Equitable Use of Wearable Technology in Employee Wellness Programs

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Wearable fitness devices are becoming ubiquitous in everyday life and offer an efficient way to learn more about one's health and wellness. While wearables can be beneficial for personal use, including them in workplace wellness programs with financial incentives linked to completing fitness challenges can be discriminatory due to the technology's shortcomings measuring activity for darker or thicker-skinned users and activity completed by disabled users. These technological limits impose financial and social consequences on these user groups because of the current structure of wellness programs.

In this research paper, I employ The Social Construction of Technology framework along with Disability Studies and Race Critique to analyze the equity of wearable devices in wellness programs. As SCOT outlines, human values shape the way technology evolves, and our current values reflect the need for constant access to information to make data-driven decisions. These technological developments provide the ideal functionalities of some user groups but can be experienced differently by others. This makes understanding the historical treatment of people of color and with disabilities within the medical and technological space is necessary, especially because leaving out user groups from testing and product design leads to further marginalization. As Harriet Washington details in *Medical Apartheid,* the African American population has been historically exploited in medical research while simultaneously being denied access to medical care (2006). Similarly, in *Brilliant Imperfection,* Eli Clare argues that disabled people have historically suffered from unequal access to healthcare, and the problems are being further exacerbated by the wellness movement promoting the idea that everyone can be "healthy" if they

make the effort (2017). These groups and their relationship with the medical community as well as within workplace wellness programs will be further explored in the following sections.

My STS paper and technical project work in tandem to explore the benefits and risks of incorporating technological solutions to improve general health. Our technical project's overall goal is understanding whether aligning daily activities with a person's circadian rhythm helps improve their productivity and wellbeing. Results from our project could be incorporated within the wearable technology space to provide further integration of healthy recommendations through the device. For both employees in wellness programs and users receiving recommendations about optimal activity times, it is important to consider how individual physiologies may impact their willingness and ability to adjust their lifestyles.

In this thesis, I will first introduce wearable devices and how collecting personal health information has become a normal part of everyday life. I will then introduce the employee wellness program's inception, how wearable fitness trackers became an important component of the programs, and the legal guidelines (or lack) that currently exist regarding them. My main argument lies in understanding how the technology and design of wearable devices on the market systematically disadvantages users of color, disabled users, and other vulnerable groups. Lastly, I will recommend possible solutions to make wearable device-based wellness programs more equitable for all employees with considerations for evolving wearable device capabilities and working in a post-pandemic society.

The Rise of Wearable Devices and the Quantified Self

Wearable devices, like smart watches or rings, are a growing technological commodity, most often used for tracking health and activity metrics such as heart rate, steps, sleep quality, calories burned, and exercise types and amounts. Dr. Yoshiro Hatano, a professor at the Kyushu University of Health and Welfare in Japan, first introduced wearable devices in 1965 with the development of the "10,000 steps meter" in an effort to combat obesity (Douglas-Walton, 2020). In 2021, the global wearable fitness tracker market was worth over $45 billion and is estimated to grow almost 18% each year until 2030 (Straits Research,). Continued advancement in the devices' capabilities have also led to the inclusion of features such as measuring a user's blood oxygen levels, taking ECGs, tracking ovulation cycles, and are enabled with fall detections systems that can alert authorities if a user is unable to stand up (Apple Press Release, 2022). These advancements in wearable devices allow users to better understand their physical health and make changes to their daily habits.

Alongside with the mass production and availability of modern wearables, the Quantified Self Movement originated and grew in the late 2000s with the goal of self-improvement through tracking and analyzing physiological metrics. In particular, the movement's members are interested in improving their health and overall lifestyle, including daily moods, sleep, activity levels and stress (Rijmenam, 2013). Wearable technology, and its integration with smartphones and the internet of things, has made tracking personal data convenient and readily available. The rise of the Quantified Self Movement has also brought forth discussion of a "tracked society" in the public discourse and helped normalize the concept of collecting personal data to make health improvements (Hepp, Alpen, Simon, 2019).

