

The American Society of Pain and Neuroscience (ASPN) Evidence-Based Consensus Recommendations on Programming and Coding Implantable Spinal Cord Stimulation Devices for Treatment of Chronic Intractable Pain

Timothy R Deer¹, Ali Nairizi², Corey W Hunter^{3,4}, Hemant Kalia⁵, Jason E Pope⁶, Eric G Cornidez⁷, Dawood Sayed⁸, Gregory L Smith⁹, Johnathan H Goree⁹, Ajay B Antony¹⁰, Peter S Staats¹¹, Christopher Gilligan¹², Marcin Karcz¹, Drew Trainor¹³, Mustafa Y Broachwala¹⁴, Dustin Reynolds¹⁵, Andrew Bloomfield¹⁶, Chau M Vu⁶, Shivanand P Lad¹⁷, Robert Trainer¹⁸, Carla Monacelli¹⁹, Jolayne Devers¹⁹, Erika A Petersen²⁰

¹The Spine and Nerve Center of the Virginias, Charleston, WV, USA; ²Reno Tahoe Pain Associates, Reno, NV, USA; ³Ainsworth Institute of Pain Management, New York City, NY, USA; ⁴Physical Medicine & Rehabilitation, Icahn School of Medicine at Mount Sinai Hospital, New York City, NY, USA; ⁵Center for Research and Innovation in Spine & Pain, Rochester, NY, USA; ⁶Evolve Restorative Center, Santa Rosa, CA, USA; ⁷Pain Institute of Southern Arizona, Tucson, AZ, USA; ⁸Department of Anesthesiology and Pain Medicine, The University of Kansas Medical Center, Kansas City, KS, USA; ⁹Department of Anesthesiology, University of Arkansas for Medical Sciences, Little Rock, AR, USA; ¹⁰The Orthopaedic Institute, Gainesville, FL, USA; ¹¹National Spine and Pain Centers, Atlantic Beach, FL, USA; ¹²Robert Wood Johnson University Hospital, New Brunswick, NJ, USA; ¹³Denver Spine and Pain Institute, Denver, CO, USA; ¹⁴Department of Physical Medicine & Rehabilitation, Johns Hopkins School of Medicine, Baltimore, MD, USA; ¹⁵OrthoNeuro, Columbus, OH, USA; ¹⁶Comprehensive Spine Institute, Tampa, FL, USA; ¹⁷Department of Neurosurgery, Duke University Medical Center, Durham, NC, USA; ¹⁸Hunter Holmes McGuire VAMC, Richmond, VA, USA; ¹⁹JD Lymon Group, Mendota Heights, MN, USA; ²⁰Department of Neurosurgery, University of Arkansas for Medical Sciences, Little Rock, AR, USA

Correspondence: Timothy R Deer, The Spine and Nerve Center of the Virginias, 400 Court St, Ste 100, Charleston, WV, 25301, USA, Email doctdeer@aol.com

Background: The evolution of Spinal Cord Stimulation (SCS) from simple bipolar programming to sophisticated physiologic closed-loop technology has introduced significant complexity into programming and associated reimbursement coding and billing. To address these challenges, the American Society for Pain and Neuroscience (ASPN) developed this evidence-based consensus document to establish best practices for integrating advanced SCS programming into clinical workflows.

Materials and Methods: A US-based expert panel in neuromodulation convened to develop consensus recommendations for traditional and modern complex programming. No international experts in neuromodulation participated in this exercise. This process informed the development of a framework that combines technological advances with improved clinical decision-making and creation of customized care plans for chronic pain patients.

Results: Complex programming is defined as the adjustment of more than three stimulation parameters. However, innovations like Evoked Compound Action Potential (ECAP) dose-controlled closed-loop SCS technology provide objective neurophysiological data requiring additional physician engagement and clinical decision-making in the programming process. Objective data provide additional documentation, and when combined with traditional subjective data it ensures that clinical decisions are evidence-based and well-documented in patients' medical history. This article reviews Current Procedural Terminology (CPT) codes and billing processes, offering clear recommendations on billing for complex programming. The framework aims to ensure that reimbursement models accurately reflect the time, resources, and expertise required for modern SCS programming while complying with coding and billing regulations.

Conclusion: Current billing and reimbursement structures must be refined to recognize the additional diagnostic and therapeutic value provided by ECAP dose-controlled closed-loop therapy neural metrics. The incorporation of ECAP dose-controlled closed-loop SCS technology into routine clinical care has the potential to improve patient outcomes through comprehensive physician-led programming.

This in turn will reduce the burden of chronic pain on the healthcare system by minimizing unnecessary reprogramming and emergency room visits.

Keywords: spinal cord stimulation, chronic pain, SCS programming, closed-loop, ECAP

Introduction

Programming is a fundamental aspect of neuromodulation therapy, encompassing different modalities such as Deep Brain Stimulation (DBS), responsive neurostimulation, Sacral Nerve Stimulation (SNS), Peripheral Nerve Stimulation (PNS), Vagus Nerve Stimulation (VNS), and Spinal Cord Stimulation (SCS). In implantable neuromodulation therapies, programming is clinician-directed, requiring active involvement in setting, adjusting, and optimizing therapy parameters. For instance, DBS programming requires a detailed clinician-led monopolar review where individual lead contacts are tested for efficacy and safety to identify optimal parameters.¹ However, SCS programming presents unique challenges in standardizing care, ensuring appropriate clinical oversight, and integrating programming into broader treatment workflows. In addition, new and advanced SCS programming will bring a level of increased complexity to the physician decision-making process.

Chronic pain affects over 20% of US adults,² with a significant subset experiencing high-impact pain unresponsive to conventional medical management, including physical therapy, interventional procedures, and pharmacotherapy. SCS has emerged as a key alternative treatment, with approximately 100,000 new devices implanted annually.³ Traditional SCS programming has evolved from simple bipolar configurations to complex systems incorporating multiple waveforms and adjustable parameters. Modern SCS now presents clinicians with an overwhelming array of adjustable parameters, exceeding 10^{16} potential programming combinations⁴ due to the introduction of novel waveforms and expanded parameter settings. Given the wide range of interventions and programming strategies, clinicians must stay updated on the latest scientific evidence to choose the best therapy for each patient.⁵ Once a therapy is selected, similar to prescribing medication, the correct electrical dosage must be set by programming the device with the right number and polarity of active electrodes, and adjusting settings for pulse width, frequency, amplitude, and duty cycling (the percentage of time the device is on).⁶ While these innovations allow for more refined and personalized therapy, they have also increased programming complexity, requiring significant expertise and training for effective implementation.

Despite this complexity, traditional SCS programming still relies on subjective patient feedback. Given the vast number of adjustable parameters, the programming process is both time-consuming and resource-intensive, often requiring multiple sessions over weeks or months to optimize therapy.^{5,7} Recent studies indicate that, even after determining the appropriate therapy, patients still require an average of 6.1 maintenance visits per year for SCS-related therapy optimization and reprogramming.⁸ This paradigm not only burdens clinicians but also creates a misalignment between the time and expertise required for programming and the reimbursement structures currently in place. Data available to chronic pain physicians from traditional SCS systems for clinical decision making include impedance measurements, program usage, battery trends, and stimulation parameters.⁹ While this data is crucial for assessing device functionality and patient compliance, it has limitations since it lacks objective physiological insights necessary for personalized clinical decision-making.

Evoked Compound Action Potential (ECAP) dose-controlled closed-loop SCS offers a paradigm shift by integrating real-time neurophysiological data into the programming process. Unlike traditional programming, where parameter adjustments are based on subjective reports of pain relief or paresthesia coverage, ECAP dose-controlled closed-loop SCS programming is based on each patient's physiologic response to electrical stimulation of the spinal cord.^{10–13} Programming ECAP dose-controlled closed-loop SCS requires simultaneous optimization of stimulation and sensing parameters to achieve stable, reproducible therapy. The advent of neural metrics, such as dose ratio and dose accuracy as described in the EVOKE study,¹⁴ provides clinicians the ability to identify responders,¹⁵ optimize therapy settings using robust data-driven strategies,^{16,17} and develop comprehensive, individualized patient management care plans based on individual patients' measurable neural responses.

Beyond optimizing therapy, these advancements have significant implications for clinical workflow, documentation, and reimbursement. The integration of physiological data from implantable devices has the potential to transform SCS

management by improving outcomes, standardizing treatment pathways and enabling better documentation of clinical decisions. Unlike traditional SCS programming, which is highly variable and dependent on the physician or Qualified Health Professional's (QHP's) knowledge of different SCS programming systems and subjective patient feedback, ECAP dose-controlled closed-loop systems provide objective data that clinicians can use to guide programming decisions, document therapy adjustments, and ensure compliance with reimbursement guidelines.

The shift towards real-time physiological insights changes clinical decision-making and may enhance the role of the physician. Despite these technological advancements, current billing and coding frameworks have yet to fully account for the complexity of modern ECAP dose-controlled closed-loop SCS programming. Given the significant expertise required to optimize SCS therapy, it is essential that reimbursement structures evolve to reflect the time, training, and clinical decision-making involved. Recognizing these challenges, the American Society for Pain and Neuroscience (ASPN) has developed this consensus document to establish best practices for integrating advanced SCS programming including closed-loop technology into clinical workflows. With multiple adjustable parameters, diverse waveform options, and the integration of real-time neurophysiological feedback, there is a critical need for standardized protocols that ensure both clinical efficacy and proper reimbursement. This document provides evidence-based recommendations for aligning coding practices with modern neuromodulation technology, ensuring that clinical care remains under the control of the treating physician and that reimbursement accurately reflects the physician's work and the expertise required to manage patients with more sophisticated therapy.

