Han Nguyen

IT-104-001

2/21/2018

“Is Nanomedicine beneficial for human?”

GMU honor code:

"By placing this statement on my webpage, I certify that I have read and understand the GMU Honor Code on https://oai.gmu.edu/mason-honor-code/ and as stated, I as student member of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work. In addition, I have received permission from the copyright holder for any copyrighted material that is displayed on my site. This includes quoting extensive amounts of text, any material copied directly from a web page and graphics/pictures that are copyrighted. This project or subject material has not been used in another class by me or any other student. Finally, I certify that this site is not for commercial purposes, which is a violation of the George Mason Responsible Use of Computing (RUC) Policy posted on http://copyright.gmu.edu/?page_id=301 web site."

INTRODUCTION

Have you ever heard of a nanotechnology before? If yes, what is a nanotechnology? Nanotechnology is a branch of technology that is designed in the size of nanoscale, where a dimension of a device that can be few nanometers or less. Due to its convenient in size and its role, nanotechnology is widely used in the various field such as computer manufacturing, communication, agriculture, home and business construction, medical, etc. However, nanotechnology is most developed in the medical field. Human has researched and used nanotechnology to provide prevention, diagnosing, and treatment of diseases in healthcare, therefore the application of nanotechnology in the medical field is known as a nanomedicine. Nanomedicine involves the use of nanoparticles and nanorobots in order to assist a physician to achieve various difficulties that it cannot be done manually by the human. Nanomedicine is commonly used in the medical field; however, people express their concerns about the nanomedicine legal and ethical issue where some believe that nanomedicine is not safe. Many researchers have conducted experiments and concluded that the nanomedicine will bring more benefits than disadvantages for the human.

BACKGROUND

Contrasting to other medical technologies, nanomedicine is a novice owing to the fact that its evolution only burst out around the 20^{th}-21^{th} century. The biotechnology development in the 19^{th} century was the beginning of nanotechnology, later the nanomedicine. After the invention of the microscope, it brought human the simultaneously evolution not only in chemistry, biology, and physic but also the foundation in microelectronics and molecular biology. Even though the nanomedicine only started to grow for a few decades, however, the use of nanotechnology had been brought up by Albert Einstein and Max Planck in the 1900s. For the

first time, in 1920, structures with a nanoscale size were first detected under the ultramicroscope by Richard Zsigmondy and Henry Siedentopf (Krukemeyer, Krenn, Huebner & Resch, 2015). Starting from then, many researchers had found ways to observe and understand closer to the cell structures and its function. Around the 1980s, due to the invention of scanning the tunneling microscope, an individual atom was shown vividly. With the new microscope, researchers and scientist were able to illustrate and control the nanoscale structure. In 1959, the idea of developing and using nanotechnologies was mentioned for the first time by Richard Feynman, which later started the new interest for the scientist in the nanotechnology field. Finally, in 1974, the term “nanotechnology” was ultimately defined by Norio Taniguchi and it has been used until today. In 1999, Robert Freitas officially used the term nanomedicine as the title of his book to imply the use of nanotechnology in medicine based on the idea of Feynman. Later in the time, the National Cancer Institute launched the nanotechnology for cancer project in 2004. In the USA, FDA has approved for the nanomedicine since 1995, however, the approval reaches its peak around 2001-2005. Nanomedicine is considered as a newly developed technology in the medical field, however, the history of its foundation of biotechnology and nanotechnology first started in the early 19th century, quite long time ago.

CURRENT USE

Now a day, as human lives in the technology century, it is not surprising that everything revolves around the high tech. People interact with the technology every single day such as they communicate through phone, use laptops and computers to record data at work, watch television for amusement, etc. Technology expands in not only human daily lives, but in the present, they are also applied to the medical field. Beside the famous robotic surgery, the nanomedicine is another advanced technology that is commonly used. Researchers have concluded that human

