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Utility of an e-Health Tool in the Selection of Patients to Be Treated With Spinal Cord Stimulation: Experience of an Italian Pain Unit

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ABSTRACT

Objectives: Spinal cord stimulation (SCS) is a surgical therapy for chronic neuropathic and mixed-origin pain refractory to conventional treatments. Patient selection considering both clinical and psycho-social factors is essential. This study prospectively validated an online e-health tool for SCS candidate selection and compared its recommendations with expert physician judgment.

Materials and Methods: A total of 80 patients (aged 18–85 years) with persistent spinal pain syndrome, complex regional pain syndrome, neuropathic pain syndromes, or ischemic pain syndromes were enrolled at a single pain unit (December 2020–May 2024). Clinical, demographic, and psycho-social variables were collected and entered into the SCS e-health tool, which provided implantation recommendations. Physicians blinded to the tool output rated the probability of trial success. The patients underwent a 45-day SCS trial, followed by implantation in responders. Agreement between tool recommendations and expert judgment was assessed using Fisher exact test and Cohen's κ.

Results: Overall, 69 patients (86.3%) showed positive trial results and were implanted. Success rates corresponded to tool recommendations: 100% for "strongly recommended," 86.2% for "recommended," and 57.1% for "rarely recommended" ($p = 0.0214$). One-year follow-up confirmed sustained benefits in the strongly recommended group. Agreement between the tool and physician judgment was moderate for clinical variables (unweighted $\kappa = 0.51$, weighted $\kappa = 0.54$) and fair/moderate when including psycho-social variables (unweighted $\kappa = 0.38$, weighted $\kappa = 0.44$). Pain intensity and disability were relieved over time.

Conclusions: The SCS e-health tool is a reliable aid for selecting candidates, integrating clinical and psycho-social factors reflecting trial and long-term outcomes. It can guide clinicians in identifying patients most likely to benefit from SCS and support preimplant decision-making.

Keywords: Chronic pain, e-health tool, patient selection, psycho-social factors, spinal cord stimulation

INTRODUCTION

Spinal cord stimulation (SCS) is a surgical treatment primarily used to treat chronic neuropathic pain but also to treat pain conditions of mixed origin that do not respond to medical or surgical treatment. The most common pain syndromes treated are persistent spinal pain syndrome (PSPS), complex regional pain syndrome (CRPS), neuropathic pain syndromes (NPSs), and ischemic pain syndromes (IPSs).[1–7]

Experience gained over the years, technologic innovations, and the possibility of applying new waveforms have favored the success of SCS. Patient selection is crucial for successful long-term outcomes, considering not only the neurophysiologic aspects of the disease but also the psycho-social aspects of the patient.[8] Neuropathic pain is not a single clinical entity but rather a group of different clinical conditions generated by various neurophysiologic mechanisms. A careful clinical and instrumental evaluation is therefore mandatory.[7] Major psychiatric disorders are considered

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absolute contraindications for SCS by both the International Association for the Study of Pain and the Neuromodulation Appropriateness Consensus Committee.[9,10] Patients with chronic pain often exhibit signs of psychologic distress, such as depression and/or anxiety, but it is challenging to determine their predictive value when assessing patient eligibility for SCS.[11–13] For this reason, a comprehensive psychologic and behavioral assessment is necessary. Because SCS is a chronic treatment, scheduled and continuous monitoring of the patient's condition and stimulation parameters is required, and patient cooperation is essential.

The uncertainty of the clinical examination made it advisable to adopt a trial period between the implantation of the lead(s) and that of the pulse generator to assess pain relief and to choose the most effective waveforms and stimulation paradigms. Certainly, a thorough examination could limit the trial only to doubtful cases.[10,14]

An educational online e-health tool platform (https://www.scstool-org/en/home) was created with the aim of educating and helping physicians correctly select patients proposed for SCS. The SCS e-health tool gives the user, after entering different clinical profiles with diagnostic, clinical, and psychologic information, a degree of recommendation to implant a SCS system.[7,15]

The SCS e-health tool was developed by a multidisciplinary panel of health care professionals from different specialties on the basis of literature review and expert opinion. Four primary indications were identified according to literature: chronic low back and leg pain (CBLP) or PSPS type 1 and 2, CRPS, NPSs, and IPSs. For each of these, several clinical variables were added for the user to select on the basis of the patient's clinical history, site of pain, anatomical abnormalities, and response to previous treatments.

Eight psycho-social factors were identified and added to the clinical variables to be considered when selecting patients for SCS: lack of commitment, dysfunctional coping, unrealistic expectations, inadequate daily activity level, problematic social support, secondary gain, psychologic disorder/mental health problems, and reluctance to reduce high-dose opioids. For each of these factors, there are three possible categories: absent/weak, moderate, and severe.[8] Further information regarding the relevant variables recommended by the e-health tool is in the article by Thomson et al.[7]

On entering all the variables, the e-health tool provides a degree of recommendation of the appropriateness of the treatment, both for clinical variables only and for the combination of clinical variables with psycho-social factors. In particular, on the basis of scores ranging from 1 to 9, it defines whether the implant is not recommended (1–3), recommended (4–6), or strongly recommended (7–9).

