Australian Government

Department of Health

Application 1701

Deep Brain Stimulation of the Thalamus for the Treatment of Severe Refractory Epilepsy

This application form is to be completed for new and amended requests for public funding (including but not limited to the Medicare Benefits Schedule (MBS)). It describes the detailed information that the Australian Government Department of Health requires to determine whether a proposed medical service is suitable.

Please use this template, along with the associated Application Form Instructions to prepare your application. Please complete all questions that are applicable to the proposed service, providing relevant information only. Applications not completed in full will not be accepted. The separate MSAC Guidelines should be used to guide health technology assessment (HTA) content of the Application Form

Should you require any further assistance, departmental staff are available through the Health Technology Assessment Team (HTA Team) on the email below to discuss the application form, or any other component of the Medical Services Advisory Committee process.

Email: hta@health.gov.au
Website: www.msac.gov.au

PART 1 – APPLICANT DETAILS

1. Applicant details (primary and alternative contacts)

Corporation / partnership details (where relevant): Neurosurgical Society of Australasia
Corporation name: **REDACTED**
ABN: **REDACTED**
Business trading name: **REDACTED**

Primary contact name: REDACTED

Primary contact numbers
Business: **REDACTED**
Mobile: **REDACTED**
Email: **REDACTED**

Alternative contact name: REDACTED

Alternative contact numbers
Business: **REDACTED**
Mobile: **REDACTED**
Email: **REDACTED**

2. (a) Are you a consultant acting on behalf on an applicant?

☐ Yes
☒ No

(b) If yes what is the Applicant(s) name that you are acting on behalf of?

Not applicable

3. (a) Are you a lobbyist acting on behalf of an Applicant?

☐ Yes
☒ No

(b) If yes, are you listed on the Register of Lobbyists?

Not applicable.

(c) Have you engaged a consultant on your behalf?

☐ Yes
☒ No

PART 2 – INFORMATION ABOUT THE PROPOSED MEDICAL SERVICE

4. Application title

Deep Brain Stimulation of the Thalamus for the Treatment of Severe Refractory Epilepsy

5. Provide a succinct description of the medical condition relevant to the proposed service (no more than 150 words – further information will be requested at Part F of the Application Form)

Epilepsy is a common chronic neurological condition, affecting people of all ages. The lifetime chance of a seizure is 3%, and around 250,000 Australians (> 1%) have active epilepsy. Around 60 - 70% of individuals become seizure free on anti-epilepsy medication, but some have ongoing seizures, causing seizure related injuries, loss of independence and restricted life opportunities. For these people, brain surgery and other treatments may be considered.

Epileptic seizures are characterised by abnormal brain activity, causing sudden and unpredictable changes in behaviour and awareness. The brain area affected, and duration of the seizure determine the seizure manifestations. There are many different underlying causes, including congenital brain abnormalities, acquired lesions and genetic changes.

Uncontrolled epilepsy significantly increases the risk of SUDEP (sudden, unexpected death in epilepsy). There are approximately 170 SUDEP- deaths/year in Australia, affecting 1 in 1,000 people with epilepsy. Seizure control reduces the risk of SUDEP.

6. Provide a succinct description of the proposed medical service (no more than 150 words – further information will be requested at Part 6 of the Application Form)

Deep Brain Stimulation (DBS) therapy is a surgical treatment for epilepsy, which has not been adequately controlled with medication (medically refractory epilepsy) and where brain resective surgery is either not an option or has been unsuccessful in halting seizures. DBS delivers electrical impulses to a key central location deep in the brain, suppressing the bursts of epileptic discharges that characterise seizures. Under general anaesthetic, a neurosurgeon places electrode leads into the thalamus of the brain through small holes in the skull. The leads are connected to wires running under the skin behind the ear and down the side of the neck and are attached to a battery powered neurostimulator device (like a pacemaker) implanted in the upper chest. After implantation, the frequency and amplitude of the delivered electrical stimuli are adjusted to maximally suppress the frequency and severity of seizures.

7. (a) Is this a request for MBS funding?

☒ Yes
☐ No

(b) If yes, is the medical service(s) proposed to be covered under an existing MBS item number(s) or is a new MBS item(s) being sought altogether?

☒ Amendment to existing MBS item(s)
☐ New MBS item(s)

(c) If an amendment to an existing item(s) is being sought, please list the relevant MBS item number(s) that are to be amended to include the proposed medical service/technology:

MBS items 40851, 40852, 40854, 40856, 40858, 40860, 40862

(d) If an amendment to an existing item(s) is being sought, what is the nature of the amendment(s)?

i. ☐ An amendment to the way the service is clinically delivered under the existing item(s)
ii. ☒ An amendment to the patient population under the existing item(s)
iii. ☐ An amendment to the schedule fee of the existing item(s)
iv. ☐ An amendment to the time and complexity of an existing item(s)
v. ☐ Access to an existing item(s) by a different health practitioner group
vi. ☐ Minor amendments to the item descriptor that does not affect how the service is delivered

(e) If a new item(s) is being requested, what is the nature of the change to the MBS being sought?

Not applicable.

i. ☐ A new item which also seeks to allow access to the MBS for a specific health practitioner group
ii. ☐ A new item that is proposing a way of clinically delivering a service that is new to the MBS (in terms of new technology and / or population)
iii. ☐ A new item for a specific single consultation item
iv. ☐ A new item for a global consultation item(s)

(f) Is the proposed service seeking public funding other than the MBS?

Not applicable

(g) If yes, please advise:

Not applicable

8. What is the type of medical service/technology?

☒ Therapeutic medical service
☐ Investigative medical service
☐ Single consultation medical service
☐ Global consultation medical service
☐ Allied health service
☐ Co-dependent technology
☐ Hybrid health technology

9. For investigative services, advise the specific purpose of performing the service *(which could be one or more of the following)*:

Not applicable.

10. Does your service rely on another medical product to achieve or to enhance its intended effect?

☐ Pharmaceutical / Biological
☒ Prosthesis or device
☐ No

11. (a) If the proposed service has a pharmaceutical component to it, is it already covered under an existing Pharmaceutical Benefits Scheme (PBS) listing?

Not applicable.

(b) If yes, please list the relevant PBS item code(s):

Not applicable.

(c) If no, is an application (submission) in the process of being considered by the Pharmaceutical Benefits Advisory Committee (PBAC)?

Not applicable.

(d) If you are seeking both MBS and PBS listing, what is the trade name and generic name of the pharmaceutical?

Not applicable.

12. (a) If the proposed service is dependent on the use of a prosthesis, is it already included on the Prostheses List?

☒ Yes.
☐ No

Please note that the DBS prosthesis which ae available for other indications in Australia are the same items that will be used in the prosed service.

Percept PC – Deep Brain Stimulation implantable pulse generator

Trade/Clinical Name	Model number	Description	Benefit per unit	Qty needed	Billing Code	ARTG Certificate
Percept PC Brainsense	B35200	Implantable pulse generator	13592	1	MI401	351630
StimLoc	924256	Bur hole cover	497	2	MC767	151095
Model 3387 Lead	3387-xx	Leads that are implanted into the brain	3746	2	MC244	137374
Lead Extension Kit models: 37086	37086xx	Accessory that connects the DBS Leads to the IPG	1895	2	MC852	239412
TH91D Kit:	TH91D02	A patient controller that allows patient to control stimulation settings	1264	1	MI400	351590
Tunneller	3755-40	Accessory to tunnel DBS Extensions from head to chest/abdomen	158	1	MI003	121281
MER Cable	FC1020	Accessory to connect microelectrode to recording amplifier	181	1	MC764	138186
MER Canula / Microtargeting Insertion Tube	FC1036	Accessory to allow MER electrode and DBS lead to reach desired target	158	1	MI119	212222
MER Electrode	FC2002	Accessory that records brain activity and transmits to amplifier via MER cable	1354	1	MI073	133619

(b) If no, is an application in the process of being considered by a Clinical Advisory Group or the Prostheses List Advisory Committee (PLAC)?

Not applicable.

(c) Are there any other sponsor(s) and / or manufacturer(s) that have a similar prosthesis or device component in the Australian marketplace which this application is relevant to?

☒ Yes.
☐ No

Please note, that other DBS device manufactures do not have ARTG certificates with indications for epilepsy.

(d) If yes, please provide the name(s) of the sponsor(s) and / or manufacturer(s):

- Abbott
- Boston Scientific

13. Please identify any single and / or multi-use consumables delivered as part of the service?

The following consumables will be used as part of the service:

Item	Description		ARTG number
Medtronic DBS Tunnelling Tool Accessory Kit	DBS Tunnelling Tool Accessory Kit	One size only	121281
Medtronic MicroTargeting Electrodes	Microelectrodes used for intra-operative recording of neuronal activity for DBS	Various	133619
Microelectrode Cable	Cable used for intracranial recording of neural activity prior to DBS	One size	138186
Electrode Insertion Tube set	Electrode Insertion Tube Set for DBS	One size only	212222
Medtronic Screening Cable (Twist Lock)	Screening Cable with Twist Lock for Intraoperative testing	One size only	119991
Medtronic Screening Cable (Alligator Clip)	Screening Cable with Alligator Clip for Intraoperative testing	One size only	119991
Medtronic Accessory Kit for Deep Brain Stimulation	Boots accessory kit for DBS (3550-25)	N/A	240576

PART 3 – INFORMATION ABOUT REGULATORY REQUIREMENTS

14. (a) If the proposed medical service involves use of a medical device, in-vitro diagnostic test, pharmaceutical product, radioactive tracer, or any other type of therapeutic good, please provide details

The following device components are required for DBS therapy for epilepsy (these are also listed for question 12b):

Two Model 3387 leads would be implanted into the thalamus:

Type of therapeutic good: Electrode/lead, stimulator, implantable, neurological
Manufacturer's name: Medtronic Inc.
Sponsor's name: Medtronic Australasia Pty Ltd

Two StimLoc Caps would be used to secure the leads to the skull to mitigate movement of the leads:

Type of therapeutic good: Cover, burr hole
Manufacturer's name: Medtronic Inc.
Sponsor's name: Medtronic Australasia Pty Ltd

Two Neuromodulation Lead Extensions would connect to the DBS leads and then to the IPG (implantable pulse generator):

