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AI-Powered Care Robots for Compassionate Care: A Value-Sensitive Approach to Humanizing Healthcare

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Abstract. Compassionate care is increasingly recognized as a cornerstone of high-quality healthcare, essential for optimal outcomes for patients and families. However, stress, exhaustion, and emotional depletion often undermine the ability of caregivers to provide patient-centered attention. This paper aims to (i) propose that integrating care robots equipped with Artificial Intelligence (AI) systems into healthcare environments has the potential to reduce caregivers' workloads and emotional strain, thereby revitalizing the human-centered dimension of care. Achieving this, however, requires designing care robots that adopt a Value-Sensitive Design (VSD) approach. Accordingly, the second aim of this work is to (ii) demonstrate how a VSD in line with the above-mentioned aim can guide the development of care robots that are responsive to the real needs of healthcare professionals. This can be achieved through careful examination of their preferences, specific requirements, and the contexts in which they operate. A specific VSD aims at promoting a model of technological development that enhances professional expertise, ensuring that robotic entities function as supportive tools, while preserving the meaningful dimension of care work.

Keywords: Robot Ethics · Patient-Centered Care · Value Sensitive Design

1 Introduction

Compassionate care has been defined by the literature as "the understanding and emotional resonance of healthcare provider (HCP) with patients' ailments in conjunction with the choice to act in the interest of alleviating their concerns, distress, pain, or suffering" [1, p. 2]. The critical role of humane and compassionate care in enhancing patient satisfaction and health outcomes has been extensively argued in the literature [2]. However, the possibility for healthcare professionals to engage in truly patient-centered care is increasingly undermined by structural limitations such as bureaucratic overload and

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heightened workflow demands. Such constraints can lead to burnout and compassion fatigue-escalating issues among professionals-negatively affecting the quality of life of healthcare workers and further deteriorating the quality of care provided [3, 4].

Overcoming these obstacles requires innovative solutions; one promising avenue involves the integration of Artificial Intelligence (AI)-powered robots into healthcare environments. AI can enhance robotic capabilities, ensuring more dynamic and responsive interactions. Our paper investigates the potential of these intelligent systems to transform caregiving landscape by reducing workloads, mitigating emotional strain, and fostering a renewed emphasis on compassionate, personalized care.

However, achieving this goal requires not only advancements in technical features but also an approach that prioritizes the promotion of specific values, central to care practices. To ensure that AI-enhanced robotic systems align with the contextual values and ethical principles embedded in caring practices, we propose the adoption of a Value Sensitive Design (VSD) framework [5], which would ensure ethically grounded caregiving from both the human and the technological perspectives.

2 The Role of AI-Powered Robotic Assistance in Healthcare

Burnout has been identified as an escalating factor among healthcare professionals [6]. Excessive bureaucratization increased administrative burden, and chronic understaffing have been shown to contribute to deteriorating working conditions and increasing emotional strain. These dynamics have a dual impact: they can significantly affect the psychological well-being of healthcare workers [7, 8] and compromise the quality of care delivered to patients.

The integration of healthcare practices with AI-powered robotics has been playing an increasingly significant role in clinical settings, offering innovative solutions across multiple domains [9, 10]. Specifically, robotic systems equipped with AI can serve as valuable tools in supporting healthcare personnel. By offloading administrative tasks and offering intelligent assistive functions, AI-powered robots have the potential to improve the overall work experience of caregivers. For instance, robotic medication delivery systems such as the Pyxis automation system are designed to ensure the precise and secure dispensing of medications, thereby helping to reduce human error and easing the workload of pharmacists. Similarly, HOSBOT-developed within the ODIN Project (H2020 – 2024) [11]-is a mobile robotic platform designed to automate internal logistics, including the transportation of medications and medical supplies across hospital departments. By handling these repetitive and time-consuming tasks, HOSBOT can mitigate the operational burden on nursing staff, improve workflow efficiency, and contributes to the timely and accurate administration of drugs.

