain intensity, better physical fitness at 6 weeks postoperative
CBT	Lumbar fusion; N=90	Rolving *et al*[48]	Group sessions; Psychoeducation on the interaction of cognition and pain perception, coping strategies, pacing principles, ergonomic directions, return to work, and details about the surgical procedure group sessions	Six 3-hour group sessions (4 preoperative, 2 postoperative)	No improvements in pain or HRQL were found at 3, 6, and 12 months; Improvements in disability (ODI) at 3 months and up to 1 year.
Third Wave CBT Interventions (ACT, MBCT)					
Treatment	**Surgical population; N**	**Author, year**	**Modality; Intervention Description**	**# Sessions and duration**	**Outcomes**
Mindfulness-Based CBT	Total knee arthroplasty; N=44	Pester[30]	Individual, 1 in person 3 telehealth (ie, phone); psychoeducation on mindfulness and cognitive behavioral theory, physical activity pacing, body scan, cognitive restructuring, healthy coping behaviors (eg, sleep hygiene), and various mindfulness exercises	Four 1-hour therapy sessions during the preoperative and postoperative periods	Reduced pain and pain interference at 6 weeks postoperative

*Unless specified otherwise, comparator is usual care. Outcomes assessments >3 days after surgery.
CBT, Cognitive Behavioral Therapy.

present moment, and nonjudgmentally."[27] Several interventions have been shown to cultivate this skill for acute and chronic pain management. One perioperative study demonstrated analgesic benefits and reduced opioid use 28 days after surgery (N=118); another (N=48) reported improved pain interference, physical function and disability at 3 months with sustained improvement at 12 months for pain interference only (no analgesic benefits at 3 or 12 months).

Mixed-type interventions: Interventions included here do not fall neatly into mindfulness, cognitive–behavioral therapy (CBT) or acceptance and commitment therapy categories; rather, they include key elements of these various interventions and thus are labeled "mixed-type". Moreover, two studies involve digital (self-paced, autonomous) interventions and thus are neither therapist-delivered nor are they considered "therapy" in the classic sense. In terms of results, three studies (N=74; N=100; N=84) reported pain reductions at 2 weeks and 3 months post-surgery and two studies (N=68; N=402) reporting no difference in pain at 2 weeks, 6 months and 12 months following surgery. One study (N=68) reported increased time to opioid cessation at day 14 in the postoperative period compared with active control intervention.

CBT: CBT is a widely used psychological intervention for pain, particularly chronic pain. CBT can be delivered in a group or individual context but typically involves a therapist teaching behavioral skills including, but not limited to, changing thoughts about pain (ie, cognitive restructuring), relaxation exercises, and sleep hygiene. Results for perioperatively applied CBT were mixed in terms of format, duration and results. Of the eight perioperative trials, one ended prematurely due to infeasibility. Two studies (N=80; N=83) reported reductions in pain catastrophizing but not pain at 3 days and 3 months. Two studies (N=60; N=90) reported no decreases in pain at three and 12 months. However, pain reductions during activity were reported in one study (N=80) at 3 months, and two additional studies (N=39; N=50) reported pain reductions at 6 months and decreased highest pain intensity at 6 weeks.

Third wave CBT: Following the development of CBT, a "third wave" of psychosocial interventions that integrated mindfulness concepts was introduced. ACT, one of the third wave treatments, has demonstrated efficacy for improving physical functioning and mood in chronic pain patients. One perioperative study (N=44) revealed decreased pain and pain interference at 6 weeks.

DISCUSSION

There is burgeoning interest in skills-based behavioral pain intervention for post-surgical pain management and enhanced surgical recovery, particularly given an emphasis on reduced opioid prescribing and patient concerns about opioid risks. Other non-opioid analgesic agents may be contraindicated or poorly tolerated by individual patients, thus underscoring the need for a multimodal approach. Key benefits of behavioral pain treatments include that they are non-pharmacologic, can work alongside any other analgesic regimens, provide patient education and emphasize engagement in skills that improve

self-regulation and symptom management in the postsurgical recovery period and beyond.