Materials and Methods

In April 2025, under the guidance of ASPN leadership, a diverse, multidisciplinary expert panel was convened, including experts in anesthesiology, pain medicine, neurosurgery, physical medicine, rehabilitation, and reimbursement consultants, all with extensive experience in neuromodulation, billing, coding, and clinical research. Consensus recommendations were developed for both traditional SCS and modern closed-loop SCS programming. Emphasis was placed on enhancing physician oversight and ensuring that clinical decision-making remains central to therapy optimization.

A structured literature search was performed using MEDLINE, Embase, Cochrane Central, and Scopus, supplemented by manual reference checks. Eligible studies included randomized trials, observational studies, and relevant case series. Case reports and preclinical studies were considered when higher-level evidence was unavailable. Non-peer-reviewed publications were excluded.

Given the limited availability of high-level evidence such as randomized controlled trials, recommendations were informed by the best available data, including observational studies and expert consensus, when appropriate.

Billing and Coding Considerations

Overview of Current Billing Codes

Billing for SCS programming is complex, and understanding these codes in relation to the programming that is being performed is essential to ensure proper reimbursement, compliance, and that the provider is accurately compensated for their level of time and expertise.

Accurate billing for SCS programming must reflect the time, technical expertise, and clinical decision-making involved. Current reimbursement frameworks utilize three primary Current Procedure Terminology (CPT®) codes,¹⁸ which are defined by the level of programming complexity and the extent of physician involvement. Under the American Medical Association (AMA) guidelines described in, these services must be performed directly by a physician, or QHPs, or under their direct supervision.

Historical Decisions and Their Implications

A multi-physician specialty society workgroup under the guidance of the American Medical Association's CPT Editorial Panel played a pivotal role in 2016 and 2017 in shaping current physician compensation for programming. The workgroup's coding decisions and guidance along with the subsequent valuation by the Relative Value Scale Update Committee (RUC) recognized the increased complexity of modern SCS programming and attempted to align reimbursement with the level of physician work and clinical decision making involved.

The key implications include:

- **Alignment with Clinical Workflows:** The new codes are designed to reflect the time and expertise required for programming, incentivizing physicians to engage directly in device management.
- **Encouraging Best Practices:** By appropriately compensating for detailed programming and follow-up, the new codes encourage practices that prioritize patient outcomes and optimal device performance.
- **Challenges in Implementation:** Despite these advances, variability in payer policies remains. Clinicians must stay abreast of changes in reimbursement guidelines to ensure compliance and avoid under- or overutilization of programming services.

Fee-for-Service Utilization Data (2023)

Recent 2023 Medicare Fee-for-Service (FFS) Resource-Based Relative Value Scale (RBRVS) data reveal underutilization of these codes relative to the potential volume of reprogramming sessions.

- **CPT 95970:** Approximately 29,020 unique Medicare billing instances were recorded for all neuromodulation procedures (including DBS, RNS, SNS, PNS), with the diagnosis code Z45 (Encounter for adjustment and management of implanted device) used in only 7.2% of SCS cases.
- **CPT 95971:** Around 18,091 Medicare instances were recorded for all neuromodulation procedures (including DBS, RNS, SNS, and PNS), with G89 (Pain, not elsewhere classified) category used in 7.0% and G89.4 (Chronic pain syndrome) diagnosis code used in 6.5% of cases.
- **CPT 95972:** Approximately 37,260 Medicare instances were recorded for all neuromodulation procedures (including DBS, RNS, SNS, and PNS), with G89 (Pain, not elsewhere classified) category, and diagnosis codes G89.4 (Chronic pain syndrome), and G89.2 (Chronic pain, not elsewhere classified) used in 14.6%, 13.9%, and 0.7% of cases, respectively.

Recent evidence shows that patients reported a mean of 6.1 visits per year to address SCS-related therapy optimization and reprogramming.⁸ Given the estimated 100,000 SCS implants annually,³ there is potential for up to 600,000 reprogramming and therapy optimization visits per year for new implants alone. The current underutilization is likely due to the complexity of modern programming and inadequate training.

Challenges in Training and Integration

One of the most significant challenges in the modern era of SCS is the rapid pace of technological development, which often outstrips the training available to clinical staff. Traditional SCS programming, once a task that could be managed by clinicians with minimal training, now demands a high level of technical expertise.

Moreover, the integration of complex data streams from implantable devices and smart technology platforms into clinical decision-making algorithms has not yet been standardized. This lack of integration means that, despite the wealth of data available, actionable clinical insights remain limited, and the potential for clinician-led adjustments is minimal.

Evolution of SCS Programming

Traditional SCS

Initial Approach

Early SCS systems utilized a manual, stepwise approach with bipolar electrode configurations (Figure 1). Clinicians adjusted basic parameters: frequency (typically 40–100 Hz), pulse width (100–500 μ s), and amplitude (Table 1) guided by subjective patient feedback to generate paresthesia over the painful region.⁴

Expanded Parameter Space

Modern SCS systems offer an array of waveform options (Table 1) including high-frequency (up to 10 kHz),^{21,30} differential targeted multiplexing (DTM),²⁷ and burst stimulation.²⁴ These advancements have resulted in numerous potential programming configurations,⁴ significantly increasing the complexity of the programming process. Clinicians must now navigate an extensive parameter space to optimize therapy for individual patients, a task that requires substantial training and expertise.

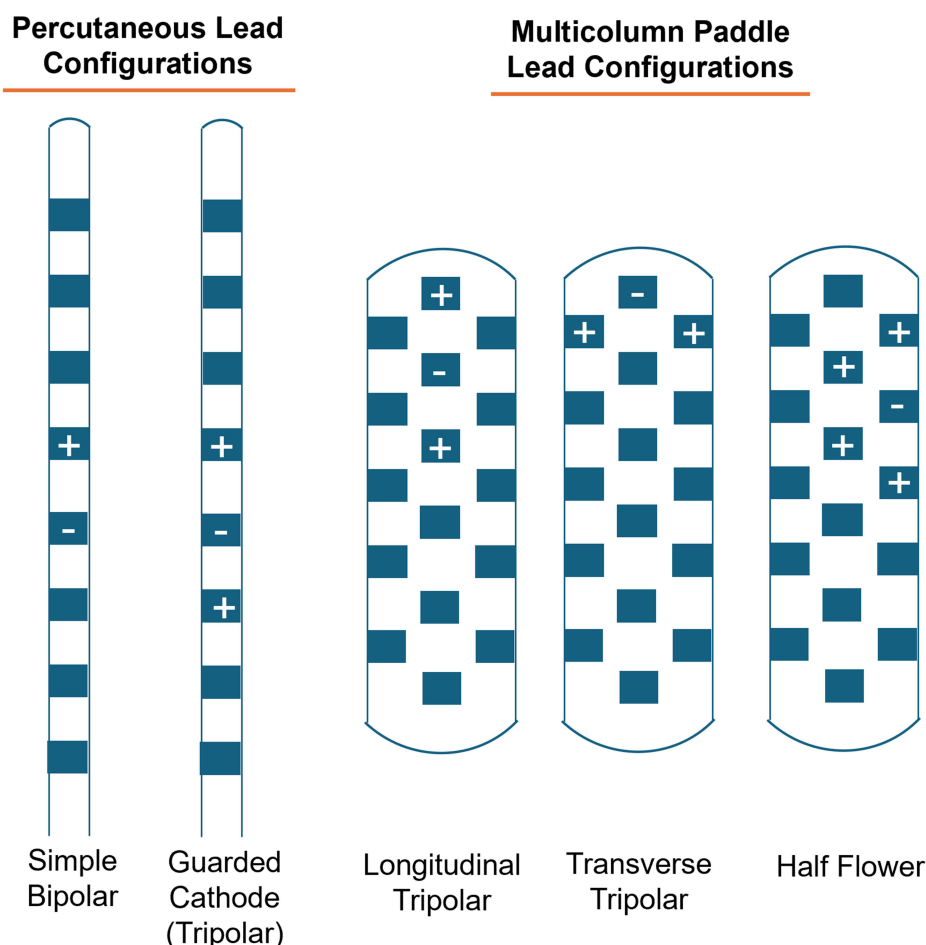


Figure 1 Typical lead configurations in traditional SCS systems. Lead configurations are utilized for shaping the stimulation field so that appropriate coverage of the painful areas can be achieved. There are 8–16 contacts in percutaneous leads and 16–32 contacts in paddle leads. Bipolar configurations are typically utilized with traditional SCS systems, and the width of the field increases as the distance between the anode (+) and cathode (-) increases. Deeper penetration of the dorsal column without creation of a wider electrical field is produced by a technique of “guarding.” When the cathode is in the center and is surrounded by anodes (tripolar configuration in this figure), the cathodal field is prevented from expanding beyond the anode on either side. Paddle leads have multi-column contacts enabling more complex field shaping.