Type of therapeutic good: Neural tissue electrical stimulator lead adaptor
Manufacturer's name: Medtronic Inc.
Sponsor's name: Medtronic Australasia Pty Ltd

Percept PC, an implantable pulse generator (IPG) would be implanted into the chest/abdomen to provide stimulation pulses, and sensing hardware/software:

Type of therapeutic good: Brain electrical stimulation system, anti-tremor
Manufacturer's name: Medtronic Inc.
Sponsor's name: Medtronic Australasia Pty Ltd

A Clinician Programmer (CT900 A610) is required for the application that runs on the clinician's programmer:

Type of therapeutic good: Multipurpose electrical stimulation system programmer
Manufacturer's name: Medtronic Inc.
Sponsor's name: Medtronic Australasia Pty Ltd

A Patient Programmer (TH91D A620) is required for the application that runs on the patient's programmer:

Type of therapeutic good: Multipurpose electrical stimulation system programmer
Manufacturer's name: Medtronic Inc.
Sponsor's name: Medtronic Australasia Pty Ltd

Also required for the procedure are some of the accessories listed above (micro electrodes, cannulas etc.):

Item	Description		ARTG Number
Medtronic DBS Tunnelling Tool Accessory Kit	DBS Tunnelling Tool Accessory Kit	One size only	121281
Medtronic MicroTargeting Electrodes	Microelectrodes used for intra-operative recording of neuronal activity for DBS	Various	133619
Microelectrode Cable	Cable used for intracranial recording of neural activity prior to DBS	One size	138186
Electrode Insertion Tube set	Electrode Insertion Tube Set for DBS	One size only	212222
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Medtronic Screening Cable (Alligator Clip)	Screening Cable with Alligator Clip for Intraoperative testing	One size only	119991
Medtronic Accessory Kit for Deep Brain Stimulation	Boots accessory kit for DBS (3550-25)	N/A	240576
Micro electrode recording system	Manufacturer – Medtronic, FHC, Alpha Omega		148374

(b) Has it been listed on the Australian Register of Therapeutic Goods (ARTG) by the Therapeutic Goods Administration (TGA)? If the therapeutic good has been listed on the ARTG, please state the ARTG identification numbers, TGA-approved indication(s), and TGA-approved purpose(s).

Yes, the above-mentioned DBS device system components have been listed on the ARTG by the TGA as indicated below:

DBS Leads
ARTG ID: 137374
TGA approved indication(s), if applicable: Not applicable (not discussed on RTG certificate).
TGA approved purpose(s), if applicable: This lead is designed to electrically stimulate specific areas of the brain (deep brain stimulation) to treat drug refractory movement disorders (such as Parkinson's disease, Essential Tremor, Dystonia, and the treatment of epilepsy).

Bur Hole Covers
ARTG ID: 151095
TGA approved indication(s), if applicable: Not applicable (not discussed on RTG certificate).
TGA approved purpose(s), if applicable: The StimLoc is intended to be used as an implantable 14mm burr hole cover following cranial surgery. It does not penetrate the dura. StimLoc comes in a single pack or a pack of 2 and also contains insertion tools, centering cap and screwdriver.

DBS Leads
ARTG ID: 239412
TGA approved indication(s), if applicable: Not applicable (not discussed on RTG certificate).
TGA approved purpose(s), if applicable: The Lead Extension is part of an implanted Neuromodulation System.

Percept PC IPG
ARTG ID: 351630
TGA approved indication(s), if applicable: Indications discussed in approved purpose below.
TGA approved purpose(s), if applicable: The Percept PC system is an active implantable device system for deep brain stimulation (DBS) and sensing of bioelectric signals in the brain. Therapy for movement disorders is indicated for stimulation of the ventral intermediate nucleus (VIM) for patients with disabling essential tremor (ET) or Parkinsonian tremor, or stimulation of the internal globus pallidus (GPi) or the subthalamic nucleus (STN) for patients with symptoms of Parkinson's disease (PD).

DBS Therapy for movement disorders is also indicated for the stimulation of the internal globus pallidus (GPi) or the subthalamic nucleus (STN) as an aid in the management of chronic, intractable (drug refractory) primary dystonia, including generalized and segmental dystonia, hemidystonia and cervical dystonia (torticollis) for individuals 7 years and older.

Bilateral anterior thalamic nucleus (ANT) stimulation using the Medtronic DBS system for Epilepsy is indicated as adjunctive therapy for reducing the frequency of seizures in adults diagnosed with epilepsy characterized by partial-onset seizures, with or without secondary generalization, that are refractory to antiepileptic medications.

Medtronic DBS Therapy is indicated for bilateral stimulation of the anterior limb of the internal capsule, AIC, as an adjunct to medications and as an alternative to anterior capsulotomy for the treatment of chronic, severe, treatment-resistant OCD in adult patients who have failed at least three selective serotonin reuptake inhibitors (SSRIs)

Physician Programmer
ARTG ID: 308196
TGA approved indication(s), if applicable: Not applicable (not discussed on RTG certificate).
TGA approved purpose(s), if applicable: The Medtronic Clinician Programmer Software A610 is intended for use by clinicians in the programming of neurostimulators (external and implantable) for deep brain stimulation (DBS).

Patient Programmer
ARTG ID: 351590
TGA approved indication(s), if applicable: Not applicable (not discussed on RTG certificate).
TGA approved purpose(s), if applicable: The Model A620 DBS Patient Programming Application, along with the TH91D handset and communicator kit, is intended to be used to view or adjust DBS therapy, as prescribed by your DBS clinician.

(c) If a medical device is involved, has the medical device been classified by TGA as a Class III OR Active Implantable Medical Device (AIMD) under the TGA regulatory scheme for devices?

Components of the DBS device system have been classified by the TGA as a Class III OR Active Implantable Medical Device (AIMD) under the TGA regulatory scheme for devices. Details are listed below:

- ARTG ID: 137374 - Class III
- ARTG ID: 251630 - AIMD
- ARTG ID: 308196 - Class III
- ARTG ID: 351590 - Class III

For completeness, please note that ARTG ID: 151095 and ARTG ID: 239412 are both listed as Class IIb.

(d) Is the therapeutic good classified by TGA for Research Use Only (RUO)?

No.

15. (a) <u>If not listed on the ARTG</u>, is the therapeutic good to be used in the service exempt from the regulatory requirements of the *Therapeutic Goods Act 1989*?

Not applicable.

(b) If the therapeutic good is <u>not ARTG listed</u>, is the therapeutic good in the process of being considered by TGA?

Not applicable.

(c) If the therapeutic good is NOT in the process of being considered by TGA, is an application to TGA being prepared?

Not applicable.

PART 4 – SUMMARY OF EVIDENCE

16. **Provide one or more recent (published) high quality clinical studies that support use of the proposed health service/technology. At 'Application Form lodgement', please do not attach full text articles; just provide a summary.**

Abbreviations used in table:

DBS – Deep brain stimulation / ANT – Anterior Thalamic nucleus / CM - centromedian nucleus of the thalamus / DRE - drug resistant epilepsy / SUDEP – Sudden Unexpected Death in Epilepsy

	Type of study design	**Title of journal article or research project**	**Short description of research**	**Website link to journal article or research**	**Date of publication**
1.	Prospective cohort	The SANTÉ study at 10 years of follow-up: Effectiveness, safety, and sudden unexpected death in epilepsy Salanova V et al.	Long term (10yr) follow-up of n=110 SANTE study patients. Median seizure frequency percent reduction was 75% ($p < .001$). Severe convulsive seizures were reduced by 71%, and SUDEP rate was 2.0 deaths for 1000 person-years (significantly lower than historical cohorts of medically refractory epilepsy).	Website link	2021
2.	Prospective cohort	Long-term efficacy and safety of thalamic stimulation for drug-resistant partial epilepsy. Salanova V et al.	Long term follow-up of n=110 SANTE participants provided Class IV evidence that ANT stimulation was associated with a 69% reduction in seizure frequency, a 34% serious device-related adverse event rate at 5 years and statistically significant improvements in the Liverpool Seizure Severity Scale and Quality of Life in Epilepsy tool.	Website link	2015

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
3.	Multicentre, double-blind, parallel design, randomized controlled clinical trial	Electrical stimulation of the anterior nucleus of thalamus for treatment of refractory epilepsy. (SANTE trial) Fisher R et al.	Bilateral stimulation of the ANT in n=110 patients reduced seizures in refractory epilepsy. By 2 years, there was a 56% median percent reduction in seizure frequency; 54% of patients had a seizure reduction of at least 50%, and 14 patients were seizure-free for at least 6 months.	Website link	2010
4.	Prospective cohort	Memory and mood outcomes after anterior thalamic stimulation for refractory partial epilepsy. Tröster AI et al., for the SANTE group	Initial increases in subjective depression and memory scores at 6 months did not persist to any significant objective cognitive declines or worsening of depression scores through the blinded phase or open-label at 7-years. AEs did not result in reduced QOL measures. Executive function and attention improvements at 7 years were reported.	Website link	2017
5.	Retrospective cohort	Long-term follow-up of anterior thalamic deep brain stimulation in epilepsy: A 11-year, single centre experience. Kim SH et al.	Retrospective analysis of n=29 consecutive patients with refractory epilepsy over 11-years. Median percent seizure reduction was 71.3% at 1 year;73.9% at 2 years; 61.8% to 80.0% over post-implant years 3-11 (overall 70% median reduction). In the 11-year study period, 13.8% (4/29) of subjects were seizure-free for at least 12 months.	Website link	2017