In this scoping review, we identified several behavioral interventions with analgesic efficacy, largely in the early perioperative time frame (>3 days to 1 month after surgery), with four key studies demonstrating durable analgesic effects 3–12 months after surgery (ie, Hanley *et al*,[28] Hadlandsmyth *et al*,[29] Pester *et al*,[30] Ziadni *et al*[23]). These four interventions spanned four distinct behavioral treatment types and thus we suggest that the specific intervention studied is of greater importance than its particular treatment category. Notably, all four of these interventions are relatively brief and novel.

Three studies examined opioid use as a postsurgical outcome to positive effect. One study showed mindful breathing showed positive impact for reduced opioid use at 1 month[28]; another showed a digital skills-based intervention improved time to opioid cessation after breast cancer surgery[24]; and the Hadlandsmyth *et al* showed four brief sessions of pain self-management reduced opioid use at 3 months after surgery.[29] While future behavioral treatment studies may benefit from the inclusion of postsurgical opioid use as an outcome, pain and pain interference are likely to remain of primary importance given decreased opioid prescribing overall. We also underscore the need for studies to include rigorous capture of patient daily opioid use to minimize the recall bias associated with 7-day or 14-day surveys.

While some behavioral interventions may provide months of pain relief after surgery, to date no studies have shown enhanced time to pain cessation after surgery. In part, the current literature is limited by relatively small studies that are not designed to determine whether the interventions prevent chronic postsurgical pain. Despite this evidence gap, the analgesic benefits of certain behavioral interventions are promising. Particularly for interventions that are low/no risk, low-resource and low burden to patients and clinicians alike, moderate-term postsurgical efficacy may support the inclusion of such interventions into standard clinical pathways and possibly ERAS programs.

CBT is arguably the most widely known behavioral pain treatment and remains the best studied within the perioperative context. In spine surgery patients, analgesic evidence for CBT exists at 6-week postsurgical follow-up.[31] This finding mirrors a recent review in lumbar fusion surgery in which authors noted that perioperative behavioral interventions appear to have a short-term effect on pain and longer-term effect on disability.[13] However, notably, we found the data for CBT studies to be mixed with multiple negative studies for various surgical populations. Pain relief was demonstrated in total joint arthroplasty for two of six studies. We highlight a common problem in the literature: heterogeneity across studies for surgical populations and how CBT was operationalized and studied (who administered the treatment, in what quantity, and when).

Newer interventions have integrated elements from multiple treat approaches into a single blended or mixed-type treatment. Three mixed-type treatments yielded good efficacy evidence. A pilot study of Mindfulness-Based CBT (4-hour long individual treatment sessions received over 4 weeks; three of the sessions via telehealth) showed efficacy for reducing pain and pain interference 6 weeks after total knee arthroplasty.[30] Individual preoperative pain self-management (Peps) delivered over four sessions (2 hours total treatment time; telehealth) showed efficacy for reducing pain and opioid use at 3 months after urologic, orthopedic, and general surgeries.[29] Empowered relief for surgery (formerly called My Surgical Success) is a self-paced, autonomous and interactive treatment that showed efficacy for enhancing time to opioid cessation after breast cancer surgery and for extended analgesia up to 3 months after orthopedic trauma surgery.[23 24] Notably, these latter two studies used an active digital health education control for surgical condition rather than the usual care comparator used in every other study reviewed.

Challenges of perioperative interventions include treatment burden, clinician availability (in cases where treatments are clinician delivered), and multisession treatment formats that may impede clinical feasibility. In one striking example, a recent large clinical trial sought to study in-person six-session CBT for preventing chronic postsurgical pain following surgical repair of long-bone fracture.[32] As no evidence exists for behavioral treatment preventing chronic postsurgical pain, results from this trial would have filled a critical data gap. However, the trial was halted and abandoned due to infeasibility. The authors cited difficulty identifying trained and available therapists, challenges implementing CBT within 8 weeks after surgery, patient burden associated with in-person treatment sessions, and difficulty recruiting patient participants. The infeasibility of this multisession in-person treatment study underscores the importance of ensuring low treatment burden and telehealth or online treatment options that are home-based and conveniently accessible to patients. We highlight the two studies that used autonomous digital interventions[23 24] and the potential of these approaches to improve patient access to skills-based perioperative pain management. However, additional research is needed to inform practical implementation that optimizes integration into patient pathways and patient engagement with interactive digital interventions. Finally, patient engagement and treatment efficacy comparisons by modality (eg, live-clinicians-delivered interventions vs digital interventions) would be useful.