Iterative Adjustments

Traditional programming strategies involve repeated in-clinic sessions where clinicians fine-tune settings based on patient feedback.⁵ This process, while effective, is labor-intensive and often requires multiple visits to achieve optimal results. Sub-perception SCS results in a delayed onset of analgesia, typically taking several hours to days after stimulation is initiated, compared to paresthesia-based SCS, where pain relief can be usually observed within minutes.^{19,30} The extended “wash-in” period (ie, the time until maximum analgesia is achieved) and other limitations associated with current sub-perception methodologies can be burdensome for patients. Specifically, optimizing therapy programs is likely to be prolonged, as evaluating any single parameter set may require approximately 1–2 days, and the number of programming settings that can be practically tested is limited.^{7,20,30} Consequently, patients using conventional sub-perception techniques often do not experience pain relief during their programming visit, and the effectiveness of the treatment cannot be immediately confirmed.

The manual nature of adjustments could lead to inconsistencies over time, and variability in patient responses often necessitate further fine-tuning. Moreover, the lack of objective data means that adjustments are made without a clear understanding of the underlying neurophysiological changes, potentially leading to variability in long-term outcomes and high explant rates due to inadequate pain relief (up to 38%).²²

Table 1 Stimulation Parameters Utilized in Traditional SCS Systems. Commonly Used Stimulation Parameters in Traditional SCS Systems with Supporting Evidence From Randomized Clinical Trials

Waveform	Frequency	Pulse Width	Typical Duty Cycling Parameters	Pulse Amplitude
Low Frequency ^{19,20}	40-100Hz	100–500µs		Adjust to produce comfortable paresthesia based on patient feedback
High Frequency ^{21,22}	10kHz	30µs	14% Pulse Dosing (20 seconds ON and 2 minutes OFF) ²³	Amplitudes are typically set at 60–70% of the patient's perception threshold.
Burst ^{24,25}	500Hz pulse frequency (in each burst) with a burst frequency of 40 Hz	1000µs	30 seconds ON and 90 seconds OFF; 30 seconds ON and 6 minutes OFF ²⁶	
Differential Targeted Multiplexing ^{27,28}	Multiplexing of 4 programs: One 10–60Hz program and two or more 200–250Hz programs ²⁹	200µs	15 minutes ON and 30 minutes OFF ²⁹	

Training Challenges

As the complexity of SCS programming increases, many clinicians struggle to keep pace with the rapid advancements in technology. This gap in expertise means clinicians are often unable to translate technological innovations in SCS into improved patient outcomes and are routinely inadequately compensated for the time taken to perform complex programming.

ECAP Dose-Controlled Closed-Loop SCS

Objective Feedback

ECAP dose-controlled closed-loop systems incorporate physiological feedback through ECAPs. ECAPs are objective electrophysiological responses representing synchronized activation of dorsal column fibers activated by SCS. ECAP measurements adjust on every pulse in real-time and maintain a prescribed neural activation level.^{11–13} An overview of ECAP dose-controlled closed-loop programming methodology is provided in [Figure 2](#).

Enhanced Precision Leads to Superior Clinical Outcomes

The integration of ECAP measurements allows for precise control over stimulation parameters in closed-loop therapy. ECAP dose-controlled closed-loop SCS continuously modulates pulse amplitude to ensure that neural activation is consistently maintained at the clinician-defined target with minimal deviation.^{11–13} In a prospective, double-blind, randomized trial with 36-month follow-up, ECAP dose-controlled closed-loop SCS achieved superior and durable pain relief than open-loop stimulation, demonstrating that objective, dose-based control translates into superior long-term outcomes.^{11–13} Neural activation accuracy (deviation of observed ECAP response from the prescribed ECAP response) was three times more accurate with ECAP dose-controlled closed-loop SCS compared to open-loop SCS.¹³ This level of precision is not achievable with traditional SCS systems that rely solely on subjective patient feedback.

Objective Clinical Decision Making

Emerging evidence supports the role of these neural metrics in guiding programming and predicting clinical outcomes.

- **Early Identification of Responders and Differential Diagnosis:** ECAP dose-controlled closed-loop therapy enables the immediate identification of responders versus non-responders during the postoperative programming phase.¹⁵ Objective metrics enable clinicians to rapidly distinguish between patients who will benefit from SCS therapy and those who may require differential diagnostic approaches on the day of the trial.²³

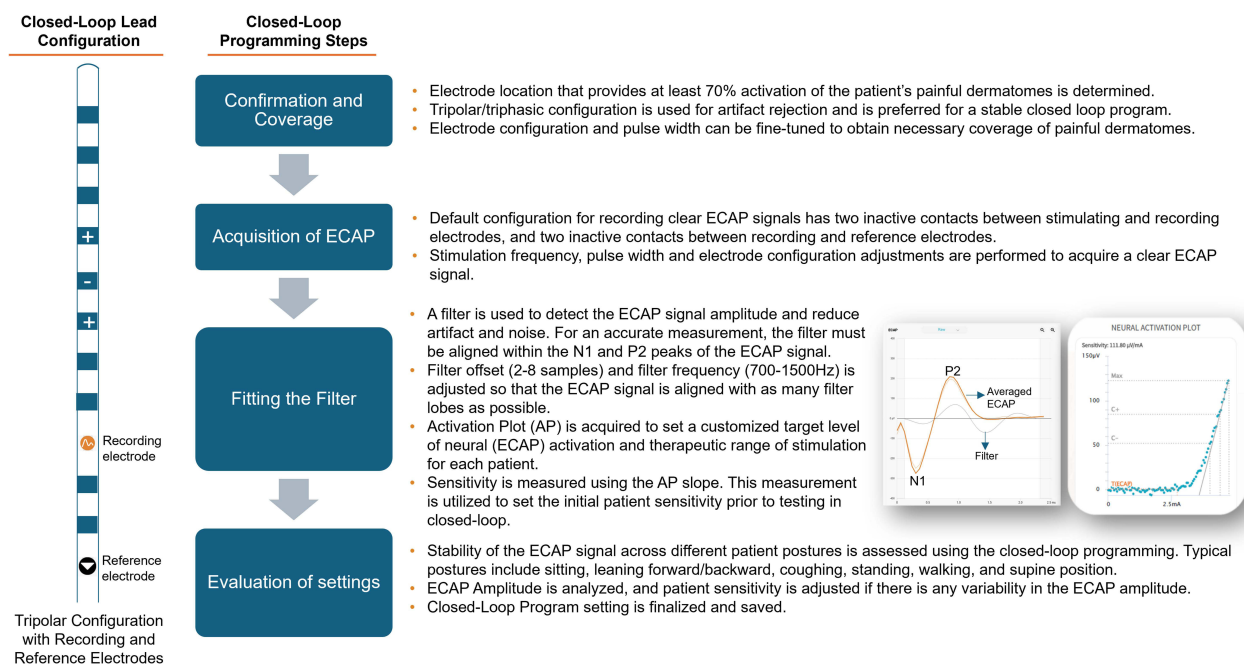


Figure 2 Overview of ECAP Dose-Controlled Closed-Loop SCS Programming.

- Therapy Optimization:** Recent data reinforces the role of objective neurophysiological measures in guiding therapy optimization.^{16,17} The first evidence of a biomarker-based dose–response relationship in chronic pain management demonstrated that higher dose ratios and increased time above the ECAP threshold correlated with better clinical outcomes.¹⁷ Retrospective case studies¹⁷ further support the utility of objective ECAP-derived neural metrics in refining therapy for patients experiencing suboptimal pain relief. Metrics such as dose ratio, percent utilization above threshold, and dose accuracy have been employed to guide adjustments in stimulation parameters.⁷ These objective indicators facilitate targeted modifications, leading to enhanced analgesic outcomes and demonstrating their value as actionable tools for personalized therapy optimization. Fine-tuning neural metrics allow clinicians to customize stimulation based on each patient's unique neurophysiological profile, maximizing analgesic effects.¹⁶ By leveraging objective neural metrics, SCS programming transitions from a subjective process reliant on patient feedback to a quantifiable, reproducible, and evidence-based treatment modality.¹⁶ This approach provides a consistent framework for delivering personalized pain management, improving both the reliability and effectiveness of SCS therapy.

Collectively, these findings suggest that real-time monitoring and adjustment of neural metrics can objectively optimize SCS therapy, predict patient responsiveness, and provide valuable insights into individual clinical conditions, thereby informing personalized care plans.

Clinical Integration

The use of ECAP dose-controlled closed-loop systems brings clinical decision-making back to the forefront of the practice workflow. A comparison of data provided for clinical decision-making by traditional and ECAP dose-controlled closed-loop SCS systems is provided in Table 2. The integration of closed-loop technology into clinical practice requires robust training programs and clear guidelines to ensure that clinicians can effectively utilize these advanced systems.

Table 2 Comparison of Device Data Available for Clinical Decision-Making

Description	Data metrics Available	Traditional SCS	ECAP Dose-Controlled Closed-Loop SCS
Stimulation program parameters	• Electrode configuration • Pulse amplitude • Pulse width • Frequency • Duty cycling • Programming session changes		
Stimulation usage	• System utilization trends • Program utilization trends		
Battery usage	• Extent of battery life • Recharging trends		
Lead status	• Impedance • Position of implanted leads		
Patient activity	• Posture trends • Activity trends		
Objective Neural Insights	• Dose ratio (Optimal range: 1.2–1.6)¹⁷ • Dose accuracy (Optimal range: $\leq 10\mu\text{V}$)¹⁷ • ECAP dose • Patient sensitivity • Percentage of Time above ECAP Threshold		

Reimbursement Report Requirements

For a reimbursement claim to be accepted, the following detailed report must accompany each programming session:

Patient and Device Identification

Patient demographics, clinical history, device model, serial number, and implant date.

