

Research Project In Health And Social Care

Topic: "Impact of the developing technologies on the healthcare sector of UK in the last decade"

Table of Contents

| | |
|------------------------------|----|
| 1.0 Introduction..... | 3 |
| 2.0 Aim of the research..... | 4 |
| 3.0 Methodology..... | 4 |
| 4.0 Findings..... | 5 |
| 5.0 Summary..... | 8 |
| References..... | 10 |

1.0 Introduction

Technology has been gaining prominence in a number of fields for the past few decades. The contribution of technology to healthcare has been instrumental in helping medical professionals provide better and more efficient care to people across the world (Schön, 2017). The United Kingdom has witnessed significant advances in the healthcare industry and its citizens enjoy one of the highest standards of living and life expectancies in the world. The healthcare provided in the country therefore incorporates all relevant advances in healthcare technologies (Drummond *et al.*, 2015). This research project focuses on the effects of implementing specific technologies such as gene therapy, ingestible sensors, and nanoparticles in the healthcare sector.

1.1 Background

Technologies implemented in the healthcare sector have had a dramatic effect on the quality and efficiency of healthcare delivered to people across the UK. Not only did they radically change the way healthcare services were provided to people, but also eradicated a number of previously untreatable diseases (Lennon *et al.*, 2017). The advancements in medical technology have steadily enabled healthcare professionals to provide better services to people, and revamp healthcare standards. These advances have saved millions of lives and have greatly helped improve the quality of life experienced by people. The average life expectancy in the UK has risen from below 70 years in the 1960s to above 82 years in 2017.

1.2 Background literature review (with rationale)

The healthcare sector in the UK has undergone a paradigm shift in the last few decades, owing to its adoption of radical new technologies. These technologies have enabled healthcare professionals to provide vastly superior healthcare services to people across the nation and have been a prime contributor to the increase in the standards of living and life expectancies. This research project focuses on the implications of employing further advanced technologies such as gene therapy, ingestible sensors, and nanoparticles in healthcare applications, and helps current as well as future researchers gauge their effects.

The literature published by scholars and researchers relevant to the specific technologies this research focuses on have been analysed and the findings have been described below:

GENETIC THERAPY FOR TREATING HEREDITARY DISEASES

Genetic or gene therapy has long been proposed by medical researchers as an effective way to treat single gene defects, with the help of suitable gene editing methodologies. Gene therapy methodologies incorporate technologies to remove the part of the genetic sequence responsible for the hereditary disease and replace it with a healthy gene (Annualmeeting.asgct.org, 2018). The most prevalent diseases that could be treated with this technology include cardiovascular diseases, AIDS, cystic fibrosis, haemophilia, and various kinds of cancers. However, traditional means of gene sequencing often had short-lived effects (Nature.com, 2018). The advent of new tools such as CRISPR-Cas9 has been significantly hopeful for researchers, since it could provide a permanent fix unlike previous methodologies.

THE USE OF DIGESTIBLE SENSORS IN THE HEALTHCARE SECTOR

Methods of monitoring and tracking vital physiological and biological patient information have traditionally relied on samples that were tested on a regular basis. However, these methods of tracking changes in a body have considerable lag and can often be unreliable and prone to false results (Wang, 2018). In order to combat these disadvantages of traditional methods, radical means of monitoring have been developed such as ingestible sensors, which track their vitals from inside the body of an individual in real time and transmit the information to a suitable destination, where they can be stored (Kalantar-zadeh *et al.*, 2017). This data can then be used by doctors and medical professionals to provide better patient-centric care and track changes and responses in the body at a much faster rate. This increase in speed can be a vital factor in healthcare applications, and save numerous lives.

