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Transcending human frailties with technological enhancements and replacements: Transhumanist perspective in nursing and healthcare

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Abstract

As human beings age, they become weak, fragile, and feeble. It is a slowly progressing yet complex syndrome in which old age or some disabilities are not prerequisites; neither does loss of human parts lead to frailty among the physically fit older persons. This paper aims to describe the influences of transhumanist perspectives on human-technology enhancements and replacements in the transcendence of human frailties, including those of older persons, in which technology is projected to deliver solutions toward transcending these frailties. Through technologies including genetic screening and other technological manipulations, intelligent machines and augmented humans improve, maintain, and remedy human-linked susceptibilities. Furthermore, other technologies replace parts fabricated through inorganic-mechanical processes such as 3D-printing. Advancing technologies are reaching the summit of technological sophistication contributing to the transhumanist views of being human in a technological world. Technologies enhance the transcendence of human frailties as essential expressions of the symbiosis between human beings and technology in a transcendental world.

KEYWORDS

artificial intelligence, caring in nursing, human frailties, nursing technologies, technological competency as caring in nursing, transcendence, TRETON

> As biotechnology advances, so too may our ideas of what it means to be human. Today, we can alter our bodies in previously unimaginable ways, whether that's implanting microchips, fitting advanced prosthetic limbs, or even designing entirely new senses. So-called transhumanists – people who seek to improve their biology by enhancing their bodies with technology – believe that our natural condition inhibits our experience of the world and that we can transcend our current capabilities through science
>
> (CNN, May 29, 2020)

1 | INTRODUCTION

Before 1980, the term 'human frailty' was rarely used at all in the literature particularly concerning older people. However, in 1978, the Federal Council on Aging (FCA) in the United States introduced the term 'frail elderly' to describe a specific segment of the population as those older persons who may not be over 75 years old but may require supportive amenities to cope with daily life (Hogan et al., 2003). The term 'frailty' is often used to label a range of situations, and 'human' frailty is described as a slowly progressing yet complex syndrome of older people, whose defining characteristics are weakness and lack of health or strength. (https://dictionary.cambridge.org/dictionary/english/frailty). However, growing old is not a prerequisite to becoming frail; neither is it a disability, since loss of human parts may lead to frailty even among physically fit persons.

Nevertheless, a growing compromise among specialists declares that frailty is a distinct syndrome among a particular group of people who live with an increased risk of being hospitalized, dependent, and suffering a diminished quality of life.

Consequently, healthcare today is influenced by technological developments such as machines that produce efficiency, and cybernetic organisms, augmented humans, and replacement prosthetic devices as 'spares' to complete human persons. These developments critically frame the physical being of humans. Inspired by philosophical and theoretical perspectives that underpin the shaping of praxis as influential technological advances, a *transhumanist perspective* that manipulates the growing sophistication of the 'being' of humans impacts the complex ontology of human frailty and the consequent healthcare condition.

1.1 | Purpose of the article

The purpose of this article is to describe the influence of transhumanist perspectives in human-technology enhancements and replacements on the transcendence of human frailties.

2 | PHILOSOPHICAL AND THEORETICAL PERSPECTIVES

2.1 | Transhumanist perspectives

While manipulation of the growing sophistication of the being of humans constitutes the essence of transhumanism, understandably, other thematic foci in transhumanist perspective can also include the colonization of space, the possibility of the creation of superintelligent machines, and the potential developments that have the possibility of radically altering the human condition (Szocik & Braddock, 2019; Thompson, 2017). Transhumanism gradually developed over the past decades. The first self-described 'transhumanists' met formally during the early 1980s at the University of California, Los Angeles, where the main center of transhumanist thought began (Bostrom, 2005). Transhumanism promotes an interdisciplinary approach to the understanding and evaluation of the opportunities for the 'enhancement of the human condition' and the human organism, brought about by the advancement of technology (McNamee & Edwards, 2006). Much concern was given to available technologies such as genetic engineering, information technology, and other expected futurist views such as artificial intelligence and molecular nanotechnology (Porter, 2017).

