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The importance of technology in the management and development of the medical field and hospitals

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***Abstract*---**Technological advancement has made a significant positive impact on the field of medicine. It has changed the traditional way of treatment and diagnosis of diseases. The advanced methodologies and methods of treatment using technology prevent the escalation of diseases and improve the efficiency of treatments. In addition, the advanced technologies used in medicine reduce the chances of failures and surgical errors. The advanced technologies have made it possible to cure diseases at an early stage and have also improved the lives of patients with chronic diseases such as heart failure.

***Keywords*---**Technology, management, medical field, hospitals, diseases.

1. Introduction

Throughout history, technological advances have had a major impact on medical research and treatment. Everything from the invention of safety syringes to the advent of minimally invasive laparoscopic techniques has contributed to improvements in healthcare. In modern times, technological leaps have contributed to the understanding of the human genome, the exploration of how biological agents affect health, and the accumulation of vast amounts of digital healthcare information that is now starting to pay dividends.

Technology has played a major role in the development of medicine since mankind began to explore the relationships between the environment and human health. There are examples of devices designed to handle simple tasks, free up the hands of clinicians, and improve their productivity. All these applications are clearly designated as technologies. Today, because of the advancement of digital technology, applications that are the direct result of technological innovation are exponentially increasing in all sectors. Industry uses networked computers in managing productivity, growth, and quality control of production. Marketing

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incorporates technologies that automate the monitoring of customers' behavior via mall shops using electronic cards or networked techniques worn as portable devices; these technologies monitor and analyze data from customers and influence their buying behavior. It is now timely and essential to search for appropriateness, implement, and evaluate strategies that could allow similar technological applications in the clinical setting of health and medicine.

The translation of the knowledge accumulated in the life sciences to practice is not guaranteed by itself. To obtain useful diagnostic tools and/or therapeutic agents, the implementation of new strategies that bridge understanding to practice is required. The same deterministic developmental pathway is impossible in medicine. New rules apply. Addressing a single issue - scientific, commercial, ethical - is not enough to ensure the translation of technologies to practice. Solutions must be multidimensional in the sense that they address scientific, commercial, ethical, and technical issues simultaneously and in a highly interactive manner. Moreover, the group or 'community' that develops the research tools and the one that is expected to use them is different. Thus, careful and continuous dossier and core activities of the user community, the healthcare industry, and the public policy must accompany the effort in life sciences research. As with other technologies used in health and medicine, biosafety, health, and environment issues must also be addressed.

1.1. Overview of the Relationship Between Technology and Medicine

For many years, technology has advanced dramatically, and no area is more celebrated for this than medicine. Technology has proven to be a crucial ally in this endeavor, and as a result, the medical field has progressed quickly. The extent to which technology and medicine will coexist and one will aid the development of another in future endeavors, however, is unclear. As technology progresses, it becomes more decisive in devising prospective solutions and aids; nevertheless, a time may come when it does more harm than good.

On a grand scale, medical technology is the "technology that is used to treat patients and assist them in their daily lives" (i.e., not restricted to hospitals, general practitioners, clinics, or surgeons). With advancements in computers, tools, and equipment specifically for the medical field, the creation of technology for medicine has catapulted. Computers for research, experimental simulations, and even extensive medical databases have proven to be beneficial in the medical domain, for both primary benefits and indirect assistance. Computer technology has advanced medicine and aided in its development. Computer training has become compulsory in various medical-related fields, from local clinics to prestigious universities.

A specific, precise type of technology is used primarily in observing and recording actively (though passively also), or the general procedure of testing, inspecting, or observing phenomena, occurrences, and individuals. In medicine, this is particularly relevant, as observing has played a key part in it. The observation technology in medicine is commonly atmospheric pressure (though many more usual types exist), X-ray machines, ultrasounds, infrared cameras, blood pressure monitors, and thermometers. X-rays and ultrasounds currently dominate, as they provide the clearest images, the best resolution, a large field of view, easy-to-use styles and setups, and have no need to open up the body. They enable everything from routine checkups to efficient diagnoses and operation planning.