Technological Shortcomings of Fitness Trackers

Current fitness trackers use photoplethysmographic (PPG) green light sensors to detect health metrics like heart rate, but these results are a cause for concern for new applications like blood pressure as well. PPG light sensors work by emitting non-invasive light to illuminate the wearer's skin and measuring the intensity of light reflected using a photodetector (Sviridova, et al., 2018). The inequity in results is due to the sensors struggling different skin properties like absorption of light from higher levels of melanin for darker skins, or thicker skin with less water/blood flow for people who are obese (Ajmal, Boonya-Ananta, Rodriguez, Le, and Ramella-Roman, 2021). This issue has been underreported and not given appropriate attention in the medical community. As wearable devices continue to become staples in the medical industry, the inaccuracy of devices will only further marginalize health disparities and medical treatment for certain races. Along PPG's innate problems, the lack of diversity in validation studies for these devices in an effort to bring them to market quickly also contributes to the current inequities in wearable devices (Colvonen, DeYoung, Bosompra, and Owens, 2020).

With the increased demand for wearable devices for fitness and health management over the last decade, Ajmal et al., conducted a study to investigate how accurate these devices (2021). Based on anecdotal and systematic reports, there is a higher rate of error for users with elevated skin tones and high body mass indices (Ajmal et al., 2021). In their study using Monte Carlo modeling, an algorithm that uses repeated random sampling over a range of uncertain values to determine an expected numerical result, of a PPG signal, Ajmal et al. found that higher BMI and skin tones can create a relative loss of signal up to 61.2% for a Fitbit Versa, 32% in a Series 5 Apple Watch, and 32.9% in a Polar M600 (2021). These results are concerning when there are

financial and social consequences to employees who participate in physical wellness challenges but whose activity and performance are not being accurately represented.

In a similar study investigating the accuracy of physical activity measurements by a number of wearable technology products like the Apple Watch, Fitbit Surge, and Samsung Gear S2, researchers found that device error was higher for participants with higher body mass index, darker skin tones, and while walking (Shcherbina, et al., 2017). While some devices were more accurate in measuring heart rates, all the tested wearables had at least 20% error when measuring energy expenditure. A researcher from the study, Mattsson, specified that while their study made an effort to recruit a diverse selection of participants, which was not true in "many of the [early] validations from the companies themselves" (Hailu, 2019). Though many research studies highlight the inequity of wearable device technology, these devices continue to pervade our society as self-quantification becomes a norm. The transition of wearables into employee wellness programs is natural given that both share a goal of bettering health and wellbeing of its users.

Introduction of Workplace Wellness and its Development

The concept of workplace wellness goes back to 1600s Italy when the physician Bernardini Ramazzini began the discussion of preventative care for employees working long hours (Rucker, 2016). The concept developed further through the Industrial Revolution in the 1800's with the eight-hour workday's introduction, but the inception of the Employee Assistance Programs in the 1950s truly spurred the focus on employee wellness (Rucker, 2016). Corporations created wellness programs due to a change in culture that increased awareness of

fitness, a new recognition of how costly an employee's unhealthy habits could be to employers, and the rise of workplace health promotion groups (Greiner, 1987).

By 2000, wellness programs expanded from mainly focusing on physical health to creating a more comprehensive structure by also including supportive social and physical environments, integrating wellness into the administration, screening for mental illness, and providing assistance to workers (Hughes, Patrick, Hannon, Harris, & Ghosh, 2011). With the rise of wearable technology in the 2000s, employee wellness programs evolved to include these new devices. Over 35% of companies in 2017 offered a wearable technology-based wellness program, this number being 10% higher than just two years prior. Though wellness programs seek to improve the health and wellbeing of employees, not all employee groups receive the same benefits or are afforded the same opportunities to participate.

Benefits and Motivations of Employee Wellness Programs

To understand why inequities in wellness program access are necessary to address, it is first important to understand the benefits wellness programs can provide to companies and why they have a financial incentive to implement them. In a 2010 article about workplace wellness programs, Baicker, Cutler, and Song found that medical costs fall by $3.27 for every dollar spent on wellness programs and absenteeism costs fall by $2.73 for every dollar spent (2010). The companies that choose to implement wellness programs tend to provide insurance plans to employees, and by investing in healthy habits, companies can reduce their overall health care costs and premiums. By encouraging and rewarding healthier behavior, employees may also become more productive and miss fewer days of work, benefitting both the employee and employer (Baicker, et al., 2010). Wellness programs are almost always voluntary and can entail

health risk assessments, education materials, and counseling, and even intervention methods such as weight loss or quitting smoking (Baicker, et al., 2010).

Similarly, in a case study conducted by Souza et al., the researchers found that participants enjoyed the gamification of activities and were successful in creating healthier habits. In the study, researchers assigned participants four daily health goals: walk 6,000 steps, drink two liters of water, perform 30 minutes of exercise, and get at least six hours of sleep. For every fully completed task, the participants received points in a competition with other users as an incentive for participation. While the main goal for employers in offering wellness programs is reducing their total health insurance and medical clearance costs, employees receive the benefits of developing healthier lifestyles which can decrease their absenteeism and increase overall productivity, a secondary benefit for employers.