Nonetheless, the options for enhancements under contemporary consideration include the drastic extension of human health-span, the eradication of disease, the elimination of unnecessary suffering, and the augmentation of human capacities such as the physical, emotional, and intellectual (Jotterand, 2010). Transhumanists view human nature as a 'work-in-progress' and believe that current humanity does not need to be the endpoint of evolution (McNamee & Edwards, 2006). Furthermore, they hope that through the responsible use of science, technology, and other reasonable methods, humans shall eventually manage to change into 'posthuman' beings with exceedingly greater capacities than those of present human beings (Mirkes, 2019). Considering an evolutionary human ontology focused on human physiognomy, emotive expressions, and physiological revelations, a posthuman is considered a science fiction concept (Oxford Dictionary, n.d.) related to a hypothetical species that might evolve or be engineered from humans. More likely, however, is the existence of a transhuman, or a posthuman who is 'intimately integrated into the being' (Pruski, 2019, p. 4). As such, posthumans become something that cannot be called human anymore, but rather more like a hominid ancestor of homo sapiens (Oxford Dictionary, n.d.).

2.2 | Transhumanism and biological limitations

Transhumanism has roots in secular humanist thinking, but it is considered more radical in that it not only promotes traditional means of improving human nature, such as cultural refinement and education, but also direct application of technology and medicine to prevail over some of the human being's basic biological limits (Hofmann, 2017). From a transhumanist viewpoint, driven by technologies of nursing and healthcare, human physiognomy, emotive expressions, and physiological revelations demonstrate human weaknesses in a variety of forms and functions, allowing human beings to exhibit abilities to re-live personhood, that is, living meaningful lives, in alternative ways.

Transcending human frailties encompasses designing, developing, and utilizing technological advances incorporating computers, electronic devices, biological enhancements, and engineering hardware which are necessities in re-asserting the 'being' of humans in unlimited ways, particularly when recognized, realized, and revealed as humanly possible. The idea of envisioning the realities of living the benefits of prior normalcy seems to be reshaping the clamor for what needs to be the new normal. With technological advancements, technology hearkens efficiency as an important accouterment.

2.3 | Transcendence and transhumanism in nursing

Transcendence is frequently understood as an indistinct term concerned with the mystical and mythical. However, with transhumanism, completeness and wholeness are more appropriately appreciated with technological advances giving meaning to that which is consistent with total precision. Nursing as a discipline and a profession is concerned with the wholeness of persons demonstrated in professional practice. Guided by theoretical advances as described by Silva and Rothbart (1984), the changing trends in the philosophies of science on nursing theory development, and the shifting paradigmatic views on the concept of wholeness altogether reflect the paradigm shift that Parse (1987) declared. In the totality view, persons as whole are viewed as separate from but influenced by the environment, while in the simultaneity view, the wholeness of persons encompasses the human-universe process, describing and explaining the central focus of persons as wholes and complete in the moment.

Consequently, Newman, Sime, and Corcoran-Perry (1991) supported varying lenses through which human wholeness is viewed, such as the particulate-deterministic, interactive-integrative, and unitary-transformative viewpoints, with competing views of wholeness. While logical positivism and empiricism emphasized the perspective of wholeness as the summation of composite human parts, Kuhn's (1970) views explained the circle of science as influenced by the shifting paradigmatic views from empiricism to historicism.

Most relevant to theoretical advancements, the human science view furthered perspectives of human persons as always whole. From wholeness-defining views of human beings, structuring humans as functional beings inspired by technology-simulated parts within human functionality, the appreciation of being is not the only defining feature of wholeness of persons. Therefore, it may seem that enhancements of human physiognomies and affect-driven functionalities are targets within transhumanist perspectives in consideration of transcending human frailties. With technological enhancements, the composition of the human likeness in physicality and language capabilities require judicious investigations toward the successful otherworldliness of human frailties.

2.4 | Relating technological viewpoints on the futurist schema

Human frailty as a complex condition can be approached within technological dominance encompassing enhancements and replacements of human physiognomies. Dependent relationships between human beings and technology that Ihde (1990) explained as postphenomenology are described as a relationship where human-technology associations are derived from four human-technology relations, namely embodiment relation, alterity relation (or otherness), hermeneutic relation, and background relations. With the current biotechnologies and virtual realities dominating the human-technology realm, Rosenberger and Verbeek (2015) determined a likely scenario of 'fusing' technologies with the biological body. However, fusion may not be an entirely organic formulation, but it can be appreciated as technological dependency that human beings have essentially depicted in technology-human 'fusion'.

