How Have Robotics Impacted Healthcare?

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Abstract
In lieu of an abstract, below is the first paragraph of the paper.

Robots are virtual or mechanical objects that are used in facilitating the occurrence of multiple everyday activities. They have been heavily depended upon in U.S. industry, since 1961, and in health care after the mid 1980s. The virtual and mechanical robots have assisted people in a variety of tasks within and outside the laboratory and operating rooms. Some examples of robot intervention include medication administration, assisting children with autism, telemedicine, and transferring / lifting patients. Although robots have made many activities easier to handle, there have been various consequences associated with utilizing such technology which has impacted ethical policy and pharmacist staffing.
How Have Robotics Impacted Health Care?
Lorelei E. Kujat

Robots are virtual or mechanical objects that are used in facilitating the occurrence of multiple everyday activities. They have been heavily depended upon in U.S. industry, since 1961, and in health care after the mid 1980s. The virtual and mechanical robots have assisted people in a variety of tasks within and outside the laboratory and operating rooms. Some examples of robot intervention include medication administration, assisting children with autism, telemedicine, and transferring / lifting patients. Although robots have made many activities easier to handle, there have been various consequences associated with utilizing such technology which has impacted ethical policy and pharmacist staffing.

Robot Technology in Telehealth

Certain ethical considerations are a consequence of robot technology applied to elderly care. For instance, if older adults or family members were to provide care using robots such as computers, and video and audio conferences, learning how to operate these devices may prove to be a challenge since elder adult caregivers can have little computer experience and/or possess vision and hearing impairment. In telemedicine, where telehealth robots such as recordings and monitors show patient medical procedures and discussions, preserving patient confidentiality has been another ethical issue since video and audio recordings are transmitted via telephone lines, satellite, and technical staff at the clinical site, and can be viewed by other patients with the same condition or support groups (Demiris, Doorenbos, & Towle, 2009). Often patients unfamiliar with how their recordings are transmitted over great distances may feel their privacy violated during videoconferencing sessions. Telesupport group facilitators would need to assure maintenance of patient confidentiality through standard encryption, security protocols, and non-recordings during support group meetings (Demiris et al., 2009). To low-income rural and urban adults, computer and/or Internet access may be restricted to where Telehealth would cost more than benefit. Thus, if computers were widely accessible through economic status and community facilities (i.e. high income; public library) to American Indian and Alaskan Native elderly populations, going distances for telesupport would not be needed (Demiris et al., 2009).

The lack of therapeutic touch with robotics (i.e. video monitors and recordings) would also present an ethical concern with patients since touch is considered one of the most effective and frequently used interventions in clinical care. Although health staff would have to consider the value of touch and direct communication differing with each patient, Gardner (1992) stated that universally among health care, "physical closeness is considered as an embodiment of caring in clinical care" (pp. 191-200). As a usual result, therapeutic touch such as holding someone’s hand can instinctively cue how someone feels while allowing trust to be established more easily with a physician or nurse, compared to a video monitor or indirect communication medium that may possibly leave both wondering whether trust exists (Butter et al., 2008). However, face-to-face interactions through a video monitor can still be as effective with patients if practitioners demonstrate significant adroitness in their interaction through the medium (Gardner, 1992). Since it is essential for health care providers to sense how their interaction is affecting their patient, the ability to read another's body movements would be grossly different when being physically near someone without robotic technology.

Robots as Patient Lifts and Transporters

In addition to providing hands-on patient care, robots have also served as mentors and lifts for patients of various ages. Japanese inventors created the "Robot for Interactive Body Assistance" to transport patients weighing a maximum of 134 lbs to bedsides and wheelchairs using built-in sensors and foam support technology (Dean, 2009). Researchers at Japan’s Institute of Physical and Chemical Research and Tokai Rubber Industries anticipate the smiley-faced bear robot to be marketed soon for Japan’s aging population (Dean, 2009). In American society, researchers at the University of Pittsburgh and Carnegie Mellon University tested the “Nursebot” on elderly patients in Pittsburgh, Pennsylvania. According to Judith Matthews of the University of Pittsburgh, the “Nursebot” was not effective for care because the robots could not do enough to help patients (Borenstein, 2006). In other words, Nursebots were unable to perform complex psychomotor tasks like changing a patient’s diaper and giving patients a bed bath. Sebastian Thrun, inventor of Nursebot, proclaims that robots able to remind people to take their medications and...
transport patients to the bathroom are to be present in health care's future (Borenstein, 2006).