In addition to the technologies mentioned above, other noteworthy examples include robotic systems designed to assist with routine and labor-intensive tasks within clinical environments. Robots such as Toyota's Human Support Robot, TUG mobile robot, and Moxi are designed to transport medications, samples, meals, and linens, as well as manage supply stocking and basic administrative support [5, 12]. ROBEAR, on the other hand, has been designed to provide physical support, lifting patients from beds or assisting with transfers, thereby reducing the physical strain on caregivers [13]. In this

sense, robotic systems may serve as valuable allies and intelligent collaborators within care processes, enabling healthcare professionals to devote more time to patient-centered interactions. AI-powered care robots can optimize scheduling, ensure error-free distribution; in the future they may be even capable of interacting with patients to confirm compliance with prescribed treatments. Beyond logistical benefits, the ability of AI-powered care robots to interact with patients has the potential to introduce additional advantages in future personalized care. These systems could engage patients in conversation, assess their emotional state, and relay relevant information to caregivers, ensuring that even routine tasks such as medication distribution become opportunities for patient engagement and data collection. By recording patient responses, tracking emotional and physical well-being, and identifying trends over time, care robots could provide healthcare professionals and family members with valuable insights into a patient's condition. This continuous monitoring may lead to early detection of health issues, personalized adjustments to treatment plans, and enhanced communication between patients, medical teams, and caregivers.

Such support, however, presupposes a parallel capacity for self-reflection and emotional regulation as an excessive emotional attachment can be detrimental to both professionals and patients [14]. Over care can lead to phenomena such as compassion fatigue, burnout, and emotional exhaustion. This highlights the importance of acknowledging one's own needs and vulnerabilities, and a continuous work on one's character [15, 16].

3 An Innovative Value-Sensitive Design for AI-Powered Care Robots

Ensuring humane and compassionate care requires AI-driven care robots to be designed within a robust framework of ethical values. Value Sensitive Design (VSD) has been defined as "a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process" [17, p. 56]. VSD emphasizes the importance of embedding moral and social values within technological artifacts. Building on this foundation, Umbrello et al. [5] extends VSD to care robots by integrating core care values, AI-specific values, and broader considerations such as the UN Sustainable Development Goals (SDGs). This approach, rooted in van Wynsberghe's framework [18], expands the focus beyond attentiveness, responsibility, competence, and responsiveness, and opens to additional, meaningful values relevant to modern care contexts. Such an approach is particularly relevant in this domain, as it underscores the importance of identifying and prioritizing values that are appropriate to a specific setting. Specifically, a VSD approach to care robots designed to assist healthcare professionals and reduce their burden should begin with a thorough contextual analysis, followed by the identification of the values at stake. Central to this process is the active involvement of stakeholders in the design phase, to ensure that the resulting technological solutions reflect and respond to their needs. It is also essential to delineate the boundaries of robotic systems which are crucial to support, rather than supplant, the role of healthcare professionals, thereby reinforcing healthcare professionals' agency and sustaining the meaningfulness of their work.

Among the most relevant values for designing care robots aimed at supporting healthcare professionals are *relationality*-which is the foundation of ethically meaningful humans-machines interaction- and *self-care*, intended as a space for reflection and emotional decompression, and the capacity of technological systems to provide psychological and motivational reinforcement. Equally important is *contextual adaptability*, which refers to the system's ability to function appropriately across diverse and evolving clinical settings and *responsivity*-the capacity to detect and respond effectively to users' needs, thereby ensuring that the interaction remains aligned with the professionals' experience. While not exhaustive, this set of values highlights some of the key ethical and contextual dimensions that should inform the design of care robots.

These values must guide not only human-to-human interactions but also the integration of intelligent machines (equipped with AI systems) into caregiving practices.

Further developing this framework into the development of care robots enables engineers to create systems that center on human needs and values.

4 Conclusion

This paper has synthetically examined how AI-powered care robots may contribute to reshaping the caregiving landscape by reducing workload, mitigating emotional strain, and enabling the careful prioritization of compassionate, patient-centered care. We have shown that this potential can only be realized by aligning technological development with the ethical and relational dimensions of care. In this regard, VDS provides a valuable framework to guide the creation of robotic systems that support-rather than replace-healthcare professionals. By automating routine tasks and supporting healthcare professionals with intelligent, assistive features, robots can create a more sustainable and compassionate healthcare system. Beyond their functional roles, robotic systems have the potential to re-humanize healthcare by enabling providers to focus on empathetic and personalized care. The goal is to think of a professional-patient relationship not inhibited by robots but facilitated by their presence and proactive interaction. However, achieving this vision requires more than technical advancements alone, as we have emphasized throughout this paper. A VSD approach is essential to ensure that robotics aligns with the values central to care practices. By embedding specific ethical principles into the design and implementation of robotic systems, VSD provides a framework that bridges the human and technological dimensions of caregiving. Future research should prioritize the development of VSD methodologies tailored to healthcare robotics, fostering innovations that balance technical progress with ethical responsibility. This approach will ensure that robots advance healthcare efficiency while remaining aligned with the fundamental ethical principles of caregiving.

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