This human-technological upgrading seemed to situate Kurzweil's (2005) technological singularity where computers have advanced enough to achieve human-like intelligence by 2029 and achieve a singularity in 2045. He predicted that human beings will proliferate effective intelligence by merging with the humanly created intelligence and that ordinary humans will someday be overtaken by artificially intelligent machines or cognitively enhanced biological intelligence, or both. This prediction has moved from the realm of science fiction to serious debate (Shanahan, 2015. The technological singularity. *The MIT Press Essential Knowledge series*. https://mitpress.mit.edu/books/technological-singularity). With human-technology fusion, the alterity relation becomes immaterial in the design of technologies of 'fixing' human frailties that are more commonly seen in ageing. Ihde's (1990) adoption of pragmatism into phenomenology as an intellectual exercise results in postphenomenology, referring to a shift in subject matter toward the technological underpinning of embodiment. Embodiment therefore illustrates what Rosenberger and Verbeek described as fusing technologies and human beings, thereby illuminating Kurzweil's viewpoint of the singularity of human technology.

Capturing a theoretical view of nursing and transhumanism, within the human science philosophical view, theoretical developments in Nursing support the design and improvement of intelligent machines, including novel technological advancements in robotics within the idealist-historicist human science view as described by Silva and Rothbart in 1984. One theory that advanced the appreciation of persons as always remaining whole regardless of missing parts is Locsin's (2005) theory of Technological Competency as Caring in Nursing.

This theory assumes that 'all persons are caring by virtue of their humanness' (Boykin & Schoenhofer, 2001, p. 201) and that the process of knowing persons as caring through technological knowing serves nursing practice well through the use of technologies in nursing and healthcare. In this theory, within the Universal Technological Domain© (Locsin & Purnell, 2015), nurses are provided opportunities and capabilities to find meaning in the nursing encounters between the nurse and persons being nursed (Locsin, 2005). Therefore, as nurses realize the significance of technological enhancements and replacements of persons as well as the hope that inspires these advancements, the efficiencies of transhumanism are heightened, thereby enabling the transcendence of human frailties.

3 | HUMAN ENHANCEMENTS: TECHNOLOGIES, INTERVENTIONS, AND PRACTICES

For centuries, human enhancements frequently populated the imagination of people and are featured in stories ranging from the myths of supernatural strengths and eternal life to the superpowers illustrated in twentieth-century comic book superheroes and characters. The superhuman drive for overcoming the natural capacities of humans and for transforming to a nearly 'perfect' form has been part of civilization's history that extends from arts and religion to philosophy (Bowden, 2004; Peligrin-Borondo et al., 2020).

Nevertheless, it is also the continuing goal of human healthcare to improve the condition of human beings consistent with the biomedical developments and innovations of the times (Hirsch et al., 2016). In the expansive sense, the method of human enhancement can be reasoned as an improvement of the 'limitations' of a constitutional version of the human species concerning a distinct reference in time, and to dissimilar environments (Tamburrini & Tännsjo, 2007).

The use of human enhancement has been characterized as 'biomedical interventions' that are used to augment the human form or functioning, over the requirements for sustaining or restoring health (Almeida & Diogo, 2019). The range of these augmentations has now been raised due to technological developments including genetic, pharmaceutical, and/or biomedical interventions aimed at perfecting human capacities, dispositions, or human well-being, despite having no pathologies needing treatment (Haenssgen & Ariana, 2018; O'Donovan & Smith, 2020). Human enhancement practices could be envisioned as 'upgrading a system', wherein interventions occur to improve the performance of the original system.

Human enhancement practices are far from being a hypothetical situation. The accelerated progress within the fields of information technology, nanotechnology, cognitive science, and biotechnology has revived discussions about the evolutionary trajectory of the human species with the advent of new applications that are capable of providing abilities beyond current ones (Roco & Bainbridge, 2002; Wolbring, 2008).

The arrival of new technologies has broadened the range of conceivable human interventions and the potential for transitioning from external modifications to the bodies of human beings (e.g., external prosthesis) to internal ones, specifically when considering genetic manipulation, whose modifications can be permanent and transmissible (Almeida & Diogo, 2019; 'Human–robotic interfaces to shape the future of prosthetics,' 2019; Pariseau-Legault et al., 2019; Warwick, 2018).

Transhumanists are advocates of extensive human enhancement and are supporters of technology that result in radical interference of human life through the use of technology to overcome human limitations and allow humans to live healthier, longer, and even happier lives (Lipowicz, 2019; McNamee & Edwards, 2006; Porter, 2017).