**History of Robotics in Helping Autistic Children**

During the 1990s, the Roball robot was invented to assist in a child's development through providing autistic children with stimulation and interaction experiences. Its spherical ball, which encases sensors and processing elements, would allow the robot to navigate obstacles in playroom environments for 60 seconds (Michaud, Salter, Duquette, & Laplante, 2007). Afterwards, the robot would request to be spun, shaken, or pushed in order to move again, and indicate whether it feels dizzy or wants another spin (Michaud et al., 2007). If the child appropriately responds to Roball's request (e.g. spinning Roball after Roball has asked to be spun), the robot says thank you. According to Michaud (2007), children become more compliant with robots that look and move like people who repeat themselves. Thus, the Roball has been replaced with humanoid robots to help children with autism grow in social skills.

Humanoid robots engage in children's play through moving its facial structures to create facial expressions (i.e. winking; smiling; frowning) and conducting imitation exercises. Robota robots are a specific type of humanoid robot that can be taught to dance, utter simple vocabulary words, and put on clothes through the child's teaching via sound and sensory movement (Billard, Robins, Nadel, & Dautenhahn, 2006). Although the Aurora project, which examines how autistic children interact with humanoid robots, is still ongoing, the child's learning outcome from using Robota technology would be to discriminate their own movements as a result from Robota's motions (Billard et al., 2006). The child may also be able to distinguish between perceptions resulting from their own actions from perceptions caused by another's actions. However, the downside of humanoid robotics would be their limited accessibility to households due to their price range of $3,000 to $30,000 in the U.S (Billard et al., 2006). Other disadvantages with humanoid robots and Roball technology also include lack of therapeutic human touch and not enough unpredictability in the robot's actions to adequately prepare autistic children for interaction with peers and situations out of the ordinary (Billard et al., 2006).

**Robotics in Pharmacy**

A robot's predictability can have its benefits on medication administration. Since the new millennium, health care staff has had to increase their service hours within inpatient and outpatient care. As a result of increased hours along with prescriptions, a prescription-filling robot has been utilized in more than one thousand pharmacies for the year 2007 alone (Lin, Huang, Punches, & Chen, 2007). The device's robotic arm will attain the appropriate vial, collect the medication, and label each vial, in addition to scanning and using bar codes to verify medication; these robots also package, store, and dispense filled prescriptions to patients (Butter et al., 2008). Before the installation of ScriptPro SP-200, an automation prescription-filling robot invented in 2001, pharmacists and technicians were spending 0.56 more minutes in completing direct and indirect prescriptions (Lin et al., 2007). Post-installation of ScriptPro SP-200 also benefited health care by boosting pharmacist and technician effectiveness at filling prescriptions. However, automation prescription-filling robots have contributed to overstaffing because pharmacist duties have substituted some of the technician's roles, possibly dealing with operating, stocking, and troubleshooting robot dispensing systems (Lin et al., 2007). Other disadvantages include equipment cost, remodeling of dispensing system, and robot's inability to store injectables, bulk products, and refrigerated items into its courier system (Mullett, 2009).

Although expense to implement robot technologies in medical facilities can be unaffordable for patients, inventors and researchers continue to pursue enhanced robot technology for health care. According to eHealth's Robotics for Health Care: Final Report (2008), increasing a robot's intelligence for tele-diagnostic and patient monitoring devices have been considered for further investigation (Butter et al., 2008). The invention of intelligent tele-diagnostic and patient monitoring robot systems would be anticipated for lessening a nurse's and physician's tasks through the robot being able to consult with patients, report incidents, and monitor patient vital signs (Butter et al., 2008). Yet, the amount of therapeutic touch and direct communication from medical staff may change with these robots, and present an ethical issue.

In many ways, robots have assisted patients and health vocations in the medical field. Although ethical concerns lie with technological affordability, ability to assure patients of their privacy protection,
and assuring patients that less therapeutic human touch is acceptable from health personnel, the health benefits for both patients and staff seem to outweigh the ethical cons of using robot technology. In regards to future automation interventions, robot-managed surgery, patient monitoring, motor coordination analysis, and mental, cognitive, and social therapies are being further investigated in Europe (Butter et al., 2008). However, it may take 25 more years for any new technology to enter health care (Butter et al., 2008).

References