USING NANOPARTICLES AS A DELIVERY MECHANISM FOR TREATING CANCER

The most common ways of treating a variety of cancers in the world today include radiation therapy and chemotherapy. Although, these methods have been largely successful in treating cancers of various kinds, both of them suffer from one significant drawback of being unable to be targeted to specific cells. These methods therefore harm not only the cancer cells, but also the healthy cells surrounding it. These lead to dramatic side effects such as hair-loss, weakness, loss of appetite etc (Patel *et al.*, 2015). To combat these drawbacks, nanoparticles have been proposed to deliver chemotherapy drugs to specific cells in the body, which eliminates the most significant disadvantage of chemotherapy and enables medical professionals to target the drugs and not harm healthy tissue.

2.0 Aim of the research

The research aims to evaluate the impact adoption of technologies such as gene therapy, ingestible sensors, and nanoparticles have had on the healthcare sector in the UK.

3.0 Methodology

3.1 Study design

Researches today are conducted on numerous fields regarding numerous topics. Thus, scholars have proposed a number of different approaches to research project, depending upon its purpose and the tools used in it. Choosing a suitable research design and conforming to it throughout the research helps keeps the project remain coherent and helps the researcher map his or her research objectives better. The research design chosen for this project is exploratory, which aims at merely exploring the issues it addresses further and not provide any concrete conclusions. The reason this approach is perfectly suited to the project is due to the scarcity of a large number of reliable sources to base the research upon, which compels the researcher to explore the issue further and not provide concrete conclusions to the issues.

The research bases its conclusions on analysing secondary data, using online databases to find relevant publications on the topics chosen for this research project. These sources of information were used to construct an effective literature review. Reviewing existing literature is a vital component of undertaking any research project. It helps the researcher become more familiar with the ideas and concepts discussed in the later parts of the research project and helps the reader gain a deeper insight into the research and understand its significance.

3.2 Data collection

The data required for the study was primarily collected from already published literature, which consisted of relevant research publications, journals, and articles. These publications were obtained by browsing through online databases containing vast amounts of research and were sorted using relevant factors to help keep the research appropriate to the research aims and objectives. The inclusion and exclusion criteria developed for the purpose of this research have been detailed below:

| Inclusion | Exclusion |
|------------------------------------|---|
| Type | Type |
| Qualitative and Quantitative | Qualitative and Quantitative |
| Primary studies, secondary studies | Primary studies, secondary studies |
| Focus | Focus |
| Nanoparticles in cancer therapy | Not complying to the technologies focused in this study |
| Gene Therapy | - |
| Digestible sensors | - |
| Limits | Limits |
| Post 2008 | Pre 2008 |
| English | Non English |

3.3 Analysis

Over 100 articles were found to be relevant to the research aims and objectives. Thus, it was important to sort them through effective means and utilise the most vital publications for the research purposes. The inclusion factors chosen for the purposes of the study include both qualitative and quantitative studies, which incorporate primary as well as secondary data sources. The publications were then filtered based on their topics, which include gene therapy as a treatment for hereditary diseases, nanoparticles as an effective drug delivery mechanism for cancer treatment, and the use of digestible sensors to monitor physiological and biological patient data in real time. Thus, the articles found were filtered based on whether or not they focused on these specific topics. Further, the articles were filtered base on their age. Since the research focuses on technologies developed in the last decade, any publication before the year 2008 would be irrelevant for the purposes of the research. Lastly, to address language barriers, all non-English articles were filtered out. Upon applying all these criterions, only five articles were chosen for the research, and the key conclusions of the project were based upon these publications. These articles provided a significant understanding of the technologies chosen, their respective strengths, and weaknesses, and helped the researcher make valid conclusions and fulfil the research objectives.

4.0 Findings

4.1 Search results

The key words like 'developing technologies in health and social care', 'impact of digital technologies in the health and social care sector', 'use of nanoparticles in cancer research', 'use of digestible sensors in the healthcare sector' and 'use of gene therapy in treating genetic disorders' were used for this research. The search included both qualitative as well as quantitative studies, related to the impact of the developing technologies mentioned above on the healthcare sector of UK. The initial numbers of articles resulting from the search were 48,000 results, of which, after the application of the search constraints, key terms and the date of publication of the article, the number was reduced to 25,000 articles. The titles of all the articles were screened, to choose the most suitable articles to be studied for the project. The abstracts of 30 related articles were chosen for the study and six (6) articles were adopted for the final study, after consultation.