Employee Wellness Programs and Discrimination Concerns

With the near ubiquity of employee wellness programs in large and medium sized companies and their potential reward structures, the Equal Employment Opportunity Commission (EEOC) established guidelines to ensure that the programs abided by the Americans with Disabilities Act (ADA) and the Genetic Information Non-Discrimination Act (GINA). The ADA is a civil rights law which prohibits discrimination of disability status and ensures that employers provide reasonable accommodations to people with disabilities so they can receive the same benefits as able-bodied employees. The EEOC established the first standards with regard to employee wellness programs in 1990 when they required that employee participation in be voluntary (Fisher Phillips). In 2000, the EEOC clarified that employers cannot mandate that employees participate in wellness programs or penalize employees who do not participate. With

a number of other regulations changes issued over the past two decades, as the rules currently stand, employers are allowed to offer up to 30% of the total cost of self-coverage as an incentive to participate in wellness programs and meet certain health outcomes. The EEOC deemed the 30% rate as a fair level of incentive for companies to offer, but with the average self-coverage rate being approximately $6,000 annually, employees who are unable to participate or feel uncomfortable disclosing medical information are missing out from saving $1,800 each year, a non-significant amount for many (Center, 2015).

As employee wellness programs continue to integrate wearable technology to track health metrics, it is also important to consider how an employer may use this data and what it could mean for discrimination against employees who fail to meet the fitness challenges. While the Health Insurance Portability and Accountability Act of 1996 (HIPAA) protects information from "covered entities" such as health coverage, health care providers, and treatments, manufacturers of wearable devices do not fall under the purview of HIPAA and do not have to abide by its regulations (North, 2019). Employees who sign-up to participate in wellness programs and voluntarily provide their employer data from their wearable devices are not protected by HIPAA's regulations on disclosing personal health information (Rowland, 2019). Employers could use this data to discriminate between employees who participate more frequently or successfully in wellness challenges because there are currently no discrimination laws particularly targeted to wearable device data (Brown, 2016). Also, if a disabled employee signs up for the wellness program but is uncomfortable revealing their disability to their employer, they are now at risk from the employer finding out about their private medical status due to trends in their activity habits and reported fitness metrics.

Disability Stigma in the Workplace and Wearable Technology

People with disabilities cannot reap the true benefits of health and wellness programs because most health care professionals focus on their disabilities rather than their overall health, and wellness programs are not generally created with needs of disabled individuals in mind (Office of the Surgeon General, 2005). This is especially a concern because studies have found that significantly less people with disabilities report their health to be excellent or very good compared to able-bodied people (Center for Disease Control and Prevention, 2004).

The misconceptions and stigma surrounding the health of disabled people remains an important part of Disability Studies. Even with the ADA's passing to prevent workplace discrimination, disabled individuals have higher rates of unemployment compared to their able-bodied counterparts.

While certain fitness goals, like walking 10,000 steps each day or getting a few hours of moderate to vigorous aerobic exercise (as measured by a percentage of maximum heart rate), are common recommendations, exercise standards for wheelchair users and people with other physical disabilities are not readily available (Wallis, 2021). Heart rate as a metric may not be representative of exercise for people who have abnormal responses to exercise because of underlying health conditions. Even if wheelchair users dedicate time for cardiovascular exercise as outlined by a wellness program, a wearable device must account for a number of variables to accurately track the activity. While going on a walk or run may be accurately tracked by the number of steps and heart rate, exercises completed in wheelchairs must also account for the terrain the exercise takes place on, the speed of rolling, and even the type of wheelchair being used since some wheelchairs are much heavier than others and require more exertion (Wallis, 2021).

Ethical Considerations for Wearable-Dependent Wellness Programs

While both employers and employees benefit from participating in wearable device-based wellness programs, there must also be a consideration of whether employees are opting-in due to the financial incentives and health benefits or because of the employee-employer hierarchy and possible workplace pressure. According to the National Bioethics Advisory Committee, employees are considered to fall in the "Institutional Vulnerability" category in an identification of vulnerable subjects because they may be making choices due to coercion rather than one that is truly voluntary (National Bioethics Advisory Commission, 2001). Also, if a company has instituted a voluntary wellness program with the majority of employees participating, employees who may not be comfortable with the program may feel the need to opt-in due to feeling excluded or shamed for not participating.

