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INSIGHT : AN ETHICAL FRAMEWORK TO ASSESS COVERT CONSCIOUSNESS

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Supplementary appendix

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The potential for cognitive motor dissociation in patients who are behaviourally unresponsive after a severe brain injury poses profound ethical challenges. An international study revealed that one in four patients who appear unresponsive to verbal commands is capable of doing cognitive tasks detected through functional MRI or EEG (ie, has cognitive motor dissociation). Cognitive motor dissociation can be considered a subset of covert consciousness—that is, preserved consciousness that evades routine bedside detection.[2] Current task-based functional MRI and EEG tests are insensitive, because they are tailored to patients who can follow cognitively demanding instructions. Given the global burden of brain injury, the potential widespread prevalence of covert consciousness is likely to become a public health issue. Access to technologies to detect covert consciousness and to enhance prognostication remain out of reach for most patients worldwide. These circumstances introduce unprecedented questions. What obligations exist to detect covert consciousness and democratise access to neurotechnologies? What values and principles ought to

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guide the development and deployment of neurotechnologies for responsible assessments of consciousness and the prediction of recovery? Here, we describe an aspirational framework, co-designed by specialists in disorders of consciousness, clinical care, neurotechnology, and neuroethics. Our framework is not a definitive guide, but a starting point for collective deliberation, acknowledging the resource-limited environments in which medicine is practised. The obstacles to achieving these goals vary by country, necessitating approaches tailored to specific local conditions.

Insofar as consciousness grounds the possibility of subjective experience and self-expression (as Immanuel Kant designated "the essential condition of all logical forms of cognitions"), society at large has a vested interest in discovering its presence and neuronal substrate. Individuals with disorders of consciousness are at heightened risk of undertreatment, goal-discordant care, and marginalisation. Investments in research and infrastructure are therefore needed to democratise the implementation of, and access to, covert consciousness testing to ensure that patients who stand to benefit most from these techniques can equitably access them, and that these innovations do not remain siloed at their source. In tandem, educational initiatives involving caregivers, patient advocates, policymakers, health insurers, and other stakeholders are necessary to inform the public about the implications of covert consciousness. These efforts should seek societal input on whether and how to consider covert consciousness when determining approaches to care. Such multi-stakeholder dialogue can help shape policies that reflect diverse ethical considerations, societal values, and the evolving scientific understanding of coma and consciousness.

In the international study, the detection of cognitive motor dissociation across sites was not uniformly one in four, but ranged from 2% to 45% of patients in the different centres— a discrepancy unlikely to be explained solely by the different populations. Furthermore, a high false-negative proportion of 62% was observed across sites in patients who were overtly conscious, underscoring the poor performance of task-based functional MRI or EEG for detecting consciousness. Many patients are unable to demonstrate command-following through functional MRI or EEG, and even healthy individuals can have difficulties with such tasks. Standard operating procedures should therefore be established to promote consistency in stimulation paradigms, analysis methods, and the interpretation of results. Reproducibility across different settings, including resource-limited environments, is essential. Furthermore, complementary techniques for

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detecting consciousness that are not cognitively demanding are warranted. These techniques might include passive paradigms, such as EEG or neuroimaging assessment of cognitive processing, or the use of transcranial magnetic stimulation combined with EEG that probes brain complexity, with the ultimate goal of establishing a toolkit of complementary assessments. Empirical neuroethics inquiry, including examining the experiences of patients who have emerged from covert to overt consciousness, should be embedded in future research efforts to clarify its phenomenology and normative dimensions, elements that have been conspicuously overlooked so far.

Given the relatively high incidence of covert consciousness among behaviourally unresponsive patients, it is incumbent upon clinicians to adopt a default assumption that any unresponsive patient might still possess residual consciousness. This precautionary premise should inform bedside manner and overall approaches to patient care.

For clinicians involved in assessing consciousness, a standardised, tiered assessment strategy is appropriate for patients in facilities with access to the necessary infrastructure. This strategy should begin with serial standardised neurobehavioural assessments. If neuro- behavioural assessments indicate a positive result (ie, overt signs of consciousness), no further testing might be necessary. However, if the assessments yield a negative result, clinicians should consider more sophisticated testing. The next step in a tiered approach should include testing for covert consciousness, which can include task-based EEG or functional MRI. If unavailable, at a minimum, resting- state EEG should be obtained. Results of testing should be carefully framed and responsibly shared with carers and families, by use of visual aids to enhance communication when possible, and pre-test and post-test counselling. Recognising that states of consciousness can fluctuate, repeated assessments, particularly with EEG due to its relative ease of administration, might be warranted. In line with European guidelines, a patient should be classified according to the highest level of consciousness detected through any test, implying that, when testing has not been exhausted, the evaluation remains incomplete. Disparate approaches are offered by US and UK guidelines, and opportunities for harmonisation exist. For patients in settings without advanced testing, clinicians should consider transferring patients to facilities that offer bundled testing. In some cases, screening tests like resting-state EEG might be indicated. Hub-and-spoke model systems and open-sourcing of testing pipelines are candidate strategies that could be leveraged to enhance global accessibility of advanced techniques. The high costs of advanced

