Modern-day medicine: An integration of technology and biomedicals, presenting its future vision

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Abstract

Medicine, a foremost component of every human's life is progressing well towards developments. On such approach, E-medicine has drastically gained importance due to its rapid development in a short period of time and enormous benefits, especially during the pandemic and post pandemic period. Therefore, this chapter discusses the technological developments and its methods which bring about the betterment of future medical scenario. Technology involves the development of software, data management, accessibility, biomedical approach, etc., which clearly depicts the prospects of future world of medicine. Moreover, starting from smart watches to robotics each and every instrument focusses on healthy humans in the mere future which could be easily attained through these innovations. Thus, it is our sole duty to wisely implement these technologies and create a healthy human population.

Keywords: E-medicine, Software, Data, Biomedical, Innovations.

1. Technology; the treasure of medicine

Medicine is the most important fragment of everyone's life, as when concerns arise it may require intensive care or may be even life threatening in some cases, recommending immediate and crucial medical support. In such instances, conventional medical treatments represent in-person interactions of both health care provider and patients. But in today's scenario it has become much difficult to attain medical assistance uninterruptedly due to certain constrains such as inability to travel, economy, fear of infections etc., especially post pandemic period. In order to breakthrough all these constrains many ideas were implemented and innovations arose, yet technological development rocked the globe. Though it constitutes of innumerable negative impacts, its positive effects outstand the circumstances. These types of medico-technologies are discussed below.

2. Telemedicine

Telemedicine refers to the interaction of doctors and patients through telecommunication technology such as monitoring their health in remote areas and providing treatment plan via electronic communication systems. It involves the use of technological gadgets such as computers, mobile phones, laptops, tablets etc (Robbie, 2022).

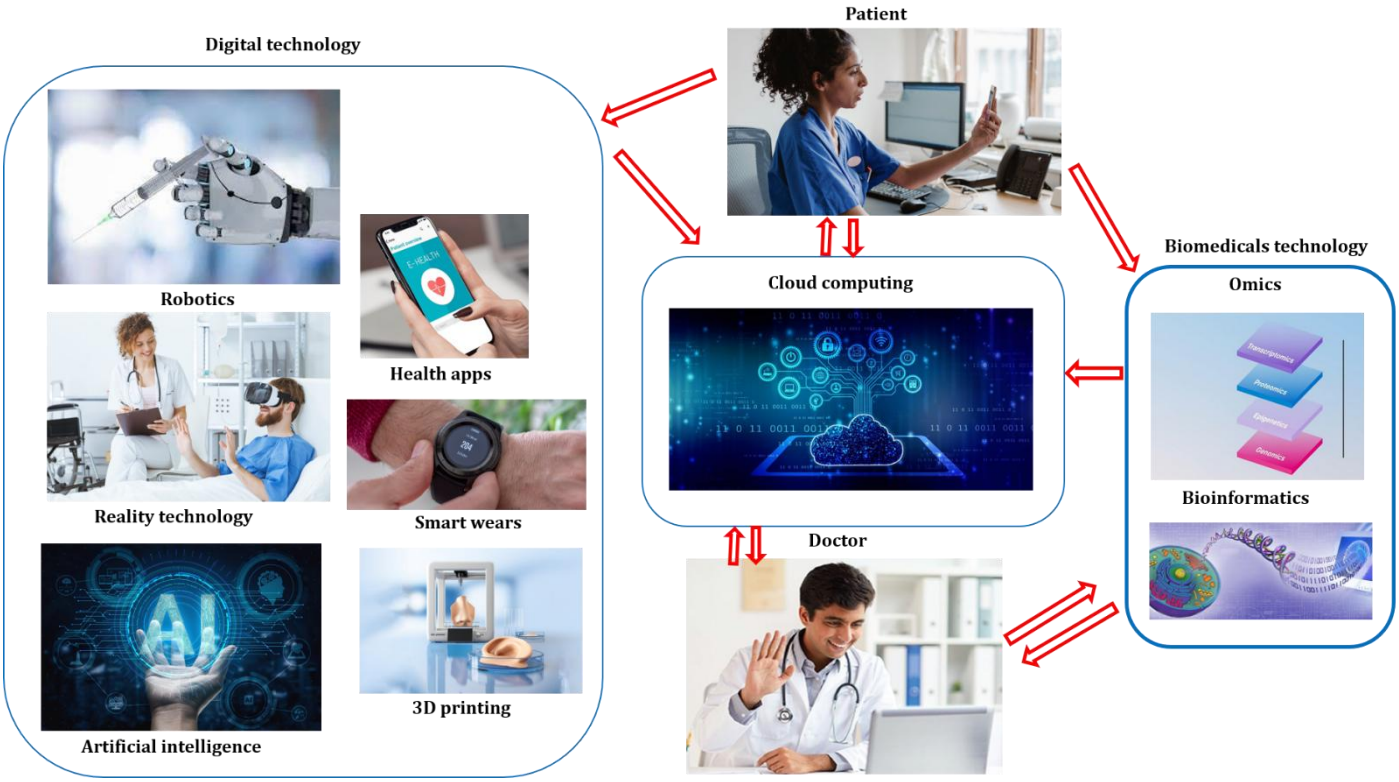
According to CogniHab (2021), the use of telemedicine is expected to show an elevation rate of 38 times, in comparison to 2020 (79.79 billion dollars) and 2027 (396.76 billion dollars). Especially in emergency situations where travelling is a big challenge telemedicine leads the role, as it provides timely suggestions by which first aid could be provided and therefore saving lives (Kontaxakis *et al.,* 2006). Moreover, pandemic and post pandemic period has increased the rate of tele health utilization up to 43%, as it possesses multiple advantages such as nil contact, continuous access and easy process for non-covid patients (Robbie, 2022).

