NICE National Institute for Health and Care Excellence

NICE guidance

Senza spinal cord stimulation system for delivering HF10 therapy to treat chronic neuropathic pain

HealthTech guidance

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Your responsibility

This guidance represents the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, healthcare professionals are expected to take this guidance fully into account, and specifically any special arrangements relating to the introduction of new interventional procedures. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

All problems (adverse events) related to a medicine or medical device used for treatment or in a procedure should be reported to the Medicines and Healthcare products Regulatory Agency using the Yellow Card Scheme.

Commissioners and/or providers have a responsibility to implement the guidance, in their local context, in light of their duties to have due regard to the need to eliminate unlawful discrimination, advance equality of opportunity, and foster good relations. Nothing in this guidance should be interpreted in a way that would be inconsistent with compliance with those duties. Providers should ensure that governance structures are in place to review, authorise and monitor the introduction of new devices and procedures.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

Contents

This guidance replaces MTG41.

1 Recommendations

1.1 The case for adopting Senza spinal cord stimulation (SCS) for delivering HF10 therapy as a treatment option for chronic neuropathic back or leg pain after failed back surgery is supported by the evidence. HF10 therapy using Senza SCS is at least as effective as low-frequency SCS in reducing pain and functional disability, and avoids the experience of tingling sensations (paraesthesia).

1.2 Senza SCS for delivering HF10 therapy should be considered for patients:

- with residual chronic neuropathic back or leg pain (at least 50 mm on a 0 mm to 100 mm visual analogue scale) at least 6 months after back surgery despite conventional medical management and
- who have had a successful trial of stimulation as part of a wider assessment by a multidisciplinary team.

1.3 Patients with other causes of neuropathic pain were included in the evaluation and may be considered for HF10 therapy using Senza SCS but any additional benefits compared with low-frequency SCS are less certain. Cost modelling indicates that, over 15 years, HF10 therapy using Senza SCS has similar costs to low-frequency SCS using either a rechargeable or non-rechargeable device.

1.4 Clinicians implanting SCS devices including Senza should submit timely and complete data to the UK Neuromodulation Registry.

1.5 When assessing the severity of pain and the trial of stimulation, the multidisciplinary team should be aware of the need to ensure equality of access to treatment with SCS. Tests to assess pain and response to SCS should take into account a person's disabilities (such as physical or sensory disabilities), or linguistic or other communication difficulties, and may need to be adapted.

Why the committee made these recommendations

The use of SCS for chronic neuropathic pain is recommended in the NICE technology

appraisal guidance on spinal cord stimulation for chronic pain of neuropathic for ischaemic origin. This medical technology guidance assessed the evidence to support the additional benefits of HF10 therapy using Senza compared with low-frequency SCS in patients with chronic neuropathic pain.

Clinical trial evidence shows that HF10 therapy using Senza SCS is at least as effective as low-frequency SCS in relieving pain for patients with chronic back or leg pain after failed back surgery. For other patients with chronic neuropathic pain, HF10 therapy using Senza SCS remains an option alongside other SCS options because there is more uncertainty about its additional benefits compared with low-frequency SCS.

2 The technology

Description of the technology

2.1 The Senza spinal cord stimulation (SCS) system (Nevro) is a neuromodulation device that delivers electrical impulses to the spinal cord. The treatment Senza provides (known as HF10 therapy) is a combination of high-frequency (10 kHz) low-amplitude electrical pulses designed to relieve pain and not be felt by the patient, and a proprietary programming algorithm. The impulses are delivered by small electrodes, which are placed in the spinal epidural space and are connected to a small, battery-powered pulse generator that is implanted under the skin. The strength, duration and frequency of the electrical pulses can be controlled remotely. HF10 therapy using Senza SCS is referred to as Senza in the main body of this guidance.

2.2 Senza was CE marked as a class 3 device in May 2010 and is intended to be used only for patients who have had effective pain relief in a trial of stimulation. Patients who have a Senza device in place should not have shortwave, microwave or therapeutic ultrasound diathermy because of the risk of severe injury or death. They should only be exposed to MRI under conditions outlined in the instructions for use and the full-body MRI conditional label issued in November 2017.