4.2 Included studies

Ali et al., 2015

The study introduces the processes encompassed in nanotechnology and the properties of the nanoparticles, which makes it suitable for treating the cancer cells in the human body. Cancer is a reason of rising concern in the developing as well as the developed nations and in UK alone, cancer causes around 163,500 deaths every year, of which 38% are believed to be preventable and 50% of them possess fair chances of regaining their normal health (Ali *et al.*, 2015). Nanotechnology incorporates the usage of nanoparticles of different compounds, for targeted drug delivery to the cancer cells and aid in its destruction. The use of nanoparticles in the health and social care sector, for the treatment of cancer, has gained popularity in the last decade owing to several factors like specificity of the treatment, ability to kill the cancerous cells while not affecting the healthy cells and increased chances of survival as noted among the patients. The large surface area of the gold nanoparticles, with ease of surface modification and increased chances of exhibiting stability and biocompatibility when introduced into the physiological systems, vouches for its suitability for being used as an effective medium for drug delivery among the cancer patients, by targeting the cancer cells specifically.

Wang et al., 2008

Cancer is a leading cause of death in most of the developing and the developed countries. The common treatment procedures available for the treatment include chemotherapy, surgery and radiation therapies. The nonspecific distribution of anticancer medicines within the physiological systems of the body, improper concentration of drugs reaching the tumor, after passing through the physiological systems and barriers and there are less chances available for monitoring the treatment procedures are the challenges encountered with the traditional treatment procedures (Wang *et al.*, 2008). The characteristics that are to be exhibited by the nanoparticles, in order to be efficient enough for impacting the health of the individuals and helping to eradicate the illnesses like cancer includes larger surface area, better stability of the nanoparticles within the physiological systems, better abilities to exhibit Surface Plasmon Resonance. The development of multifunctional nanoparticles possesses the abilities to carry the drugs to the specified target location within the body, without any interventions and helping in delivering the drug to the cancerous cells, without affecting the healthy cells in the process. On the other hand, they also act as signal contrast agents, enabling for the monitoring of the effects of treatment procedures in real time is the need of future.

The development of this system would help in managing incidences of cancer to a larger extent in future.

Kalantar-zadeh *et al.*, 2017

The ingestible sensors act as an efficient way of monitoring the functions of the internal organs and thus, act as a great way for monitoring and maintaining the health of the individuals. The sensors are ingested and enable monitoring of the conditions and the functions of the internal organs connected through the gastrointestinal tract. The ingestible sensors are connected via internet to the smart phones and the analytical software, which can be consulted by the physicians as well as the individuals, for analyzing the state of metabolism, enzymatic activities, and hormonal balance as well as gauge the impact of food, medicines and external environment on the physiological conditions of the individuals. The future holds great prospects for this technology and can allow for the determination of the microbiome of the gastrointestinal tract in real time, which would allow for the adoption of preventive measures to control numerous diseases.

Belknap *et al.*, 2013

This study is based on the usage of ingestible sensors for the detection and containment of tuberculosis among patients. The costs of the treatment that are rendered to the patients includes the DOT therapy, which is somewhat high on the sustaining costs and thus, limits its availability to the patients. The usage of the ingestible sensors acts as a one-time investment for the patients and its efficacy in the determination of the incidences of Tuberculosis makes it the technology of choice among the patients. This is a quantitative study, that had been carried out among thirty patients and the success rate for the detection of the TB conditions was 95% for the sensors. The low risks associated with it (for the users) and the efficacy and ability to diagnose correctly, vouches for its greater acceptance in the health care scenario in the future.

