Thesis Project Portfolio

Kronos Knee Brace

Value Sensitive Design in Medicine

An Undergraduate Theis

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Liam Matthew Kidd

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Department of Biomedical Biomedical Engineering

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Sociotechnical Synthesis

Value sensitive design (VSD) is a theory and process that attempts to fundamentally integrate human values into a system. A value is something that is regarded as useful, essential, deserved, or a principle and VSD seeks to uphold and bolster these values that are held by a user. At the core of VSD is the tripartite methodology that seeks to identify value, design for said value, and test for efficacy in an additive and iterative manner throughout the process allowing for a more well-rounded approach to some final product. The first of these methodologies is the conceptual investigation in which direct and indirect users are identified and a rigorous investigation of their most essential values is conducted to afford an understanding of what they hold dear or expectations of some product or service. The second in this tripartite methodology is the technical investigation that seeks to create some iteration of the product or service that can be evaluated in the third part of the methodology that is the empirical investigation that allows the efficacy and use of not only the prototype product but of the original values that were identified. All of this is useful in a design process because expectations or needs change all the time and it is critical to be able to readily adapt and identify new values or design parameters that improve a user experience. An area of design that could benefit from the application of VSD is clinical care biomedical engineering. Biomedical ethics is a rich and abundantly researched ethical framework that has its roots in the Hippocratic oath and medical paternalism and of course stands on its own fundamental principles of justice, beneficence, autonomy, and nonmaleficence. Biomedical ethics seeks to not only increase positive outcomes to all patients but to mitigate and eliminate poor outcomes to underserved patients. VSD could be used to integrate patient values more thoroughly into a host of different services in the clinical world. Surgeons could evaluate the actual needs of knee replacement patient past the generic return to some ability to walk, oncologists and hematologists could design a chemotherapy or radiation therapy treatment plan that aligns with a patient's ability to return to work or get vaccinated after their immune system is deleted, medical device companies could incorporate their users into a design process to create a better performing prosthetics or shunts. Currently so few medical efficacy parameters exist past a patient's expected lifetime and cursory glances at quality of life. Often these parameters are instantiated by outside companies that fill the gap after the hospital services such as private physical therapist, brace and cast makers, or even corrective private practices. VSD could be implemented to create a procedure, treatment, or device that centers around a user or patient's experience with that service and how it affected their value system. This would serve to increase the more positive patient outcomes, which is of course the goal of any operational medical system. The author will be attempting to explain VSD more thoroughly

and biomedical ethics and how the intersection of these two fields may be capable of improving the practice of medicine. Through this research. This paper will cover example of when these practices have been applied or ignored individually in multiple pandemics and sicknesses in Africa and attempts at a vaccination campaign and in the AIDs crisis of the 80s and 90s. Also to be addressed is the author's own 4th year capstone in which he and a group of his peers attempted to implement VSD during the design of a knee brace for total knee replacement or reconstructive surgeries. Our conceptual investigation of users' values revealed a desire and value of returning to normal activity levels specifically around sports. The technical investigation yielded prototypes knee braces that incorporated a dampening system to take shock away from the knee throughout a range of motion to assist in muscle retention and regeneration. Empirical metrics culminated in the use of industry standard tests that identified users' preoperational abilities and aimed to weigh them against post operation abilities to test efficacy. We believe that our iterative approach to VSD implementation served to create a better product for our users which is currently in human trials. VSD could be beneficial to clinicians and engineers who are seeking to create a system that upholds or even bolsters a user's values through use or interactions with a product.