The aim of this prospective study is to confirm the reliability of the SCS e-health tool, already assessed in retrospective studies,[8,15] and to compare it with the judgment of the physicians working in our pain unit.

The study was conducted at the pain unit of ICS Maugeri IRCCS in Pavia; 80 patients, candidates for SCS implant, were enrolled from December 2020 to May 2024.

MATERIALS AND METHODS

Study Population and Design

In this prospective study, 80 patients were enrolled who experienced chronic pain not responsive to medical and less invasive treatments due to PSPS, CRPS, NPSs, and IPSs. These syndromes are generally indicated as diseases responsive to SCS.

The patients were enrolled on an outpatient prehospital basis; this included, once the indication for SCS implant had been established, obtaining informed consent (Fig. 1).

Patients considered eligible for an SCS trial on the basis of the existing literature were required to fulfill the inclusion and exclusion criteria established by the e-health tool.

Inclusion Criteria

The inclusion criteria were as follows:

- general: subjects of both sexes aged between 18 and 85 years who could independently express consent
- cognitive/psychologic: The absence of cognitive deficits and serious untreated psychiatric disorders was assessed during the anamnestic examination
- clinical: insufficient response to adequate pharmacologic trials and/or minimally invasive therapies (such as nerve blocks with local anesthetics and steroids and/or neuromodulation techniques), and/or intolerable side effects from these therapies, absence of indications for other resolving interventions, and absence of immunodeficiencies and coagulopathies; and one of the following primary indications: CBLP, CRPS, NPS, IPS, or at least moderate pain intensity (visual analog scale score ≥5) with a significant impact on daily function and quality of life.

Exclusion Criteria

The exclusion criteria were as follows:

- general: aged <18 and >85 years, refusal to sign the informed consent form
- cognitive/psychologic: untreated psychiatric disorders or cognitive deficits, alcohol or substance abuse, inability to manage the device
- clinical: absolute contraindications to invasive treatment (eg, pregnancy, spinal infection, coagulation disorders).

Data Collection

Demographic variables and clinical variables useful for characterizing and quantifying pain were recorded: type and area of pain, current and previous pharmacologic therapies, injections/minimally invasive treatments performed, pain intensity by numerical rating scale (NRS), and disability by Oswestry Disability Index (ODI).[16]

Questionnaires to assess cognitive/psychologic components were administered and analyzed by a psychologist during preimplantation screening: Pain Catastrophizing Scale; Generalized Anxiety Disorder Scale; and Patient Health Questionnaire-9.[17–19]

A fellow in pain management entered the clinical and psychosocial data provided by the clinician and the psychologist in the e-health tool and obtained the scores and the recommendations for the patients. The physician who proposed the patient for implant and was usually the case manager was asked to rate the probability (high, medium, low) of trial success according to their experience while blinded to the e-health tool recommendation.

Because the patients were enrolled in the study once they already had the indication for SCS given by an experienced pain specialist, all of them were trialed with a permanent lead tunneled subcutaneously and connected through an extension to the external generator; the trial lasted 45 days to test different waveforms and for reimbursement reasons.

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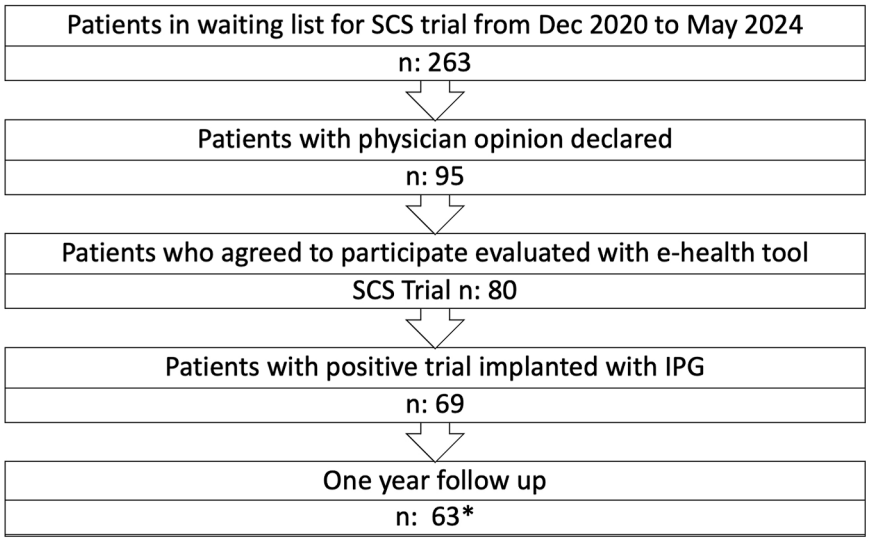


Figure 1. Patients enrolled and treated with SCS. *Three patients explanted and three lost to follow-up.