3.1 | Genomics and genetic engineering

Genomics and genetics have composed the burgeoning intellectual and knowledge-based developmental know-how. With genetic engineering, humans are provided profound control over their biology. Genome editing (also called gene editing) comprises genetic engineering. Genome editing technologies provide the ability to directly modify the DNA of an organism through targeted interventions in the genome (e.g., deletion, insertion, or replacement of genetic material) (Gaj et al., 2016).

Table 1 exhibits the types, classifications, and descriptions of genetic engineering. Two other types of genome editing are described, namely somatic and germline genome editing. Somatic genome editing is the modification of cells that do not affect gamete formation and thus cannot be passed on to the individual's lineage. Germline genome editing refers to genome editing that occurs in a germ cell that produces changes that are theoretically present in all the cells of an embryo and that could certainly be passed along the modified individual's lineage (Griffiths et al., 2000; Sun et al., 2018).

Genetic Engineering is considered to have many applications for human health, both in treatment and prevention of disease; genetic engineering also has the potential to modify human germline genome that enables humans to possess traits considered positive or useful such as intelligence, memory, and muscle strength (Affifi, 2017; Almeida & Diogo, 2019).

In recent years, the possibility of advanced genetic engineering has become much more realizable, largely due to two developments. The first one is the sophisticated and inexpensive gene-mapping technology that has enabled scientists to gain an increasingly sophisticated comprehension of the human genome (Barwell et al., 2018; Cheifet, 2019; Stoeger et al., 2018).

In 2004, Collins expressed that every healthcare problem, except for those caused by trauma, has a genetic base. The reality of Collins' view illuminated the appreciation of Genomics and Genetic Engineering as impacting biological processes that can influence human abilities, indirectly modifying genetic components through responsive and informed practices (Gaj et al., 2016). As a result, a

TABLE 1 Genetic engineering: types, classifications, descriptions

Technology	Types	Description
Genetic Engineering. (Provides humans a profound control over their biology).	Genome editing (also called gene editing)	Genome editing (gene editing) comprises genetic engineering. Genome editing technologies directly modify the DNA of an organism through targeted intervention in the genome (e.g., deletion, insertion, or replacement of genetic material) (Gaj et al., 2016)
	A. Somatic	Somatic genome editing is the modification of cells that do not affect gamete formation and thus cannot be passed on to the individual's lineage
	B. Germline	Germline genome editing refers to genome editing that occurs in a germ cell that produces changes that are theoretically present in all the cells of an embryo that could be passed from individual's lineage (Griffiths et al., 2000; Sun et al., 2018)
	C. CRISPR	CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeat. The name refers to a characteristic organization of short, partially palindromic repeated DNA sequences found in the genomes of bacteria and other microorganisms (Hsu et al., 2014) CRISPR technology also has the possibility of disrupting the evolutionary process in humans. A human with more significant or unusual advantages such as having greater muscle mass, more acute senses, obviating the need for sleep, or even a decelerated ageing process may be possible through the use of CRISPR technology

few ways of applying genetic surveillance exists, such as in genetic counseling, thereby preventing the progression of genetically influenced diseases. Controlling these diseases, therefore, enhances the capacities of human beings to live better lives, decreases consumption of global resources, and improves human relationships.

3.2 | Applications of genetic editing

Another significant development involves a powerful novel gene editing technology known as CRISPR that stands for Clustered Regularly Interspaced Short Palindromic Repeat. The name refers to a characteristic organization of short, partially palindromic repeated DNA sequences that are found in the genomes of bacteria and other microorganisms (Hsu et al., 2014). The CRISPR sequences are an important component of the immune systems of microorganisms. If a viral infection endangers a bacterial cell, the CRISPR immune system can hinder the attack through the destruction of the genome of the invading virus that includes genetic material that is essential for the continued replication of the virus (Hsu et al., 2014; Rodríguez-Rodríguez et al., 2019). The destruction of the viral genome by the CRISPR immune system protects the bacteria from ongoing viral infections.

Applications of the CRISPR technology could endow human beings with significant advantages such as greater muscle mass, acute senses, sustained high-level functioning without sleep, or even a decelerated ageing process. Furthermore, through the use of CRISPR technology as a targeted, efficient enhancement of human beings, people can expect better living.