Mingozzi and High, 2011

The treatment procedures involving the replacement of the damaged or mutated genes, for controlling the incidences of disease is a research arena that had stormed the healthcare sector in the last decade. The inherited diseases are the ones which gets transferred from one generation to another, depending on the genetic constitution inherited by the offspring, from their respective parents. The use of adeno-associated vectors (AAV) for the transfer of the genes to the diseased animals, have shown good efficacy and thus, are proposed to be used in future among the human population as well. Till date, the AAVs have been effectively used for curing congenital blindness among the humans, for the correction of the phenotype responsible for causing Hemophilia B among the individuals and for curing Parkinson's disease to a significant extent. The researches in this field, in future, holds great promises for being able to cure the genetic disorders among individuals and help them lead a healthy life.

Doudna and Charpentier, 2014

The study deals with the usage of CRISPR-Cas 9 systems for the regulation, modification or engineering of the genetic loci, for improving the overall genetic performance of the organisms. The CRISPR- Cas 9 systems are undergoing clinical trials in animal models while the usage of only CRISPR systems have been implemented in humans, for the modification of the genetic composition of the

individuals and curing leukemia and other genetic disorders. The CRISPR- Cas 9 systems are basically a replica of the type 2 CRISPR-Cas systems as observed in bacteria, which helps them gain adaptive immunity from viruses and plasmids. The treatment is cost-effective and promises to help cure a lot of disorders in future, among patients.

5.0 Summary

5.1 Overview of the findings

The advanced technologies in the medical scenario aim to provide greater help to the population and help them get cured of all their ailments, thus leading a healthy life for long. The usage of ingestible sensors, the applications of gene therapy and the use of nanoparticles in the treatment of cancer are all technologies that have been developing since the last decade. These promises to improve the quality of medical help that is provided to the patients, in the UK healthcare scenario, cancer is a growing concern and more than 14 million people are affected by it every year. The incidences of genetic disorders among the UK population are also high and the amount of pollution and disruptive factors that the individuals are subjected to, in their daily life, leads to genetic mutations and thus, rise in genetic disorders. The findings revealed the fact that the developing technologies holds great future prospects of being implemented in the healthcare sector of UK in near future.

5.2 Limitations

The research paper solely focused on the topic chosen for the research was limited and the areas focused on, have been developing ever since. There was a lack of quantitative studies dealing with the research topic aimed to be executed and thus, almost only qualitative studies have been adopted for the secondary research. Many of the full articles were inaccessible for free and full reading and thus, scope for consulting those literatures were lost.

5.3 Reflection

The research had been started about a year back and deciding on the objectives and the research questions had been initially difficult. Deciding on suitable topic for the research was also difficult and involved a lot of contemplation, to express the impact on the UK healthcare sector maximally. After deciding on the topic, the screening for the research papers to be consulted for the study began. There were numerous articles available for consultation but few matched the criteria of the research and thus, had to be eliminated, in a step-wise fashion. Once all the articles that were suitable for the research to be executed had been identified, then the work for secondary research, for arriving at proper conclusions regarding the topic intended to be researched in this project, started. The project was finished on time, however, next time, it would require more organized management for dealing with the articles.

5.4 Implications

The developing technologies prove to be an efficient way of dealing with deadly diseases and improving the quality of care and medical attention that the patients will be able to avail in future. The use of ingestible sensors can be specifically investigated in the field of treating the disorders of the gastrointestinal tract as well as of Tuberculosis. The number of people suffering from

gastrointestinal tract as well as tuberculosis, in the UK scenario is quite high and thus, utility of this kind of devices is quite high and needs to be investigated in details. The modern CRISPR systems of gene therapy have been able to improve the health conditions of the individuals to a great extent and thus, needs to be checked and tested further, for application on a wider scale in the healthcare scenario.