The data were collected at baseline, just before lead implant for trial, at the end of trial, usually 45 days after lead implant, and one year after the pulse generator implant in patients showing positive trial results. At baseline and at the end of trial, the patients also were administered the Patient Global Impression of Change scale to evaluate patients' experience of the efficacy of treatment; eventual side effects were recorded.[20]

During the trial, patients could evaluate different stimulation modalities to achieve the greatest pain reduction and maximum possible satisfaction. The 45-day trial duration is motivated by (Italian/regional) reimbursement reasons but offers the possibility to evaluate different stimulation programs. We tested both tonic and subthreshold stimulation according to clinical and engineering judgment and selected the modality that best met patient satisfaction. More detail about trial durantion and infection prevention strategies can be found in Supplemental Material.

The collected data were entered into a purpose-built data set on Microsoft Excel. Data protection was ensured for each patient through pseudonymization.

Statistical Methods

Quantitative variables distribution is described by mean ± SD; categorical variables distribution is described by absolute (relative frequency, %). The two-sided Fisher exact test was applied to test the null hypothesis of independence between categorical variables. The presence of statistically significant changes over time in NRS and ODI was assessed using linear mixed effect models. The same approach was used to test for interaction between time and group when testing for statistically significant differences in terms of individual-level change from baseline in NRS scale. Both unweighted and equal spacing weighted Cohen's κ and 95% CI were computed to estimate the level of agreement between ratings. Cohen's κ estimates were obtained assuming that e-health tool judgment = "rarely appropriate" corresponds to an expert medical opinion = "low"; e-health tool judgment = "recommended" corresponds to an expert medical opinion = "medium"; and e-health tool judgment = "strongly recommended" corresponds to an expert medical opinion = "high". Agreement levels were derived by the definitions provided in McHugh.[21] Statistical analyses were performed by the R statistical software tool 4.2.2.[22]

Ethics Committee Review and Approval

This study was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was submitted to the ICS Maugeri IRCCS Ethics Committee and received approval (number 2506 CE) before data collection (December 1, 2020).

The patients signed an informed consent form for data collection.

RESULTS

Patient Characteristics

Demographic and clinical data are listed in Table 1. The most frequent indication was PSPS (56.25%) including both patients with previous surgery and those with no previous surgery; there also was a high percentage (32.5%) of patients with peripheral neuropathic pain including posttraumatic or postsurgical peripheral mononeuropathies, polyneuropathies, and postherpetic neuralgia.

Regarding the psychologic profile of each patient, eight aspects were considered that according to the studies[7] might reduce the appropriateness of neurostimulation treatment.

It is interesting to note that among the psychologic factors, the most frequent was mild or moderate psychologic disorders present in 41 patients. Problems such as "inadequate level of daily activity," "unwillingness to reduced opioids," and "probably secondary gain" were poorly evaluated by psychologic screening so may be underestimated in our study. According to the e-health tool, psycho-social problems interfere with SCS outcomes in a severity-related manner[8] (Table 2).

e-Health Tool Recommendations, Trial Outcome, and One-Year Follow-Up

Among the patients enrolled, 69 (86.25%) had a positive trial result (≥50% pain relief without further specifying the exact percentage or

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Table 1. Patients' Characteristics.

Age	(y)
Mean ± SD	62.34 ± 14.76
Min–max	24–87
Sex	*n* (%)
Female	36 (45%)
Male	44 (55%)
Disease	*n* (%)
PSPS	45 (56, 25%)
Type 1	15
Type 2	30
CRPS	7 (8, 75%)
Type 1	5
Type 2	2
NPS	26 (32, 5%)
IPS	2 (2, 5%)

Variable distribution is described by mean ± SD, median (25th, 75th percentile), or by absolute frequency (relative frequency, %).
max, maximum; min, minimum.

pain relief considered relevant by patient) and were implanted with a pulse generator. Trial outcomes confirm the validity of the e-health tool in predicting the response to SCS treatment.

In our patient cohort, there was no trial failure among the 15 patients with a strong recommendation (success rate = 100%), whereas only four of the seven patients in whom SCS was rarely recommended had a positive trial result and were implanted (success rate = 57.1%). Most patients ($n = 58$) belonged to the e-health tool judgment-derived category "recommended;" of these, 50 had a positive trial result (success rate = 86.2%) (Fig. 2, Table 3). These results suggest the association between the e-health tool judgment and the trial outcome (p-value = 0.0214).

At one-year follow-up, the 15 patients in the cohort strongly recommended were still receiving SCS treatment even if one patient was lost to follow-up because she was observed by a center closer to her home.

In the first year after implant, three patients required SCS components removal: one patient with diabetes (recommended), for infection two months after implantable pulse generator (IPG) implant and who did not want a reimplant; and two patients for loss of efficacy (one recommended and one rarely recommended), both of them with pain after knee replacement and for whom the neuropathic component was doubtful.

A patient with IPS (recommended) was lost to follow-up because of amputation after six months from the implant; he had poorly controlled diabetes and did not stop smoking; he did not ask for SCS removal at the time.