3.3 | Reconciling genetics as an influential technology

From a utopian perspective originating from Bacon's 'knowledge is power' formulation (Farrington, 1966), human limitations could be overcome by expending this power. Technology is a prime focus in Ihde's (1990) dystopian view that people entangled in technology will eventually threaten human existence. With genetics and its manipulation playing a role into the future, the benefit of genomic research and genetic sequencing in the transcendence of human frailties may not be far-fetched. Today, genetic testing for genetic diseases can be the initial step, legitimizing futurist processes to eliminate genetic elements thereby extending human lives. Together with Kurzweil's (2005) prediction of the technological singularity, the human being of tomorrow may be transcendent.

4 | ARTIFICIAL INTELLIGENCE, MACHINE LEARNING, AND ROBOTICS

Artificial intelligence and machine learning collectively encompass sophistication in human augmentation. Extended reality furthers this realm of capabilities by fostering communal human-like actions. Table 2 exhibits these technologies as creating intricacies and enhancements in human-like features and capacities.

Artificial Intelligence (AI) is a term that is used to describe machines that can imitate human functions such as problem-solving and learning (Zawacki-Richter et al., 2019). Machine Learning (ML) is an application of AI that enables computer systems to automatically learn and improve from experience without being specifically programmed (Nichols et al., 2019). Meanwhile, Intelligence Augmentation (IA) refers to the effective use of information technology in the augmentation of human capabilities (Bhandari & Reddiboina, 2019). AI and ML enable humans to work faster and smarter, which boosts productivity (Loh, 2018). (Please see Table 2).

4.1 | Machine learning

Machine Learning (ML) technologies enable better use of data to obtain 'deeper insights' that can aid in decision-making. ML systems can identify patterns from huge swathes of data exponentially faster than humans. Technologies of ML augment the abilities of humans by enabling a faster and more accurate interpretation that is based on large data sets that cannot be done by humans alone (Jiang et al., 2017; Liu et al., 2019; Panch et al., 2018). Healthcare data in the form of features are integrated with an algorithm to create an ML model. The algorithm identifies and maps the relationships between features and outcomes and narrows it to predictive features. This process is called ML because the algorithm learns relationships from former or current healthcare data or a data source like a Subject Area Mart (SAM) through the Enterprise Data warehouse (EDW) (Larsen, 2017).

Experts anticipate that human effectiveness will be amplified by networked artificial intelligence (Davenport & Kalakota, 2019). The primary use of AI in the future will be the automation of tasks that are currently handled exclusively by humans. Division of processes into a series of smaller tasks will occur to determine the areas that can benefit the most from automation and which tasks need to remain with humans (McBride et al., 2014). The goal is not the displacement of people but the utilization of AI to augment existing processes.

4.2 | Extended reality and augmented reality

Extended Reality (XR) is an umbrella term for all immersive technologies such as Augmented Reality, Virtual Reality, and Mixed Reality. Immersive technologies extend the reality experienced by a person by either blending the 'real' and virtual worlds or by creating a fully immersive experience (Cipresso et al., 2018). Extended Reality has applications in these industries: entertainment; e-commerce and retail; interior design, landscaping, and urban planning; real estate; tourism; education; healthcare; communication; manufacturing; and marketing.

TABLE 2 Types and descriptions of artificial intelligence, machine learning, and extended reality technologies

Technology	Types	Description
Artificial intelligence and machine learning	Artificial intelligence	Artificial Intelligence (AI) describes machines that can imitate human functions such as problem-solving and learning (Zawacki-Richter et al., 2019)
	Machine learning	Machine Learning (ML) is an application of AI that enables computer systems the ability to automatically learn and improve from experience without being specifically programmed (Nichols et al., 2019)
	Intelligence augmentation	Intelligence Augmentation (IA) is the effective use of information technology for human capabilities (Bhandari & Reddiboina, 2019)
Extended reality	Extended reality	Extended Reality (XR) an umbrella term for all immersive technologies such as Augmented Reality, Virtual Reality, and Mixed Reality
	Augmented reality	Augmented Reality (AR) is a digital element added to a live view (Berryman, 2012)
	Virtual reality	Virtual Reality (VR) is a completely immersive experience in which the users are transported into real-world and imagined environments
	Mixed reality	The Mixed Reality (MR) experience combines elements of both VR and AR where real-world and digital objects interact, for example, Microsoft's HoloLens (Flavián et al., 2019)

Augmented Reality (AR) is where digital elements are added to a live view. This is often done by using the camera of a device (Berryman, 2012). Virtual Reality (VR) indicates a completely immersive experience that closes out the physical world. The users are transported into a selection of real-world and imagined environments with the use of VR devices such as Oculus Rift, HTC Vive, or Google Cardboard (Keshner et al., 2019). The Mixed Reality (MR) experience combines elements of both VR and AR where real-world and digital objects interact. An early mixed reality device is Microsoft's HoloLens (Flavián et al., 2019).