can use nanomedicine with different purposes in the future, however, the current application of nanomedicine for human treatment is drug delivery and cancer therapeutic. Many people would wonder how the nanomedicine works as a drug delivery in the human bodies. Medical experts and researchers believe that when the drug is delivered to a desired place in the body, the drug will be degenerated by the barriers it meets on the path like the digestive system, which then decreases the efficiency of an ability of healing and treatment of the drug. The pharmacist then produces far more dose than the actual need due to the degeneration of the medicine in the body. Therefore, in order to improve the benefit of the drug, nanomedicine is operated to overcome the difficulties. Scientists created a nanomedicine with the function of distinguishing between the healthy cells and the sick cells. A patient will be injected the nanomedicine into their bodies by the physicians, which the nanomedicine carries the substance or the drug along with it. The nanomedicine will protect the content of the drug when it goes through the barriers, when it arrives at the targeted destination, with the help of the ultrasound from the exterior, the nanomedicine will release the medicine. With the use of nanomedicine as a drug delivery, it will boost up the healing process, increase the efficiency of the drug, and reduce the cost of producing excessive doses. Besides the drug delivery, the nanomedicine can work to enhance cancer therapeutic. Nanomedicine in cancer therapeutic works similarly as if it is the drug delivery. People with cancer will be treated with the chemotherapy in order to destroy the tumor and the sick cells in the body. However, the chemotherapy is strong so it cannot detect the sick cells; it then destroys the healthy cells which causes the hair loss for the patient. In order to prevent that, the nanomedicine is used to protect the healthy cells. A patient will be injected the nanomedicine, it will then detect the healthy cells and protect them against the chemotherapy, decreases the side effects, and it can increase its effectiveness, therefore, it will boost the treating

process of the cancer therapy. After many studies, the nanomedicine now operates as a drug delivery and cancer therapy.

LEGAL AND ETHICAL ISSUE

Since the nanotechnology is rapidly growing to satisfy the human need, the legal and ethical issues come in concerned. The nanomedicine does not only face the ethical concerns about its environmental safety, consumer and the human health, but it also opposes the legal issue initially. The nanomedicine has an arduous path to proceed to be approved by the FDA in America. According to the FDA, the medical product that is approved by them will be categorized either as “drug”, “medical”, or “cosmetic” based on its functions. The approval processes for drug, medical, or cosmetic are various from one another. The drug takes more time and more complicated to be approved by the FDA because it directly affects the function or the structure of the body. The drug manufacturer needs to submit the case studies of the drug to the FDA so the agency can determine the safety and efficacy, which can take many years. Unlike the drug, the FDA requires the less complexed procedure for the “device” product when it only needs the assurance from the company. A “cosmetic” product is defined as any product that is applied to the human body with the purpose of enhancing the appearance and the attractiveness. For the present, the FDA does not have an official process to approve the cosmetic. The nanomedicine does not belong to a unique place based on the FDA category because it performs with the function of a medical device, a drug, and a cosmetic. Therefore, the nanomedicine faces a complicated path before it can be approved. The FDA will only assure the safety of the nanomedicine use but without categorizing first. Not only facing the legal issue, people express their concerns about the ethical issue. The most concern of the nanomedicine is its toxicity of nanomaterial. Many believe that it will not only hazardously affect the human body, but it also

has negative impacts on the environment. There are potential risks for a patient who is treated with the nanomedicine due to the lack of knowledge about the toxicity of the nanomedicine. It also can create the contamination due to the disposal of the nanomaterial. People question their privacy and their relationship with the technology when it comes to the nanomedicine. They also fear of decreasing gap between humans and computers and soon, human will not have control or a say over their bodies. Risk will happen like particles cannot be seen or easily controlled, and it would enter the body and deliver toxic substances to unwanted locations. The use of nanomedicine as diagnosing when it enters the interior of the human body to collect the date worry human’s privacy. The development of technology already involves in the daily life of human which create anxiety of many individuals who believes that the technology will control human one day, and the nanomedicine will be the start. The nanomedicine also faces the other ethical question such as the testing of animals. The nanomedicine creation is an advanced development that will bring a lot of benefits, however, many believe that it will bring more harm due to its ethical and social implications.

SECURITY ASPECT

Nanomedicine can be a great technology that assists people in the healthcare, however, the security aspect of nanomedicine creates many concerns in people. The novelty of the machine spawned uncertain risks and the lack of knowledge that the nanomedicine brings to human health and their bodies. The application of nanomedicine initiates people anxious about their privacy and safety for their bodies. The nanomedicine is constructed to be able to travel inside the body to observe the interior, to the delivery drug, or to enhance the treatment, and the risks of the nanomedicine have not been observed. Many are worried if the nanomedicine breaks down inside and cannot be detected, or it delivers the drug to an incorrect place which can cause

dangerous effects on human bodies. Because the risks have not been observed, the cure or the solution of those have not been established. Physicians or doctors would not know how to react to a certain situation due to their lack of knowledge on the machine and its innovation (Hammed, Adekunle, Ebiesuwa & Mensah-Agyei, 2016). People do not only care about their safety, but they also pay close attention to their confidentiality. Injecting the nanomedicine in the interior part of the body, many consider that their privacy was invaded. Some do not feel safe using the nanomedicine since people have outside access to the nanomedicine and can view the information about one’s body. Without any development to improve the privacy, the nanomedicine is viewed to be unsafe for human health and its confidentiality.