Another patient refused to respond to questionnaires at one-year follow-up and asked for SCS explant after >one year for loss of efficacy. Three of these patients were in the recommended cohort and two in the rarely recommend cohort. All five patients lost to one-year follow-up in whom therapy was interrupted presented with some psycho-social problem, particularly depressive syndrome and poor adherence to treatment.

If we compare trial success and response at the one-year follow-up on the basis of the e-health tool judgment vs expert opinion, only the e-health tool judgment shows a statistically significant association with trial success, whereas expert opinion does not. This finding suggests that the e-health tool may provide better discrimination between successful and unsuccessful trials (Fig. 3).

In relation to pain intensity assessed with NRS scale (0–10) before the trial, after the trial, and one year later, a reduction in pain is observed (Fig. 4a), with no relevant difference in terms of mean values between patients with e-health tool judgment corresponding to strongly recommended and those characterized by recommended/rarely recommended (Fig. 4b). A statistically significant change in terms of individual level NRS was observed over time in the entire sample (p-value < 0.0001). Patients with an e-health tool judgment corresponding to strongly recommended were characterized by a more evident reduction at one-year follow-up with respect to baseline than were those with recommended/rarely recommended judgment (mean = −3.77, 95% CI = −4.64, −2.90 vs mean = −2.45 95% CI = −2.92, −1.99, interaction p-value = 0.0092). No statistically significant difference in terms of NRS change between baseline and the end of the trial was observed between the same two groups (mean = −3.67, 95% CI = −4.52, −2.81 vs mean = −2.82, 95% CI = −3.26, −2.36, interaction p-value = 0.0827).

We also observed alleviation of disability: The ODI questionnaire scores changed from 46.5% at baseline, indicating severe disability with pain as the primary cause for limitations in daily activities, to 28.6% at the end of the trial and 31% after one year, indicating moderate disability (Fig. 5). A statistically significant change was observed when analyzing individual level changes in ODI over time in the entire sample (p-value < 0.0001).

Agreement Between e-Health Tool Recommendation and Expert Opinion

To assess the concordance between the e-health tool and the opinion of the physician expert in pain management, the expert judgments were compared with the global e-health tool recommendations by two independent analyses, considering 1) both clinical and psycho-social aspects, and 2) clinical recommendations only.

Results from the two analyses are reported in Tables 4 and 5.

1. Table 4 describes the agreement between e-health tool recommendations based on clinical and psycho-social data and expert opinion on the probability of SCS success: Results from

Table 2. Distribution of Psycho-social Factors by e-Health Tool Judgment.

Psychosocial factors	e-Health tool judgment			Total ($N = 80$)
	Strongly recommended ($n = 15$)	Recommended ($n = 58$)	Rarely recommended ($n = 7$)	
No/mild	15 (100%)	21 (36.2%)	3 (42.9%)	39 (48.8%)
Yes	0 (0%)	37 (63.8%)	4 (57.1%)	41 (51.2%)

The absolute and relative frequency of patients with and without psycho-social problems by e-health tool judgment is described.

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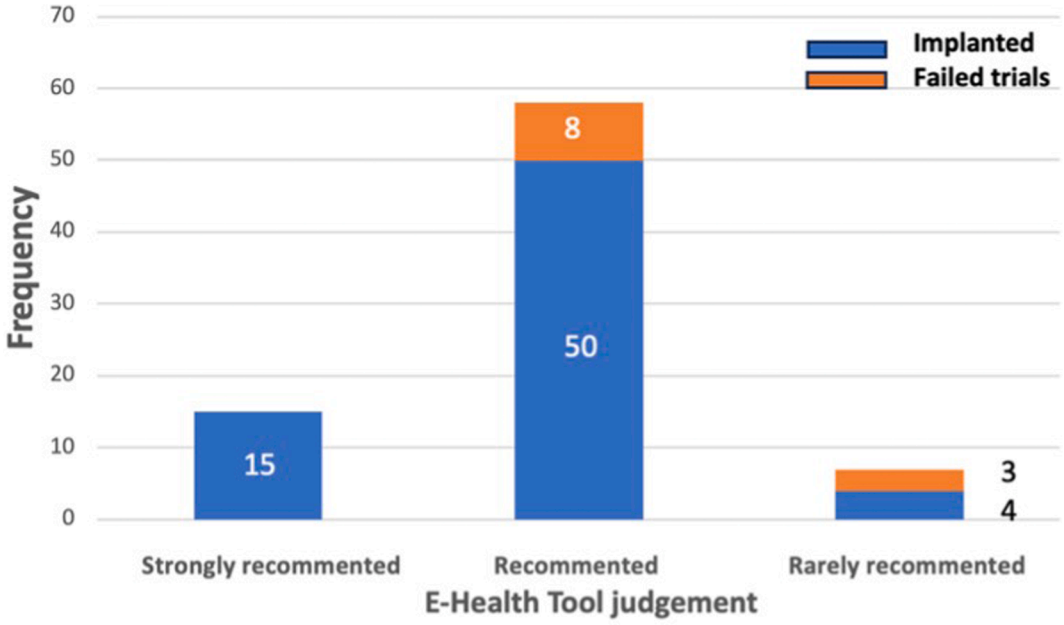