Programming Session Details

Date and time of the session, the specific CPT code used, and the clinical rationale for intervention.

Technical Parameters and Adjustments

- Baseline Data: Document pre-adjustment stimulation parameters.
- Adjustments Performed: Detailed changes to all parameters (eg, frequency, pulse width, amplitude, ECAP dose, dose ratio) and the rationale behind each adjustment.
- Objective Metrics:
 - System utilization data (ie, proportion of active time over the past week).
 - Neural metrics including ECAP dose, dose ratio, and dose accuracy.

Clinician Involvement

- Confirmation that a physician or QHP [eg Nurse Practitioners (NPs), Physician Assistants (PAs)] performed the programming.
- Documentation of the clinical decision-making process.
- Programming by a company representative does not constitute that a physician or QHP has programmed the device.

Reporting

Inclusion of downloadable logs and data from the SCS programming platform providing an audit trail of the session.

Follow-Up and Outcome Projections

A plan for subsequent monitoring or programming sessions, along with patient education notes.

An example of a health insurance claim form is provided in [Figure 3](#).

Best Practices for Billing and Coding

Documentation and Coding Criteria

Given the complexity of SCS programming, office visits for device reprogramming require rigorous documentation. For a reprogramming session to be billable as a complex service, more than three distinct parameters ([Table 3](#)) that affect the patient's clinical outcome must be modified (eg, ECAP target, patient sensitivity, dose ratio). Clinicians should document each parameter change and the clinical rationale for adjustments. This detailed documentation supports both clinical decision making and proper reimbursement and aligns with AMA guidelines that require demonstration of substantive programming effort.

Billing Considerations

During SCS reprogramming visits, physicians may provide an evaluation and management (E/M) service (commonly billed under 99214 or 99215 for established patients) while also performing an electronic analysis and adjustment of device settings. When these services are performed on the same day, it is crucial to understand when and how to report the additional codes. When both an E/M service and a device programming service are performed during the same visit, the programming service may be reported separately if it is independently documented as a distinct service. National Correct Coding Initiative (NCCI) edits are currently unavailable for this type of billing on the same day. The documentation should clearly outline the nature and extent of both distinct services, including the specific parameters adjusted during the neurostimulator programming and the details of the office visit (ie patient history, details pertaining to the examination, and clinical decisions made).

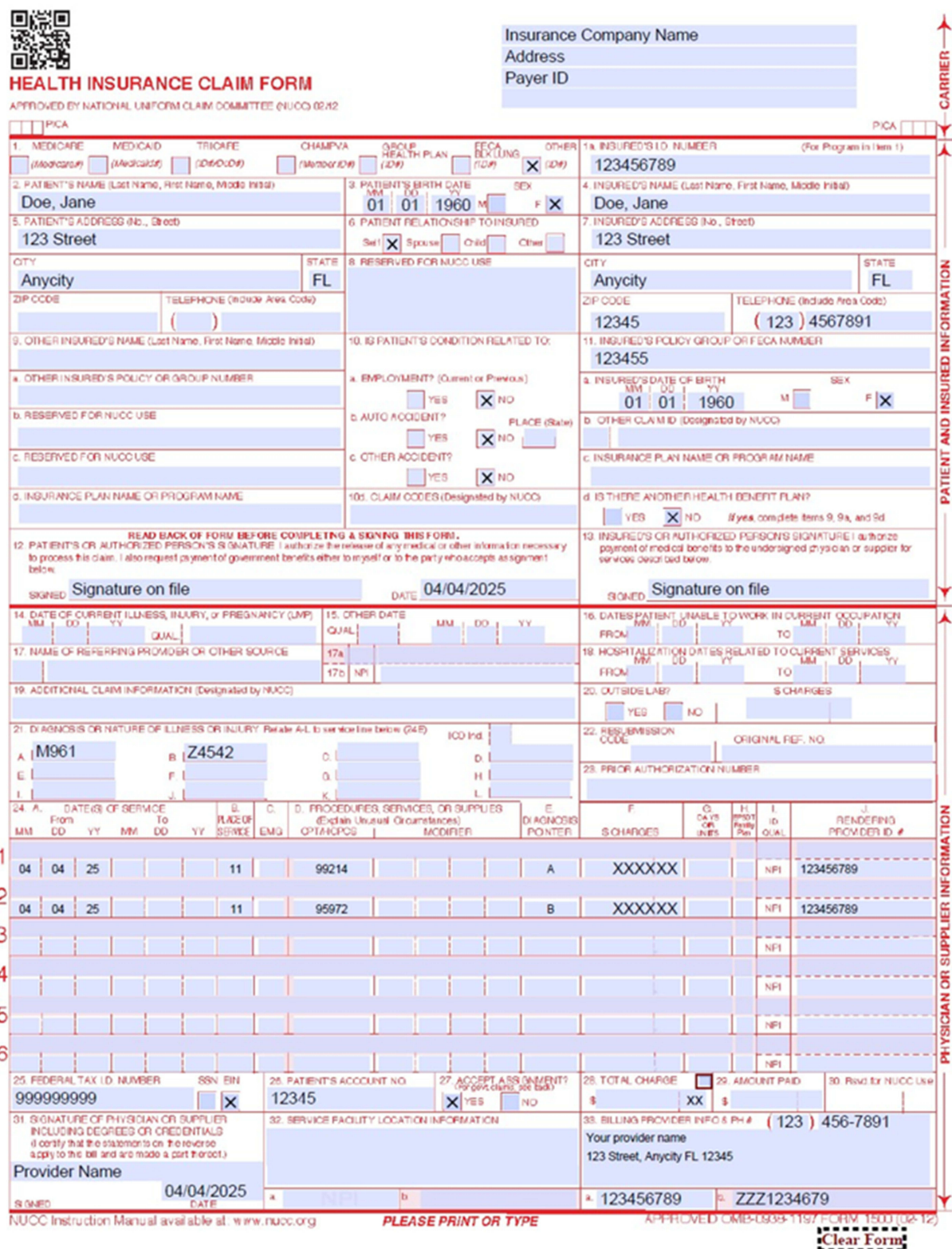
Time spent on SCS analysis/programming should be documented separately and should exclude any time spent on the E/M service. It is important to note that SCS programming codes are not time-based like DBS programming codes. Modifiers may be required but guidance is payor specific. It is imperative to engage your billing team to ensure proper coding and modifier application.

[Figure 3](#) illustrates how the health insurance claim form can be filled out for a scenario when the patient underwent an E/M and programming session during the same visit.

Multidisciplinary Involvement in Programming

Programming SCS devices requires a collaborative approach:

- **Clinical Oversight:** Physicians must remain involved in programming decision to ensure that the clinical context is always considered.
- **Role of Support Staff:** NPs, PAs and technical staff play an essential role in device setup, data collection, and preliminary adjustments. Their involvement should be clearly documented to support billing and clinical decisions.
- **Interdisciplinary Teams:** In complex cases, input from pain specialists, neurologists, and even psychologists may be required to tailor the stimulation parameters to the patient's unique needs.



HEALTH INSURANCE CLAIM FORM
APPROVED BY NATIONAL UNIFORM CLAIM COMMITTEE (NUCC) 02/12

Insurance Company Name
Address
Payer ID

1. MEDICARE MEDICAID TRICARE CHAMPVA GROUP HEALTH PLAN FECA BLX (LUNG) OTHER
(Medicare) (Medicaid) (D6/D6/D6) (Member ID#) (ID#) (ID#) (ID#) (ID#) (ID#) ☒ (ID#)

2. PATIENT'S NAME (Last Name, First Name, Middle Initial)
Doe, Jane

3. PATIENT'S BIRTH DATE
MM DD YY 01 01 1960 SEX F ☒ M

4. INSURED'S NAME (Last Name, First Name, Middle Initial)
Doe, Jane

5. PATIENT'S ADDRESS (No., Street)
123 Street

6. PATIENT RELATIONSHIP TO INSURED
Self ☒ Spouse ☐ Child ☐ Other ☐

7. INSURED'S ADDRESS (No., Street)
123 Street

8. RESERVED FOR NUCC USE

9. OTHER INSURED'S NAME (Last Name, First Name, Middle Initial)

10. IS PATIENT'S CONDITION RELATED TO:
a. EMPLOYMENT? (Current or Previous) YES ☐ NO ☒
b. AUTO ACCIDENT? YES ☐ NO ☒ PLACE (State)
c. OTHER ACCIDENT? YES ☐ NO ☒

11. INSURED'S POLICY GROUP OR FECA NUMBER
123455

12. PATIENT'S OR AUTHORIZED PERSON'S SIGNATURE (I authorize the release of any medical or other information necessary to process this claim. I also request payment of government benefits either to myself or to the party who accepts assignment below.)
Signature on file DATE 04/04/2025

13. INSURED'S OR AUTHORIZED PERSON'S SIGNATURE (I authorize payment of medical benefits to the undersigned physician or supplier for services described below.)
Signature on file

14. DATE OF CURRENT ILLNESS, INJURY, or PREGNANCY (UMP)
MM DD YY QUAL

15. OTHER DATE
MM DD YY QUAL

16. DATES PATIENT UNABLE TO WORK IN CURRENT OCCUPATION
FROM MM DD YY TO MM DD YY

17. NAME OF REFERRING PROVIDER OR OTHER SOURCE
17a. NAME 17b. NP

18. HOSPITALIZATION DATES RELATED TO CURRENT SERVICES
FROM MM DD YY TO MM DD YY

19. ADDITIONAL CLAIM INFORMATION (Designated by NUCC)

20. OUTSIDE LAB? YES ☐ NO ☒ \$ CHARGES

21. DIAGNOSIS OR NATURE OF ILLNESS OR INJURY. (Refer to A-L to service line below (24E))
A. M961 B. Z4542 C. D. E. F. G. H. I. J. K. L.