Observing technology for medical applications as a field has expanded, and numerous young companies outside the existing leaders have emerged in the hope of entering the market and initiating competition. These are attempting to develop new observing techniques utilizing fresher, unique approaches or enhancing the existing techniques. One purpose of observing experimentation technology in medicine is solely improvement and enhancement to the situations, instances, and requirements, which is proving difficult with preventing factors (i.e., the trusting in the existed and common technologies).

2. Historical Evolution of Technology in Medicine

The origin of medicine goes back to the beginning of civilization, along with the understanding of pain, suffering, and death. Health disorders severely affect quality of life and personal loss, leading to incidence-based socio-economic impacts. Efforts have been made to identify and treat conditions since prehistoric times. Ancient people examined body organs, diagnosed disorders, and developed herbal drugs. Healing practices were initially dominated by religion, with priests as physicians. Practical knowledge gained importance, and anthropometric surgery became common. Eventually, philosophy replaced religion, giving birth to rational medicine.

The ancient Greeks introduced the concept of disease as natural rather than divine, revolutionizing life sciences. Hippocrates of Kos is considered the father of Western medicine, emphasizing clinical observation and documentation for the first time. Hippocratic text presented detailed accounts of medical treatment, herbal microbiology, and clinical discoveries in sanitation, obstetrics, and child development. Later, Galenic texts established the basis of pharmacology for more than 1500 years. Pioneering surgical texts on instruments, operative procedures, and treatment of wounds were produced. However, medical science lagged in the West from the 13th to 14th century, falling behind the Middle East and Asia, where various contributions were made in medicinal preparation, pharmacology, surgical knowledge, and diagnostic instruments.

European universities were established in the 12th century, and after a renaissance in the 15th century, western medicine progressed rapidly. Robert Hooke invented a compound microscope, discovering microorganisms and stimulating microbiology research. Edward Jenner invented vaccination in 1796, preventing smallpox and leading to immunology. A classical physics revolution in the 19th century accelerated the development of more technological instruments, such as the stethoscope, thermometer, ophthalmoscope, laryngoscope, sphygmomanometer, radiography, electrocardiogram, and a lot more. The germ theory of disease was proposed, and bacteriology and antibiotics were discovered. The life cycle of cells was examined, and the field of biochemistry began. The 20th century saw progress such as tissue culture, enzymes, sterilization methods, antibiotics, anesthetics, drugs, and chemotherapy.

1966

2.1. Ancient Medical Technologies

The advent of technology was a watershed moment in human history. It was a game-changer for all fields of human activity, upending existing paradigms and paving the way for previously unimaginable possibilities. Technology brought immense possibilities to various fields, helping to integrate them into larger systems that changed the dynamics of social interactions and significantly advanced scientific fields. Medicine, given the complexity of the subject ahead, needed to advance more carefully and gradually than other scientific fields because of the complexities of the cosmic phenomena it covered, in order to be successful.

The oldest collections of medical writings in the Western tradition comprise a group of medical texts dating from the latter half of the Fifth Century to the middle of the Fourth Century B.C. This group of texts is commonly referred to as the Hippocratic Corpus. These texts record the thoughts of persons who had become concerned with medical matters and focused their attention on healing and health as natural activities. Writings in the Corpus ambitiously sought to explain, analyze, and debate diverse medical phenomena and highly scrutinized the viability of pre-Hippocratic orations - factual or fictitious narratives that discussed medical practices, observations, and reflections.

There are two important collections of ancient Egyptian medical writings, the Ebers and the Smith's Papyrus, both written in hieratic characters for priests. The Ebers Papyrus, a long roll of papyrus about 90 feet long, was presented to the Berlin Museum in 1873. The Smith Papyrus, a shorter papyrus about 228 inches long, was discovered in 1862 and was presented to the British Museum. It was believed to have been written by a priest or a learned man about 1800 B.C. Smith's Papyrus contains a collection of diseases and remedies. It consists of twenty-three cases, the first six of which are simple palpations of prayers and euphemistic expressions. Each of the remaining seventeen cases commences with "O, Thou X". A number of them, e.g. Cases I, IV and X, are pure and simple, imprecatory prayers, in which the sufferings of the patient are delineated and the deity appealed to for relief. The anatomy and physiology of the human body, ideas about sex and the sexual organs, fetus and its development, infant's growth and feeding, diseases and death, healing practices, and tomb diseases are illustrated.