2.3 The company also offers a newer system called Senza II, which delivers the same HF10 therapy. Senza II is intended for use in patients with a low BMI who need a smaller device. It has not been considered as part of this evaluation.

2.4 The acquisition cost of Senza, as stated in the company's submission, is £16,648 (excluding VAT). This includes electrodes, leads, an implantable pulse generator (with rechargeable battery), a remote control and a battery charger.

2.5 The claimed benefits in the case for adoption presented by the company are that, compared with low-frequency SCS, Senza is associated with:

- clinically superior pain relief, as well as better clinical and functional

outcomes, for most people with back or leg pain

- no paraesthesia, so treatment can be continued during sleep and while driving or operating machinery
- sustained and long-term improvement in pain relief and function, which may reduce the need for pain medication and follow-up attendance at pain clinics
- no need for paraesthesia mapping during implantation, which allows for shorter and more predictable procedure times.

Current management

2.6 The NICE technology appraisal guidance on spinal cord stimulation for chronic pain of neuropathic or ischaemic origin recommends SCS as a treatment option for adults with chronic pain of neuropathic origin that continues for at least 6 months despite conventional medical management (including pharmacological treatment, physiotherapy and psychological support) who have had a successful trial of stimulation as part of a wider assessment by a multidisciplinary team. SCS is not recommended for adults with chronic pain of ischaemic origin, except in the context of research. The devices considered in the guidance deliver low-frequency SCS. The guidance was last reviewed in 2013, before all the evidence on Senza considered in this evaluation was available. The review concluded that more recent evidence would be unlikely to change the recommendations, and the guidance was placed on the static list.

2.7 NICE has also produced related guidelines on neuropathic pain in adults in non-specialist settings and low back pain and sciatica in over 16s.

3 Evidence

Summary of clinical evidence

3.1 The evidence for Senza considered by the external assessment centre (EAC) comprised 10 studies in adults with chronic neuropathic pain. Of these 10, 3 studies (Al-Kaisy et al. 2017b, De Andres et al. 2017 and Van Buyten et al. 2017) became available during consultation on the original draft recommendations, and 1 became available (Amirdelfan et al. 2018) after a further consultation on the second draft recommendations. The 10 studies were:

- 2 randomised controlled trials comparing Senza and low-frequency spinal cord stimulation (SCS; Kapural et al. 2015 and 2016 and De Andres et al. 2017)
- 1 before-and-after study (Tiede et al. 2013)
- 5 single-arm observational studies (Al-Kaisy et al. 2014, Russo et al. 2016, Rapcan et al. 2015, Al-Kaisy et al. 2017a and Al-Kaisy et al. 2017b)
- 1 retrospective chart review (Van Buyten et al. 2017)
- 1 quality-of-life analysis using data from Kapural et al. 2016 (Amirdelfan et al. 2018).

Full details of all the evidence are in the project documents on the NICE website.

Main points from the EAC's analysis of the clinical evidence

3.2 The EAC initially considered Kapural et al. (2016) to be the most relevant study providing the best quality evidence. Although it identified that the study had the potential for performance, detection and reporting bias, the EAC was satisfied that the trial's limitations did not affect the overall direction of the results.

3.3 The other 5 studies initially identified were single-arm observational studies, the results of which generally supported and corroborated the results of Kapural et al. (2016). The highest quality of these was Al-Kaisy et al. (2014), which reported results up to 2 years.

3.4 The EAC initially concluded that the evidence was strong and relevant to the decision problem, and that it showed that Senza provided substantially better pain control than low-frequency SCS. However, it noted gaps in the evidence base, particularly the lack of long-term studies and the absence of a sham control.

Evidence identified during consultations

3.5 Following consultation on the draft guidance, 4 additional studies were identified as being relevant to the decision problem: De Andres et al. (2017), Van Buyten et al. (2017), Al-Kaisy et al. (2017b) and Amirdelfan et al. (2018).