These technologies can enable humans to create innovative solutions to sustain activity, reduce error, and improve efficiency (Flavián et al., 2019; Khan et al., 2019; Trahan et al., 2019). VR games that require players to utilize their entire body can be designed to keep people active, fit, or even lose weight (Checa & Bustillo, 2020).

The extended reality also enables humans to receive training and education in low-risk virtual environments. Surgeons, pilots, police, firefighters, chemists, and medical students will be able to closely simulate risky scenarios with minimal risk and reduced expenses. The experience they gain will prove invaluable when handling real-life scenarios (Kaplan et al., 2020; Keshner et al., 2019; Trahan et al., 2019; Zweifach & Triola, 2019). Extended Reality also improves patient care by streamlining medical procedures. It enables surgeons to visualize intricacies of the organs in 3D that enables them to plan each step of a complex surgery. It makes it possible for surgeons to perform surgeries in a more effective, precise, and safe way (Besharati Tabrizi & Mahvash, 2015; Eckert et al., 2019; Mikhail et al., 2019; Zweifach & Triola, 2019).

4.3 | Robotics and robotics engineering

Robotics is the design, construction, and use of machines (robots) to carry out duties that are traditionally done by humans (Raj & Seamans, 2019). Robots are widely used in manufacturing industries to perform simple, repetitive tasks and also in industries where the work environment is dangerous to humans (Belanche et al., 2020; Qureshi & Syed, 2014).

Currently, robots perform different jobs in a variety of fields. One example is industrial robots used in manufacturing environments. These robots are specifically created for material handling, welding, painting, and other simple, repetitive tasks (Belanche et al., 2020; Qureshi & Syed, 2014). Household/domestic robots are used at homes, such as robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners, and other robots that execute different household tasks (de Graaf et al., 2019; Kim et al., 2019; Young et al., 2009).

Table 3 contains the types and descriptions of robotic technologies that have some influence in healthcare. Hospital robots perform a wide range of functions to aid doctors, nurses, and surgeons such as the distribution of medication, laboratory specimens, and other sensitive materials like patient data around the hospital (Cresswell et al., 2018; Jeelani et al., 2015; Kim, 2018). Robots are also designed to disinfect equipment and devices in healthcare settings. Surgical robots are equipped with mechanical arms with surgical equipment attached and cameras which can be controlled by a surgeon. Robot-assisted surgeries are complicated procedures that can be completed with enhanced precision and control. Robot-assisted surgeries are also minimally invasive which means there is diminished risk and a shorter period of recovery (Lane, 2018; Peters et al., 2018).

4.4 | Healthcare robots: types and functionalities

Healthcare robots provide support to older people and/or disabled persons in their home environments. These robots are commonly used to carry out functions such as helping patients get out of bed (Cresswell, Cunningham-Burley, & Sheikh, 2018; Rantanen et al., 2018). An example of a healthcare robot is Robear, which is a bear-shaped robot designed to lift patients out of beds and into wheelchairs or assist them in standing up. In the future, healthcare robots will be called upon to perform more complex tasks such as reminding patients to take their medication, offering emotional support, taking blood samples, recording temperatures, and improving the patient's hygiene (Van Aerschot & Parviainen, 2020; Erikson & Salzmann-Erikson, 2016; Robert, 2019; Wang et al., 2017).

Exoskeleton robots are deployed in a wide range of applications where mimicking, augmenting, or enhancing a person's body movements is critical. These robots provide the necessary support for human motion, with potential applications ranging from rehabilitation and military deployment to consumer products (Fox et al., 2019; de Looze et al., 2016; Rupal et al., 2017).

4.5 | Cyborg technology

As we move deeper into the 21st century, a major trend is the enhancement of the human body with 'cyborg technology'. Due to medical necessity, millions of people worldwide are currently equipped with prosthetic devices that restore lost functionalities. There is a growing movement to enhance the body to create new senses or to enhance current senses to 'beyond normal' performance levels (Duarte & Park, 2014). From implants capable of creating brain-computer interfaces, artificial heart defibrillators and pacers, cochlear implants, deep brain stimulators, prosthetic limbs, exoskeletons, retinal prosthesis, magnet implants to Bionic fingertips, wearable computers, Bionic eyes, the Biostamp digital tattoo, implantable RFID chips, implantable sensors, and a variety of other enhancement technologies, the human body is becoming more computational and mechanical and thus less biological (Barfield, 2019; Barfield & Williams, 2017; Fox, 2018). There will be a continued acceleration of this trend as the human body transforms into an information processing technology.