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
6.	Retrospective cohort	Anatomical connectivity and efficacy of electro- therapy for seizure control: A SANTE's single-center regression analyses. Osorio I et al.	Comparison of seizure frequency for 15 patients with ANT DBS for either seizure emergence from inside Papez Network (IPN) vs outside Papez Network (OPN). Degree of anatomical connectivity between stimulation target and epileptogenic networks plays a pivotal role in therapeutic efficacy.	Website link	2021
7.	Retrospective cohort	The Role of Anterior Thalamic Deep Brain Stimulation as an Alternative Therapy in Patients with Previously Failed Vagus Nerve Stimulation for Refractory Epilepsy Park HR et al.	Studied the efficacy of 7 patients who failed VNS. 5 of the patients experienced >50% seizure reduction, 1 responder reached seizure freedom. Of the two non-responders, 1 subject showed improvement in seizure strength and duration.	Website link	2019
8.	Retrospective cohort	Cognitive improvement after long-term electrical stimulation of bilateral anterior thalamic nucleus in refractory epilepsy patients Oh YS et al.	Studied cognitive and behavioural efficacy after 12 months of an ANT DBS implant in 9 patients. The mean seizure reduction rate was 57.9%. Cognitive testing showed favourable results for verbal fluency and improvement in delayed verbal memory. No significant changes to general abilities. No observation of significant cognitive decline.	Website link	2012

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
9.	Prospective cohort	Executive Functions May Predict Outcome in Deep Brain Stimulation of Anterior Nucleus of Thalamus for Treatment of Refractory Epilepsy Järvenpää, S.	16 patients with refractory epilepsy treated with ANT DBS with at least 2 years of follow-up. There were 12 responders and 4 non-responders. Responders did significantly better on neuropsychological measures of executive function and attention, compared to non-responders. The finding raises this as a potential pre-implantation measure of treatment responsiveness.	Website link	2018
10.	Retrospective cohort	Anterior Nucleus Deep Brain Stimulation for Refractory Epilepsy: Insights Into Patterns of Seizure Control and Efficacious Target. Krishna V et al.	16 patients underwent ANT DBS with at least 1 year FU. 9 patients reported an immediate decrease in seizure frequency (insertional or microthalamotomy effect). 11 patients reported long-term response, with the most efficacious target being the anteroventral ANT. The study highlights the added benefit of precise electrode placement.	Website link	2016
11.	Prospective, double blinded, parallel design, randomized control trial	Anterior thalamic deep brain stimulation in refractory epilepsy: A randomized, double-blinded study. Herrman H et al.	Studied the safety and efficacy of anterior thalamic nucleus DBS in n=18 patients with focal, pharmaco-resistant epilepsy for 12 months. Study supports results from earlier studies suggesting DBS is as a safe treatment option, with effects even in patients with severe, refractory epilepsy.	Website link	2019

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
12.	Prospective cohort	Long-term outcome of anterior thalamic nucleus stimulation for intractable epilepsy. Lee KJ et al.	Bilateral ATN DBS in patients with intractable epilepsy (n=15). Significant decrease in the seizure frequency, with a mean reduction of 70.4% (mean follow-up, 27 months). 4 patients had a ≥90% seizure reduction and 1 patient was seizure free.	Website link	2012
13.	Delphi method	European Expert Opinion on ANT-DBS therapy for patients with drug-resistant epilepsy (a Delphi consensus). Kaufmann E et al.	Expert panel 10 neurologists, 4 neurosurgeons. Delphi method consensus. Real world consensus that ANT-DBS has the potential to significantly reduce seizure frequency and severity with typical success rates in line with SANTE.	Website link	2020
14.	Prospective cohort	Outcome based definition of the anterior thalamic deep brain stimulation target in refractory epilepsy. Lehtimaki K et al.	Trial defining the optimal target for ANT DBS in refractory epilepsy in **n=15** prospectively followed patients, during a 5-year period. Ideal effective region of stimulation identified, potentially improving efficacy over original RCTs.	Website link	2016
15.	Prospective cohort	Deep Brain Stimulation in Epilepsy: A Role for Modulation of the Mammillothalamic Tract in Seizure Control? Schaper FLWVJ et al.	Investigated relationship between seizure control and location of active contacts to the ANT-MTT junction in 20 patients with ANT-DBS. After 1 yr of stimulation, patients had a median 46% reduction in total seizure frequency, 50% were responders, and 20% of patients were seizure-free. The stimulation zone for responders was further defined.	Website link	2020

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
16.	Prospective cohort	Defining the optimal target for anterior thalamic deep brain stimulation in patients with drug-refractory epilepsy. Guo W et al.	Refined the successful targeting of ATN DBS in responders (n=25 patients). 47.4% responders at 6 months. 6 patients became responders with adjustment of active contacts (total 78.9% responder rate after 6 months). Average seizure reduction 64.3% in 1 year. With this approach responder rates can potentially be improved compared to initial RCTs.	Website link	2020
17.	Cochrane systematic review	Deep brain and cortical stimulation for epilepsy. Sprengers M et al.	Assessed efficacy, safety and tolerability of DBS and cortical stimulation for refractory epilepsy. **12 RCTs** identified. 1-3 months of anterior thalamic DBS ((multi)focal epilepsy), responsive ictal onset zone stimulation ((multi)focal epilepsy) and hippocampal DBS (temporal lobe epilepsy) moderately reduce seizure frequency in refractory epilepsy patients).	Website link	2017
18.	Systematic review	Deep brain stimulation for seizure control in drug-resistant Klinger N et al.	For patients with medically refractory epilepsy, where resection is not an option, DBS provides and effective means at seizure control. Bilateral ANT-DBS is well established, but other emerging targets are emerging.	Website link	2018

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
19.	Systematic review	Deep Brain Stimulation as a Treatment for Refractory Epilepsy: Review of the Current State-of-the-Art. Ganguli MP et al.	Review discusses DBS surgery and equipment, mechanisms of DBS for epilepsy, and efficacy, technological specifications, and offers suggestions for future research. A historical summary of experiments involving DBS for epilepsy is reviewed. Concludes that further studies are warranted for medically refractory epilepsy using DBS.	Website link	2017
20.	Systematic review	Deep brain stimulation for drug resistant epilepsy. Li MCH & Cook MJ.	Reviewed clinical evidence on the antiepileptic effects of DBS for drug-resistant epilepsy, its safety, and the factors influencing individual outcomes. Study identified several patient, disease, and stimulation factors that potentially predict seizure outcome following DBS.	Website link	2018
21.	Systematic review	Open-loop deep brain stimulation for the treatment of epilepsy: a systematic review of clinical outcomes over the past decade (2008-present). Zhou JJ et al.	Identified & evaluated all studies on open-loop DBS for epilepsy [2008 to present; PubMed; 41 studies met inclusion criteria]. Level I evidence supports safety and efficacy ANT and hippocampal stimulation for the treatment of medically refractory epilepsy. Level III and IV evidence supports stimulation of other targets for epilepsy.	Website link	2018

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
22.	Systematic review & meta-analysis	Deep brain stimulation for refractory temporal lobe epilepsy: a systematic review and meta-analysis with an emphasis on alleviation of seizure frequency. Chang B & Xu J.	Identified predictors of seizure reduction (SR) for DBS in patients with refractory temporal lobe epilepsy (TLE). Higher SR was associated with lateralization of stimulation, lateralized ictal EEG findings, and a longer follow-up period. Hippocampal and ATN stimulation had similar odds of producing SR. DBS is an effective for intractable TLE.	Website link	2017
23.	Systematic review	Deep brain stimulation of the anterior nucleus of the thalamus for drug-resistant epilepsy. Bouwens Van Der Vlis TAM et al.	DBS represents an effective and well-tolerated therapy, even when curative procedures or lesser invasive neuromodulative techniques failed. When compared to VNS, ANT DBS shows slightly superior treatment response.	Website link	2019
24.	Non-randomised clinical trial	The effect of medial pulvinar stimulation on temporal lobe seizures. Filipescu C et al.	Proof of concept study. Investigated the electrical stimulation of the medial pulvinar (PuM) on temporal lobe seizures in **8 patients** with drug-resistant temporal lobe epilepsy undergoing stereo-electro-encephalographic exploration. Compared to non-PuM-stimulated seizures, 5/8 patients experienced clinically less severe seizures, suggesting PuM stimulation could be an effective DBS approach.	Website link	2019

	Type of study design	Title of journal article or research project	Short description of research	Website link to journal article or research	Date of publication
25.	Two-centre, single-blind, controlled clinical trial	Deep brain stimulation of the centromedian thalamic nucleus for the treatment of generalized and frontal epilepsies. Valentin A et al.	Evaluated bilateral centromedian thalamic nucleus (CMN) DBS for seizure control in generalized epilepsy (GE) and frontal lobe epilepsy (FLE). Two-centre, single-blind, controlled trial (11 patients). Long term results: 2/5 patients with FLE had >50% improvement in seizure frequency; 5/6 with GE showed >50% improvement in the frequency of major seizures.	Website link	2013

17. **Identify yet-to-be-published research that may have results available in the near future (that could be relevant to your application). Do not attach full text articles; this is just a summary.**

	Type of study design	Title of research	Short description of research	Website link to research	Date
1.	Clinical trial Randomised, parallel assignment, open label	Clinical and Medico-economical Assessment of Deep Brain Stimulation of the Anterior Nucleus of the Thalamus for the Treatment of Pharmacoresistant Partial Epilepsy. NCT No. - NCT02076698 Other Study ID no. - 1317 FRANCE	Phase 3 clinical trial investigating DBS of the ANT versus usual treatment for epilepsy, including vagus nerve stimulation (VNS). Currently recruiting. Estimated study completion June 2022.	Website link	?

	Type of study design	Title of research	Short description of research	Website link to research	Date
2.	Clinical trial Non-randomised (open) single group, treatment trial	Safety and Efficacy of a Deep Brain Stimulation System in Epilepsy: A Feasibility Study for Tracking Neural Excitability. Registration No.: ACTRN12617001312336	Testing a new device called the 'Medtronic Activa PC+S system' using electrical stimulation of the brain for the treatment of epilepsy. Electrodes will be surgically implanted bilaterally into the hippopotamus and ANT. The primary outcome is change in seizure rate. N=5 Recruiting.	Website link	?
3.	Retrospective, observational	Microendoscopic Transventricular Deep Brain Stimulation of the Anterior Nucleus of the Thalamus as a Safe and Efficient Treatment in Intractable Epilepsy.	Reviewed follow up data from their prospective database for patients 18 years and over, surgically treated between 2010-2019 for refractory epilepsy DBS of the ANT, using microendoscopy. All patients had a minimum follow up of 1 year. Recruiting. Study completion date December 29, 2021.	Website link	?
4	Double-blind, parallel design, randomized controlled clinical trial	ESTEL: Electrical Stimulation of the Thalamus for Epilepsy of Lennox-Gastaut phenotype	Bilateral stimulation of the CM nucleus of thalamus in n=20 patients with severe generalised epilepsy of Lennox-Gastaut Phenotype. Median seizure reduction at study exit (having received 3 or 6 months stimulation) was ~50%. ***(Paper under review)***	Website link	2021

PART 5 – CLINICAL ENDORSEMENT AND CONSUMER INFORMATION

18. **List all appropriate professional bodies/organisations representing the health professionals who provide the service. For MBS-related applications ONLY, please attach a brief 'Statement of Clinical Relevance' from the most relevant college/society.**

    - Neurosurgical Society of Australasia
    - Royal Australasian College of Surgeons
    - Australian and New Zealand Association of Neurologists
    - Epilepsy Society of Australia

    Please find **attached** 'Statements of Clinical Relevance'. at the end of this application.