With the increased normalization of wearable devices in society and datafication of personal information through the quantified self movement, employees may be forced to participate in these wellness programs or be left out of the company culture. Forcing disabled employees to make that choice continues feed into the power divide between able-bodied and disabled employees, and while able-bodied workers get to reap the program's financial and social benefits, other groups may be left behind (Basas, 2014). The basis of these employee wellness programs is that individuals are in complete control of their health, and with a concerted effort they can achieve significant improvements. For some disabled individuals, however, even when making that effort, some aspects of health are simply not in their control (Basas, 2014).

Along with the opportunity cost of participating in wellness programs, some disabled employees have actually been charged a fee for their refusal to join. In the 2012 case *Seff v. Broward County*, an employee sued their place of work over being charged $20 every two weeks

for not participating in the wellness program the company provided. The court found in the employee's favor and cited that the program evaluated cost and risk of high insurance costs in a county with an aging workforce (Basas, 2014).

If an employee with a physical disability is unable to physically complete the fitness goals set forth by a wellness program, he/she may feel uncomfortable revealing the disability to their employer in order to receive a reasonable accommodation. Even though they would benefit from participation in a more tailored wellness program, disabled employees have historically had low participation in these initiatives (U.S. Department of Labor, 2009). This is especially concerning because people with disabilities are more likely to develop chronic conditions like lower back pain or diabetes due to secondary conditions from their disability (U.S. Department of Labor).

Proposed Solutions for Improving Workplace Equity

As the tracking capabilities of wearable technology continue to evolve, developers must be purposeful about recruiting diverse participants for any device's early trials to ensure that any differences in the device's accuracy are known and corrected before development continues. The green light technology currently used for wearables has benefits such as lower interference when a user moves, low barriers to implementation due to widespread knowledge of the system, and offers a lower expense to include (Hailu, 2019). However, because the metrics collected by these devices can have financial and medical consequences to their users, it is the responsibility of technology companies to ensure the products they provide are equitable and accurate across all user groups. An alternative to use in tandem with existing green light systems is infrared light which is better at penetrating the skin and is commonly used in medical settings. The Apple

Watch already includes the infrared capability which it uses every five minutes to confirm the user's heart rate while continuously using the green light (Hailu, 2019). As previously mentioned, the Apple Watch is more accurate at detecting heart rate across diverse user groups, and it could be used as an industry standard for tracking.

Federal organizations should require companies to develop alternative plans or goals for employees with disabilities to ensure wearable-device based employee wellness programs are equitable for all employees. These plans could include things like changing a target health metric from getting 10,000 steps each day to taking a specified amount of time to perform physical activity, or switching a weight loss goal to a greater focus on nutrition by offering a class with a nutritionist. These alternative plans should be offered freely, and knowledge of their existence should be readily available to prevent information frictions from preventing disabled employees from participating in wellness programs. Since the ultimate goal of a wellness program is improving an employee's health and wellbeing in order to increase productivity at work, employers should use any resources they can to ensure as many employees as possible join the wellness programs and are successful in reaching their goals.

Future researchers and wellness program participants should also be considerate of how wearable technology will progress over the next decade. While wrist-based wearables are the most common at form of wearable technology currently being used in programs, as the technology continues to develop, they will be further integrated into everyday clothing and become even more convenient to always have on without needing to be repeatedly charged, including smart jewelry such as earrings or socks that measure a wearer's gait (Covert, 2022). Increasingly private information is also subject to be revealed as new iterations of wearables make their way into mainstream use. Devices are being designed to monitor mental health

conditions through continuously tracking cortisol levels and drug testing employees through their sweat (Covert, 2022). Technological develops in the wearable technology space must be monitored by policy makers and employees to ensure medical information remains private and companies do not use the collected data in a discriminatory way.

Lastly, as workplace programs evolve in the post-pandemic era and more companies allow employees to work from home/implement more flexible schedules, wellness programs will have to adjust accordingly. A work from home schedule may allow employees to better reach their fitness goals (more sleep, regular exercise if they are capable) by cutting out commute time from an employee's schedule (CDC Workplace Health Resource Center, 2020). If wellness programs are adjusted to encourage common fitness goals or challenges to motivate employees and provide a social opportunity to connect, companies should take careful consideration about what disabilities may prevent participation in these programs and how to ensure all employees stay engaged and feel included. Also, since wearable devices track movements (and other health metrics) indexed over time, companies should not use fitness tracker data to evaluate employee performance/productivity during a workday.

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