

Commentary on:

Deep Brain Stimulation and Ethics: Perspectives from a Multisite Qualitative Study of Canadian Neurosurgical Centers
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Neuroethical Principles of Deep-Brain Stimulation

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Results from translational neuroscience and novel neuroimaging methods have given us unprecedented insights into the fundamental mechanisms of the human brain. This new understanding has given rise to treatments and interventions for previously treatment-resistant disorders, perhaps most poignantly shown by the instant reversal of motor symptoms by deep-brain stimulation (DBS; e.g., see videos in supplementary material in Kringelbach et al. [14]). As such, DBS has been remarkably successful when applied to movement disorders such as Parkinson disease (3, 9), essential tremor (7, 19), and dystonia (22) and even to affective disorders such as chronic pain (15) and cluster headache (6).

The underlying principles and mechanisms of DBS have not yet been fully elucidated (13, 17), but the evidence points to a role in the modulation of oscillatory activity in large-scale brain networks (4, 12), perhaps linking DBS to a rebalancing of the brain's resting state networks (11). What is clear at this point is that DBS directly changes brain activity in a controlled manner and that, in principle, the resulting effects are reversible (18).

Despite the gaps in our current knowledge of the underlying mechanisms, DBS continues to be an important clinical treatment for movement disorders, with more than 60,000 patients treated since the early 1990s. There are risks with DBS that are similar with any stereotactic neurosurgical procedures, including intracranial bleeding, hardware-related complications such as dislocation, lead fracture, and infection, as well as stimulation-induced side effects (related to the location of the stimulation electrode) such as mania, depression, aggression, mirthful laughter, and penile erection.

The invasive and potentially harmful nature of DBS means that it is paramount that the neuroethical implications are evaluated (5, 20). In addition, given that DBS is an expensive treatment, the cost-effectiveness of DBS also needs to be carefully assessed (16).

These neuroethical considerations should ideally include the principles of nonmaleficence, beneficence, justice, and respect for autonomy and the additional principles of subsidiarity and proportionality (20). Thus, the most important issue for DBS is to find the best possible balance of potential benefits and risks while respecting the autonomous wish of the patient.

The principle of nonmaleficence, "first, do no harm," calls for minimization of the risks and potential side effects (physical and mental) of DBS surgery. It also calls for an evaluation of the potential effects of DBS on personal identity and the developing brain.

The principle of beneficence, "do well," calls for optimization of the effectiveness in the DBS treatment both during the operation and the following psychosocial care. In addition, the principle of justice, "treat all cases alike," calls for the best possible rationing and prioritization of DBS treatment for patients.

The respect for autonomy, "respect patient's well-informed choice," relies on informed and necessary competence to consent. It raises special questions for the treatment in children, and calls for the best possible management of unrealistic expectations and even desperation in the patient.

Finally, the principles of subsidiarity, "choose least burdensome alternative," and proportionality, "risks and benefits in proportion," are key to ensuring the best possible patient selection for DBS

Key words

- Deep-brain stimulation (DBS)
- Ethics
- Parkinson disease
- Patient selection
- Resource allocation

Abbreviations and Acronyms

DBS: Deep-brain stimulation



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surgery. As such, the principles prescribe that DBS should only be used when other less-burdensome or risky treatment options have been exhausted.

Some of these general neuroethical principles related to DBS have been investigated in the paper by Bell et al. in the current issue of **WORLD NEUROSURGERY**. The authors performed semi-structured interviews with health care providers in a number of provinces in Canada investigating the ethical and social challenges with DBS surgery. A content analysis of the interviews identified three main issues related to patient selection, resource allocation, and postoperative psychosocial care in the community. This analysis leads the authors to propose action for health care providers for the long-term care and postoperative monitoring of DBS patients. They also propose that more data on patient perspectives might inform and contribute to better DBS treatment, especially for patient selection, management, and resource allocation.

The paper by Bell et al. thus provides a practical perspective on the ethics and social challenges related to DBS for movement disorders in Canada. More research is needed to further investigate the central neuroethical challenges related to subsidiarity and proportionality, especially given that psychiatrists around the world have started to use DBS for the treatment of psychiatric disorders such as depression (2) and obsessive-compulsive disorders (8).

The potential future avalanche of DBS for psychiatric disorders must be guided by the hard-earned ethical lessons from psychosurgery and not provide false hope to patients where sometimes there is none (10). Any progress in DBS treatment and difficult issues such as patient selection has to rely on balancing clinical work with fundamental scientific research. This translational research has to develop models that can accurately inform human clinical treatments. The highly successful MPTP model has meant that real progress has been made in identifying safe and effective DBS for movement disorders (1). Comparable models do not yet exist for psychiatric disorders and it is essential that DBS treatments proceed with care and that we move beyond generalizing from single case-studies (21).

To summarize, DBS has great potential to alleviate human suffering. Yet, to live up to this potential, there are significant neuroethical challenges that must be met. At the very minimum, DBS should help improve the lives of patients and should only be used when all other possible interventions have been tried. In addition, full informed consent must be obtained from patients. DBS must be supported by interdisciplinary teams of neurosurgeons, neuroscientists, psychologists, and nurses who can help assess the patients' suitability for DBS and continuously monitor them over time. DBS should help restore (but not augment) normal function, should provide relief from distress and suffering, and never be used for law enforcement, political or social purposes.

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