Hippocrates, well-known as the ‘Father of Medicine’, was born in 460 B.C. in the island of Cos, which lies south of Knidos and is situated opposite to the Laconian and Cnidian coasts. He belonged to the Asclepiad family, whose members were considered to be highly skilled in cheesemongering. It is uncertain where Hippocrates died, but it is probably in Lcientum at the age of over eighty. Seven of the Hippocratic writings are confessedly his, the 'Aphorisms', the 'Epidemics', the ’Regimen in Health’, the several ‘Books on the Art’, the ‘Book on the Sacred Disease’, and the ‘Book on the Attention to Diet’. The most important of these is the Book on the Art, where he, after criticizing the prevalent (natural and Incorporeal) fancies of disease, asserts that all disease is corporeal, i.e. corporeal causes are necessarily attended by corporeal modes of generation and existences.

3. Key Technological Innovations in Modern Medicine

For centuries, the field of medicine was stagnant and relied on individuals' perceptions of pain and ailments to treat the ailment as effectively as the technology available. From viewing the patient's body to prescribing medicinal herbs, the medieval approach to healthcare was rudimentary at best. However, with the advent of the Renaissance era, an overwhelming wave of technological advancement surged through the world. The focus shifted from ignorance to knowledge, and humanity's quest for understanding the physical world began. Bright minds emerged and started to scrutinize humankind's place in the universe. The combination of superior intellect, religious disenchantment, and the use of innovative devices began to uncover the marvels of nature. Surprisingly, many of these devices - lenses, observatories, and automata - were the precursors of devices the Earth ultimately owes modernity. With the dawn of microscopy, observatory telescopes, and hydraulic automata, what once baffled individuals became understandable. This revolutionary shift in perspective paved the way for the ultimate scrutiny of the "universe inside". Nevertheless, it took years for humanity to peel its exterior layers and uncover the intricate complexities human bodies withhold beyond aesthetics.

Starting from this Renaissance flourish, it took several centuries to ascertain what most take for granted today: an existence unbounded by ignorance and an endeavor for knowledge. With the dawn of the 19th century, the field of anatomy started to break free from the chains of ignorance with the influx of luminance and simplicity, which was closely regarded as a blessing from God by many at the present. Joseph Lister, using the microscope and imbued with enormous religious awe, unveiled an intangible but unequivocal cause of the immense suffering caused by surgery in "The New Regimen in Surgery". This "supernatural" sphere, which was beyond the perceptive capabilities of the surgeon/physician, was not nothing but microbial life. After Lister's death, as if the last chains were broken, with the burgeoning turmoil as the First World War approached, a myriad of studies figuring microbes' mechanisms of destruction, their mode of reproduction and spread, and immunity began.

Alongside anatomical scrutiny, over centuries a keen interest emerged in understanding the intricate functioning of the cosmos with Earth at its periphery, but surprisingly, few made an effort in exploring humankind's place in this universe: bodily movements and their regulation. Nevertheless, unbeknownst of its beneficial side, the ability to question its own existence hid a deadly curse for the social order. Using basic physical principles, the understanding of movement and regulation was suddenly rocketed; a dimensionless number "Reynolds Number" suddenly united all shape of objects being propelled in air and liquid. As blood circulation commenced in the Early Modern universities, with massively interlinked channels an entirely new mode of analyses was uncovered: network theory. Baffling the grotesque aspect of individuals, unexpected synchronization occurred; this harmony and simplicity disguised under chaotic motion amazed bystanders beyond their ability to comprehend.

1968

3.1. Imaging Technologies

Many imaging technologies are used in medicine. The basic idea for all imaging is to take a picture of what is happening inside people. Different imaging technologies work in different ways and can be used to look in different places in the human body, and pictures can be taken with so much clarity and detail that doctors and physicians can see how the human body works. Many of these technologies can create pictures or videos in real-time, enabling doctors to see how a human heart is beating, how blood is flowing, or how needles are precisely placed in tissue in the heart. A key advance in imaging technologies is real-time 3D motion imaging.