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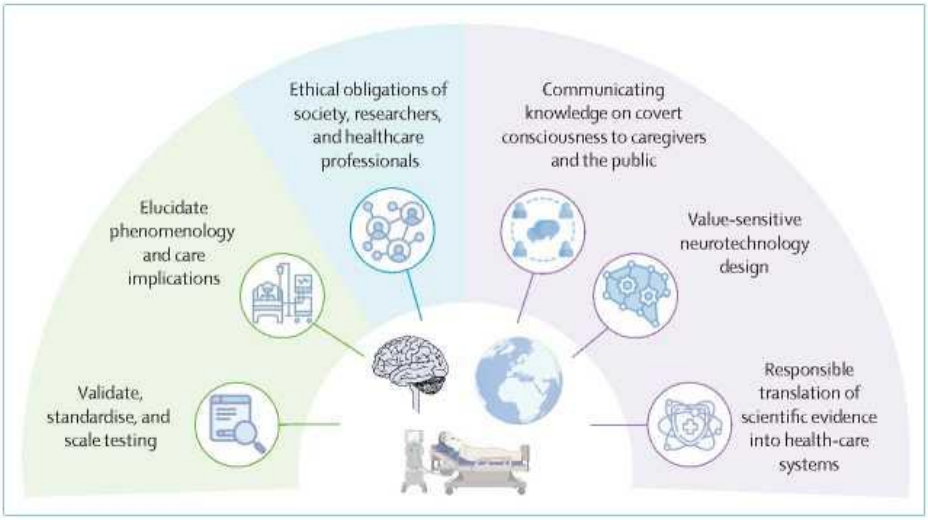
technologies, the need for specialists to process and interpret results, lack of health provision in many parts of the world, and the inherent uniqueness of each patient limit uniform access to testing.

Moreover, despite that up to 40% of patients diagnosed by medical consensus as being in a vegetative state are actually in a minimally conscious state, with significant prognostic implications, many countries still lack the basic infrastructure to routinely mandate such evaluations. This situation underscores a need for foundational infrastructure and education.

Communicating the diagnosis of covert consciousness requires a nuanced approach that emphasises diagnostic humility. It is important to convey that a person can be conscious, that is, have subjective experiences, even in the absence of external signs of awareness.

Technologies such as EEG and functional MRI can reveal brain activity indicative of consciousness, but these tools have limitations, and the absence of signs of covert consciousness does not necessarily imply the absence of consciousness. Conversely, their presence can provide hope for future recovery, though outcome remains a complex and uncertain area of study. Further research is needed to elucidate optimal approaches to interpret composite test results and reconcile discordant results.

Figure: A framework for expanding principles with research and clinical



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The detection of covert consciousness should inform patient care in ways that prioritise potential for recovery, and support liminal capacities and the restoration of self-expression. Management should also involve optimisation of pharmacological approaches to promoting wakefulness and awareness. While the presence of command-following or preserved brain complexity might warrant a search for subtle motor output or obstacles to self-expression, it is appropriate to remain agnostic about prioritising patients based solely on advanced technology, especially as the sensitivity and specificity of such tests are not enough. Advance care planning should prompt proactive consideration of covert consciousness.

Care directives should reflect the possibility of covert consciousness and guide interventions in alignment with patients' preferences and quality-of-life considerations. Proactive attention to potential sources of pain and discomfort is therefore essential and can be optimally addressed in consultation with palliative care specialists.

As neurotechnologies evolve, their development and deployment must be guided by values and principles that ensure responsible design and ethical use. Key considerations include accessibility, feasibility, reproducibility, sensitivity, specificity, relative risk, and cost-effectiveness.

These considerations should be balanced with the practicalities of bedside testing and the need for technologies that are both easy to use and economically viable. In the context of brain-computer interfaces, which hold promise for refining assessment and management of covert consciousness, it is important to consider the trade-offs between invasive and non-invasive approaches.

The discovery of covert consciousness and its underdiagnosis requires a re-evaluation of current practises. Reconciling the ethical, clinical, and societal challenges raised by these discoveries requires an approach that proactively incorporates the perspectives from clinicians, researchers, ethicists, patient advocates, and policymakers (figure). As knowledge on consciousness continues to increase, so too must approaches to its detection, and to prognosis and management, and communication to carers and the public. From recognition of covert consciousness thus follows a moral obligation to foster the development of accessible approaches to testing for all patients affected.

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