19. **List any professional bodies / organisations that may be impacted by this medical service (i.e. those who provide the comparator service):**

    - Please refer to the list above.

20. **List the consumer organisations relevant to the proposed medical service (noting there is NO NEED to attach a support letter at the 'Application Lodgement' stage of the MSAC process):**

    - Epilepsy Foundation
    - Epilepsy Action

21. **List the relevant sponsor(s) and / or manufacturer(s) who produce similar products relevant to the proposed medical service:**

    - Medtronic Australasia Pty Ltd
    - Abbott
    - Boston Scientific

    Please note, **REDACTED** have TGA approved devices for deep brain stimulation. However, while **REDACTED** and **REDACTED** produce devices that are used for deep brain stimulation procedures, their devices are not currently TGA approved for epilepsy indications.

22. **Nominate two experts that can be contacted about the proposed medical service, and current clinical management of the condition:**

    Name of expert 1: **REDACTED**

    Telephone number(s): **REDACTED**

    Email address: **REDACTED**

    Justification of expertise: **REDACTED**

    Name of expert 2: **REDACTED**

    Telephone number(s): **REDACTED**

    Email address: **REDACTED**

    Justification of expertise: **REDACTED**

PART 6 – POPULATION (AND PRIOR TESTS), INTERVENTION, COMPARATOR, OUTCOME (PICO)

PART 6a – INFORMATION ABOUT THE PROPOSED POPULATION

23. Define the medical condition, including providing information on the natural history of the condition and a high-level summary of associated burden of disease (in terms of both morbidity and mortality):

Defining Epilepsy

Epilepsy is a serious neurological condition affecting people of all ages, characterised by a tendency for recurrent, convulsive, or non-convulsive unprovoked seizures. Certain triggers may increase the risk of seizures and recognition of known triggers may help reduce/avoid seizures (e.g., fatigue, stress & illness).

The term 'epilepsy' is an umbrella term for a diverse range of neurological disorders that includes many different seizure types and syndromes, with diverse aetiologies, and variable prognoses. An epilepsy syndrome is defined by features including family history, age of seizure onset, seizure type(s), cause, and other linked diseases/conditions, progression of the syndrome over time, the presence or absence of brain abnormalities, imaging findings, as well as response to medication (Epilepsy Action Australia, Epilepsy Syndromes). Diagnosis of epilepsy by syndrome is useful for determining treatment options, prognosis, and genetic ramifications.

Around 250,000 Australians (~ 1% of the population) are currently diagnosed with epilepsy (Epilepsy Action Australia 2021, Epilepsy the Facts). An Australian Bureau of Statistics 2017 – 2018 National Health Survey reported that 0.6% of Australians of all ages were living with epilepsy (active cases). It is projected that about 800,000 Australians will develop epilepsy in their lifetime; approximately 3% of the population (Epilepsy Action Australia 2021, Facts & Statistics).

The International League Against Epilepsy (ILAE) defines epilepsy in the presence of any of the following conditions 1), at least two unprovoked seizures occurring more than 24 hours apart 2), one unprovoked seizure and a probability of further seizures, similar to the general recurrence risk after two unprovoked seizures (≥60 percent) occurring over the next 10 years and/or 3), diagnosis of an epilepsy syndrome (Fisher et al. 2014). Some people meet the criteria for epilepsy at the time of a first seizure.

Seizures are generally classified as being focal or generalised, reflecting whether seizures begin in one or more part(s) of the brain (focal,) or both sides of the brain simultaneously (generalised). The signs and symptoms of a seizure are determined by the brain regions involved. Generalised seizures involve the whole brain and symptoms can affect the whole body, with effects ranging from brief periods of impaired responsiveness and awareness to full body convulsions and loss of consciousness, lasting minutes to hours. Focal seizure affects are determined by the region of brain where the seizure is present (e.g., a seizure in the region that controls the arm will result in uncontrollable jerking of the respective limb). They generally last a few minutes, and the person may remain in a state of confusion for minutes or hours afterwards.

The aetiology of epilepsy is multifactorial and the ILAE broadly classify epilepsy in six aetiological categories, including genetic, structural, metabolic, immune, infectious, or unknown (around 50%) causes (Scheffer et al 2017). Age at first seizure may also influence epilepsy causation. In adults, epilepsy is often due to acquired vascular, degenerative, or neoplastic aetiologies; while childhood, epilepsy is more often due to genetic, metabolic, or congenital structural abnormalities (Schachter 2021).

The Natural History of Epilepsy

Epilepsy can begin at any age but is somewhat more commonly diagnosed in childhood or older age.

The management of epilepsy is aimed at controlling seizures, avoiding treatment side effects, and maintaining or restoring quality of life. First line treatment involves the use of antiseizure medications; selected based on seizure type, potential adverse events, drug interactions with other medications, comorbid conditions, age, gender, childbearing plans, lifestyle, and patient preferences. If medications do not control seizures, then brain surgery and neuromodulation may be considered. Surgery involves removal of the epileptic focus via resection or ablation. Neuromodulation options are non-destructive alternatives, which involve stimulation of specific

neuroanatomical brain structures with the aim of modulating hyperexcitability in their circuits (e.g., vagal nerve stimulation [VNS], responsive neural stimulation [RNS], and deep brain stimulation [DBS]).

If the first medication prescribed fails to stop seizures, addition of a second anti-seizure medication is usually recommended. The probability of successful seizure control is reduced with each subsequent medication trial. A 30-year longitudinal study reported that around 50% of patients with newly diagnosed epilepsy achieved seizure freedom with the first antiepileptic medication trailed, and a further 11% of patients become seizure free after trailing a second medication. Only 3% of people subsequently stop having seizures after failing a second medication trial, leaving 30-40% of people with medication-resistant epilepsy, also called medically refractory epilepsy (Chen et al 2018). The suggested prevalence of medication resistant epilepsy is corroborated by the findings of 2021 systematic review and meta-analysis of 103 observational studies, which reported a 36.3% prevalence of medication resistant epilepsy in clinic-based cohorts and higher rates in people with focal epilepsy (Sultana et al. 2021). Medication resistant epilepsy has been described as a multifaceted problem (French 2007) and people with medication resistant epilepsy are candidates for second line treatment options.

Approximately two thirds of people with newly diagnosed epilepsy generally have a good prognosis for full seizure control and eventual discontinuation of anti-seizure medications. The most important positive predictor of long-term prognosis is early response to treatment. Different prognostic patterns can be identified, suggesting that the epileptogenic process is not static (Beghi et al. 2015). Four different prognostic groups have been described for people with epilepsy syndrome (Beghi et al. 2015). Around 20-30% of people have a high probability of spontaneous remission. A good prognosis occurs in 30-40% of people who easily achieve pharmacological control and possible spontaneous remission. While 10-20% have a drug dependent prognosis, where seizures respond to medications but tend to relapse after treatment withdrawal and 20% have a poor prognosis, where seizures recur despite intensive treatment.

A person's response to antiseizure medications may be influenced by the type of epilepsy they have, the underlying syndrome and aetiology, as well as the patient's history of seizure frequency, severity, and clustering. Environmental factors, such as trauma and prior drug exposure, as well as genetic factors (including absorption rates, metabolism, and uptake of a medications by target tissue) may potentially impact on an individual's response to pharmacotherapy (French 2007). The estimated average duration of active epilepsy is around 10 years, based on calculations derived from prevalence and incidence data (Beghi et al 2015). Population studies following newly diagnosed epilepsy cases for several decades report that up to 80% of people may enter prolonged periods of seizure remission and up to 50% continue to be seizure-free after treatment discontinuation (Sillanpää and Schmidt 2006).

Burden of Disease

Epilepsy is a chronic disease which may profoundly impact a person's quality of life and can be debilitating, conferring serious adverse effects on personal lives and capacity to maintain employment.

Epilepsy has been linked with increased rates of comorbidities which adversely affect quality of life and life expectancy. People with epilepsy have a greater likelihood of experiencing psychiatric conditions, fractures, motor vehicle accidents, cardiovascular disease, sleep disorders, neurodevelopmental disorders, and migraines, on top of the stigma that a diagnosis of epilepsy carries. For example, depression and anxiety are commonly reported in people with epilepsy. Significantly increased odds of active and lifetime depression have been reported in people diagnosed with epilepsy (13-35% lifetime prevalence of depression) compared to those without epilepsy (Fiest KM et al. 2013). The unpredictable nature of seizures poses additional dangers for personal safety. Epilepsy is also associated with an increased risk of premature death, relative to the general population (Beghi et al 2015).

People with epilepsy are at increased risk of sudden unexpected death in epilepsy (SUDEP), which is defined as "the sudden, unexpected, witnessed or unwitnessed, non-traumatic and non-drowning death in patients with epilepsy with or without evidence of a seizure, and excluding documented status epilepticus, in which post-mortem examination does not reveal a structural or toxicological cause for death" (Nashef et al 2012).The causes of SUDEP are multifactorial and may include respiratory or cardiac dysfunction. Review of data from people (n=57,775) with a hospital-based ambulatory care or hospital discharge diagnosis of epilepsy in the Swedish National Patient Registry over 1998–2005, reported that death certificates underestimate the incidence of SUDEP. Death certificates mentioned in 63% SUDEP cases and the risk of SUDEP was underestimated in boys and older people (regardless of sex). People with epilepsy and psychiatric

comorbidities had an increased risk for SUDEP (Sveinsson et al. 2017). A recent systematic review suggested that the genetic causes of SUDEP are not well understood because of the limited availability of clinical data such as ECGs and formal cardiac and neurologic pathology evaluations to further elucidate causation in SUDEP cases (Chahal et al 2020). People living with epilepsy have a risk of up to 1.2 in 1,000 of SUDEP per year, translating into around 171 SUDEP-related deaths annually in Australia (Epilepsy Australia).