Apart from this, in continuous therapeutic conditions like physiotherapy (Sathya and Ramakrishnan, 2011), autistic disorders, psychiatric treatment (Yellowlees *et al.,* 2011), etc., videos showing either the doctor's therapy or patient's behaviour would be more accurate, rather than just explaining in words. Technologies such as WebRTC are highly recommended for communications among web browser and handy gadgets such as mobiles, tablets, laptops etc., (Oleksii, 2022).

Specifically, doctors those who have been quarantined can be indulged in telemedicine services without any other form of complications which paves way and time for the other doctors to carry out the procedures such as surgeries, etc., that need to be done in-person (Sinha et al., 2020). Telemedicine, also acts as a solution to activities such as documentation of insurance, treatment methods, summary reports which frees practitioners and therapists from load of works (Bhaskar *et al.,* 2020).

Thus, it gains more importance and also acts as a vital tool in enhancing medical services through telecommunications via, audio, video, internet data access and so on.The overall concept of E-medicine is depicted in Figure 1.

Figure 1: Overall concept of E-medicine



3. Artificial intelligence (AI)

Artificial intelligence represents a technology where human intelligence is implemented into instruments or machineries such as computers which exhibits its efficiency as such as humans. It paves way for betterment of technology and furthermore, its uses in technological aspects of medicine and healthcare departments due to its efficient functioning is astonishing. AI (i.e.) machine learning is way better in diagnosing diseases and decision making on which types of drugs to be preferred.

"Project Inner Eye" is an AI tool developed by Microsoft that prevails well and pretty faster so that it reduces the time of practitioners in Radiotherapy. Similarly, AI astounds in diagnosing pneumonia via CT scans in COVID-19 patients, which literally reduce contact from person to person. In case of cancer diagnosis, AI is highly efficient as it reduces the burden of biopsy by extracting tissues of the organ and also in analysing the whole organ through imaging by humans. It was much time consuming and image resolution hindered the diagnosis as it was not that clear as well as, pathologists were tired of tracing the images of whole organ and identifying the cancerous site. Here comes the AI which diagnosis the site of mutation and cancerous cells much rapidly, reducing the effort and time of pathologists (Oleksii, 2022). Similarly in diagnosis and treatments of many other diseases such as Cerebral palsy, Parkinson's syndrome, Sclerosis, Speech disorder and so on, AI is much significant.

According to "Compunnel Digital" (2021), the market rate of AI as on 2020 was 6.7 billion dollars, which is projected to increase annually at a compound growth rate of 41.8% in between 2021 and 2028. In addition, it is estimated to reduce approximately 150 billion dollars by 2026 in US healthcare services.

Though AI is efficient and time saving, certain implications in the field of medicine is carried out by the inner conscience of doctors and practitioners which lacks drastically in AI mediated treatment and diagnosis. Thus, it is suggested that rather than working manually or implementing AI alone, the integration of AI and human intervention will reduce 85% of error in imaging lymph nodes for cancer detection (Jarrahi, 2018).

4. Robotics

Robotics is also a type of machine learning, where robots perform activities instead of practitioners. It is a promising technology to carry out clinical trials, initial examination and monitoring. Especially in the period of outbreaks such as Ebola and COVID robots will be much effective as a tool that hinders the spread of the diseases through contacts (Yang *et al.,* 2020). Robot assisted surgery has gained importance over traditional methods of laparoscopic and open surgery according to "The Society of European Gynaecological Surgery" (Kimmig *et al.,* 2020). Yet it also possesses certain concerns such as network problems, communication errors and issues arise due to the distance between patient and practitioner (Avgousti *et al.,* 2016) and overall, it creates emotional constrains (Weidemann and Rußwinkel, 2021).