Figure 2. Trial success rate in each e-health tool judgment-derived category. Numbers represent the frequency of successful and failed trials. [Color figure can be viewed at www.neuromodulationjournal.org]

the two-sided Fisher exact test indicate a statistically significant association between the two criteria (p-value < 0.001). Overall, the level of agreement between ratings was fair (Cohen's unweighted κ = +0.38, 95% CI = +0.21 to +0.56) although moderate when accounting for the ordinal nature of the ratings (weighted κ = 0.44, 95% CI = +0.27 to +0.61).

2. Table 5 describes the agreement between e-health tool recommendations based on clinical data only and expert opinion on the probability of SCS success. Results from the two-sided Fisher exact test also show a statistically significant association between ratings in this analysis (p-value < 0.001). Overall, the level of agreement between ratings was moderate (Cohen's unweighted κ = +0.51, 95% CI = +0.33 to +0.68, weighted κ = +0.54, 95% CI = 0.36–0.71), thus is higher than in the estimate deriving from the previous analysis.

Results show that the evidence of agreement between the expert opinion and the e-health tool recommendations is stronger when evaluating only the clinical aspects and weaker when also considering the psycho-social aspects, suggesting that even physicians working for years with patients with pain tend to underestimate the patients' psycho-social problems.

DISCUSSION

According to the literature,[1,6,7,10,14] the primary indications for SCS are PSPS, CRPS, NPSs, and IPSs, but all these definitions include a number of clinical variables that can affect the success of therapy. PSPS type 2 is a typical example, in which pain can be caused by the persistence of spinal instability at a different level from the treated one(s), scar tissue, recurrent disk herniation, or persistent radiculopathy, but in the literature, all these different clinical pictures are included under the same term, PSPS (formerly termed failed back surgery syndrome).

The SCS e-health tool, whose applicability and validity has already been indicated in retrospective studies,[8,15] proposes the evaluation of clinical variables describing more specifically patients' characteristics. These include, for example, the type of pain: nociceptive, neuropathic (for PSPS radiculopathy), neuropathic-like (for PSPS radicular pain), or mixed.[23,24] We know from the literature that nociceptive low back pain has been considered more difficult to treat than neuropathic radicular pain.[25] In our case records, patients with PSPS in whom the trial failed presented primarily with nociceptive pain. Anatomical abnormalities, such as recurrent disk herniation, scar tissue, or

Table 3. Association Between e-Health Tool Judgment and Trial Outcome.

Trial outcome	e-Health tool judgment			Total (N = 80)
	Strongly recommended (n = 15)	Recommended (n = 58)	Rarely recommended (n = 7)	
Failure	0 (0.0%)	8 (13.8%)	3 (42.9%)	11 (13.8%)
Success	15 (100%)	50 (86.2%)	4 (57.1%)	69 (86.2%)

Fisher exact test p value = 0.0214.

The frequency of patients with failed and successful trial by e-health tool judgment is described.

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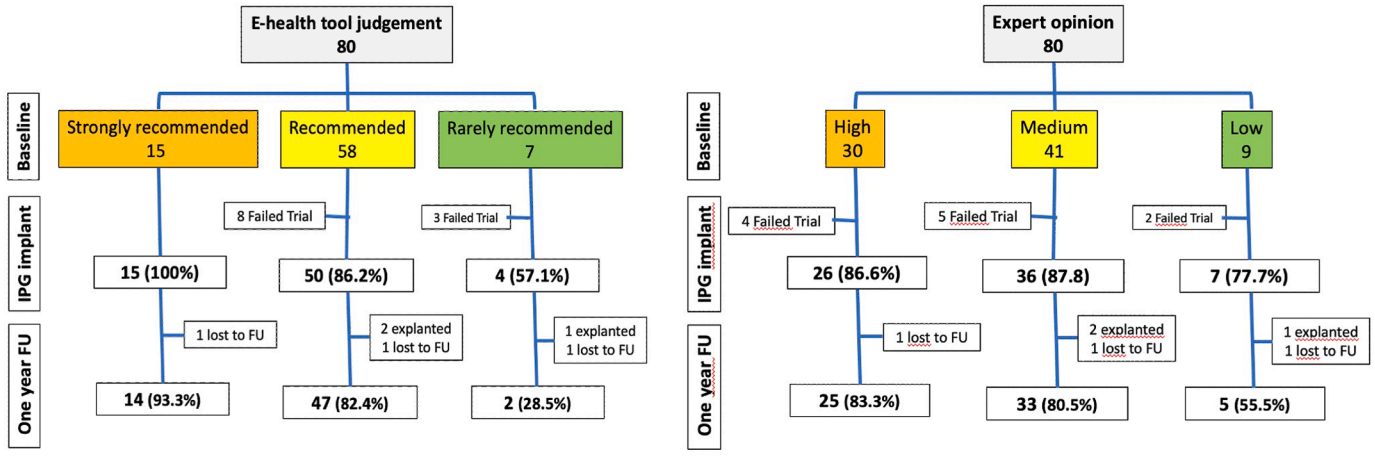