In addition to home-based treatment formats, feasibility of perioperative behavioral treatments may be enhanced with group-based interventions that can optimize therapist efficiency and revenue capture if billing is involved, as well as provide patients with a sense of community and peer support during the group intervention. Feasibility may also be enhanced with on-demand and interactive treatment options that require no therapist involvement, no scheduled appointments, and thus can be offered to patients immediately after they are scheduled for surgery. While interactive and on-demand interventions are low-cost and scalable, special considerations include a need for patients to have email and internet access, as well as a moderate level of comfort with technology.

Additional opportunities surround interventions that blend perioperative behavioral interventions with pharmacological agents such as ketamine or other N-methyl-D-aspartate (NMDA) receptor agonists that have shown promise in reducing pain postsurgery. There is some indication that the durability of ketamine analgesia may be enhanced with concurrent behavioral therapy,[33] however, there is still a paucity of research in this area. Given the complexity of chronic postsurgical pain and the multiple factors involved in its development (inflammatory processes, central sensitization, psychological factors) it is necessary to study treatments that target both physiological and psychological variables simultaneously. From a pragmatic/clinical standpoint, treatment pathways which include behavioral interventions as part of standard of care alongside pharmacological and physical therapies are most likely to enhance engagement and uptake of multicomponent treatments as opposed to the "a la carte" style of perioperative interventions.

The second goal of this report was to discuss the practical feasibility of interventions studied, and adoption and implementation considerations. Indeed, practical implementation factors

bear strong consideration due to the logistical challenges associated with a surgical population and the surgery itself. We provide implementation context through the lens of two major healthcare centers that have uniquely moved beyond the research context and are applying evidence-based behavioral pain interventions as standard perioperative care to groups of patients receiving different types of surgery. As noted above, group-based online behavioral treatment may reduce burden, enhance efficiency and revenue (if desired) while allowing patients to have connection with a live therapist as well as surgical peers. While we reviewed no published clinical trials involving group-based perioperative behavioral treatments, we describe two novel program offering behavioral pain interventions as standard care for surgery: Cleveland Clinic Spine Surgery program, and the Salem, Virginia Veterans Medical Center for orthopedic surgery.

Clinical implementation

Example 1: A group behavioral skills class for spine surgery: the standard not the exception

The Cleveland Clinic is a large multispecialty academic medical center serving patients locally, across the nation and internationally. The Cleveland Clinic Center for Spine Health serves thousands of patients each year, treating the most complex spine issues. Given the national imperative to offer scalable behavioral pain treatments to support the perioperative period alongside the lack of practical solutions for broad adoption, they piloted a group-based perioperative intervention specific to the spine surgery patient, which uses the empowered relief for surgery as a key component of preoperative care. Their process for clinical implementation has been previously documented[34] and identifies key steps of this project as it moved from a small pilot to full clinical implementation with an online, live clinician delivered group intervention as part of standard of care in the perioperative pathway. Their model puts behavioral pain medicine at the forefront of every patient's perioperative pathway and contrasts with current models of behavioral health service delivery wherein only patients at the highest risk are selected for therapist intervention. Adoption of this program across a large healthcare system required significant effort and culture change. Key components to success included leadership buy-in, physician and nursing champions, and continued education for both the patients and the providers. Importantly, patient engagement has been very high with 72% of all scheduled patients attending the visit. Patients consistently show strong acceptability and satisfaction with the class through completion of a seven-item e-survey to assess their perceptions about the class, including satisfaction, perceived usefulness of information, and likelihood to use the skills learned; all items use a 10-point scale, where 1 is the lowest rating and 10 is the highest possible rating (example item: "How satisfied were you with the class?" 1=completely dissatisfied; 10=completely satisfied). This survey has been used in prior work.[23] Free-text fields solicited additional participant feedback.