5.5 Recommendations

The developing technologies would help the healthcare system of UK to develop and provide better treatment and medication facilities to the patients. The incidences of Cancer is growing in UK and the advancements in the technologies would allow to treat and prevent the incidences to a much greater extent. The ingestible and digestible sensors would allow for the monitoring of the internal, physiological conditions of the patients as well as normal individuals and aid in adaptation of preventive measures if there are any anomalies in the medical conditions observed. The use of gene therapy would prove to be a boon for the containment and prevention of genetic disorders among the unborn and the newly born child and would probable allow the parents to choose the genetic sets for their children, well in advance.

References

- Annualmeeting.asgct.org. (2018). *Gene Therapy for Diseases | ASGCT - American Society of Gene & Cell Therapy*. [online] Available at: https://annualmeeting.asgct.org/about_gene_therapy/diseases.php [Accessed 11 Jun. 2018].
- Drummond, M.F., Sculpher, M.J., Claxton, K., Stoddart, G.L. and Torrance, G.W., 2015. *Methods for the economic evaluation of health care programmes*. Oxford university press.
- Kalantar-zadeh, K., Ha, N., Ou, J.Z. and Berean, K.J., 2017. Ingestible sensors. *ACS sensors*, 2(4), pp.468-483.
- Lennon, M.R., Bouamrane, M.M., Devlin, A.M., O'Connor, S., O'Donnell, C., Chetty, U., Agbakoba, R., Bikker, A., Grieve, E., Finch, T. and Watson, N., 2017. Readiness for Delivering Digital Health at Scale: Lessons From a Longitudinal Qualitative Evaluation of a National Digital Health Innovation Program in the United Kingdom. *Journal of medical Internet research*, 19(2).
- Nature.com. (2018). [online] Available at: https://www.nature.com/articles/ng0899_313.pdf [Accessed 11 Jun. 2018].
- Patel, D., Mistri, P. and Prajapati, J. (2015). Treatment of cancer by using Nanoparticles as a Drug Delivery. *International Journal of Drug Development and Research*, [online] 4(1), p. Available at: <http://www.ijddr.in/drug-development/treatment-of-cancer-by-using-nanoparticles-as-a-drug-delivery.php?aid=4948> [Accessed 11 Jun. 2018].
- Schön, D.A., 2017. *The reflective practitioner: How professionals think in action*. Routledge.
- Wang, F., 2018. *The Once and Future of Medicine*.
- Doudna, J.A. and Charpentier, E., 2014. The new frontier of genome engineering with CRISPR-Cas9. *Science*, 346(6213), p.1258096.
- Jinek, M., Jiang, F., Taylor, D.W., Sternberg, S.H., Kaya, E., Ma, E., Anders, C., Hauer, M., Zhou, K., Lin, S. and Kaplan, M., 2014. Structures of Cas9 endonucleases reveal RNA-mediated conformational activation. *Science*, 343(6176), p.1247997.
- Ali, P., Ahmed, D. and Khan, D. (2015). *GOLD NANOPARTICLES IN CANCER THERAPY AND DIAGNOSTICS*. [online] Research Gate. Available at: https://www.researchgate.net/publication/292606673_Gold_Nanoparticles_in_cancer_therapy_and_diagnostics [Accessed 11 Jun. 2018].
- Wang, X., Yang, L., Chen, Z.G. and Shin, D.M., 2008. Application of nanotechnology in cancer therapy and imaging. *CA: a cancer journal for clinicians*, 58(2), pp.97-110.
- Belknap, R., Weis, S., Brookens, A., Au-Yeung, K.Y., Moon, G., DiCarlo, L. and Reves, R., 2013. Feasibility of an ingestible sensor-based system for monitoring adherence to tuberculosis therapy. *PLoS one*, 8(1), p.e53373.
- Mingozzi, F. and High, K.A., 2011. Therapeutic in vivo gene transfer for genetic disease using AAV: progress and challenges. *Nature reviews genetics*, 12(5), p.341.