People with medication resistant epilepsy have a greater burden of disease compared to people with epilepsy who become seizure free. Medication resistant epilepsy is associated with serious psychosocial consequences, cognitive problems, and reduced quality of life. Specifically, ongoing seizures are associated with increased rates of anxiety and depression, higher rates of unemployment and underemployment, and loss of independence, including from inability to drive. Poorer outcomes occur across the life span for people with medication resistant epilepsy. For example, in infants and young medication resistant epilepsy is associated with developmental delay, while in older children and adults it is associated with severe disability and morbidity (Engel J 2016).

Epilepsy is the second most burdensome neurological condition after dementia in Australia (AIHW 2019). The total annual cost of epilepsy in Australia in 2019 – 2020 was estimated to be $12.3 billion, where $4.2 billion of this amount reflected the financial costs of epilepsy. The biggest financial cost $2.3 billion was productivity loss (the impact of epilepsy on a person's lifetime productivity). Other financial costs were costs to the healthcare system ($557.1 million), the cost of informal care ($438.2 million), equipment ($8.6 million), transportation costs ($9.9 million) and deadweight losses ($821.6 million), that is losses from government payments and taxation forgone (Deloitte Access Economics Report 2020). The balance of the annual cost of epilepsy reflects the burden of the disease, (loss of wellbeing) and was estimated to be $8.2 billion (based on the value of a statistical life year and the disability adjusted life years lost due to epilepsy) in 2019 -2020. The annual burden of disease conferred by epilepsy in Australia was greater than prostate cancer and similar to Parkinson's disease and lung cancer (Deloitte Access Economics Report 2020). The total lifetime cost of epilepsy was estimated to be $22.2 billion for the 14,603 new cases of epilepsy diagnosed in Australia in the period 2019-2020. (Deloitte Access Economics Report 2020).

Modelling suggests that modest improvements in seizure control can lessen the economic burden of epilepsy. Using life table modelling, a 2017 study, followed Australians of working age with epilepsy until 70 years of age and predicted over 14,000 excess deaths, more than 78,000 years of life lost, and over 146,000 productivity-adjusted life years lost due to epilepsy, amounting to a gross domestic product (GDP) loss of US $22.1 billion. The model showed that improving seizure freedom by 5%, for a 75% seizure freedom rate, reduced health care costs and save years of life, translating to US $2.6 billion savings. US $5.3 billion GDP savings were reported for a 10% improvement in seizure freedom and a seizure freedom rate of 80% (Foster et al 2020).

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24. Specify the characteristics of patients with (or suspected of having) the medical condition, who would be eligible for the proposed medical service/technology (including details on how a patient would be investigated, managed, and referred within the Australian health care system, in the lead up to being eligible for the service):

Target Group

Eligibility for Deep Brain Stimulation (DBS) of the thalamus for epilepsy will be limited to patients, who continue to experience seizures despite the use of two or more anti-seizure medications at therapeutic doses (i.e., medically refractory). Eligible patients will have been considered for alternative treatment options such as curative resective brain surgery, and these therapies would have been either a) deemed not appropriate, or b) previously trialled without success. Lastly all eligible patients will have been referred to and assessed by a Comprehensive Epilepsy Program.

According to the ILAE, medication resistant epilepsy occurs when a person has failed to become (and stay) seizure free with adequate trials of two anti-seizure medications, chosen appropriately for the person's seizure type, tolerated by the person, and tried alone or together with other seizure medications (Kwan et al 2009). The frequency and severity of seizures is generally not considered in the definition, although these vary among people with medication resistant epilepsy and may help inform future treatment decisions (Berg & Kelly 2006; Dlugos 2001)

The probability of achieving seizure freedom in newly diagnosed patients with epilepsy has not changed considerably, despite the availability of new anti-seizure medications in recent decades (Perucca et al 2020, Engel 2016). Around, 30-40% of patients are diagnosed with medication resistant epilepsy after trials of anti-seizure medications and need to explore other treatment options (Chen et al 2018).

People with medication resistant epilepsy experience the greatest burden of epilepsy related disabilities and higher mortality and morbidity. This includes greater adverse medication effects, higher levels of stigma and social handicap (e.g., poor academic performance, unemployment), higher somatic and emotional comorbidities, and poorer quality of life (Beghi et al 2015) and an increased morality rate, around 5 – 10% higher than that of the general population (Engel 2016). The economic impacts of medication resistant epilepsy are also significant. For example, in the United States around 40% of people continue to experience seizures

despite appropriate treatment with antiseizure medications (Kobau et al 2008) and this subgroup accounted for 80% of the total cost of epilepsy in 2000 (Begley et al 2000).

Investigation, Management & Referral

People with medication resistant epilepsy should be referred to a Comprehensive Epilepsy Program for further evaluation. Initial assessment of suspected refractory epilepsy includes review of the electrical and clinical features of the seizures, family history, and review of current and prior anti-seizure medications trialled. Careful review of neuroimaging is particularly important, as this may reveal subtle abnormalities that could provide a target for curative resective epilepsy surgery.

Patients requiring further evaluation are usually referred for a period of inpatient video electroencephalography (VEEG) monitoring with neuropsychology assessments, as well as additional structural and functional brain imaging, including high quality magnetic resonance imaging (MRI), and positron emission tomography (PET) (Schuele & Luders 2008). Studies show that early referral to a Comprehensive Epilepsy Program provides patients with the best prospect of seizure freedom avoiding adverse outcomes associated with treatment resistant epilepsy, including irreversible psychological and social problems, disability, and death (Engel 2016).

When evaluating medication resistant epilepsy, patients may be encouraged to keep a seizure diary for a nominated period, to help document response to therapy changes and provide insight into potential seizure triggers (Sirven 2021). Data captured in the seizure diary may include information about any seizures experienced and other related information that may impact on seizure episodes (e.g., use of anti-seizure medications and other medications, details about sleeping patterns such as the amount and quality of sleep).

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PART 6b – INFORMATION ABOUT THE INTERVENTION

25. Describe the key components and clinical steps involved in delivering the proposed medical service/technology:

The Deep Brain Stimulation (DBS) procedure consists of three main steps:

Preoperative Planning

Preoperative planning includes presurgical testing to determine whether a patient will benefit from DBS therapy. Testing is performed in an outpatient setting or after admission to an epilepsy monitoring unit at a Comprehensive Epilepsy Program. Video EEG (electroencephalogram) monitoring, MRI, PET, and other imaging tests, as well as neuropsychology testing may be undertaken. A key activity prior to surgery, is obtaining stereotactic coordinates for the target brain region by merging magnetic resonance imaging (MRI) data of the patient's brain with information from a brain atlas (Gionfriddo et al 2013).

Surgical Implantation

Implantation of the DBS system involves two steps. The first is placement of the stimulating electrode in the brain and the second step involves surgical placement of a small pacemaker-like device, or neurostimulator, under the skin in the chest. These steps are often performed in a single procedure. Surgery involves a multidisciplinary team of surgeons, epileptologists, theatre, and technical device staff.

Surgery requires shaving part or all of the patient's head, and the use of a fixed frame that surrounds the patient's head entirely or use of newer frameless systems which provide increased patient comfort and shorter operating times (Roth et al 2018). Under either local or general anaesthesia, a neurosurgeon determines the exact placement and trajectory path for the electrode lead before burr holes are drilled into the skull at the planned electrode entry points. Functional landmark region-specific neuronal activity is used to confirm the target implantation region/structure during the surgical procedure. Under imaging guidance, one or more permanent microelectrodes are inserted into the brain and intraoperative fluoroscopy and postoperative MRI or computed tomography (CT) scans are obtained to confirm electrode placement. The leads are then connected to wires called lead extenders, which are tunnelled subcutaneously under the skin behind the ear and down inside the skin, down the side of the neck, to below the clavicle, where they are attached to the neurostimulator (pulse generator) (Zangiabadi et al 2019).

Part two of the surgery involves placement of the neurostimulator, which is often implanted on the same day/time as placement of the leads in the brain. Under general anaesthesia the surgeon places the neurostimulator under the skin of the chest, just below the collarbone and then connects the leads to the neurostimulator. The neurostimulator device is similar to a heart pacemaker and contains a small battery and a computer chip programmed to send electrical impulses to the brain, via the implanted electrodes.

Depending on the person's surgical plan, people typically spend a day or two in hospital. Analgesia is prescribed to manage pain at the incision sites and overall healing usually takes several weeks.

Post-operative Assessment

Several postoperative outpatient clinic visits are arranged, over a three-to-six-month period, to program the neurostimulator system and determine optimal parameters including amplitude, frequency, and pulse width (Edwards et al 2017). At the first visit, several weeks after surgery, the stimulator is programmed by a clinician using a small hand-held computer that sets the amount (strength and length of time) of electrical stimulation given. These details are fined tuned at subsequent visits using patient feedback and seizure control information. Precise settings vary from person to person, and it can take several months to find the right level of stimulation. Throughout this time the person's progress is closely monitored by their medical team. Patients are given their own programming device (about the size of a mobile phone), enabling them to manage the neurostimulator themselves. When a person experiences a seizure and feels that further seizure(s) are likely, they can use their programmer to activate DBS therapy to try to stop a seizure from happening.

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26. Does the proposed medical service include a registered trademark component with characteristics that distinguishes it from other similar health components?

The proposed medical service does not include a trademark.

27. If the proposed medical service has a prosthesis or device component to it, does it involve a new approach towards managing a particular sub-group of the population with the specific medical condition?

DBS involves a new approach to managing sub-groups of the population with epilepsy in Australia, specifically people with medically refractory epilepsy. The therapy involves the use of a DBS devices, as described in Part 3. Note, DBS for epilepsy was approved in 2018 by the US Food and Drug Administration as adjunctive therapy for patients with partial onset seizures who are refractory to three or more antiseizure medications (Voelker 2018).