Real-time imaging means that imaging technologies operate fast enough to be able to see continuously changing situations in real-time and to see the motion of heart vessels and valves beating. Optical coherence tomography (OCT) enables near real-time imaging, which looks close to real-time, but not fast enough to see every image without losing some. Also, near real-time imaging looks only a few frames at a time, so enhancement algorithms cannot be done on videos. 3D imaging takes perspective into 3D imaging, but does not mean continuous scanning. Real-time imaging systems can take pictures at a high enough frame rate per second so that there is continuous image capturing, meaning that every picture is fully captured to be seen in one shot. Imaging also means that this isn't just moving images, but compute video images.

In many types of 3D imaging, imaging gradually moves to different positions creating this 3D perspective, but this motion is continuous and uniform. Capture of 3D imaging should be done of whole scene visualization and in many imaging systems envelopment capturing uses a uniform frame rate per degree imaging. In continuous scanning systems, imaging rigidly moves but on different angles, creating rotation capturing in the polar coordinates where media coordinates are in angle and radius, instead of conventional x and y coordinates. Generally, images change over time in the same principle as perspective images, but images don't change, but imaging moves in an orthogonal motion. To every pixel in acquired picture frames, there is a unique temporal signature depending on the motion, enabling analysis in motion of pixels in later stage.

Cluster states are formed of connected pixels that have globally similar temporal signatures and of independently connected clusters of pixels. Initially, all pixels have no connected cluster and randomly connected pairs of pixels are forming connected clusters. Connected pixels can implicitly construct their clusters' properties and this information is propagated within individual clusters. With pixelwise variable threshold and cluster diameter flow, clusters having very similar temporal signatures can be eventually divided. Connected cluster separately is a special case of general dynamic systems, where each individual specialized processing unit is using properties of connectivity as interaction paths between processing units.

4. Artificial Intelligence in Medicine

In the past century, medicine has benefited from many technological advances, and one of the most exciting and promising of them all is artificial intelligence (AI). Over the last few years, there has been a rise in interest and applications of AI across many industries, including transportation, finance, and agriculture. AI technologies have begun to be increasingly applied in healthcare as well, including drug discovery, robotic surgery, remote monitoring, and medical imaging analysis. AI-based medical technologies have the potential to revolutionize healthcare, transforming it from being reactive to being predictive and personalized, thus offering patients safer and more effective treatments.

Generally speaking, AI can be defined as computational systems that perform tasks claimed to require intelligence when carried out by humans. More specifically, AI systems rely on algorithms that analyze data to extract patterns used to make predictions. A subset of AI, called machine learning (ML), stems from the idea that systems should learn to adapt to new data rather than be programmed explicitly. ML algorithms can be used to analyze and extract patterns from different types of data, including text data, images, videos, and others. An advanced subset of ML is referred to as deep learning, which relies on artificial neural networks and has recently achieved great success in biomedical image analysis. Overall, AI technologies can greatly improve the analysis of complex and voluminous datasets.

Medical data may include images, text records, signal data, and genomic data. While there has been a lot of progress and advances in ML in visual/image analysis, such as automated screening, detection, and segmentation of medical images, there is still a need for ML applications on other modalities of data, such as body sensor networks, text records in clinical notes, electronic health records (EHRs), genomic sequences, audio recordings of conversations, biosensors, and more. In general, the bigger and more complex the data, the larger the potential for machine learning models. Furthermore, ethical issues, bias of data, and liability of algorithms are pressing matters that need to be addressed. Overall, AI offers many opportunities in healthcare and medicine, even if it will not make persons all-knowing and all-powerful gods.

4.1. Machine Learning Algorithms

Artificial intelligence (AI) is an umbrella term used for the new generation of computer systems that can acquire knowledge and the ability to perform tasks normally done by human beings. Machine learning (ML) algorithms are the most commonly used AI tools in medicine; specifically, predictive ML algorithms have gained enormous interest lately because of their ability to learn and classify patterns in known datasets.