3.6 The EAC considered that, in addition to Kapural et al. (2016), the De Andres et al. and Van Buyten et al. studies were most relevant to the decision problem. De Andres et al. reported that Senza and low-frequency SCS had similar benefits, conflicting with the results of Kapural et al. Van Buyten et al. is a retrospective chart review that reported the rates and reasons for removing SCS devices in 4 centres that had done 955 implantations (155 of which were Senza) in 822 patients.

3.7 Al-Kaisy et al. (2017b) reported extended follow-up data to the original study by the same author which had been included in the company submission assessed by the EAC in its original report. The new data reported that early improvements (up to 12 months) in pain, disability and quality of life were maintained until 36 months.

3.8 The Amirdelfan et al. (2018) study provided data on additional outcomes from Kapural et al. at 12 months. The EAC concluded that this study provided additional evidence that Senza may result in improved patient-reported outcome measures compared with low-frequency SCS, but did not detect a difference in generic health-related quality-of-life outcomes.

Further EAC review of the randomised controlled trial evidence

3.9 Kapural et al. (2016) and De Andres et al. (2017) reported randomised controlled trials comparing Senza with low-frequency SCS, with inconsistent findings. Specifically, Kapural et al. (2016) reported a statistically significant reduction in back and leg pain with Senza compared with low-frequency SCS whereas De Andres et al. (2017) reported no difference in pain scores. The trial design and conduct of the De Andres study was openly challenged and the authors' responses to these criticisms were summarised in a letter that was published in the same journal as the original paper (see the supplementary EAC documents for more details).

3.10 Having reviewed all of the evidence, the EAC concluded that Senza is likely to be at least as effective as low-frequency SCS in terms of reducing pain in appropriately selected patients. However, it noted that both the Kapural et al. (2016) and particularly the De Andres et al. (2017) studies were subject to bias and had design and reporting weaknesses, significantly more so for the latter. Because of this, the EAC considered that the results should be interpreted with caution.

3.11 Because of the inconsistent trial results and because of a large number of conflicting comments received during both consultations, a second EAC reviewed the randomised controlled trial evidence. It concluded that the De Andres et al. (2017) study was methodologically worse than Kapural et al. (2016). It drew specific attention to weaknesses in terms of the trial's analysis, governance and design (see the supplementary EAC documents or more details).

Summary of economic evidence

3.12 The company's cost model was based on a published cost-effectiveness study (Annemans et al. 2014) comparing Senza separately with conventional medical management, reoperation and low-frequency SCS devices (both rechargeable and non-rechargeable). The model, which was also used to inform the NICE technology appraisal guidance on spinal cord stimulation (Simpson et al. 2008), was a 2-stage decision analytic model that used a decision tree for the first 6 months, followed by a Markov state transition model with a 15-year time

horizon. For full details of the economic evidence, see section 4 of the assessment report and the supplementary EAC documents.

EAC's analysis of the economic evidence

3.13 The EAC considered Annemans et al. (2014) to be of high quality and the company's cost model to be of good methodological quality. It was therefore initially satisfied with the reported results and sensitivity analyses. However, the publication of Van Buyten et al. (2017) during the first consultation provided additional real-world data as an alternative estimate for the rate of unanticipated explantation used in the cost model. The EAC did not change the anticipated explants parameters in the model but estimated the unanticipated explantation parameters used in the cost model by extrapolating the data available from Van Buyten et al. for explantations because of inadequate pain relief (see the supplementary EAC documents for more details).

3.14 Many of the costs in the model, including the acquisition costs for Senza and its comparators, were adjusted for inflation from the original values in the Annemans et al. study. The EAC considered it inappropriate to inflate drug prices in this way because they are subject to a wide range of non-inflationary factors. The EAC explored this further with 4 hypothetical scenarios to assess how different drug costs affect the cost consequences of using Senza.