References Cited

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28. If applicable, are there any limitations on the provision of the proposed medical service delivered to the patient (i.e., accessibility, dosage, quantity, duration, or frequency)?

As described earlier, deep brain stimulation of the thalamus for treatment of medically refractory epilepsy will be limited to patients who either continue to have seizures despite prior epilepsy surgery or who are not suitable for curative resective surgery.

Patients with suspected medical refractory epilepsy will have been referred to a Comprehensive Epilepsy Program. They will have had their initial diagnosis of epilepsy reconfirmed and they will have been subsequently diagnosed with medical refractory epilepsy, despite adequate trials of two antiseizure medications, assessment by a Comprehensive Epilepsy Program and having been considered for alternative surgical options, including resection, ablation, and/or VNS.

29. If applicable, identify any healthcare resources or other medical services that would need to be delivered <u>at the same time</u> as the proposed medical service:

Healthcare resources and medical services that would need to be delivered at the same time as DBS therapy include:

- Anaesthesia medications
- Analgesia medications
- MRI—scan of head (including MRA, if performed) for epilepsy (R) (Anaes.) (Contrast) – MBS Item 63061
- Preoperative and postoperative CT scan – MBS Item 56001

30. If applicable, advise which health professionals will primarily deliver the proposed service:

DBS for epilepsy will be delivered by Neurosurgeons and Neurologists.

31. If applicable, advise whether the proposed medical service could be delegated or referred to another professional for delivery:

DBS therapy for epilepsy will not be delegated or referred to another health professional for delivery. Consequently, the proposed service should only be rebated by the health professional billing the service.

32. If applicable, specify any proposed limitations on who might deliver the proposed medical service, or who might provide a referral for it:

The delivery of DBS for epilepsy will only be undertaken by Neurosurgeons in conjunction with Neurologists.

It is anticipated that General Practitioners, Neurologists, and possibly other Medical Specialists will refer patients to Neurosurgeons for discussion/consideration of DBS for epilepsy.

33. If applicable, advise what type of training or qualifications would be required to perform the proposed service, as well as any accreditation requirements to support service delivery:

People performing the proposed service would include:

- Fellows of the Royal Australasian College of Surgery (FRACS) with specialist training in neurosurgery and expertise in functional neurosurgery
- Neurologists with advanced training in epilepsy or working in an advanced Comprehensive Epilepsy Program, with experience in neuromodulation.

34. (a) Indicate the proposed setting(s) in which the proposed medical service will be delivered (select ALL relevant settings):

☒ Inpatient private hospital (admitted patient)
☒ Inpatient public hospital (admitted patient)
☐ Private outpatient clinic
☐ Public outpatient clinic
☐ Emergency Department
☐ Private consulting rooms - GP
☐ Private consulting rooms – specialist
☐ Private consulting rooms – other health practitioner (nurse or allied health)
☐ Private day surgery clinic (admitted patient)
☐ Private day surgery clinic (non-admitted patient)
☐ Public day surgery clinic (admitted patient)
☐ Public day surgery clinic (non-admitted patient)
☐ Residential aged care facility
☐ Patient's home
☐ Laboratory
☐ Other – please specify below

(b) Where the proposed medical service is provided in more than one setting, please describe the rationale related to each:

The proposed medical service will only be provided in hospital settings.

35. Is the proposed medical service intended to be entirely rendered in Australia?

☒ Yes
☐ No

PART 6c – INFORMATION ABOUT THE COMPARATOR(S)

36. Nominate the appropriate comparator(s) for the proposed medical service (i.e. how is the proposed population currently managed in the absence of the proposed medical service being available in the Australian health care system). This includes identifying health care resources that are needed to be delivered at the same time as the comparator service):

Comparator

Vagal (or vagus), nerve stimulation (VNS) for epilepsy is as an appropriate comparator for DBS for epilepsy. Regulatory approval was granted in 2000 and VNS is listed on the MBS. Like DBS, VNS is a neuromodulation option and provides a palliative non-pharmacological alternative and/or adjunct therapy for management of seizures. VNS is not curative. While VNS is the closest comparator, there is robust multicentre evidence that DBS remains effective even if patients have not benefited from VNS.

A recent review concluded that VNS appeared to be an appropriate treatment option for a small number of adults and children with severe epilepsy whose disease is not adequately controlled with other available pharmacological and non-pharmacological treatments. VNS was deemed particularly useful for patients not responsive to, or suitable for, surgical resection of seizure foci (Shaw et al 2020).

The mechanism of action of VNS is not understood, although it is assumed to involve neuro-modulatory action via the vagus nerve. VNS prevents seizures by sending regular, mild pulses of electric signals to specific brain structures via the vagus nerve, resulting in a reduction in the frequency and intensity of seizures and changes in mood, behaviour, and cognition (Panebianco 2015).

VNS involves implantation of a vagus nerve stimulator (a pulse generator), under the skin on the left side of the chest. A wire from the device is then wound around the vagus nerve on the left side of the neck. The device produces repeating, low-level pulses of electrical current that are transmitted via electrical leads along the vagus nerve that are propagated to the brainstem (Morris et al 2013). The left vagus nerve is used to minimize adverse effects (Giordano et al 2017).

Surgical adverse events (infection, vocal cord paresis) and stimulation side effects (hoarseness, voice change, cough) have been reported following VNS (Gonzalez et al 2019). Minor side effects (coughing, voice alteration) are often temporary and usually decrease over time (American Academy Neurology 2013). Adverse events can be minimized through adjustment of the stimulation parameters and are more likely to occur on high stimulation settings than low settings (Panebianco 2015). If the VNS equipment or its components fail, people can be exposed to rare, but serious harms (Shaw et al 2020). As DBS is administering stimulation directly to the brain, it is not associated with many of the listed adverse effects that are associated with vagal nerve stimulation.

A review of the 30-day risk profile for 77 adults undergoing VNS, using multicentre patient data from an international database over 2005 – 2016 reported a mean operative time of 81.7 minutes and an average hospital stay of 0.27 days. Most (87.0%) patients were discharged on the day of operation. Low readmission (6.2%), reoperation (1.3%), and postoperative infection (1.3%) rates were reported (Selner et al 2019). A systematic review of 78 studies (2,869 patients) and VNS registry data (5,554 patients), reported that around 60% of patients achieved a ≥50% seizure reduction after 2–4 years, with a seizure-freedom rate of 8% (Englot 2016).

There are several important issues when considering VNS procedures. VNS creates safety issues for subsequent imaging, primarily due to patient safety concerns from lead heating in the MRI environment (Shellock et al 2006). This means that many advanced imaging sequences are not able to be used for patients who have VNS leads in situ, limiting the ability to detect subtle, surgically amenable lesions in the future. Inability to access appropriate imaging may also impact on the accurate targeting of thalamic nuclei, which is aided by specific high quality MRI sequences, some of which are unsafe in the presence of VNS electrodes. Consequently, for safety reasons, a modified protocol needs to be followed when performing MRI brain scans in patients with VNS implanted (Jonge et al 2014). Where VNS does not work, it is not easy to remove the electrode wires without damaging the vagus nerve. A review of 497 VNS procedures for 247 primary VNS implantations, over a 25-year period (mean follow up 12 years), reported that while hematoma, infection, and vocal cord palsy, were the most common complications postoperatively (rate approx.2%), it was noted that these complications may cause major suffering and even be life threatening (Révész et al 2016).

Healthcare Resources Delivered with VNS

The surgical placement of the VNS device and its components requires utilisation of the following healthcare resources:

- Surgical placement of the electrical pulser generator; also, possible surgical repositioning and/or removal of the electric pulse generator [REQUIRES – surgery, anaesthesia medications, anaesthetist fees, surgical fees etc.]
- Surgical placement of VNS lead; also, possible surgical repositioning and/or removal of lead [REQUIRES – surgery, anaesthesia medications, anaesthetist fees, surgical fees etc.]
- Electrical analysis and programming of VND device (electric pulse generator) using an external wand [REQUIRES – outpatient clinic visits, wand device]

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37. Does the medical service (that has been nominated as the comparator) have an existing MBS item number(s)?

☒ Yes (please list all relevant MBS item numbers below)
☐ No

Several Medicare Benefits Schedule (MBS) item numbers cover VNS for epilepsy as described below:

- **MBS Item Number 40701**
  Vagus nerve stimulation therapy through stimulation of the left vagus nerve, subcutaneous placement of electrical pulse generator, for: (a) management of refractory generalised epilepsy; or (b) treatment of refractory focal epilepsy not suitable for resective epilepsy surgery

- **MBS Item Number 40702**
  Vagus nerve stimulation therapy through stimulation of the left vagus nerve, surgical repositioning or removal of electrical pulse generator inserted for: (a) management of refractory generalised epilepsy; or (b) treatment of refractory focal epilepsy not suitable for resective epilepsy surgery

- **MBS Item Number 40704**
  Vagus nerve stimulation therapy through stimulation of the left vagus nerve, surgical placement of lead, including connection of lead to left vagus nerve and intra-operative test stimulation, for: (a) management of refractory generalised epilepsy; or (b) treatment of refractory focal epilepsy not suitable for resective epilepsy surgery

- **MBS Item Number 40705**
  Vagus nerve stimulation therapy through stimulation of the left vagus nerve, surgical repositioning or removal of lead attached to left vagus nerve for: (a) management of refractory generalised epilepsy; or (b) treatment of refractory focal epilepsy not suitable for resective epilepsy surgery

- **MBS Item Number 40707**
  Vagus nerve stimulation therapy through stimulation of the left vagus nerve, electrical analysis and programming of vagus nerve stimulation therapy device using external wand, for: (a) management of refractory generalised epilepsy; or (b) treatment of refractory focal epilepsy not suitable for resective epilepsy surgery

- **MBS Item Number <u>40708</u>**
  Vagus nerve stimulation therapy through stimulation of the left vagus nerve, surgical replacement of battery in electrical pulse generator inserted for: (a) management of refractory generalised epilepsy; or (b) treating refractory focal epilepsy not suitable for resective epilepsy surgery

38. (a) Will the proposed medical service/technology be used in addition to, or instead of, the nominated comparator(s)?