FUTURE USE

Due to its convenience in size and its ability to perform difficult tasks, the nanomedicine is continually developed and researched by scientists in order to enhance the medical field. Tissue engineering will be another function that the nanomedicine has. The nanomedicine will be used to reproduce or repair the damaged tissues when it works as a tissue engineering. Scientist believe that the nanomedicine later will be used to diagnose and provide visualization various diseases in human body. The nanomedicine will have the competence to recognize cells and its constituent, individual genes, and produce the three-dimension image that is beneficial to acquire a concise picture of the interior. Along with the robotic surgery, the physician will operate many surgeries with the coordination of the nanomedicine. It could also use to improve HIV therapies with the similar technique of cancer therapy. Antibiotic resistance and immune response are other functions that the researchers believe that the nanomedicine could perform. The nanomedicine is not only used in the medical field but also the dentistry. It can also be applied to dentist field for inducing anesthesia, tooth repair, and renaturalization, etc. The nanomedicine

development is enhanced more in the future to assist not only physicians but also dentists to perform better treatment on patients. It does not only help with the treatment; however, it also helps to improved patient cost, health and the effectiveness of the healing process.

CONCLUSION

Nanomedicine is a new nanotechnology that has a huge impact on the human lives. With many studies and researchers, the human has used to the nanomedicine to operate many various medical functions such as drug delivery, cancer therapeutics, tissue engineering, etc. Nanomedicine has brought many benefits for human, especially assist the physicians in order to promote the healthcare, treatments, and patient’s health. However, like other technology, it opposes many legal and ethical issues and the security aspects that people question. There are risks and unpredicted consequences that the scientists have not been observed, therefore, it irritates other people. According to the researchers, the nanomedicine generates more benefits than harm for the human. Unlike the robotic surgery, the nanomedicine is more commonly used due to its convenience in size to perform many difficult tasks that human cannot operate. Nanomedicine is a new improvement in technology and it can create unknown risks and problems, however, no one has opposed to its application on the human yet. Researchers have been conducted to continually discover the nanomedicine, so it can be improved and performs its function better to help the physicians in the healthcare.

Reference page

Advances in nanotechnology's fight against cancer. (2013, Dec 19). *US Fed News Service, Including US State News*. Retrieved February 10, 2018 from https://search-proquest-com.mutex.gmu.edu/docview/1469004894?accountid=14541

The article talks about the use of nanomedicine in cancer therapy. It mentions the research of Ho who studies the nanomedicine with his teams in order to make cancer easier to be detected. The article also mentions that if the computation-based design methods combine with nanomedicine, it will improve the effective and safety of cancer treatments. The author also conveys that the nanomedicine is still in a development stage where nothing is uncertain, however, the use of nanoparticle as a drug delivery is a marvelous beginning for the use of nanomedicine in cancer therapy in the future. In general, the nanomedicine will be used as a cancer therapeutic in the nearly future because people believe it will a beneficial treatment for human.

Allon, I., Ben-yehudah, A., Dekel, R., Solbakk, J., Weltring, K., & Siegal, G. (2017). Ethical issues in nanomedicine: Tempest in a teapot? *Medicine, Health Care, and Philosophy*, *20*(1), 3-11. Retrieved February 5, 2018 from http://dx.doi.org.mutex.gmu.edu/10.1007/s11019-016-9720-7

Different from other article, this author talks mainly about the ethical issues of nanomedicine. The author expresses his concern about the nature of nanomedicine where he believes it is related to the ethic challenges that human face. In the article, risks about the nanomedicine is mentioned, the risk of moral blindness, and the question about the nanomedicine and its uniqueness. The author provides more negative views about the

nanomedicine than many other authors when he mainly talks about the health risk, the moral risk, and the practice risk because nanomedicine is a new developed technology. He tends to inform the knowledge for everyone, especially, people with the same opinion on the nanomedicine.