Table 2 shows findings from 136 patients who completed the empowered relief treatment satisfaction survey.

Figure 1A shows a working clinical CarePath for their "TREK for Surgical Success," program developed from the integration of a behavioral skills class tailored to spine surgery in their system over the past 3 years. The team has expanded their efforts at education and clinical "touchpoints" to address vulnerabilities and opportunities on the inpatient side immediately after surgery as well as postoperative services for patients with additional challenges.

Key guideposts for clinical implementation

A key component of this project is ongoing continuous improvement efforts which have allowed them to continue to develop and expand the program. To the authors' knowledge, no other healthcare system in the country has developed behavioral intervention with active skills training as part of a standard CarePath for spine surgery. The following guideposts are designed to help organizations implement a standardized care path for patients undergoing surgery.

1. Patient engagement is highly dependent on understanding and expectations:
   As noted, psychological factors are repeatedly implicated in the outcomes of surgical procedures and identified as high-value targets in the perioperative period. However, pain psychology or behavioral pain management is a highly specialized field, with limited access and understanding of what it entails. Patient and provider education is critical to the program's success and should be delivered continuously with a variety of modalities. Accounting for staff turnover is key to ensure that new providers are aware of the class and able to explain it to their patients. At a minimum, a nursing and physician/surgeon champion is recommended.
   Similarly, create systematic ways to monitor patient engagement and proactively identify barriers. Many electronic health records have reporting functions that can pull information on patient engagement, no show and cancel rates. Attaching the class to a particular "order/consult" in the EHR allows also for tracking gaps in orders being placed or orders that do not get scheduled.
2. Brevity and accessibility are key to success in a busy perioperative pathway:
   The perioperative pathway is quite busy for both the patients and the providers. Consider ease of scheduling to reduce burden and accommodate the various demands from other appointments in the presurgical period. While an order is a convenient way to schedule the class for patients, it is essential that providers tie this step to key messaging regarding the benefits of the class. Provide clinicians with verbiage, handouts and even links to digital videos to explain the class and reinforce messaging. Technology can enhance access and even allow patients from out of state to participate virtually. Systems should be in place to address

Table 2 Patient satisfaction: empowered relief for spine surgery

	Mean (SD)	Median (IQR)	Answered 10 N (%)
How satisfied were you with the class?	7.89 (2.02)	8 (7–10)	37 (27.2)
Please rate your likelihood to recommend this class to another person who has chronic pain.	8.01 (2.13)	9 (7–10)	44 (32.4)
How relevant was this class to you?	7.82 (2.17)	8 (7–10)	41 (30.1)
How useful was the information presented in the class?	7.86 (2.05)	8 (7–9.25)	34 (25.0)
How likely are you to use the skills and information you learned?	8.11 (1.95)	9 (7–10)	42 (30.9)