If the trends of innovation and research in cyborg technology continue, the human race will soon face a new kind of human with very different sorts of capabilities. As cyborg technology becomes more advanced, and additional capabilities are integrated more within the brain and body, it would not be difficult to imagine human beings opting to replace their basic biological parts with the upgraded cyborg version (Barfield & Williams, 2017; Fox, 2018; Greguric, 2014; Krstić & Prodanović, 2013; Palese, 2012). Human beings of the future could possess nearly unlimited cognitive and physical capabilities due to cyborg technology.

4.6 | Bio-artificial organ manufacturing technologies

Bio-artificial organ manufacturing technologies produce human organs that are based on bionic principles. Significant progress has been made in the last decade in the development of various organ manufacturing technologies (Grumezescu, 2018; Wang, 2019a, 2019b). One of the most encouraging bio-artificial organ manufacturing technologies is the combined multi-nozzle 3D printing technique that automatically assemble personal cells with other biomaterials to construct exclusive organ substitutes for failed/defective human organs (Munaz et al., 2016; Wang et al., 2016).

In this era of technological dependency in healthcare, it is the first time that advanced bio-artificial organ-manufacturing technologies have been extensively developed (Wang, 2019a). With human frailties involving organic and systems dysfunctions and or

TABLE 3 Types and descriptions of robotic technologies influencing healthcare

Robotics	Robotics—the design, construction, and use of machines (robots) to carry out duties that are traditionally done by humans (Raj & Seamans, 2019)
A. Industrial robots	Currently, robots function in several different jobs in a variety of fields such as industrial robots used in an industrialized manufacturing environment (Belanche et al., 2020; Qureshi & Syed, 2014)
B. Household/ domestic	Household/domestic robots are used at home, such as sweepers, vacuum cleaners, sewer cleaners, and other robots that execute different household tasks (de Graaf et al., 2019; Kim et al., 2019; Young et al., 2009)
C. Medical robots	Medical robots are utilized in the medical field. Hospital robots perform a wide range of functions to aid doctors, nurses, and surgeons including the distribution of medication, laboratory specimens, and other sensitive materials such as patient data (Cresswell et al., 2018; Jeelani et al., 2015; Kim, 2018), and to disinfect equipment and devices in healthcare settings
D. Surgical robots (robot-assisted surgeries)	Surgical robots are equipped with mechanical arms with surgical equipment attached and cameras which can be controlled by a surgeon. Robot-assisted surgeries are complicated procedures. Robot-assisted surgeries are also minimally invasive involving diminished risk and a shorter period of recovery (Lane, 2018; Peters et al., 2018)
E. Care robots	Care robots provide support to the elderly or disabled patients in their home environments, to carry out simple functions, for example, helping patients get out of bed (Cresswell et al., 2018; Rantanen et al., 2018)
F. Exoskeleton robots	Exoskeleton robots are deployed in a wide range of applications where there is an intention to mimic, augment, or enhance a person's body movements, providing support for human motion, ranging from rehabilitation, military deployment, to consumer products (de Looze et al., 2016; Fox et al., 2019; Rupal et al., 2017)
G. Military robots	Military robots are utilized in the military and armed forces, in missions hazardous for humans, for example, shipping robots, bomb discarding robots, and exploration drones (Simon, 2015)
H. Space robots	Space robots are employed in space agencies like those onboard space shuttles, the international space station, mars explorers, and other robots that function in space exploration and other activities (Chien & Wagstaff, 2017)

TABLE 4 Computerization and bio-electronics: cybernetic organisms (cyborgs), bio-artificial enhancing organs