22. RE submission CODE ORIGINAL REF. NO.

23. PRIOR AUTHORIZATION NUMBER

24. A. DATE(S) OF SERVICE From To B. PLACE OF SERVICE C. D. PROCEDURES, SERVICES, OR SUPPLIES (Explain Unusual Circumstances) E. DIAGNOSIS F. G. DAYS OF INJURY H. I. ID QUAL J. RENDERING PROVIDER ID #
1 04 04 25 11 99214 A XXXXXX NPI 123456789
2 04 04 25 11 95972 B XXXXXX NPI 123456789
3
4
5
6

25. FEDERAL TAX ID NUMBER SSN EIN 999999999 ☒ 12345

26. PATIENT'S ACCOUNT NO. 12345

27. ACCEPT ASSIGNMENT? (If yes, please see back) YES ☒ NO ☐

28. TOTAL CHARGE \$ XX \$

29. AMOUNT PAID \$

30. Ring for NUCC Use

31. SIGNATURE OF PHYSICIAN OR SUPPLIER INCLUDING DEGREES OR CREDENTIALS (I certify that the statements on the reverse apply to this bill and are made a part thereof.)
Provider Name DATE 04/04/2025

32. SERVICE FACILITY LOCATION INFORMATION
a. b. c. d. e. f. g. h. i. j. k. l. m. n. o. p. q. r. s. t. u. v. w. x. y. z.

33. BILLING PROVIDER INFO & PH # (123) 456-7891
Your provider name
123 Street, Anycity FL 12345

34. a. 123456789 b. ZZZ1234679

NUCC Instruction Manual available at: www.nucc.org PLEASE PRINT OR TYPE APPROVED OMB-0905-1197 FORM 1500 (02-12)

Clear Form

Figure 3 Health Insurance Claim Form. Illustration of a health insurance claim form filled out for an established patient with the diagnosis of post-laminectomy syndrome. In this example, patient came in for an office visit for a routine evaluation and had to undergo a complex SCS reprogramming session. ICD-10-CM diagnosis code M96.1 reflects the patient's pain diagnosis of post-laminectomy syndrome, and ICD-10-CM diagnosis code Z45.42 reflects that the patient underwent SCS reprogramming. CPT procedure code 99214 is utilized to reflect that the patient underwent an evaluation and management (E/M) service. The patient also underwent a complex reprogramming session where more than 3 SCS parameters were adjusted, and CPT procedure code 95972 was reported to reflect the programming session. Prior Authorization number should be included on every claim submitted to commercial insurance providers where prior authorization is required.

Table 3 Description of Common Procedure Terminology (CPT) and Diagnosis Codes for SCS Programming

CPT Procedure Code	Code Description	Comments
95970	Device Analysis <i>only</i> , without programming, subsequent visits <i>only</i>	Not to be used during trial or initial permanent implant programming
95971	Device analysis and simple programming (<i>One to three parameters</i>)	Parameters listed below have been programmed or changed during simple or complex programming: • Electrode configuration • Pulse width • Pulse amplitude • Frequency • Duty cycling • Closed-Loop Specific Parameters (each setting change can be counted as one parameter) ○ ECAP threshold current ○ ECAP target minimum ○ ECAP comfort ○ ECAP target maximum ○ Patient sensitivity ○ Filter offset ○ Filter frequency
95972	Device analysis and complex programming (<i>More than three parameters</i>)	
Diagnosis coding for routine SCS interrogation and reprogramming may involve the following code:		
ICD-10-CM Diagnosis Code	Code Description	
Z45.42	Encounter for adjustment and management of neurostimulator	
In addition, physicians and facility staff must ensure primary (eg Failed Back Surgery Syndrome, Complex Regional Pain Syndrome I and II) and secondary (eg M96.1 for Post-laminectomy syndrome, G57.71 for Causalgia of right lower limb) diagnosis codes most accurately reflect individual patient characteristics.		

Ethical and Compliance Considerations

Compliance with regulatory standards and ethical billing practices is paramount. Ethical billing practices necessitate that every billed reprogramming session directly correlate with a measurable impact on patient outcomes. Overbilling or “upcoding” sessions that do not meet the more than three-parameter threshold is not only noncompliant with AMA rules but also undermines the integrity of clinical practice. Incorporating closed-loop documentation systems where changes are electronically recorded and time-stamped can further ensure that office visits for reprogramming are both accurate and transparent.

- **Documentation Standards:** Every programming session should be thoroughly documented, including the rationale for adjustments, device data used, time spent, and the subjective and/or objective outcomes observed. Such documentation not only supports clinical decisions but also ensures compliance with billing regulations.
- **Audit Preparedness:** Practices should implement internal audits to monitor programming frequency and ensure that billing reflects actual clinical work. This mitigates the risk of overutilization and financial discrepancies.
- **Patient-Centered Care:** Decisions should always be guided by patient outcomes rather than billing incentives. Ethical programming practices ensure that the patient’s well-being remains the primary focus.

Ethical and Financial Considerations

As SCS technology becomes increasingly sophisticated, ensuring ethical and transparent billing practices remains critical. Reimbursement for SCS programming must align with medical necessity, reflect the complexity of care provided, and support long-term sustainability of neuromodulation services.

Key Considerations Include

- **Patient Financial Responsibility:** Patients should be informed early and clearly about potential financial obligations related to SCS programming. This includes outlining co-insurance, deductibles, and the possible frequency of follow-up visits. Transparent discussions can help patients make informed decisions and foster trust. However, coverage policies and benefit structures may vary across payers, and ambiguity in payer language or prior authorization processes can complicate communication. Practices should develop internal protocols to address common payer variations and proactively educate patients.
- **Avoiding Overutilization and Billing Integrity:** While SCS programming often requires multiple sessions to optimize therapy, practices must avoid excessive or medically unnecessary programming. Establishing clinical guidelines and tracking mechanisms (eg, EHR flags or audit dashboards) to monitor visit frequency can help ensure that each session is justified by clinical need. Overutilization not only undermines ethical standards but may also increase audit risk and payer scrutiny.
- **Multidisciplinary Team Involvement and Scope of Practice:** SCS programming may be performed by various team members, including physicians or QHPs. Billing must accurately reflect the provider's credentials, the complexity of the service rendered, and compliance with local and national guidelines. Additionally, while industry support may be useful for technical guidance, final clinical decisions including reprogramming frequency and goals should rest with the physician or other QHP to maintain objectivity and uphold ethical standards.

By proactively addressing these ethical and financial considerations, practices can maintain high standards of care while safeguarding against potential compliance pitfalls. Ethical billing reinforces the value of SCS therapy, supports patient-centered care, and contributes to the sustainability of neuromodulation in modern pain management.

Tracking, Billing Frequency, and Quality Assurance

Tracking Mechanisms for Billing

Effective tracking systems are critical to ensure that programming sessions are billed appropriately without leading to overutilization:

- **Software Integration:** Utilize programming software that automatically logs session details, including duration, parameters adjusted, and patient outcomes. These logs can be cross-referenced with EMR data for billing accuracy.
- **Periodic Reviews:** Implement routine reviews of programming logs to identify trends in device usage and billing frequency. This helps prevent unnecessary sessions and ensures compliance with AMA guidelines.
- **Compliance Checklists:** Develop checklists that document key aspects of each session, ensuring that all necessary information is captured for future audits.

Billing Frequency Considerations

Determining the appropriate frequency for billing programming sessions requires a balance between clinical need and ethical practice:

- **Initial Programming:** During the trial and initial programming phases, frequent adjustments may be necessary. These sessions should be billed separately, with clear documentation justifying the increased frequency. According to Medicare guidelines, electronic analysis and programming services (CPT 95970, 95971, and 95972) are not considered medically necessary more often than once every 30 days—except during the first three months post-implantation when more frequent adjustments may be warranted.

- **Maintenance Programming:** Once optimal parameters are established, routine follow-up sessions should be scheduled at intervals that reflect clinical necessity rather than a fixed billing cycle. A quarterly visit is recommended to ensure that the SCS device is functioning well, and the patient is compliant with the programmed stimulation parameters and is utilizing the therapy as intended.⁹

A subset of patients may require more frequent adjustments due to fluctuations in pain intensity or location and certain clinical scenarios (eg, $\leq$ three months post-implant, in case of an acute event) to ensure there is no gradual loss of efficacy.⁹ In these cases, documentation should clearly reflect the clinical need to avoid perceptions of overutilization.