Modern medicine is inundated with data from research and clinical practice. High-throughput or high-dimensional data in "omics" fields (genomics, proteomics, transcriptomics, metabolomics) are generated as a way to better understand a biological system. Another good example is functional data derived from medical imaging, pathology, and other diagnostic tests. AI methods have been actively proposed to handle massive amounts of data, to improve the extraction of knowledge from data, and to assist clinical decision-making. Nine different types of machine learning algorithms and models used in medicine have been identified based on methodology and application fields: artificial neural networks, linear models, support vector machines, regularized linear models, Gaussian processes, random forests, other tree-based models, deep learning frameworks, and the K-nearest neighbor method.

Understanding the working principles of the algorithms most commonly applied in medicine can facilitate the thoughtful selection of ML technology for a specific application. Most studies lay out the workflow of developing a predictive ML algorithm; however, the focus is often only on model evaluation. Consequently, the working principles of the algorithms themselves are seldom explained in detail. To make the concept of predictive ML algorithms easier to understand, the general classification, the working principles of widely applied algorithms, and instructions for choosing an algorithm suited for a specific medical application are presented.

5. Telemedicine and Remote Patient Monitoring

In recent years, telemedicine has gained popularity as a method for timely and regular follow-up for patients. Telemedicine relies on technology, such as computers, phones, or tablets, along with audio and video to transfer health information instead of conventional treatment methods. Telemedicine is rapidly growing globally, particularly for cancer care and other chronic conditions. It entails communication between a patient and a physician remotely, as opposed to face-to-face meetings. Regular follow-ups help in early detection of relapses, which positively affects treatment duration and survival rates; hence, maintaining routines for follow-ups and examinations is crucial. However, it may be challenging for patients living in rural areas or other states, making telemedicine an ideal and viable solution.

A study conducted for breast cancer patients in the USA between 2010 and 2013 examined follow-ups using telemedicine as a substitute for routine in-clinic visits. It was determined that telemedicine was as effective as conventional follow-ups for reassurance among patients. Furthermore, telemedicine certifications can be offered for health professionals to become well-trained in this equally effective resource for particular situations, and it can be utilized for other disease types. An additional advantage of telemedicine is cost allocation. Due to high prices associated with conventional treatment methods, telemedicine grants affordable transfers of medical information without any service charge.

The rapid expansion of remote patient monitoring technology improves patient quality of care while containing costs; this, in turn, reduces hospital visits and re-admissions. A rise in the demand for quality healthcare services, along with the rising aging population, is expected to enhance growth for the forecast period. However, concerns regarding patient safety risk and the impact of telemedicine on healthcare services are anticipated to restrain the market growth. The North American region is expected to dominate the telemedicine market, accounting for the largest market share.

6. Robotics in Surgery

The subject of robots and surgery has become popular thanks in part to the success of minimally invasive surgical robots that use specialized tools to perform advanced surgical procedures with precision, flexibility, and control far beyond the capabilities of the human hand. The latest surgical robots allow the surgeon to view the surgical site in 3D (sometimes even augmented reality, which combines real-time imaging with the surgical site) using the body's own visualization of the organs. Everything is intuitive, controlled by mimicking actions naturally done by the hands, and the movements of the devices are pre-scaled, restraining their movement in space, so that the robot doesn't move too much allowing for precise movements. This technology takes time to learn, and with current reimbursements it may not be morally sensible if curative surgery is not improved, but applied robotic technology to surgery has a definite future.

The rapid development of medical robot systems has also gained attention due to the uncertainty and extreme limitations in surgical arms. New concepts have emerged to design robots that have soft arms with less invasive access. These soft robots may look different from traditional robots used in industry, such as robotic arms, but they use innovative techniques to control them. Soft robots have different structures and materials that allow them to be more flexible and adaptable in various medical situations. The most common techniques include inflatable tubes, shape memory alloys, and cables or tendons. These techniques can be more complicated than traditional systems and require extreme expertise in these areas. Although soft robots can be more effective in certain situations, there are still huge limitations in perception and accuracy. Thus, further development is needed for these systems to be reliable in medical applications.