3.15 The main drivers of the cost modelling results were acquisition costs, explantation rates and device lifespan, particularly for non-rechargeable SCS devices, which need to be replaced around every 4 years. The company's base-case results showed that, over 15 years, Senza could lead to cost savings of £4,795 compared with rechargeable low-frequency SCS devices and £7,755 compared with non-rechargeable low-frequency SCS devices.

4 Committee discussion

Clinical effectiveness

4.1 The committee considered the clinical evidence and noted the inconsistent results from the 2 randomised controlled trials (Kapural et al. 2016 and De Andres et al. 2017). In particular, the committee noted that Kapural et al. demonstrated statistically significantly better pain reduction using Senza compared with low-frequency spinal cord stimulation (SCS), but that in De Andres et al. there was no statistically significant difference between the 2 treatments in this regard. The expert advisers explained that the low-frequency SCS devices used as the comparator in both studies work in the same way as those used in standard clinical practice in the NHS. However, the response to low-frequency SCS was lower than expected in De Andres et al., compared with both clinical experience and other trial results including Kapural et al. The external assessment centre (EAC) also highlighted that pain reduction was greater in Kapural et al. for both Senza and low-frequency SCS compared with both treatment arms in De Andres et al.

4.2 The committee was concerned about the methodological quality of the De Andres et al. (2017) study, noting the conclusions of the 2 EAC reports about the reliability and robustness of the evidence. Although the committee noted the weaknesses in both randomised controlled trials, including the potential for bias and concerns about the relevance of the results to the NHS, it agreed with the EAC's conclusion that Senza is at least as effective as low-frequency SCS in terms of relieving pain. It acknowledged that current studies are limited to 2 years' follow-up; a clinical expert explained that 3-year outcome data will soon be available, and that the ultimate intention is to collect 5-year follow-up data. The committee considered that long-term outcome data would be particularly important, given that Senza and other similar devices are used to treat a chronic condition and have a lifespan of at least 10 years. The committee concluded that, in view of these uncertainties, it would be beneficial for clinicians to routinely collect clinical and procedural outcome data on the use of SCS including Senza. It was encouraged to hear that the UK Neuromodulation Registry has well-established data collection arrangements to support the gathering of useful data.

Avoiding paraesthesia

4.3 People having low-frequency SCS often experience paraesthesia (or tingling sensations), but this is not the case with high-frequency SCS (such as Senza). The experts explained that people may have paraesthesia throughout the use of low-frequency SCS devices and that this can impair day-to-day living. For example, intense paraesthesia may be distracting enough to interrupt sleep or prevent tasks such as driving or operating machinery. However, the committee heard that some patients (usually those who have had low-frequency SCS for a long time) find the presence of paraesthesia reassuring, because it confirms that the device is still working. The committee concluded that paraesthesia after SCS device implantation is an important issue that should be discussed with patients before choosing a device.

Patient selection

4.4 The committee noted that most of the higher quality evidence for the clinical benefits of Senza is in people who have chronic back or leg pain despite previous back surgery. The clinical experts agreed that this is the largest group of patients who are likely to benefit from Senza, but highlighted others who may benefit (for example, people for whom surgery is either not possible or unlikely to be successful and people with neuropathic pain of other causes including complex regional pain syndrome). However, the committee concluded that there is limited evidence to support the claimed benefits for Senza in these other patient groups. It noted that these patient groups are already covered by the recommendations in the NICE technology appraisal guidance on spinal cord stimulation. The committee also concluded that more evidence would be valuable about the potential role of Senza for neuropathic pain in patients who have not had previous back surgery. The committee was supportive of further research in these difficult circumstances, and would encourage SCS users to include patient data following all implantations in the UK Neuromodulation Registry.

Mode of action

4.5 The clinical experts advised that Senza uses different physiological mechanisms

to low-frequency SCS, but these are not yet fully understood.

