Ethical tensions of virtual reality treatment in vulnerable patients

Emerging virtual reality systems offer intriguing therapeutic possibilities, but their development and use should be guided by ethical priorities that account for the specific vulnerabilities of patients.

Philipp Kellmeyer, Nikola Biller-Andorno and Gerben Meynen

Virtual reality (VR) technology provides a digital simulation of an environment, for instance a classroom, a city center or a rollercoaster. Using a VR headset, often also in combination with handheld motion controllers, the user can feel particularly 'present' (see Box 1) and can explore such an environment, meet other persons in the form of avatars and interact with them.

In recent years, VR systems have made substantial technological progress, particularly in terms of their simulation capacities. As a result, they have become highly 'immersive' (see Box 1). Today, VR is popular for consumers, but also for research purposes in psychology, cognitive sciences and clinical medicine[1]. In health care, such highly immersive VR systems can provide significant benefits for various groups of patients (see Table 1). For instance, paralyzed patients may use VR to augment physical rehabilitation therapy[2]. Patients suffering from anxiety disorders may experience powerful virtual exposure, for instance in the treatment of fear of heights (see Fig. 1)[3]. People with paranoia may walk virtual streets and learn to interpret external cues more appropriately with the help of VR training programs[4]. In forensic psychiatry, VR opens up the possibility of creating contexts in which people may safely learn to cope with aggressive feelings and antisocial behavior: nobody is harmed when the patient responds aggressively[5].

A significant advantage of VR is that this type of 'reality' can be controlled, so patients learn to deal with challenges in a stepwise manner. Yet, as many of the clinical applications are still confined to clinical research, VR must be considered an emerging medical technology rather than a routine treatment option.

Meanwhile, the use of VR in clinical research and treatment creates new forms of human–technology interaction in medicine with substantial ethical tensions[6], particularly in regard to vulnerable patients.

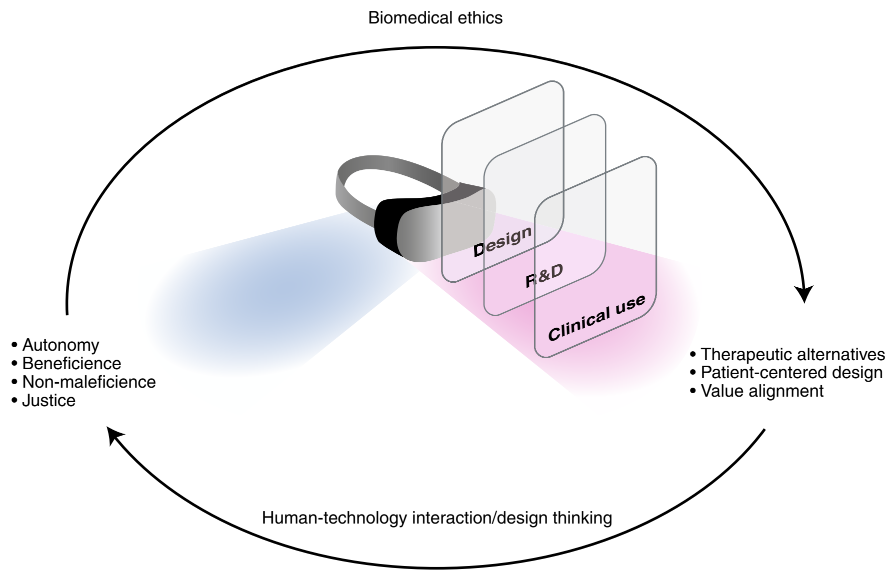

Fig. 1 | The responsible design, research and development (R&D) and clinical use of VR systems should be embedded in a framework that includes concepts and priorities from biomedical ethics, human–technology interaction studies and design thinking.

Ethical tensions in VR treatment

The ethical tensions created by VR use in medicine may vary considerably depending on the patient's underlying condition (summarized in Table 1) and specific vulnerabilities.

Current classifications in medical ethics and disability studies distinguish between many types of vulnerability, but most definitions include the core notion of susceptibility to physical or psychological harm[7–9]. While acknowledging the definitional diversity, we have taken the comprehensive classification by Mackenzie et al.[7] as our frame of reference (Table 1). In this classification, vulnerability can be inherent (e.g., through congenital conditions), situational (e.g., in a forensic institution) or pathogenic (e.g., cognitive dysfunction in dementia).