☐ In addition to (i.e., it is an add-on service)
☒ Instead of (i.e., it is a replacement or alternative)

(b) If yes, please outline the extent to which the current service/comparator is expected to be substituted

DBS and VNS are both established methods of providing neuromodulation in order to reduce seizure frequency and severity in patients with medically refractory epilepsy who are not suitable for curative resective surgery. Deciding between DBS and VNS requires highly trained expert opinion from qualified neurosurgeons and epilepsy neurologists practicing in a Comprehensive Epilepsy Program. This decision is based on a complex discussion; based on patient factors, such as seizure type and epilepsy syndrome, neuroimaging features, electrographic characteristics, and up-to-date knowledge of the literature. Within this difficult to treat cohort there are clearly patients that will benefit from DBS, rather than VNS (i.e., DBS as an alternative to VNS).

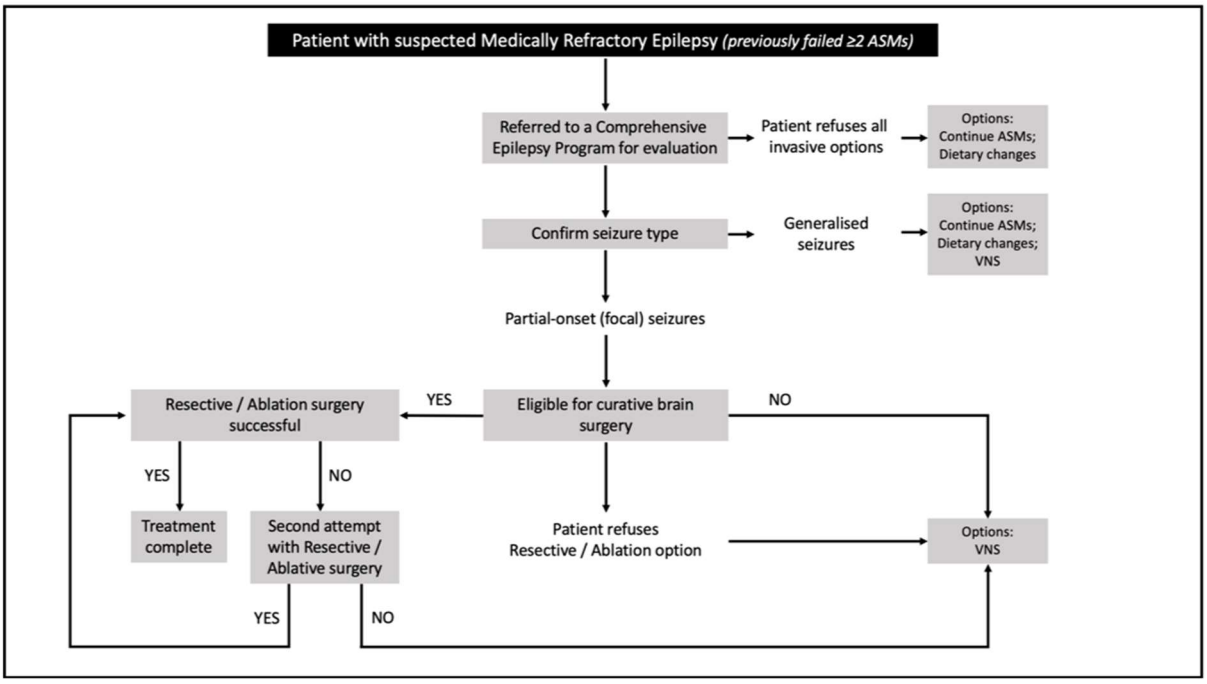
Having VNS as a pre-requisite to DBS (i.e., as an add-on service) places patients at risk of harms. If a less than optimal therapy is provided for a given patient, that patient may not achieve as significant reductions in seizures; or may take longer to achieve that reduction. For a patient with medication refractory epilepsy this would infer a sub-optimal reduction in harms or prolonged exposure to such harms. These harms have been previously outlined, including injury, hospitalisation, and SUDEP. Despite this, DBS has been repeatedly proven to provide significant seizure reduction in patients that have previously failed VNS. In addition, this effect was no different in magnitude or significance, compared to patients that had not previously had VNS (i.e., neuromodulation naïve). Not only is DBS a better alternative to VNS in a selection of patients, but the effect of the two can often be synergistic.

It is anticipated that DBS will be approved for use in patients with medically refractory epilepsy that has not responded to seizure medications and who are not candidates for VNS and/or who have failed a trial of VNS. Hence, DBS may potentially be used in addition to VNS (not as an add-on service, but as a new service to be delivered in the future, after an unsuccessful trial of VNS) or instead of VNS, where a patient is considered not to be a good candidate for VNS therapy.

<u>PART 6c CONTINUED – INFORMATION ABOUT ALGORITHMS (CLINICAL MANAGEMENT PATHWAYS)s</u>

39. Define and summarise the CURRENT clinical management pathway (algorithm) that patients follow when they receive the COMPARATOR service (i.e. the landscape <u>before</u> the proposed service is introduced). An easy-to-follow flowchart is preferred, depicting the current <u>clinical management pathway</u>), but dot-points would be acceptable. Please include health care resources used in the current landscape (e.g. pharmaceuticals, diagnostics and investigative services, etc.).

The diagram below summarises the current clinical management pathway for people diagnosed with Medical Refractory Epilepsy:

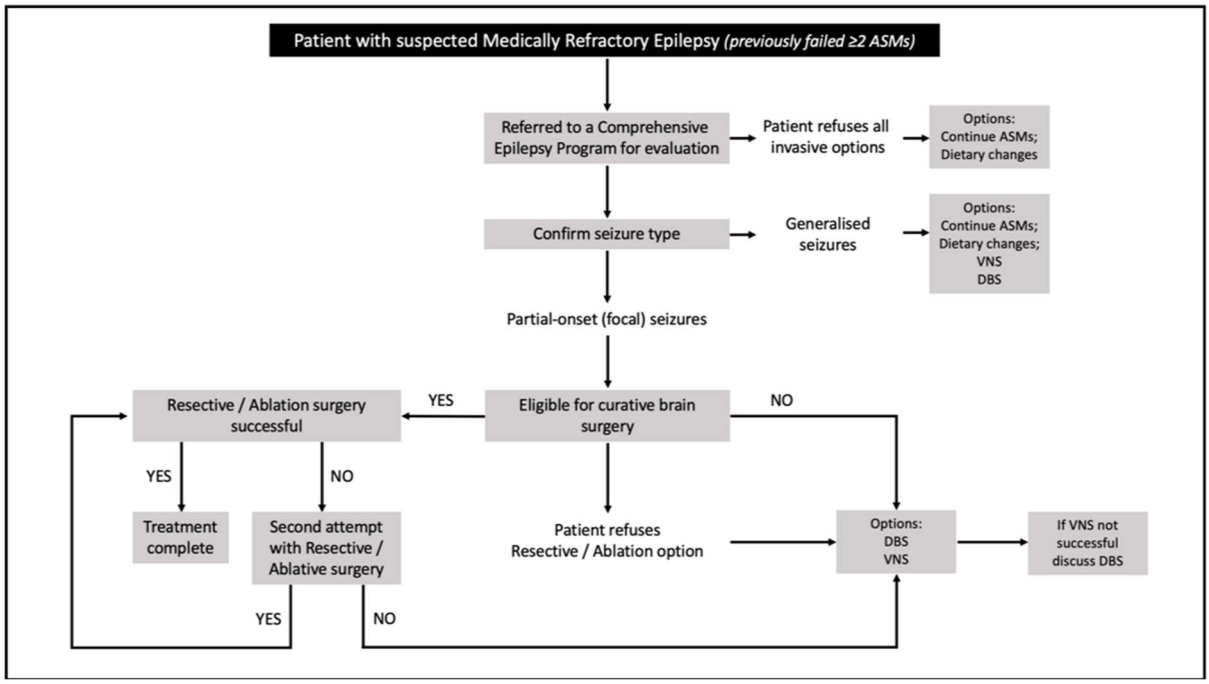


Abbreviations
EEG = electroencephalography, MRI = magnetic resonance imaging, ASM = antiseizure medication
VNS = vagal nerve stimulation

40. Define and summarise the PROPOSED clinical management pathway (algorithm) that patients would follow <u>after</u> the proposed service/technology is introduced, including variation in health care resources.

After the introduction of the proposed new therapy, deep brain stimulation (DBS), there would be changes to the clinical pathway for people with medically refractory localised (focal) seizures and no change to the clinical management pathway for people with generalised seizures.

People with **localised seizures and medically refractory epilepsy** will have an additional MBS approved treatment option, in addition to brain surgery and VNS, as described in the diagram below:



Abbreviations
EEG = electroencephalography, MRI = magnetic resonance imaging, ASM = antiseizure medication,
VNS = vagal nerve stimulation

PART 6d – INFORMATION ABOUT CLINICAL OUTCOMES

41. Summarise the clinical claims for the proposed medical service against the appropriate comparator(s), in terms of consequences for health outcomes (comparative benefits and harms):

The clinical evidence to support the clinical effectiveness of DBS is described in Part 4. DBS should only be considered when the patient is not suitable for curative resective brain surgery

For the treatment of medically refractory epilepsy, compared to VNS, it is expected that DBS will be:

- Superior with respect to clinical efficacy in selected patients
- Non-inferior with respect to safety

42. Please state what the overall clinical claim is:

The overall clinical aim of DBS therapy is to reduce the frequency and severity of epileptic seizures and improve quality of life in patients with medically refractory epilepsy, who have considered and/or trialed other pharmacological and surgical approaches without success.

43. List the key health outcomes (major and minor – prioritising major key health outcomes first) that will need to be measured in assessing the clinical claim for the proposed medical service/technology (versus the comparator):

Major (Primary) Outcomes

- Reductions in seizure frequency and severity, including seizure free days/month & proportion of patients with a 50% seizure reduction
- Improvements in Quality of Life/Activities of daily living - measured using an appropriate tool e.g., Washington Psychosocial Seizure Inventory, the Social Effects Scale, the Epilepsy Surgery Inventory, and the Quality of Life in Epilepsy Inventory (QOLIE), and the Liverpool QOL Battery, Liverpool Seizure Severity Scale (LSSS), Epilepsy Risk Awareness Scale (ERA), Generalised Anxiety Disorder Scale-7 (GAD-7), GASE (global assessment of severity of epilepsy- 7-point scale).