Quality Assurance in Programming and Billing

To maintain high standards, quality assurance measures should be integrated into both clinical and administrative workflows:

- **Regular Audits:** Conduct periodic audits of programming logs and billing records to ensure that all sessions meet established guidelines.
- **Feedback Mechanisms:** Establish a system for clinicians and patients to provide feedback on the programming process. This information can be used to refine protocols and improve overall care.
- **Benchmarking:** Compare programming and billing data against regional and national benchmarks to identify areas for improvement. This comparative approach helps ensure that practices remain compliant with evolving standards.

International Coding and Billing Practices

This section provides a comparative overview of SCS programming and reprogramming practices, as well as associated procedural coding systems, in major global regions. The comparison addresses both clinical workflows and billing code frameworks, with emphasis on differences in procedural coding.

Clinical Workflow Differences

In the United States (U.S.), SCS programming is typically conducted in outpatient pain management clinics by physicians or QHPs. Programming sessions occur during the initial post-implant period, followed by as-needed visits based on patient-reported outcomes.

In contrast, in Europe and Australia, device programming may be delegated more frequently to specialized nurses or technicians, particularly in high-volume centers, with physicians providing oversight. The frequency of reprogramming varies widely, with some systems adopting structured follow-up schedules (eg, at 1-, 3-, 6-, and 12-months post-implant) and others relying on patient-initiated visits. In parts of Asia and Latin America, programming is often physician-led due to regulatory and training constraints.

Coding and Billing Differences

Table 4 provides a comparison of global SCS programming and coding practices. The US employs CPT codes¹⁸ to describe SCS programming and reprogramming services. While implantation and trial procedures are widely codified in other global regions, outpatient programming and reprogramming encounters are inconsistently represented in national and regional fee schedules. In the United Kingdom, programming is captured within the Office of Population Censuses and Surveys (OPCS)-4 coding²⁵ framework, with specific codes for neurostimulator reprogramming (eg, A48.5). France uses the Classification Commune des Actes Médicaux (CCAM) coding system²⁶ with AELB0x series codes, while Germany's Operationen- und Prozedurenschlüssel (OPS) system²⁸ lacks a dedicated outpatient reprogramming code, often resulting in hospital-specific tariffs. Australia is notable for having explicit Medicare Benefits Schedule (MBS) items²⁹ for in-person (MBS 39131) reprogramming. In Chile,³³ Brazil³¹ and Argentina,³² no unified national public codes exist, with private payers using insurer-specific codes or bundling services within specialist consultations. Asian countries vary: Japan's National Health Insurance³⁴ includes outpatient management codes for neurostimulators, while China³⁵ and India³⁶ rely on provincial or payer-specific technical service codes.

Table 4 Comparison of SCS Programming Practices and Coding: United States Vs Global Regions

Country	Programming/Reprogramming Code(s)	Notes and Reference(s)
United States	CPT 95970, 95971, 95972 ¹⁸	See Table 3
United Kingdom	OPCS-4: A48.5 — Reprogramming of neurostimulator adjacent to spinal cord (combined with ICD-10 for indication). ²⁵	Used in outpatient setting; ensure linkage to clinical justification (NHS Digital, 2024). ²⁵
Germany	No standalone OPS outpatient code; adjustments billed under device management or hospital-specific tariffs. ²⁸	Refer to OPS 5-039 for implantation context; outpatient reprogramming guidance in G-DRG manuals (InEK, 2024). ²⁸
France	CCAM: AELB0x series for neurostimulator adjustment. ²⁶	Tariffs depend on Assurance Maladie; pairing with ICD-10 supports medical necessity (HAS, 2024). ²⁶
Australia	MBS item 39131 (in-person reprogramming). ²⁹	Explicit Medicare items for both modalities; documentation must support medical necessity (MBS Online, 2024). ²⁹
Brazil	No SUS public code; TUSS codes for device management in private sector. ³¹	Programming usually billed as specialist consultation with device adjustment (ANS, 2024). ³¹
Argentina	No national public code; billed under payer-specific tariffs for device management. ³²	Pre-authorization often required (Superintendencia de Servicios de Salud, 2024). ³²
Chile	No FONASA public code; private insurers may use internal device adjustment codes. ³³	Billing structure varies by insurer (MINSAL Chile, 2024). ³³
Japan	NHI fee schedule includes neurostimulator management; repeat adjustments billed under outpatient management codes. ³⁴	Exact codes vary; confirm with hospital reimbursement team (MHLW Japan, 2024). ³⁴
China	Provincial/national fee schedules; billed under device management/technical service. ³⁵	Varies by province; documentation of justification required (NHSA, 2024). ³⁵
India	No national procedural code; billed as specialist consultation or device management. ³⁶	Private insurers often require pre-authorization (IRDAI, 2024). ³⁶

Discussion

Traditional SCS programming remains subjective and iterative, relying on patient feedback^{7,30,37} to guide therapy optimization. Clinicians often proceed by trial and error^{7,37} over multiple visits, without any objective measurement of neural activation. This approach limits their ability to develop truly individualized care plans, as there are no quantifiable biomarkers to drive clinical decision-making or to predict which patients will respond best to therapy. The complexity of modern SCS programming has increased with the advent of systems that incorporate multiple adjustable parameters,^{4,38} diverse waveforms, and closed-loop capabilities. The complexity creates variability in programming practices, inconsistent patient outcomes,^{22,39–43} and a disconnect between clinical decision-making and billing practices. Best practices for SCS programming include direct clinician involvement to ensure that the therapy is tailored to the individual patient's neurophysiological and clinical needs.

A fundamental aspect of achieving consistency in outcomes is the standardization of programming protocols. With modern SCS systems offering an extensive range of adjustable parameters, the potential programming combinations can exceed 10^{16} .⁴ Such complexity necessitates clear guidelines to determine which adjustments are clinically significant and how these changes should be documented.

ECAP dose-controlled closed-loop SCS represents a major innovation by using ECAPs as a real-time biomarker of activation of dorsal column targets responsible for pain inhibition.^{10,44,45} ECAP dose-controlled closed-loop SCS continuously adjusts stimulation amplitude to hold the ECAP at a target level. In effect, the device “doses” the spinal

cord by maintaining consistent neural activation despite positional or physiological changes. The superiority and durability of ECAP dose-controlled closed-loop SCS compared to open-loop SCS has been validated in a double-blinded RCT with 36-month follow-up.¹³ Objective data derived using this device also enable advanced evidence-based clinical utilities and objective clinical decision-making tools to guide therapy optimization,^{16,17} and early prediction of responders.^{17,34} Additionally, the ECAP-derived metrics can support differential diagnosis in patients with suboptimal outcomes.¹⁷ Stable neural metrics in the context of new or worsening pain may point toward an alternative etiology (eg, disease progression or new pathology) rather than lead migration or device malfunction.¹⁷ With robust, evidence-based insights into each patient's unique neural response, clinicians can more confidently adjust treatment protocols and develop individualized care-plans for chronic pain patients.

ECAP dose-controlled closed-loop programming is complex as clinicians may adjust multiple closed-loop parameters (eg ECAP target, patient sensitivity, filter offset, dose ratio, etc) in addition to traditional parameter changes (eg, lead contacts, pulse amplitude, pulse width, frequency, etc). The number of changes typically exceed three adjustable parameters which is the threshold for “complex” programming in CPT guidelines.¹⁸ Objective ECAP-derived metrics also allows these changes to be quantified and justified as clinicians can document evidence-based adjustments correlate that with clinical response.^{16,17} In summary, the availability of objective neural dosing data adds substantial value beyond traditional SCS by informing physician-led therapy optimization and thorough documentation. These advancements have important implications for billing and reimbursement. Historically, CPT codes for SCS programming (eg 95,970–95,972)¹⁸ were developed when only open-loop devices existed, and they focus on the number of parameters changed. The current scheme does not account for analysis of neural signals or the use of biomarker data in clinical decision-making. Physician or QHP time and expertise required to interpret ECAP data are not explicitly reflected in existing codes. While the CPT codes acknowledge “closed-loop parameters” as part of programming, there is no separate CPT code or modifier for the analytic component of physiologic dosing.

Interpreting ECAP metrics and customizing a neural dose takes additional time and expertise beyond standard programming. Physicians and QHPs must analyze the ECAP data, adjust targets, and educate patients. Ethical billing practices require that providers document precisely which parameters were adjusted and why, then bill the appropriate complexity level based on that documentation. Overutilization (upcoding complexity without justification) and underbilling (failing to report necessary codes) are equally to be avoided. Ethical billing practices, detailed documentation, and adherence to payer requirements are paramount. As further clinical evidence accumulates, revisions, or additions to the CPT programming codes may be necessary to reflect the detailed reports generated during each programming session capture baseline parameters, the rationale behind any adjustments, and the objective outcomes achieved. Comprehensive records serve as a valuable resource for supporting administrative and reimbursement processes by providing clear evidence of the work performed and clinical decisions made. Consequently, these reports help ensure that reimbursement claims are well supported and that claims submissions remain compliant with payor guidelines. By reducing the need for repetitive reprogramming sessions,¹² ECAP dose-controlled closed-loop platforms also alleviate patient burden and streamline clinical operations, allowing clinicians to focus more on patient care rather than on administrative tasks. This further optimizes healthcare resource utilization by preventing unnecessary office visits and reducing the overall burden on the healthcare system.