In the past years, the components used in robotic systems, in particular in surgical robots, have gone more and more towards disposables. Even though this is the case, the question arises whether it is ethically and morally correct to have disposables in the field of medicine. Because of the rising costs and because manufacturers of robotic systems are usually big companies with a lot of influence over the public, the argument becomes even larger. Performing surgical interventions over the internet is advertised as the new frontier in medicine. Because of the commercialization of the surgical techniques, surgeons no longer form the main factor limiting this technique. Current considerations, whether transmitting potentially dangerous procedures to countries who may not be ready or trained enough, are to be explicitly incorporated.

7. Nanotechnology in Medicine

Nanotechnology has emerged as one of the fastest-growing fields with the promise of revolutionizing modern technologies, particularly in medicine. The advent of nanotechnology and its applications in the medical field for diagnosis, therapy, and in vivo imaging is an exciting scientific undertaking. Novel drug delivery systems based on nano-carriers, i.e., 0-200nm in size, have been designed and engineered for targeted delivery so that drugs can be delivered to only afflicted tissues or organs while sparing healthy counts. Nanosystems employing polymeric, lipidic, metallic, and carbohydrate-based nano-carrier designs have been employed in drug delivery to enhance drug dispersal. These nanocarriers can also be tuned spatially and temporally through various conjugate chemistries to impart functionality or payloads akin to a drug. Co-delivery of a multitude of therapeutic agents in a single unit can be achieved by nanocarriers while at the same time being tracked by imaging modalities. Hence, generally challenging therapeutic goals such as combination therapy, controlled release profile, spatio-temporal drug delivery, dual-modality tracking, etc. can readily be achieved with nanoparticle-based drug delivery systems.

Exploiting characteristic size-dependent properties, nanoparticles have emerged as an invaluable and powerful tool to enhance the efficacy of therapeutic agents. Either active or passive targeting is achieved by nanoparticles by virtue of the syscall architecture and rice size, which allow them to interact with both the vascular level as well as the interstitial space of a tissue. Therefore, nanosystems do not only improve drug accumulation at the target but also provide the theranostic ability. Imaging agents are either encapsulated in the nanoparticle or covalently conjugated to track the biodistribution of therapeutics. There are two distinct pushing forces for the development and investigations of nanoparticles for drug delivery. Viscous friction exacerbates the spreading rate of neoplastic growth, which is driving research to control the growth of wide type cancer cells. High intracellular drug accumulation enhances the cytotoxicity of various chemotherapeutics against.

Ideal characteristics of Nanocarriers: Delivery needs to be improved. Cancer is a heterogeneous disease. Not all malignant cells are proliferating. Combination therapy rationale and challenges. Factors contributing to drug delivery failure. Nanosystems improve drug delivery efficacy overall. Multi-stage targeting: Passive targeting: EPR Effect; Active Targeting: Genetic recognition; Responsive nanocarriers. Nanosystems characterization. In vitro characterization; In vivo characterization - Animal models. Different imaging techniques. Bioluminescent imaging; Fluorescent imaging; TEP - Positron Emission Tomography; MRI - Magnetic Resonance Imaging; CT - Computed Tomography; In vivo nanocarrier tracking to study pharmacokinetics and biodistribution. Preclinical studies: Efficacy; Safety Studies on implantable devices and other procedures. Clinical Trials and post-marketing surveillance. Difference between safety and efficacy studies. Studies on special population and pediatric population. Clinical art forms. Phase I trials; Phase II trials; Phase III trials; Phase IV trials – also called post-marketing surveillance.

In summary, the impact of technology on advancements in medicine is immense. Emerging technologies such as artificial intelligence, robotics, tele-monitoring devices, 3D printing, and nanotechnology are changing our treatment approaches by making them more effective, accurate, targeted, and patient-centric. By understanding the characteristics of these technologies and how they work together, we can appreciate the innovation behind these advancements in medicine.