Now, consider the following scenario: A dementia patient receives VR treatment for her restlessness and fugue behavior. The VR environment is closely modeled after her old home. She is virtually living in her former surroundings. As a result, she becomes calm and less agitated. This is an important beneficial effect not only for herself but also for her family members, previously burdened by her restlessness. But ethical tension emerges from the fact that this result is achieved through a form of deceptive illusion. Made vulnerable by her decreased cognitive capacities, the patient is deceived into believing she is at home—unable to distinguish actual reality from the virtual one.

Alternatively, consider a severely paralyzed, 'locked-in' patient. He may benefit enormously from the possibilities offered by highly immersive VR in regard to interaction with other people. The VR system may be coupled with a brain–computer interface, so that the patient can navigate virtual worlds and interact socially with others through avatars. This would substantially improve his agency and autonomy. Yet, particularly

Table 1 | Current clinical applications of VR technology in medicine: therapeutic goals, methods and key vulnerabilities

	Clinical discipline(s)	Treatment goals	Treatment concepts	Key vulnerabilities
Disease or disorder				
Stroke	Neurology	Rehabilitation; reorganization	Functional assistance; brain reorganization	Type[a]: occurrent, situational, pathogenic. Time: acute and chronic Mechanism: impaired communication and/or cognition; comorbidity
Parkinson's disease	Neurology	Improvement of balance, gait, tremor	Functional assistance; training of the central and peripheral 'balance system'	Type: dispositional, pathogenic Time: chronic Other: cognitive impairment; comorbidity
Dementia	Neurology, psychiatry	Containment of harmful behavior; improvement of cognition (memory, spatial orientation); occupational	Functional assistance; containment of 'wandering' behavior	Type: dispositional, pathogenic, institutional (care facilities) Time: chronic Other: impaired agency, cognition, decision-making capacity
ADHD	Psychiatry	Improvement of cognitive performance; facilitation of focus	Functional assistance; augmentation of behavioral therapy; neural reorganization (?)	Type: dispositional, pathogenic, institutional Time: chronic Other: developmental aspects; impaired impulse control; comorbidity
Paraphilic disorders	(Forensic) psychiatry	Reduction and/or better control of paraphilic urges	Virtual provision of 'objects' of sexual desires; augmentation of behavioral therapy	Type: dispositional, pathogenic, institutional Time: chronic Other: social stigma
Eating disorders	Psychiatry	Improvement of distorted body-related perception and cognition; augmentation of behavioral therapy	Simulation of body-related aspects of personalized avatar; simulations of virtual ingestion-related objects	Type: dispositional or occurrent, pathogenic Time: transient or chronic Other: autonomy, developmental aspects
Autistic spectrum disorder	Psychiatry	Improvement of social skills	Provision of a safe and contained virtual space for social interaction; augmentation of behavioral therapy	Type: dispositional or occurrent, pathogenic Time: chronic Other: developmental aspects; comorbidity, labeling problem
Specific phobia	Psychiatry, clinical psychology	Reduction of phobic reactivity	Realistic simulation of phobia-inducing stimuli to augment behavioral therapy	Type: dispositional or occurrent, pathogenic Time: transient or chronic Other: social isolation
Anxiety disorders	Psychiatry, clinical psychology	Reduction of anxiety levels	Provision of a safe and contained virtual space for (social) interaction	Type: dispositional or occurrent, pathogenic Time: transient or chronic Other: social isolation
Symptoms				
Vertigo	Neurology, otolaryngology	Reduction of vertigo; improvement of balance	Training of the central and peripheral 'balance system'	Type: occurrent, pathogenic Time: transient or chronic Other: occupational
Pain	Multidisciplinary	Reduction of pain perception	Modulating top-down and bottom-up aspects of pain perception	Type: occurrent, pathogenic Time: transient or chronic Other: comorbidity
Anxiety	Psychiatry, clinical psychology	Reduction of anxiety	Provision of safe virtual spaces for gradual exposure to anxiety-inducing stimuli	Type: occurrent or dispositional, pathogenic Time: transient or chronic Other: comorbidity, social isolation

[a] Types of vulnerability refer to the classification by Mackenzie et al. (2013)[7].

given the persuasive aspects of VR[10], the technology may constitute an offer which the patient may find difficult to refuse. Thus, the seductive and compelling nature of "persuasive technologies"[11] (Box 1) such as highly immersive VR systems may reduce the space for autonomous choice if the intervention seems so compelling that alternatives appear not worth considering.