Secondary Outcomes

- Decrease in sudden death from epilepsy (SUDEP, as discussed earlier)
- Decrease in seizure related injuries
- Decrease in hospital admissions for seizure related injuries
- Decrease in carer stress.

Safety Outcomes

- Serious adverse events (neurologic & physical)
- Procedure related adverse events e.g., haemorrhage, implantations site infection
- Adverse events/complications e.g., depression, memory impairment.

Clinical Effectiveness Outcomes

- Reductions in seizure frequency & severity
- Quality of Life/Activities of daily living – measured using an appropriate tool as described above

PART 7 – INFORMATION ABOUT ESTIMATED UTILISATION

44. Estimate the prevalence and/or incidence of the condition in the proposed population:

The Australian Bureau of Statistics recently estimated the population prevalence of active epilepsy was 0.6% (6 per 1,000 people) using data from a National Health Survey 2017/18. Based on this prevalence data, a Deloitte Access Report estimated that around 150,00 Australians are living with active epilepsy (Deloitte 2020). After undertaking their own modelling to provide a more accurate figure, Deloitte reported that a total of 142,740 people were living with active epilepsy in 2019-20. Prevalence estimates reported for the Australian population are validated by the international literature (Deloitte 2020).

Assuming around 150,000 Australians have active epilepsy (Deloitte 2021) and given that 30-40% of people are reported to have medication resistant epilepsy (Chen et al 2018), it would be expected that 45,000 to 60,000 Australians, of all ages, have medication resistant epilepsy.

Only a fraction of people with medical refractory epilepsy in Australia are referred to a Comprehensive Epilepsy Program, a fact supported by the international literature, which reports that fewer than 1% of patients with medical refractory epilepsy are referred to a Comprehensive Epilepsy Program (Engel 2016).

References Cited

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Engel J. What can we do for people with drug-resistant epilepsy? The 2016 Wartenberg Lecture. Neurology. 2016; 87: 2483 – 2489.

45. Estimate the number of times the proposed medical service/technology would be delivered to a patient per year:

DBS surgery would be performed once in the patient's lifetime.

Programming would occur **REDACTED** times per year in the first year and possibly **REDACTED** a year thereafter for maintenance.

Battery replacement would occur about once every **REDACTED** years.

46. How many years would the proposed medical service/technology be required for the patient?

While DBS surgery is lifelong surgery, new DBS device components may be required over a patient's lifetime where therapy is successful. The time interval for revision surgery will vary amongst patients. A major determinant for the frequency of repeat procedures will be the battery life of the neurostimulator device implanted. The neurostimulator box may need to be changed on average every five years, or less often, depending on the type of device used and how often the device is used by the individual.

For example, in DBS for Parkinson's disease (PD), the frequency of device replacement is dependent on the model of neurostimulator, and the program settings used. The PerceptTM PC neurostimulator battery lasts over 3 to 5 years on average.

Electrode lead revision surgery in the context of Parkinson's DBS is around 10% of cases in Australia. An Australian cross-sectional, population-based study assessed data from the Australian Government covering a 15-year period (2002-2016) for 1849 patients with PD following DBS implantation. Annual programming rates of 6.9 in the first year, and 2.8 in subsequent years, were reported in this cohort (Xu et al. 2021).

Device performance and battery life are important considerations. DBS device performance, including the battery level, is assessed at each medical review by the person's doctor. Patients can also check battery performance using their patient programmer at any time and are instructed to contact their doctor if they stop receiving symptom relief. Patients are advised to plan to have their device replaced, rather than waiting for their battery to run out (Medtronic United Kingdom).

References Cited

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47. Estimate the projected number of patients who will utilise the proposed medical service(s) for the first full year:

It is estimated that approximately **REDACTED** patients will utilise DBS in the first year.

48. Estimate the anticipated uptake of the proposed medical service/technology over the next three years, factoring in any constraints in the health system in meeting the needs of the proposed population (such as supply and demand factors), as well as provide commentary on risk of 'leakage' to populations not targeted by the service.

It is estimated that DBS uptake will increase by approximately **REDACTED** per year, until a steady state is reached. The demand for DBS surgery is expected to plateau at three to five years, following availability of the surgery on the MBS.

Potential barriers to uptake of DBS include access/referral to a Comprehensive Epilepsy Program for evaluation of suspected medical refractory epilepsy. Other barriers include access to hospital beds in the public hospital system and access to, and availability of, the device and components to enable surgery in the public hospital system. Medical workforce would be a significant limiting factor, with a small number of specialist neurosurgeons adequately trained to insert a DBS device, and an equally small number of epilepsy neurologists with sufficient experience in neuromodulation.

'Leakage' of DBS to other patient populations is not anticipated, as several MBS items already exist for conditions where DBS is widely accepted to have proven benefits. This includes current MBS listings for DBS in Parkinson's disease, where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations, as well as in essential tremor or dystonia where the patient's symptoms cause severe disability. 'Leakage' to other population groups is unlikely, as there is a paucity of evidence to support DBS in non-research settings. For example, DBS has not received FDA regulatory approval for use in depression, bipolar disorder or for treating Tourette in the United States.

PART 8 – COST INFORMATION

49. Indicate the likely cost of providing the proposed medical service. Where possible, please provide overall cost and breakdown:

The likely cost of providing the medical service will be made up of the fee for surgical implantation of the device and leads and the inpatient hospital admission costs. A funding stream will also be required for the purchase of the neurostimulator device and associated components, including the leads and the patient handheld controlling device. The breakdown of MBS fees is described in terms of neurosurgery and neurology components for implantation of the device. The MBS items supporting DBS for epilepsy would be restricted for use by neurosurgeons.

An overall breakdown of delivery of DBS is presented in the table below:

Table Approximate Cost Profile of DBS for Epilepsy

Item	Cost	Reference
Neurosurgeon	$4,123.60	MBS item number 40851
Neurologist	$2,104.65 $197.40	MBS item number 40860 MBS item number 40862
Prostheses/single use consumables	REDACTED	Please refer to summary table below for details
Anaesthesia	Variable depending on individual patient needs & surgical plan	
Hospital admission (including investigations)	Variable depending on hospital (public/private)	

Summary of Prostheses/single Use Consumables

Model No.	Description	Quantity	Unit Prices AUD	Total Price AUD
924256	StimLoc caps	REDACTED	REDACTED	REDACTED
FC1020	MER Cable	REDACTED	REDACTED	REDACTED
FC1036	MER Canula	REDACTED	REDACTED	REDACTED
FC2002	MER Electrode	REDACTED	REDACTED	REDACTED
3387-40	DBS Lead	REDACTED	REDACTED	REDACTED
3755-40	DBS Tunneller	REDACTED	REDACTED	REDACTED
37086xx	DBS Extension	REDACTED	REDACTED	REDACTED
B35200	Percept IPG – PC	REDACTED	REDACTED	REDACTED
TH91D02	Patient Programmer	REDACTED	REDACTED	REDACTED
B37120	Carry case	REDACTED	REDACTED	REDACTED
TOTAL		**$ REDACTED**		

50. Specify how long the proposed medical service/technology typically takes to perform:

DBS surgery usually takes around four hours to perform (expert opinion).

51. If public funding is sought through the MBS, please draft a proposed MBS item descriptor to define the population and usage characteristics that defines eligibility for the medical service/technology.

It is anticipated that current item numbers will be expanded, as discussed below, to include the subgroup of people with epilepsy who have been evaluated at a Comprehensive Epilepsy Program and have been determined to have medically refractory epilepsy and who are not suitable for resective surgery. Lastly, please note that no changes have been suggested/made for existing fees.

Category 3 – Therapeutic Procedures - Proposed expansion of MBS Item Number 40851
Proposed item descriptor: DEEP BRAIN STIMULATION (bilateral) functional stereotactic procedure including computer assisted anatomical localisation, physiological localisation including twist drill, burr hole craniotomy or craniectomy and insertion of electrodes for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program. Fee: $4,123.60

Category 3 – Therapeutic Procedures - Proposed expansion of item number 40852
Proposed item descriptor: DEEP BRAIN STIMULATION (unilateral) subcutaneous placement of neurostimulator receiver or pulse generator for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program. Fee: $354.40

Category 3 – Therapeutic Procedures – Proposed expansion of item number 40854
Proposed item descriptor: DEEP BRAIN STIMULATION (unilateral) revision or removal of brain electrode for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program; or Fee: $547.50

Category 3 – Therapeutic Procedures – Proposed expansion of item number 40856
Proposed item descriptor: DEEP BRAIN STIMULATION (unilateral) removal or replacement of neurostimulator receiver or pulse generator for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program. Fee: $265.80

Category 3 – Therapeutic Procedures – Proposed expansion of item number 40858
Proposed item descriptor: DEEP BRAIN STIMULATION (unilateral) placement, removal or replacement of extension lead for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program. Fee: $547.70

Category 3 – Therapeutic Procedures – Proposed expansion of item number 40860
Proposed item descriptor: DEEP BRAIN STIMULATION (unilateral) target localisation incorporating anatomical and physiological techniques, including intra-operative clinical evaluation, for the insertion of a single neurostimulation wire for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program. Fee: $2,104.65

Category 3 – Therapeutic Procedures – Proposed expansion of item number 40862
Proposed item descriptor: DEEP BRAIN STIMULATION (unilateral) electronic analysis and programming of neurostimulator pulse generator for the treatment of: Parkinson's disease where the patient's response to medical therapy is not sustained and is accompanied by unacceptable motor fluctuations; or Essential tremor or dystonia where the patient's symptoms cause severe disability; or Medically refractory epilepsy in patients not suitable for resective surgery following assessment by a Comprehensive Epilepsy Program; or Fee: $197.40

52. If public funding is sought through an alternative (non-MBS) funding arrangement, please draft a service description to define the population and usage characteristics that defines eligibility for the service/technology.

This section is not applicable as MBS funding is being sought.