8. Bioprinting and Organ Transplantation

As human beings continue to evolve, an ever-increasing number of medical advancements have emerged, focusing on the research and treatment of numerous diseases and disorders. Due to the possibility of genetic mutation, organ growth might decline, resulting in organ transplant surgeries. Cadaver organs can only be donated if the person dies in the required state. Due to these problems, researchers are motivated to identify alternatives.

An organ bioprinter is a device used to print hybrid or synthetic organs and tissues via bioink (living cells) and synthetic materials. There are currently two techniques for tissue bioprinting: embedding and printing tissue with cells. In the first method, a biodegradable scaffold is printed in the body, which will dissolve over time as tissue grows. In the second, tissues are produced off-site and then implanted (viable, pre-designed tissues). Both techniques offer mature tissues, and there is currently no perfect approach to pre-designed organs.

An intercity experiment was conducted using an artificial heart implanted in sheep, which was successful. An organ bioprinter works much like a 3D printer. CT or MRI scans are taken of the area of interest, and the data is used to build a CAD model. This model is divided into layered slices, and the desired materials (bioink or polymer) are printed using techniques such as inkjet or laser-induced deposition. The bioprinted object is placed in a bioreactor for a period of time to experience conditions similar to a natural environment. Once this period is complete, the bioprinted object is ready to function in vivo or in vitro.

In organ transplant surgery, doctors connect blood vessels, nerves, and external drains. Currently, the main problem with transplants is the immunologic response. Many transplant recipients have to take adsorbents for the rest of their lives, increasing the risk of infections. To combat this, organ-printing technology, such as biopolymers, after the transplant operation, can be printed in real time to prevent thrombus formation and promote regeneration.

Currently, there are plans to create a bioprinter for commercial use. Companies such as Organovo Inc. and Advanced Solutions Inc. have developed technologies to bioprint tissues. One such printer is the NovoGen MMX bioprinter, which uses bioink made from living cells and macromolecules in an aqueous solution. The MMX then prints either tissues as layers or embedded structures. As with any developing technology, bioprinting has its own advantages and disadvantages.

The ability to develop organs remains completely theoretical because there is no preliminary intervention for the development of vascular systems. Creating functional tissues that replace cadaveric organ transplants represents incredible progress in bioprinting, medicine, and people.

Bioprinting offers many advantages, including the ability to bioprint organs with an asymmetric outer shape without the need for dedicated biomaterials for different tissue types. Because of the possibility of biomanufacturing with a variety of bioinks, bioprinting speeds range from the slowest to the fastest biofabrication methods available. After being bioprinted, the manufactured vascular networks could be placed in the body before placing the organs on top, enabling proper nutrition and gas exchange. Numerous material approaches with customizable bioink composition have been developed for bioprinting technology, showing great promise to meet the biocompatibility and biofunctionality requirements for different tissue engineering applications.

Bioprinting enables the creation of controlled tissue microenvironment, combining generative patterns with various cell types and biomolecules. Bioprinting technology is not solely limited to building tissues and has also been applied as a scaffolding strategy for tissue engineering. Unlike other printed structures using hydrophilic materials, bioprinting offers the possibility of building scaffolds and coating them with cells and bioactive substances. Furthermore, bioprinting allows the dual control over the fabrication parameters.

9. Ethical and Legal Considerations in Medical Technology

The rapid growth of technology in modern healthcare has created significant advantages and opportunities. However, it also poses numerous challenges. These issues can be broadly categorized into two groups: ethical and legal concerns. The legal section deals with issues directly related to the law, while the ethical section deals with socio-political issues even before they are transformed into laws.

The legal section covers issues related to data safety, privacy, and individual rights, the justice of new technologies (with regards to differentiation of access to medical technologies and their effects on socio-economic differences), and intellectual property. It is important to stress that intellectual property has a central role in medical technologies, as patents and copyrights determine access to new medical knowledge and treatments, which also influences their social consequences.

The ethical section covers a large number of diverse issues. On the one hand, some of these problems cannot be solved by law and raise further socio-political concerns. On the other hand, some ethical matters are also of utmost concern to lawyers. Issues mainly concerned by the ethical section include: regulation of experimentation on embryos; freedom of research and investigation; the social consequences of biotechnology; status of patenting genes and medicinal developments affected by genetic engineering; ethical issues related to medical genetics and eugenics; experimentation on humans or animals; economic implications of medical technologies; and the danger of biowarfare and bioterrorism.