Figure 3. Success rate at trial and adherence to therapy at one-year follow-up in the three different groups according to e-health tool judgment and expert opinion. [Color figure can be viewed at www.neuromodulationjournal.org]

spondylolisthesis, also are considered; if there are few alternatives for scar tissue, new surgery can be considered for other causes of pain, even if the probability of success decreases after the first surgery.[25]

In case of neuropathic pain, variables such as entrapment and deafferentation can interfere with SCS response and should be carefully considered. In CRPS, the nociceptive component could be more difficult to treat than the neuropathic one.

The e-health tool considers the response to previous pharmacologic and minimally invasive treatments suggesting that patients in whom poor response to treatments is shown, at least for a short time, are less likely to experience response to SCS. A total of 386 clinical scenarios for the four major SCS indications, giving a detailed description for each patient, were identified by the expert panel for the SCS e-health tool.[7] The different questions posed to the physicians are not only useful for defining patient characteristics but also represent suggestions for better patient examination and treatment during a diagnostic/therapeutic algorithm that may lead to SCS; this is particularly important for referrals and for physicians with less expertise.

Furthermore, psycho-social factors play a major role in SCS outcomes and adherence to therapy in the long term. Researchers have found a strong relationship between psychiatric comorbidities and a poor response to SCS treatment.[17,19,20] In one systematic review, 92.0% of studies exhibited a positive relationship between ≥one psychologic factors and poor treatment outcome.[13] Evidence also suggests that longer pain duration before intervention was predictive of poorer outcomes.[26]

Clinicians can grasp psycho-social problems if they follow the patient on their diagnostic/therapeutic path for a long time, but

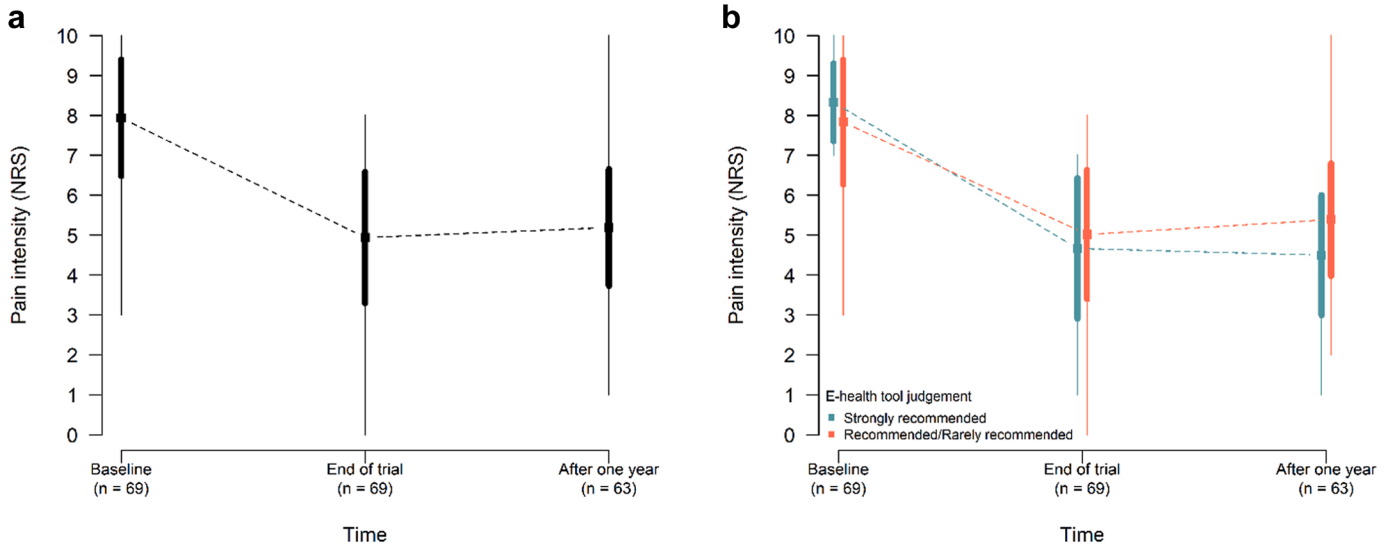


Figure 4. NRS changes from baseline. The two plots describe NRS distribution at the three timepoints in the whole sample (panel a) and by e-health tool judgment (strongly recommended vs recommended/rarely recommended, panel b). The vertical thin lines join the minimum and maximum values of NRS distribution at the three timepoints. The vertical thick lines join the mean value – SD and the mean value + SD of NRS distribution at the three timepoints. The dashed lines represent the mean value of NRS distribution at the three timepoints, graphically represented by the filled squares. The numbers below the x-axis describe the number of observations available at each timepoint. [Color figure can be viewed at www.neuromodulationjournal.org]