Limitations

This consensus document is constrained by the current state of the SCS literature, which remains sparse with respect to high-level evidence for programming workflows. This document is focused on coding and billing practices in the US, and details of global coding practices are limited. By design, we have limited our discussion to systems supported by published randomized controlled trials ensuring an evidence-based foundation. We have excluded novel devices and programming approaches that have not yet reached that benchmark. In areas where published data is insufficient, particularly around billing nuances, training requirements, and implementation workflows, our guidance relies on the consensus of a multidisciplinary panel. While this approach leverages front-line expertise, it may introduce subjective bias and reflect practices at high-volume centers that are not generalizable to all clinical settings. Furthermore, coding and reimbursement frameworks continue to evolve with technological advances. Our billing guidance reflects US AMA policies as of 2025¹⁸ but may not align with some private insurers, international systems, or future CPT updates. Finally, the successful adoption of advanced SCS programming depends on institutional resources. Specialized training,

dedicated personnel, data management infrastructure, and financial investment vary widely between practices and may limit the applicability of our recommended workflows. As the field matures, additional randomized trials, real-world outcome studies, and iterative refinement of billing and training guidelines will be essential to broaden these recommendations and ensure they remain aligned with emerging technologies and care environments.

Conclusions and Future Directions

Advancing the integration of neural metrics into SCS programming offers significant potential to refine chronic pain management. Currently, available CPT codes do not fully reflect the clinical value derived from objective neurophysiological data provided by closed-loop systems. In particular, the ability to predict responders and non-responders early and to utilize neural metrics for developing personalized treatment plans could improve both clinical outcomes and quality of care for chronic pain patients.

The transition from traditional systems to advanced systems such as ECAP dose-controlled closed-loop SCS technology represents a transformative shift in chronic pain management that will require an evolution of both clinical and administrative practices. Programming processes through objective neurophysiological data enable clinicians to deliver more consistent and reproducible therapy and regain direct control over treatment adjustments. ECAP dose-controlled closed-loop platforms enhance the precision and consistency of pain management across patients, and empower clinicians with actionable, objective data for clinical decision-making and documentation. The ability to generate comprehensive documentation supporting programming codes (95970, 95971, and 95972) ensures that the technical and clinical complexities of modern SCS therapy are appropriately recognized and reimbursed. These capabilities contribute to both improved patient outcomes and enhanced cost-effectiveness within the broader context of chronic pain management.

This consensus document provides a comprehensive framework for the programming and billing of modern SCS systems. By following these best practices, clinicians can ensure that technological innovations translate into meaningful improvements in pain management, while also maintaining ethical and compliant billing practices. As SCS technology continues to advance, it is imperative that clinical practices, training programs, and reimbursement models evolve in tandem. By integrating objective neural metrics into clinical workflows, clinicians can develop more informed, individualized care plans and improve overall patient outcomes. Future research and collaboration will be key to refining these processes, ultimately bridging the gap between technological innovation and optimal patient care in neuromodulation.

Additional Information

This document is intended as a living guidance framework; to be updated as further evidence emerges and as technological advances continue to redefine the landscape of neuromodulation for chronic pain.

Acknowledgments

The authors would like to acknowledge Lalit Venkatesan, PhD for his assistance in the formation of this article.

Funding

Development of this guideline was supported by an unrestricted educational grant from Saluda Medical, Minnetonka, MN.

Disclosure

TRD is a consultant for Abbott, SpineThera, Saluda Medical, Cornerloc, SPR Therapeutics, Boston Scientific, PainTEQ, Spinal Simplicity, and Biotronik; an advisory board member for Abbott, SPR Therapeutics, and Biotronik; and has received research funding from Abbott, Vertos, Saluda, Mainstay, SPR Therapeutics, Boston Scientific, and PainTEQ. AN is a consultant for Aurora Spine, Flowonix, Saluda Medical, and Nevro Corp as well as received research support from Nevro Corp. CWH reports personal fees from Abbott, Saluda, Biotronik; stock options from Mainstay and Nalu, outside the submitted work. HK is a consultant for Abbott and Nalu, and a speaker for Averitas Pharma. JEP is a consultant for Abbott, Medtronic, Saluda, Flowonix, SpineThera, PainTEQ, Vertos, Vertiflex, SPR Therapeutics, Tersera, Aurora, Spark, Ethos, Flowonix, Biotronik, Mainstay, WISE, Boston Scientific, Thermaquil, and SpineThera; has received grant/research support from Abbott, Flowonix, Saluda, Aurora, PainTEQ, Ethos, Muse, Boston Scientific,

SPR Therapeutics, Mainstay, Vertos, AIS, and Thermaquil; and is a shareholder for Vertos, SPR Therapeutics, PainTEQ, Aurora, Spark, Celeri Health, Neural Integrative Solutions, Pacific Research Institute, Thermaquil, Saluda, Abbott, SpineThera, and Axonics. EGC is a consultant, advisor, and faculty for Abbott, Boston Scientific, NALU Medical, NEVRO, Saluda Medical. DS is a consultant to Abbott, PainTEQ, Saluda, Mainstay, Surgentec, Nevro, and holds stock options with PainTEQ, Neuralace, Mainstay, Vertos, and SPR. JHG is a consultant for Abbott, Saluda Medical, and Stratus Medical; and has received research funding from SPR Therapeutics and Mainstay Medical. ABA is a consultant to Abbott, Boston Scientific, Saluda, Vertos, and PainTEQ, and has funded research with Abbott, Boston Scientific, Saluda, Nalu, PainTEQ, and Viadisc. PSS has received consultancy fees from Medtronic, Saluda Medical, Nalu, AIS and Biotronic outside the submitted work, and has stock or stock options from SPR, electroCore Saluda Medical and Nalu and was the co-founder and part time CMO of electroCore. CG is a consultant for Saluda, Mainstay, Persica and Iliad Lifesciences; and has equity in Mainstay; on Board of Directors for International Neuromodulation Society; Editor in Chief for Pain Practice. DT is a consultant for Saluda Medical, Boston Scientific, and Connect Pain Solutions, has a royalties' agreement with Connect Pain Solutions, and research support from Saluda Medical, Boston Scientific, NALU, and Sprint SPR. DR is a consultant for Abbott and Medtronic. He is also an advisor and faculty for Abbott. SLM is a faculty/advisor for Medtronic, Boston Scientific, Nevro and Abbott. CMV is a consultant for Saluda Medical and PainTEQ. GLS is a consultant for Saluda Medical and SPR Therapeutics. SPL reports personal fees from Mainstay Medical and Nevro outside the submitted work; he is a consultant for Abbott Laboratories, Boston Scientific, Higgs Boson Health, Medtronic, Minnetronix, Nevro, and Presidio Medical. CM and JD are consultants for Saluda Medical. EAP has received research support from Mainstay, Medtronic, Nalu, Neuros Medical, Nevro Corp, ReNeuron, SPR, and Saluda, as well as personal fees from Abbott Neuromodulation, Biotronik, Medtronic Neuromodulation, Nalu, Neuros Medical, Nevro, Presidio Medical, Saluda, and Vertos; and holds stock options from SynerFuse and neuro42. The remaining authors report no conflict of interest.