David, O. W. (2002). The next little thing. *Health Forum Journal, 45*(5), 10-15. Retrieved February 9, 2018 from https://search.proquest.com/docview/233510153?accountid=14541

This journal's topic is nanomedicine and different from other documents, this document only talks about the detail of the machine rather than talking about its application on human. It describes closely how the nanomedicine machine involves over time and its components. The purpose of this journal is to help people have a better view about the nanomedicine and understands how it works. The author wants to inform the audience about the technology with the neutral tone, he does not take side like any other authors when they talk about the nanomedicine. This article provides the detail information about the machine from the closely observations of the researchers. With this journal, it has helped me to learn about its mechanisms and how it works, therefore, I can write with more understanding.

Hammed, O., Adekunle, Y., Ebiesuwa, S., & Mensah-Agyei, G. (2016). Nanomedicine: Overview, problem, solution and future. *International Journal of Computer Science and Software Engineering, 5*(9), 218-222. Retrieved February 12, 2018 from https://search-proquest-com.mutex.gmu.edu/docview/1868264388?accountid=14541

Like other documents, this article mainly talks about the nanomedicine and its applications. It first provides details about what the nanomedicine is. Then the author talks about its applications in medical, the problems or issues with nanomedicine, the precautionary when an individual use nanomedicine, and the future use of nanomedicine. Different from other articles, this also include the recommendation for further studies to enhance the application of the nanomedicine in the healthcare. The article focuses mainly on the issues that the nanomedicine brings rather than its benefits. Following the problem issue, the author discusses how people should acknowledge the nanomedicine as a new device and be more careful. This article provides many useful and basic information about the nanomedicine that helps me to understand more about the topic.

Krukemeyer MG, Krenn V, Huebner F, Wagner W, Resch R (2015) History and Possible Uses of Nanomedicine Based on Nanoparticles and Nanotechnological Progress. J Nanomed Nanotechnol 6:336. doi:10.4172/2157-7439.1000336. Retrieved February 9, 2018 from https://www.omicsonline.org/open-access/history-and-possible-uses-of-nanomedicine-based-on-nanoparticles-and-nanotechnological-progress-2157-7439-1000336.php?aid=63383

The article provides the most detail information about the nanomedicine. It talks about the history of it, the use of nanomedicine, and the issues and concerns that it must face. The authors want to notify the audiences about the nanomedicine because they want to enhance the people's knowledge. It mainly talks about the history of the nanotechnology; therefore, the audience will understand how the nanomedicine develops throughout the time Different from most of other documents, this article does not have a critical or supportive tone because it only

uses to provide the information rather than taking stance on the ethical issues. This article provides the most useful information because I can use it to understand the nanomedicine better, and it helps me to put its history together.

Pediatric nanomedicine center links health care and engineering. (2011, Mar 28). *Targeted News Service.* Retrieved February 5, 2018 from https://search-proquest-com.mutex.gmu.edu/docview/858912815?accountid=14541

In this article, the author mentions to Professor Bao, who is conducting his research about the nanomedicine in children disease. Unlike other articles when it talks about nanomedicine in general, the author of this mainly talks about a specific application of the nanomedicine in children only. They believe that the nanomedicine will play a major role in the treatment for pediatric diseases. This article wants to inform the audiences who cares about the nanomedicine topic, other scientists and researchers, and physicians. The author also conveys the further use of the nanomedicine such as treatment for cardiovascular disease, the development of treating single gene disorders, etc. Beside the basic function that the nanomedicine can operate, this article believes that the nanomedicine can function more jobs. This document helps me to understand the future use of the nanomedicine.

Park, K. (2007). Nanotechnology: What it can do for drug delivery. *Journal of Controlled Release: Official Journal of the Controlled Release Society*, *120*(1-2), 1–3. Retrieved February 9,2018 from http://doi.org/10.1016/j.jconrel.2007.05.003

In the article, the author only talks about the nanotechnology using for drug delivery rather than talk about a specific nanomedicine. He first describes the nano system, then

he explains more carefully of how it is used to delivery drug in human body. The author mentions how the nanotechnology needs to be approved by the FDA, therefore, in this article, the author uses persuasive tone mostly. He observes carefully the use of nanomedicine as a drug delivery. Instead of talking about the cancer therapeutic function like other documents, this article goes deeply into how the nanomedicine work as a drug delivery. The author tries to inform people with the application of the nanomedicine and he supports the use of the it in the medical field.