Therefore, all descriptions of ethical and legal considerations in medical technology should take into account both the ethical and the legal standpoint. This does not imply that ethical and legal problems must be simultaneously solved. The ethical section is also split into two parts, since these problems are sometimes best categorized independently. Nonetheless, a large number of ethical issues treated in the ethical section could be classified as legal as well.

The discussion of the ethical issues is split up into three subsections devoted to three classes of medical technologies. Biotechnological and biomedical technologies lead to very similar ethical questions and are therefore treated jointly. Information technologies in medicine are dealt with separately, but almost all issues treated here also concern telecommunications in general. The ethical consequences of medical technologies on society dealt with here mostly concern the biotechnological and biomedical technologies.

10. Challenges and Future Directions

Technological advancements have profoundly altered several dimensions of life, including how healthcare professionals reach a wider network of people, the mode of information transfer, and the way people perceive and accept things. To gain a comprehensive understanding of technological advances in medicine, it is imperative to identify and analyze the wide range of emerging and state-of-the-art technologies considering their remarkable impact on common medical needs. A careful analysis reveals many significant technologies that have demonstrably influenced a number of perspectives of medicine: robotics, artificial intelligence, mobile health, electronic health records, telehealth services, nanotechnology, and 3D printing. The identified technologies under consideration exhibit some of the most common characteristics such as optimization in the structure and procedures being handled, optimization in life and health, elimination of human dominance, and adaptation of new technological resources. Consideration of these relevant technologies ensures investigating the impact of emerging and cutting-edge technologies on medicine from one or more different perspectives such as process and procedure enhancement, safety improvement, cost reduction, information and knowledge dissemination improvement, human involvement reduction, acquisition of optimized and accurate results, and time-effectiveness.

An important inquiry arises on the future directions of the presented ideas. The most common technologies can benefit from a further demonstration of their influence by representing particular cases. A clearer mapping of the potential impact and intervention of emerging technologies on medicine can be constructed through monitoring and forecasting emerging technologies. Technological advances in medicine can be anticipated through a better understanding of society's tolerable angle of acceptance toward any specific technology by improving the societal acceptance threshold model. A new road toward safe technology development can be opened through considering more distinct properties of technologies in technology path and strategy options. Consideration of these future directions represents a national and international need for global awareness of the importance of promulgating such technologies applied in human affairs.

11. Conclusion

Technological advancement has made a significant positive impact on the field of medicine. It has changed the traditional way of treatment and diagnosis of diseases. The advanced methodologies and methods of treatment using technology prevent the escalation of diseases and improve the efficiency of treatments. In addition, the advanced technologies used in medicine reduce the chances of failures and surgical errors. The advanced technologies have made it possible to cure diseases at an early stage and have also improved the lives of patients with chronic diseases such as heart failure.

The robots used in surgeries precisely perform the operations with micro-level consciousness. The robotic arms are designed according to human arms to facilitate easy movement in the surgical field. Technologies such as nanotechnology, telemedicine, and 3D printing have become useful in the field of medicine. Nanotechnology successfully targets the diseased cells and tissues in the human body, preventing healthy cells from side effects during treatment. Agri-nanotechnology uses nanoparticles to kill various pathogenic microbes in plants, preventing crop damage. 3D printing is used in the rapid prototyping of pharmaceuticals, designing bioactive cardiac patches, and developing implants with porosity and density similar to that of natural bones.

Nanomaterials in pharmaceutical applications help accelerate drug delivery, smart drug detection, and drug targeting. The combination of telemedicine and 3D printing technologies is useful for individuals with disabilities. In addition, technologies such as minimally invasive surgeries based on digital technology have become common in hospitals. Overall, technology in medicine ensures the safety of patients during operations. It helps detect diseases at an early stage, improving the chances of successful treatment. Technology has widely impacted the efficiency of treatments, detecting the diseased organs within a short period of time. Advanced treatments ensure patients with chronic diseases live a longer and healthier life.

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