References

- Lozano AM, Lipsman N, Bergman H. et al. Deep brain stimulation: current challenges and future directions. *Nat Rev Neurol*. 2019;15(3):148–160. doi:10.1038/s41582-018-0128-2
- Dahlhamer J. Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults — united States, 2016. *MMWR Morb Mortal Wkly Rep*. 2018;2018:67. doi:10.15585/mmwr.mm6736a2
- Chow C, Rosenquist R. Trends in spinal cord stimulation utilization: change, growth and implications for the future. *Reg Anesth Pain Med*. 2023;48(6):296–301. doi:10.1136/rapm-2023-104346
- Moffitt MA, Lee DC, Bradley K. Spinal Cord Stimulation: engineering Approaches to Clinical and Physiological Challenges. In: Greenbaum E, Zhou D editors. *Implantable Neural Prostheses I: Devices and Applications*. Springer US; 2009:155–194. doi:10.1007/978-0-387-77261-5_5.
- Chakravarthy K, Reddy R, Al-Kaisy A, Yearwood T, Grider J. A Call to Action Toward Optimizing the Electrical Dose Received by Neural Targets in Spinal Cord Stimulation Therapy for Neuropathic Pain. *J Pain Res*. 2021;14:2767–2776. doi:10.2147/JPR.S323372
- Miller JP, Eldabe S, Buchser E, Johanek LM, Guan Y, Linderorth B. Parameters of Spinal Cord Stimulation and Their Role in Electrical Charge Delivery: a Review. *Neuromodulation*. 2016;19(4):373–384. doi:10.1111/ner.12438
- Chakravarthy K, Richter H, Christo PJ, Williams K, Guan Y. Spinal Cord Stimulation for Treating Chronic Pain: reviewing Preclinical and Clinical Data on Paresthesia-Free High-Frequency Therapy. *Neuromodulation*. 2018;21(1):10–18. doi:10.1111/ner.12721
- Amirdelfan K, Antony A, Levy R, et al. ID: 221060 Health-Related and Economic Impacts of Clinic Visit Burdens for Spinal Cord Stimulation Patients and Caregivers. *Neuromodulation*. 2023;26(4):S122–S123. doi:10.1016/j.neurom.2023.04.213
- Staats P, Deer TR, Hunter C, et al. Remote Management of Spinal Cord Stimulation Devices for Chronic Pain: expert Recommendations on Best Practices for Proper Utilization and Future Considerations. *Neuromodulation*. 2023;26(7):1295–1308. doi:10.1016/j.neurom.2023.07.003
- Parker JL, Karantonis DM, Single PS, Obradovic M, Cousins MJ. Compound action potentials recorded in the human spinal cord during neurostimulation for pain relief. *Pain*. 2012;153(3):593–601. doi:10.1016/j.pain.2011.11.023
- Mekhail N, Levy RM, Deer TR, et al. Long-term safety and efficacy of closed-loop spinal cord stimulation to treat chronic back and leg pain (Evoke): a double-blind, randomised, controlled trial. *Lancet Neurol*. 2020;19(2):123–134. doi:10.1016/S1474-4422(19)30414-4
- Mekhail N, Levy RM, Deer TR, et al. Durability of Clinical and Quality-of-Life Outcomes of Closed-Loop Spinal Cord Stimulation for Chronic Back and Leg Pain: a Secondary Analysis of the Evoke Randomized Clinical Trial. *JAMA Neurol*. 2022;79(3):251–260. doi:10.1001/jamaneurol.2021.4998
- Mekhail NA, Levy RM, Deer TR, et al. ECAP-controlled closed-loop versus open-loop SCS for the treatment of chronic pain: 36-month results of the EVOKE blinded randomized clinical trial. *Reg Anesth Pain Med*. 2024;49(5):346–354. doi:10.1136/rapm-2023-104751
- Mekhail NA, Levy RM, Deer TR, et al. Neurophysiological outcomes that sustained clinically significant improvements over 3 years of physiologic ECAP-controlled closed-loop spinal cord stimulation for the treatment of chronic pain. *Reg Anesth Pain Med*. 2024;2024:105370. doi:10.1136/rapm-2024-105370
- Pope JE, Deer T, Goree JH, Petersen EA. Objective, physiologic, biometrically driven spinal cord stimulation trialing is a necessity—The length of the trial is not. *Pain Pract*. 2025;25(2):e70012. doi:10.1111/papr.70012

16. Levy RM, Mekhail NA, Kapural L, et al. Maximal Analgesic Effect Attained by the Use of Objective Neurophysiological Measurements With Closed-Loop Spinal Cord Stimulation. *Neuromodulation*. 2024;27(8):1393–1405. doi:10.1016/j.neurom.2024.07.003
17. Muller L, Pope J, Verrills P, et al. First evidence of a biomarker-based dose-response relationship in chronic pain using physiological closed-loop spinal cord stimulation. *Reg Anesth Pain Med*. 2024;2024:1. doi:10.1136/rapm-2024-105346
18. American Medical Association. *Current Procedural Terminology 2025*. Chicago, IL: American Medical Association; 2024.
19. Shealy CN, Mortimer JT, Hagfors NR. Dorsal Column Electroanalgesia. *J Neurosurg*. 1970;32(5):560–564. doi:10.3171/jns.1970.32.5.0560
20. Metzger CS, Hammond MB, Paz-Solis JF, et al. A novel fast-acting sub-perception spinal cord stimulation therapy enables rapid onset of analgesia in patients with chronic pain. *Expert Rev Med Devices*. 2021;18(3):299–306. doi:10.1080/17434440.2021.1890580
21. Kapural L, Yu C, Doust MW, et al. Novel 10-kHz High-frequency Therapy (HF10 Therapy) Is Superior to Traditional Low-frequency Spinal Cord Stimulation for the Treatment of Chronic Back and Leg Pain: the SENZA-RCT Randomized Controlled Trial. *Anesthesiology*. 2015;123(4):851–860. doi:10.1097/ALN.0000000000000774
22. Wahezi SE, Yener U, Naeimi T, et al. Spinal Cord Stimulation Explantation and Chronic Pain: a Systematic Review and Technology Recommendations. *J Pain Res*. 2025;18:1327–1340. doi:10.2147/JPR.S514732
23. Pope JE, Antony A, Petersen EA, et al. Identifying SCS Trial Responders Immediately After Postoperative Programming with ECAP Dose-Controlled Closed-Loop Therapy. *Pain Ther*. 2024;13(5):1173–1185. doi:10.1007/s40122-024-00631-4
24. De Ridder D, Plazier M, Kamerling N, Menovsky T, Vanneste S. Burst Spinal Cord Stimulation for Limb and Back Pain. *World Neurosurg*. 2013;80(5):642–649.e1. doi:10.1016/j.wneu.2013.01.040
25. NHS Digital. *OPCS Classification of Interventions and Procedures, Version 4*. 2024.
26. Haute Autorité de Santé (HAS). *Classification Commune Des Actes Médicaux (CCAM)*. 2024.
27. Fishman M, Cordner H, Justiz R, et al. Twelve-Month results from multicenter, open-label, randomized controlled clinical trial comparing differential target multiplexed spinal cord stimulation and traditional spinal cord stimulation in subjects with chronic intractable back pain and leg pain. *Pain Pract*. 2021;21(8):912–923. doi:10.1111/papr.13066
28. Institut für das Entgeltsystem im Krankenhaus (InEK). *OPS and G-DRG Coding Manual*. 2024.
29. Australian Government Department of Health. *Medicare Benefits Schedule (MBS Online)*. 2024.
30. Thomson SJ, Tavakkolizadeh M, Love-Jones S, et al. Effects of Rate on Analgesia in Kilohertz Frequency Spinal Cord Stimulation: results of the PROCO Randomized Controlled Trial. *Neuromodulation*. 2018;21(1):67–76. doi:10.1111/ner.12746
31. Agência Nacional de Saúde Suplementar (ANS). *TUSS Coding Manual*. 2024.
32. Superintendencia de Servicios de Salud de la Nación (Argentina). *Procedural Tariffs*. 2024.
33. Ministerio de Salud (MINSAL), Chile. *Procedural Codes*. 2024.
34. Ministry of Health, Labour and Welfare (MHLW), Japan. *NHI Fee Schedule*. 2024.
35. National Healthcare Security Administration (NHSA), China. *Provincial and National Fee Schedules*. 2024.
36. Insurance Regulatory and Development Authority of India (IRDAI). *Health Insurance Coding Guidelines*. 2024.
37. Sheldon B, Staudt MD, Williams L, Harland TA, Pilitsis JG. Spinal cord stimulation programming: a crash course. *Neurosurg Rev*. 2021;44(2):709–720. doi:10.1007/s10143-020-01299-y
38. Lempka SF, Patil PG. Innovations in spinal cord stimulation for pain. *Curr Opin Biomed Eng*. 2018;8:51–60. doi:10.1016/j.cobme.2018.10.005
39. Kirketeig T, Söreskog E, Jacobson T, Karlsten R, Zethraeus N, Borgström F. Real-world outcomes in spinal cord stimulation: predictors of reported effect and explantation using a comprehensive registry-based approach. *Pain Rep*. 2023;8(6):e1107. doi:10.1097/PR9.0000000000001107
40. Van Buyten JP, Wille F, Smet I, et al. Therapy-Related Explants After Spinal Cord Stimulation: results of an International Retrospective Chart Review Study. *Neuromodulation*. 2017;20(7):642–649. doi:10.1111/ner.12642
41. Wang VC, Bounkousohn V, Fields K, Bernstein C, Paicius RM, Gilligan C. Explantation Rates of High Frequency Spinal Cord Stimulation in Two Outpatient Clinics. *Neuromodulation*. 2020;2020:13280. doi:10.1111/ner.13280
42. Dupré DA, Tomyez N, Whiting D, Oh M. Spinal Cord Stimulator Explantation: motives for Removal of Surgically Placed Paddle Systems. *Pain Pract*. 2018;18(4):500–504. doi:10.1111/papr.12639
43. Pope JE, Deer TR, Falowski S, et al. Multicenter Retrospective Study of Neurostimulation With Exit of Therapy by Explant. *Neuromodulation*. 2017;20(6):543–552. doi:10.1111/ner.12634
44. Versantvoort EM, Dietz BE, Mugan D, Vuong QC, Luli S, Obara I. Evoked compound action potential (ECAP)-controlled closed-loop spinal cord stimulation in an experimental model of neuropathic pain in rats. *Bioelectron Med*. 2024;10(1):2. doi:10.1186/s42234-023-00134-1
45. Parker JL, Obradovic M, Hesam Shariati N, et al. Evoked Compound Action Potentials Reveal Spinal Cord Dorsal Column Neuroanatomy. *Neuromodulation*. 2020;23(1):82–95. doi:10.1111/ner.12968

Journal of Pain Research

Publish your work in this journal

The Journal of Pain Research is an international, peer reviewed, open access, online journal that welcomes laboratory and clinical findings in the fields of pain research and the prevention and management of pain. Original research, reviews, symposium reports, hypothesis formation and commentaries are all considered for publication. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/journal-of-pain-research-journal>

Dovepress
Taylor & Francis Group