NHS considerations

4.6 The clinical experts explained that because paraesthesia mapping is not needed when using Senza, implantation procedure times may be shorter and more predictable compared with those for low-frequency SCS devices. The committee was advised that, typically, 2 electrodes are used when implanting Senza compared with 1 electrode for low-frequency SCS devices. The EAC explained that these factors had not been quantified in the published studies and so were not included in the cost modelling. The committee concluded that it is plausible that using Senza may allow for better planning of procedure times (thereby potentially increasing the number of procedures per operating list).

4.7 The clinical experts explained that when first adopting Senza in their services, the company provided trained experts to attend procedures and support clinicians until competence had been achieved. This was confirmed by the company representatives who attended the meetings.

4.8 The clinical experts also explained that there may be further time savings when using Senza at follow-up appointments because, in their experience, programming is easier and less time-consuming than with low-frequency SCS devices.

Charging the device

4.9 Based on NHS Supply Chain purchase data, the committee concluded that the low-frequency SCS devices most commonly used in the NHS are rechargeable. The clinical experts explained that although Senza is also rechargeable, it needs to be charged more often than most low-frequency SCS devices (for 30 to 45 minutes each day). The committee concluded that the need for recharging is an important factor that should be discussed with patients before choosing a device.

Cost savings

4.10 The committee noted that the company's cost model replicated that used to inform the NICE technology appraisal guidance on spinal cord stimulation, and that the model has also been subjected to peer review before being published elsewhere. It agreed with the EAC that supplementation of the model with data from Van Buyten et al. (2017) was appropriate.

4.11 The committee noted that the model assumed a time horizon of 15 years. This is appropriate for a long-term condition, but clinical outcome data are currently limited to 2 years after implantation. Nonetheless, it noted the EAC's conclusions that the claimed lifespan of Senza is plausible (see the supplementary EAC documents for more details). The clinical experts also explained that they had seen no evidence in their own clinical practices to suggest that the effectiveness of Senza diminishes over time.

4.12 The committee noted the uncertainties in the cost model associated with the use of drug costs adjusted for inflation. The EAC explained that additional modelling involving attempts to more accurately estimate the cost of drug management in the relevant patient groups would be difficult.

4.13 Having acknowledged that the acquisition costs of Senza and the comparators were an important driver of the cost modelling results, the committee noted that these had also been adjusted for inflation from the cost model used to inform the NICE technology appraisal guidance on spinal cord stimulation. Acquisition costs in the model were assumed to be:

- Senza: £16,648, with a lifespan of 10 years.
- Non-rechargeable low-frequency SCS device: £11,281, with a lifespan of 4 years.
- Rechargeable low-frequency SCS device: £17,422, with a lifespan of 10 years.

The EAC confirmed that these are an accurate reflection of current device costs.

4.14 The committee noted the results of the EAC's updated cost model (which

included explantation data from Van Buyten et al. 2017), which showed that:

- Over 15 years, compared with using a non-rechargeable low-frequency SCS device, Senza is cost incurring by £351 per patient (£23.40 per year).
- Over 15 years, compared with using a rechargeable low-frequency SCS device, Senza is cost saving by £2,292 per patient (£152.80 per year).

The committee concluded that, despite the uncertainties in the cost model and the extrapolations made over the 15-year time horizon, it is unlikely that using Senza will incur additional overall costs compared with using low-frequency SCS devices.

5 Committee members and NICE project team

Committee members

This topic was considered by NICE's medical technologies advisory committee, which is a standing advisory committee of NICE.

Committee members are asked to declare any interests in the technology to be appraised. If it is considered there is a conflict of interest, the member is excluded from participating further in that evaluation.

The minutes of the medical technologies advisory committee, which include the names of the members who attended and their declarations of interests, are posted on the NICE website.

NICE project team

Each medical technologies guidance topic is assigned to a team consisting of 1 or more health technology analysts (who act as technical leads for the topic) and a technical adviser or senior technical analyst.

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Update information

Minor changes since publication

December 2025: Medical technologies guidance 41 has been migrated to HealthTech guidance 498. The recommendations and accompanying content remain unchanged.

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