Technology	Purposes	Description
Cyborg technology	Cybernetic Organism (Cyborg): A human being whose physical abilities are extended beyond human limitations through the use of mechanical and electronic elements built into the body	Due to medical necessity, there are millions of people worldwide who are currently equipped with prosthetic devices that restore lost functions. Human beings of the future could be nearly unlimited in their cognitive and physical capabilities due to cyborg technology (Barfield & Williams, 2017; Fox, 2018; Greguric, 2014; Krstić & Prodanović, 2013; Palese, 2012)
Bio-artificial organ manufacturing technologies	BIoArtificial Organs: 3D printing techniques to automatically assemble personal cells	Bio-artificial organ manufacturing technologies produce human organs that are based on bionic principles. Significant progress has been made in the last decade in the development of various organ manufacturing technologies (Grumezescu, 2018; Wang, 2019a, 2019b) These technologies hold the promise to significantly enhance the quality of health and the average lifespan of human beings soon (Aimar et al., 2019; Paul et al., 2018)

functional declines, these technologies hold the promise of significantly enhancing the quality of life of human beings, thereby impacting their health and the average lifespan of human beings (Aimar et al., 2019; Paul et al., 2018). Exhibited in Table 4 are the different computerization and bio-electronic technologies that enhance human beings.

5 | THEORETICAL UNDERPINNINGS OF NURSING IMPLICATIONS

As global healthcare needs become more complex and diverse, disruptive and frugal innovations provide a paradigmatic shift needed to truly define what and how human frailties are being transcended through technological enhancements and replacements. An aim should be a transhumanist viewpoint that is accommodating, collaborative, resilient, empathetic, and ethical yet still a work-in-progress (Constantino & Zalon, 2020).

From a transhumanist perspective, transcending human frailties implies a society that may comprise more physically able human beings, who are capable of more sophisticated activities through AI, machine learning, and enhanced organismic capacities to meet the demands of the future. These designs and developments impact the transcendence of human beings as the unfolding of future ways of living, demanding the sophistication of the interplay of co-realities between that of technology and of human beings. Technological highlights of the relevance of transhumanism generated by genomic and genetic enhancements, and replacement technologies provide critical implications to the transcendence in human frailty.

Several policy implications have been identified concerning the implementation of technologies in human healthcare, particularly among older people. One of these implications focuses on the use of digital technologies that raises some concerning ethical issues especially with older persons as the recipients of services. It is necessary to ensure that the principles of privacy, informed consent, autonomy, and data protection are maintained. Constant threats to personal information include breaches in electronic safety through the internet and iCloud hacking, and stolen access authority for data storage (Yasuhara et al., 2019). Eventually, training initiatives aiming to support and increase digital literacy should be made available. Doing so improves the demands for digital skills for healthcare professionals leading to additional lifestyle benefits.

6 | CONCLUSIONS

Exciting new possibilities are being opened up by human enhancement technologies but they are also bringing forth significant questions about what it means to be human, and what is bad or good for our individual and collective well-being. Currently, these technologies are geared toward restoring or upgrading psychological and physical abilities for medical purposes. However, other applications are slowly surfacing, boosting performance through the upgrading of physical and cognitive abilities. Upgrading physical and cognitive abilities to boost performance touches on the very essence of humankind and results in an avalanche of ethical questions.

Factors that ensure a fair society within the collective well-being of persons need to be identified within the development and distribution of new human realities of transcendent and enhancing technologies in a technological world. However, lest we become starry-eyed at transcending human frailties through technological advancements, replacements, and the transhumanist perspective in nursing and healthcare, we need to ask what happens to the human being after transcendence and enhancements. Benjamin (2019) argues that technological advancements and complex algorithms may not transcend human character, ethics, prejudices, and biases; these might deepen discrimination. Because the transhumanists view human nature as a work-in-progress, Benjamin (2019) exclaimed that transcendence by technological advancements may deepen racism, capriciousness, and arbitrariness while appearing neutral or even benevolent. Transcendence may encode inequity by implicitly or explicitly amplifying human frailties along racial hierarchies and social divisions.

While technological enhancements, replacements, and alterations may provide ways to counter outcomes of human frailties, both emerging and current technologies continually present reasons for ethical and moral trepidation, including apprehensions about ensuring efficiency and efficacy in the use of specific technological accouterments that pose economic consequences. As revealed by Yasuhara et al. (2019), privacy, autonomy, and data protection are constantly threatened, especially from breaches in online security and stolen access authority.

Advancing technologies are near the pinnacle of enhancing technological complexities, which contribute to the transhumanist views of being human in a technological world. Contemporary and future technologies push toward the transcendence of human frailties, framing humanlikeness as a rejoinder to the inefficiencies and deficiencies of being human. In transcending these human frailties, humanness can critically enhance the conviction of creating symbiotic relationships between human beings and technologies in a transcendent world.

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