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Nanotechnology in the Eyes of Healthcare Workers

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According to the Virginia and D.K. Ludwig Professor for Clinical Investigation in Cancer Research, Sam Gambhir, a study conducted by him in 2016 under the Stanford Center for Cancer Nanotechnology and Excellence for Translation Diagnostics showed that "Nanotechnology has the potential to detect and even kill early cancer cells present in the hundreds or thousands versus the billions already present in currently diagnosable tumors" (Conger 16). As Nanotechnology is introduced into the healthcare industry, workers are able to apply it to medical processes such as "medical imaging, disease diagnoses, drug delivery, cancer treatment, gene therapy" (Gwinn 1). The incorporation of this technology is causing healthcare workers to become more reliant on its abilities. Does Nanotechnology have an effect on healthcare workers' productivity and quality of work?

Healthcare workers treat patients of many different genetic backgrounds requiring the need for personalized medicine. Nanotechnology allows for an "increase [in] the speed of DNA sequencing" which can help treat genetic diseases quickly (National Nanotechnology Initiative). Furthermore, "some nanoparticle-based treatments are multi-functional", meaning they can be loaded with several treatments and target multiple problematic areas at once (National Nanotechnology Initiative). This type of efficiency from Nanotechnology allows for healthcare workers to increase their productivity levels in treatment methods and development. Healthcare workers are also improving the quality of their work with the use of Nanotechnology. In processes such as drug delivery and imaging, it allows workers to achieve a higher level of precision, eliminating chances of human error. Nanotechnology allows healthcare workers to "[enable] early disease detection and diagnosis" (Alharbi 2). Its assistance allows workers the ability to come up with an effective treatment plan, improving the quality of patient treatment. Nanotechnology should be incorporated into medicare to enhance the productivity and quality of healthcare workers.

Healthcare workers are able to be more productive in their work with the incorporation of Nanotechnology. Nanotechnology can help speed up DNA sequence readings for genetic disease patients from almost 9 days to 10 minutes (Carnegie Mellon University). Despite its quickness, it can still be challenging to find a cure for genetic diseases considering we are all born with unique DNA sequences in which various mutations can occur. With Nanotechnology, however, healthcare workers are able to read several DNA sequences quickly using "nanopore sequencing [which] measures subtle electrical current changes produced as the four base molecules that make up DNA pass through the pore" (Crampton 11). The incorporation of Nanotechnology into DNA readings will make it easier to quickly detect mutational occurrences and "speed [up] the development of personalized medicine" for all genetic diseases (Crampton 1). This process can save healthcare workers a lot of time when finding individual treatment methods for patients of various conditions. Additionally Nanotechnology can also help workers increase productivity by being multifunctional medication. A rising example of this is the use of Nanotechnology to kill cancer cells and "transport multiple therapeutic agents simultaneously" (VanDyke 19). This method increases productivity as "nanoparticles have the ability to be loaded with multiple cancer medications and conjugated with targeting moieties that allow for the targeting of various hallmarks of cancer" (VanDyke 17). Using this process enables a "combination treatment method that allows for the safe transport and release of cytotoxic agents to the core of the tumor microenvironment" in order to kill cancer cells (VanDyke 17). Speed and multifunctionality both allow healthcare workers to be more productive in patient treatment by speeding up diagnosis analysis and treatment processes.

The quality of healthcare workers is increasing as well with Nanotechnology. Specifically in Biological Medicine processes such as imaging and drug delivery. Nanotechnology has the "ability to detect, quantify, and display molecular and

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cellular changes that happen" in the human body (Gwinn 7). Existing imaging technology such as "X-rays and ultrasounds...only examine changes on the tissue surface relatively late in disease progression" (Sim 14). However, Nanotechnology can "exhibit lower toxicity, and enhanced permeability and retention effects in tissues" allowing for a more intricate imaging and analysis (Sim 14). It can help healthcare workers by incorporating "monitoring technologies" within the human body (Thompson 21). "Remote monitoring of the patient's vital signs can enable a trained person out of the pressured environment" allowing workers to focus on other tasks to improve the quality of patient care and diagnosis( ). Nanotechnology provides more detailed results allowing healthcare workers to better understand the problem and create a high-quality treatment plan that is effective for the patient before the disease begins to progress.

Additionally, drug delivery processes with the use of Nanotechnology have been "proven effective in a clinical setting and are clinically used" to improve the quality of treatment (Sim 17). Nanotechnology allows for medication to target a specific site with high precision. While other methods do exist to accomplish the same task, such as radiotherapy, they are external therapeutic methods that can be inaccurate and damaging to already existing healthy cells (Sim 16). With Nanotechnology, however, this task can be accomplished even with "a drug which exhibits high toxicity...without affecting the heart or kidneys" (Sim 18). Meaning with Nanotechnology, "drug efficiency can be ensured by specifically targeting and killing harmful or cancerous cells" without damaging others (Sim 19). This in turn improves the quality of healthcare workers regarding patient treatment methods.

Many who doubt the credibility of Nanotechnology claim that we don't have control over the technology once it is inside our bodies and that it has the ability to disrupt natural body functions. However, this is untrue considering "antibodies, collagen, and other micromolecules make them biocompatible for detection and diagnosis," leaving the patient out of danger (Gwinn 7). Additionally, the biocompatible technology can be remotely controlled, meaning doctors have complete control over them even once they are inside a person's body. Additionally, while many challenge the idea of Nanotechnology, "the FDA has already reviewed and approved some nanotechnology-based products" proving that it is safe for humans (US Food and Drug Administration).

Nanotechnology has helped enhance healthcare worker productivity and quality of work. With improved precision, quicker and multifunctional treatment, and the development of new medical procedures, Nanotechnology aids in improving the quality and productivity of patient treatment. In other words, it has helped enhance healthcare worker productivity and quality of work. To further utilize the benefit of Nanotechnology we must make it publicly available to patients who need it. In the coming years as this technology becomes commercial, it must become cost-efficient too so we can grow our economy and further advance Nanotechnology in hope of curing diseases like Cancer.

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