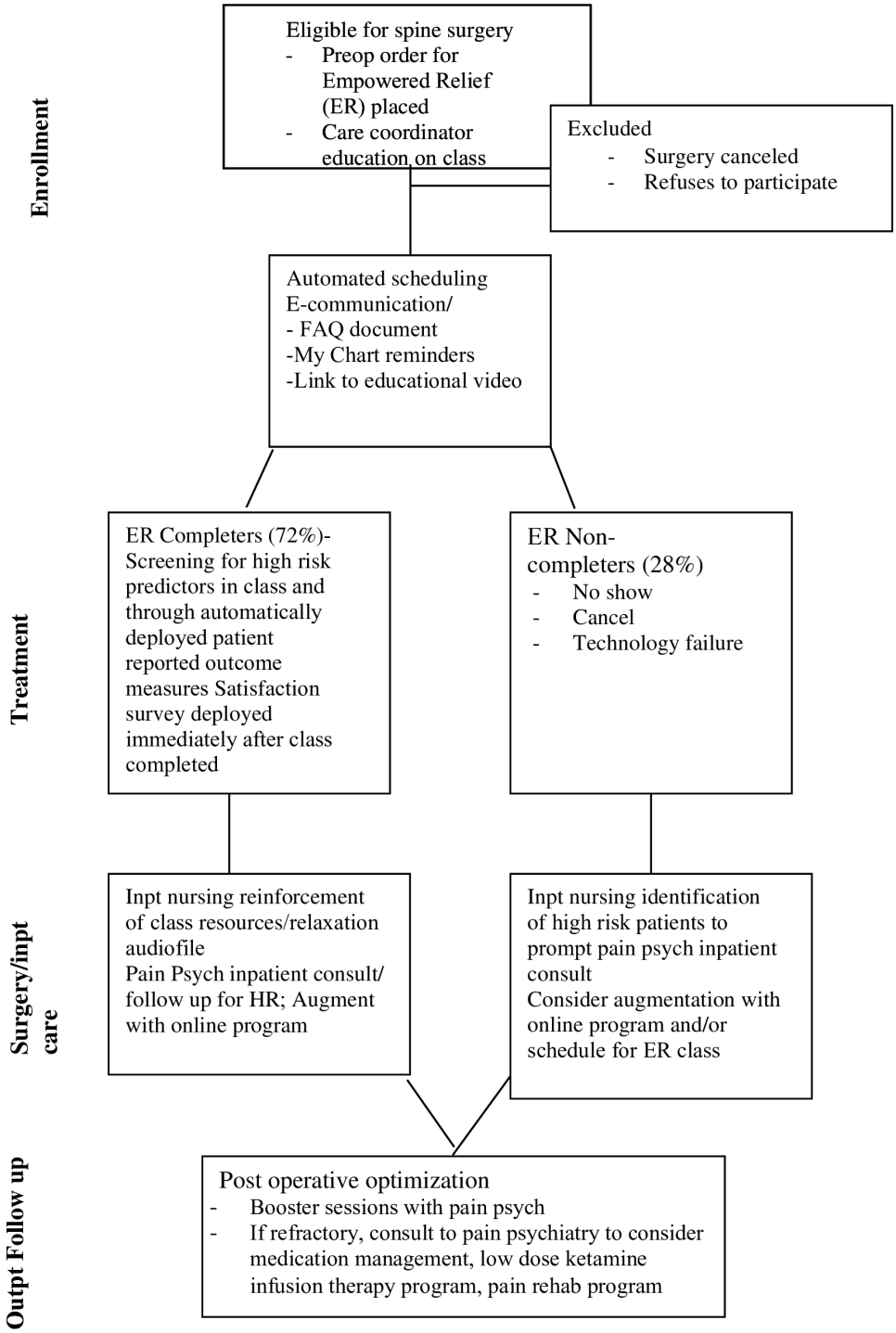

Figure 1 Clinical implementation: Sample CarePath illustrating multicomponent behavioral optimization for spine surgery patients.

technological challenges. It may be useful to also offer in-person versions of the class for individuals that are not able to navigate technology.

3. Offer opportunities for additional intervention (treatment "boosters") throughout the perioperative period:
   Presurgery behavioral intervention offers the opportunity to engage patients in behavioral treatments, teach them skills to increase self-efficacy related to their surgery as well as proactively identify patients who may be interested in or benefit from further assistance. In classes they query patients on their desire for postoperative follow-up on the outpatient side, and inpatient pain psychology or consultation-liaison services can be used to target high-risk patients for further intervention. Postoperative behavioral intervention may address specific challenges in using behavioral skills and normalize patients' responses (including pain) after surgery. Recent studies reveal that behavioral interventions have the strongest effect either after surgery or BOTH preoperatively and postoperatively. There is no clear evidence that targeting those as the "highest risk" presurgery is the most effective clinical pathway.[35]
4. Plan for prospective investigation of patient response and outcomes:

The key to monitoring program effectiveness is setting up prospective data sourcing from the outset. This can be quite challenging in the clinical setting; however, the longer-term payoff is great to demonstrate program impact. A notable limitation of the current literature is a lack of pragmatic trials and clinical effectiveness studies. Furthermore, cost-effectiveness studies are missing and needed to justify the larger term adoption of behavioral care into the perioperative pathway and to justify further resourcing from large healthcare systems.