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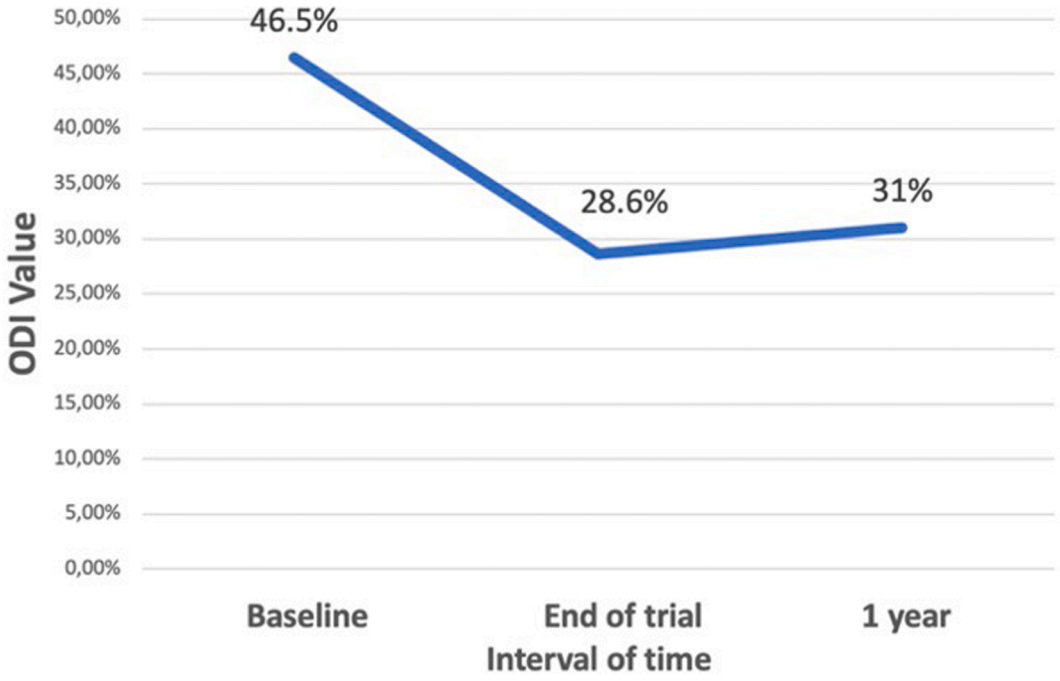


Figure 5. ODI variation after SCS implant. Distributions are presented as mean ODI values. Values between 41 and 60 indicate severe disability and between 21 and 40, moderate disability. [Color figure can be viewed at www.neuromodulationjournal.org]

implanting centers often receive patients from referrers already with the indication for SCS treatment; it is therefore particularly important for referrers to be educated in identifying psycho-social problems and that patients be examined by a multiprofessional team before implant.

In our study, we highlight that the clinician tends to consider more precisely clinical than psycho-social variables; in fact, the agreement between e-health tool recommendation and physician opinion was higher when considering only the clinical aspects but lower when psycho-social aspects also were considered. e-Health tool judgments that consider all variables tend to be more reliable in predicting patients' outcomes.

An instrument such as the SCS e-health tool, considering all the different psycho-social problems that are not all contemplated during a routine psychologic examination (eg, inadequate level of daily activity), can certainly play a major role in patient selection for SCS and also can suggest an adequate psycho-physical rehabilitation program for the patient along with pain control.

In our patient cohort, all the patients in whom SCS was strongly recommended, unfortunately only a small part of the sample (18.75%), showed positive trial results, remained in treatment after one year, and had a major reduction in NRS at follow-up. In these patients, the trial could be avoided, directly programming the lead/s and IPG implant owing to the high probability of success.

Most of our patients (72.5%) were classified as recommended owing to clinical and/or psycho-social factors; in this group, 86.2% of the patients had positive trial results, a slightly smaller percentage than in the retrospective study of Thomson et al,[15] probably owing to the smaller number of patients. Two patients (4% of the implanted) had the SCS system removed within one year from the implant. In this cohort of patients, an all-in-one implant should be more carefully considered.

The cohort rarely recommended was poorly represented in our patient population (8.75%); the inclusion in this cohort was primarily due to psycho-social factors. Only four of seven patients had a positive trial result (57%), and two of the patients implanted had

Table 4. Comparison of e-Health Tool Judgment Based on Clinical and Psycho-social Data and Expert Opinion on the Probability of Success.

E-health tool judgment	Expert opinion on the probability of success		
	Low	Medium	High
Rarely appropriate	5 (6.2%)	2 (2.5%)	0 (0.0%)
Recommended	4 (5.0%)	36 (45.0%)	18 (22.5%)
Strongly recommended	0 (0.0%)	3 (3.7%)	12 (15.0%)

Fisher exact test p value < 0.001.

Data are presented as absolute and relative frequencies (%).

Table 5. Comparison of e-Health Tool Judgment Based on Clinical Data Only and Expert Opinion on the Probability of Success.