Box 1 | Concepts from human-technology interaction and VR

Immersion refers to a VR user's experience of being wholly 'absorbed' by the simulated environment, momentarily 'forgetting' his or her embodied presence in the physical world. The user has the feeling that he or she is 'really there'. Consequently, the user will respond physically and psychologically to the environment as if it were real.

Persuasive technology refers to a technology, such as a computer or VR system, that aims to influence a user's behavior. Typically, this persuasion makes use of particular characteristics of human psychology, such as cognitive heuristics or social incentives[14].

Presence describes the VR user's perception of immediately experiencing the VR simulation. Often, it is also used in reference to other persons who might be *co-present* or *socially present* in VR, e.g., a clinical therapist or another user in a VR group therapy. The user does not experience this as the presence of an avatar, but as the actual presence of another person.

For both of these patients, VR offers unique beneficial possibilities. At the same time, both patients are vulnerable, and tensions arise regarding (1) deception and informed consent, in this scenario in a patient with cognitive vulnerability as a result of dementia; and (2) the persuasiveness of VR technology and its effect on autonomous choice, particularly in situations in which alternatives are lacking. In fact, it might well be that the more vulnerable a patient is, the more beneficial VR can be. In reality, the locked-in patient has only extremely limited options for interaction with other people; VR suddenly opens up new possibilities. At the same time, it is in these instances that the ethical tension becomes particularly acute.

The tensions created by deception in the first case and by the technology's allure in the second case, however, extend beyond the principles of autonomy, beneficence, non-maleficence and justice in biomedical ethics and require conceptual insights derived from the study of human–technology interaction[12].

Priorities for responsible VR use in vulnerable patients

Because of the ethical tensions discussed above, it is important to develop consensus guidelines for the responsible use of VR in vulnerable patients. In our view, we have the ethical obligation to let patients benefit as much as possible from new technologies while taking into account specific types of vulnerability through which VR could cause them harm. To this end, we suggest three priorities to diffuse the ethical tensions discussed above. These priorities could guide the responsible development and use of VR technology in medicine—acting in a complementary fashion to the more traditional principles of medical ethics discussed above.

The first priority for promoting the responsible use of VR technology in medicine is *therapeutic alternativism*. This means that any VR research program in vulnerable patients should ask first whether there are viable therapeutic alternatives grounded in *human–human* rather than human–machine interaction. We should resist the well-known tendency to turn to technology to solve our problems ("technological solutionism"[13]). For many patients, *real human* contact, for instance with caregivers, is likely preferable to interaction with avatars.

The second priority is *human-oriented value alignment*. This posits that medical VR technology should be oriented towards protecting important human values—such as dignity and autonomy—rather than the other way around. Therefore, the guiding question should be "How can VR be applied to allow for the free expression and flourishing of the user's values?". High levels of vulnerability often negatively impact autonomy and other key anthropological preconditions for protecting human freedom and promoting human flourishing. Therefore, VR applications should not intrude upon central human values, but foster them.

The third, related, priority is *patient-centered design*. This concerns the ways in which VR systems are developed for medical use today. Currently, existing commercial VR systems are adapted for specific medical uses. But it is important to take the clinical and social context as a point of departure: patients, not consumers, are the end users. Patient-centered design has become technically possible through open programming frameworks permitting the independent design of virtual environments by clinical research teams. To diffuse the problem of the persuasive allure of VR technology, which can be magnified by key vulnerabilities of particular patients or patient groups, developing medical VR systems should also include the voices of vulnerable patients from an early stage of design and development.

In conclusion, VR technology offers great potential benefits for various groups of patients, yet its development and application should be guided by ethical priorities that account for the specific vulnerabilities of these patients. ❒

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Competing interests

The authors declare no competing financial interests.