Example 2: Empowered Relief in veterans receiving orthopedic, podiatric, and elective amputation surgeries

The Salem VA Healthcare System (Salem VAHCS) is a level 1C (ie, low complexity, low resource) facility in Salem, Virginia serves primarily older, rural Veterans who are at high risk for both opioid prescriptions and chronic pain compared with their urban counterparts. Prior to 2023, there were no behavioral interventions offered during the perioperative period. In May 2023, author BDD presented an overview of Empowered Relief during Medical Grand Rounds. The presentation sparked discussion and enthusiasm for local implementation of the program among providers and administrators at the Salem VAHCS. As a result, funding was procured to cover the empowered relief certification costs for two psychologists and three registered nurses. Following several meetings among invested partners (eg, administrators, clinicians, schedulers), clinical pathways and workflows were established. By the end of 2023, outpatient empowered relief classes were being offered in two formats (ie, in-person and video telehealth to home) by the three registered nurses on a rotating basis twice per month. Participation in empowered relief became (and continues to be) standard of care for all patients with upcoming surgeries with orthopedics, podiatry, and elective amputation. Specifically, surgeons and/or nurse coordinators provide an overview of the empowered relief intervention using a bulleted script provided by certified empowered relief instructors as part of their usual discussion on presurgery requirements. Scheduling orders are then placed by clinicians and patients are scheduled by scheduling staff. Patients attend the single-session behavioral intervention in the format that they choose prior to their surgery, then provide written feedback about their satisfaction as part of a quality improvement project. The first few months of implementation were so successful that by early 2024, Veterans with large abdominal wall surgeries were also being scheduled for empowered relief as part of the standard of care. While data is still being analyzed, anecdotally there has been a high level of treatment engagement by Veterans (nearly 100 participants thus far), as well as high levels of satisfaction from referring providers, empowered relief Instructors, and Veterans attending empowered relief. The facility is currently considering increasing the frequency of this effective, single-session behavioral intervention to increase access to care for a broader scope of presurgical Veterans.

CONCLUSIONS: CLINICAL IMPLEMENTATION

The above clinical implementation examples highlight the integration of behavioral intervention as part of standard of care in the perioperative pathway in two unique and distinct healthcare systems and support the feasibility of behavioral integration into the perioperative pathway. The Cleveland Clinic project shows adaptability and engagement in a large healthcare system characterized by a complex, often refractory spine patient population. Also, the engagement of patients, providers and high-level leadership demonstrates commitment to a broader change in surgical care pathways. The ongoing development in the spine centers CarePath supports additional touchpoints for behavioral intervention to the patients that are "high-risk," or who may be missed preoperatively. It is worth noting that allocation of resources for similar programs will be dependent on the ability to demonstrate their impact on broader treatment outcomes such as healthcare utilization. It will also be crucial to develop strategies to scale treatments through digital/online touchpoints and/or screening for the most vulnerable patients especially in systems where resources are limited. The Salem VAHS project uniquely demonstrates effective resource allocation with the use of training a variety of providers in empowered relief, thus broadening its reach. Additionally, there is a demand for both in-person and video-based sessions to accommodate patients' treatment preferences. Lastly, the VAHS project nicely illustrates the broad adoption of a clinical care path where behavioral intervention exists across multiple surgery types. These examples provide excellent guideposts for future clinical implementation efforts and ongoing efforts to provide efficacy data related to real-world clinical examples such as those highlighted are paramount.

X Beth D Darnall @bethdarnall

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ORCID iD

Beth D Darnall http://orcid.org/0000-0003-3590-511X

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