E-health tool judgment	Expert opinion on the probability of success		
	Low	Medium	High
Rarely recommended	5 (6.2%)	1 (1.2%)	0 (0.0%)
Recommended	3 (3.8%)	35 (43.8%)	12 (15.0%)
Strongly recommended	1 (1.2%)	5 (6.2%)	18 (22.5%)

Fisher exact test p value < 0.001.

Data are presented as absolute and relative frequencies (%).

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an implant removal for loss of efficacy in the first year after implant (50%). In these patient populations, a trial is recommended if SCS is the only option for pain relief, but psycho-social support also should be guaranteed.

If failures of SCS trial in our patient population were generally due to both clinical and psycho-social aspects, the explants that occurred in the following 12 months seem to be more linked to psycho-social factors with a possible placebo effect during trial.

The psycho-social factors that appear to have the greatest negative impact on trial outcomes are depression and lack of engagement.

The e-health tool plays a transversal role, offering considerations that are valuable and may become mandatory in the future. It can support referring physicians in patient selection for specialized centers and assist implanting physicians in clinical decision-making. Its use may become an integral part of good clinical practice, as already recommended in the Dutch consensus study.[27]

CONCLUSION

SCS aims to reduce pain and improve quality of life in patients whose conditions are refractory to conventional medical therapies. This study suggests the importance of an integrated assessment of clinical and psycho-social factors and the validity of the SCS e-health educational tool. A larger number of patients should be studied to confirm that patients who are strongly recommended could avoid the neurostimulation trial, as can be deduced from the data of this study and has already been shown for both strongly recommended and recommended patients in retrospective studies.[7,15]

The e-health tool is a valuable guide for pain clinicians to consider SCS as an option for their patients with suggestions on the diagnostic/therapeutic algorithm that should be previously performed to determine as precisely as possible the clinical and psycho-social variables important for success in the long term.

A general consideration concerns the concept of therapeutic alliance. The patient must be informed and must understand that SCS is not a surgical intervention aimed at removing the cause of pain but is a therapy whose success is only possible if there are adherence and collaboration with the health care professionals.

Limits

The primary limitations of this study are the small number of patients included in the cohorts who were not recommended and strongly recommended with limited statistical power, and a single-center patient population.

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Authorship Statements

All authors contributed substantially to the conception and design of the study, data collection, analysis, and interpretation. All authors participated in drafting or critically revising the manuscript and approved the final version. All authors agree to be accountable for all aspects of the work.

Conflict of Interest

Laura Demartini reports a relationship with Boston Scientific Corporation that includes consulting or advisory; and a relationship with Abbott that includes consulting or advisory. Simon Thomson reports a relationship with Boston Scientific Corporation that includes consulting or advisory; a relationship with Galvani Bioelectronics Ltd that includes consulting or advisory; a relationship with Mainstay Medical that includes consulting or advisory; and a relationship with Saluda Medical that includes consulting or advisory. Simon Thomson and Laura Demartini serve on the Editorial Board for *Neuromodulation* but were not involved in the peer-review of this article and had no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to another journal editor. The remaining authors reported no conflict of interest.

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SUPPLEMENTARY DATA

To access the supplementary material accompanying this article, visit the online version of *Neuromodulation: Technology at the Neural Interface* at www.neuromodulationjournal.org and at https://doi.org/10.1016/j.neurom.2026.02.007.

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COMMENTS

Selecting the right patient for SCS remains one of the most decisive steps for achieving durable clinical benefit. In this prospective study, Demartini et al thoughtfully explore ways an e-health–based decision-support tool can assist clinicians in this complex process, without replacing clinical expertise. What makes this work particularly compelling is its grounding in everyday clinical practice. The authors show that when patients are classified as "strongly recommended" by the tool, outcomes are consistently favorable, both at trial and at one-year follow-up. At the same time, the study gently exposes a familiar reality: Even experienced clinicians may underestimate psycho-social factors that later influence adherence, satisfaction, and long-term success. By foregrounding these elements, the tool functions as a structured reminder of aspects that are often difficult to quantify during routine consultations. The prolonged trial period, shaped by local health care policies, also reflects real-world constraints rather than idealized protocols. Importantly, safety outcomes were reassuring, suggesting that careful patient management can mitigate risks even under such conditions. Overall, this study emphasizes that successful neuromodulation is not solely a matter of technology but of thoughtful patient engagement and multidisciplinary assessment. The work by Demartini et al supports a more transparent, consistent, and patient-centered approach to SCS selection—one that ultimately strengthens the therapeutic alliance and long-term outcomes.

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An online e-health SCS patient selection program will help improve success in SCS implantation. Assistance with patient selection for SCS will be invaluable for less experienced practitioners and validate one's ability to choose successful candidates. We enter the stage when these e-tools may be recommendations by policy makers and medical societies. Further e-health tools will evolve with artificial intelligence programming. This is a much-needed study given the poor outcomes and publicity related to SCS failure, and the high explant rate.

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