5. Digitalization

Digitalization involves the conversion of information into the format applicable for computer processing, so that computers could perform certain work rather than humans. The contemporary world of increased Internet, network facilities and easy access of computers, mobiles etc., has digitalized the life of humans in all the fields including banking, education, research, etc., One such approach refers to the digitalization of medical services involving patient's data, reports, treatment information and so on by which the patient's information could be easily accessible from both ends of patients and doctors from a common source through cloud computing technology.

6. Cloud computing

The information stored for the processing in the cloud being accessible from remote computers is known as cloud computing. It is considered more efficient in medicine today, as the medical reports and digitalized records of the crucial patients are saved in cloud and analysed further through big data analysis strategy. Its demand is projected to increase nearly up to 64.7 billion dollars by 2025, which was around 28.1 billion dollars in 2020 (Compunnel digital, 2021). It also acts as an initiation in the development of various apps regarding medical and health (CogniHab, 2021).

7. Apps

Apps (i.e.) software, that are designed for medicinal reasons tracks the information of patient's movement, speed, emotions, surroundings etc., and judges the disorders or monitors the health of the individual thereby providing recommended treatments. Healthcare apps has shown a tremendous growth in the recent 5 years. On an estimation more than 318,000 apps have been made accessible in 2018 and on average 200 new apps were implemented every day. More specifically, pandemic has been a core cause for development of technology in medicine and healthcare sectors, where, by 2022 the demand for health care apps is predictable to reach 102.43 billion dollars.

It gains much importance due to its benefits such as user friendly, clarity and convenience of interaction with doctors irrespective of time and place. Persons with severe illness, that requires constant monitoring such as heart problems, blood sugar,

blood pressure, weight gain etc., could be easily maintained via instructions provided by apps (Andrea, 2022). Examples of some apps includes:

(i) **Generis** – Either depending upon the DNA information provided or their life style it recommends alterations based on DNA, food intake, workout, diet and so on.

(ii) **Teladoc** – A specialized app for interlinking patients who seek medical attention to the currently available and efficient doctor with respect to the type of disorder.

(iii) **Better Help** – An app that provides counselling via digitalization, which favours in betterment of emotional and mental strength.

(iv) **MySugr** – Designed in special for diabetes as it is one of the most challenging diseases, as it could not be monitored properly. Whereas, this app has broken down the barriers.

(v) **MDacne** – Specialized in dermatological issues especially acne.

(vi) **Heal** – In midst of COVID situations, meeting professionals at home has become more common and considered safer as it reduces the chances of attracting viruses through hospital environments. This app performs well in assigning professionals visit to the patients (Andrea, 2022).

(vii) **Medisafe Pill Minder** – An app that remembers us regarding our medications.

(viii) **MedicalID** – Depicts our medical conditions and send information to favourite numbers in case of emergency.

(ix) **dminder –** Alerts us regarding our level of Vitamin D and suggests the time to expose ourselves to the sun as well as recommends the duration to escape sunburn.

(x) **MyFitnessPal –** Monitors the overall health and supports in further improvement strategy.

(xi) **Alivecor –** Specifically designed for heart health monitoring (Linsey, 2021).

8. Smart wears

The smart wearables are rocking today's world, as it is much handy and performs numerous functions without even touching mobiles or computers. Right from attending phone calls to monitoring the bodily activities such as heart rate, pressure, rate of sleep, workout levels and so on wearables are pretty effective. Smart wears can be in the form watches, eyeglasses, rings, dresses and head attachments. Some leading devices of smart wears are listed below in Table 1.

Table 1: Examples of some leading smart wears and their significance

Sl. No.	Smart wears	Leading devices	Significance
1.	Watch	Apple Watch Series 6	Tracks O_2, ECG, health and fitness Ratings – 5 stars
		Samsung Galaxy Watch 3	Fitness, O_2 and ECG tracker Battery life – 4 days
		Garmin Descent Mk2 Smart Dive Watch	Best suits for divers with six dive modes
		Polar Vantage V2 Smartwatch	Monitors heart rate, workout levels, sleep limits. Battery life – ultra long
		Apple Watch SE	Monitors heart rate, ECG and fitness Massive storage system
		Fitbit Versa 3	Fitness, O2 sleep, heart rate Battery life – 6 days
		Samsung Galaxy Watch Active 2	Tracks Sleep, workouts, heart rate Battery life – 5 days
		Apple Watch Series 3	ECG display, heart rate, fitness
		Fitbit Charge 4	Tracks O_2 level, stress limit, fitness Battery life – 7 days Pay by tapping device
		Fitbit Luxe	Lowest price
		Matrix Power Watch Series 2	Obtains energy from solar and body heat
2.	Rings	Oura Ring	Monitors everyday activity, sleep and also tracks the biometrics
3.	Dresses	Nadi X smart	Vibrating yoga pants
		Naviano	Swimsuits that indicate time for sunscreen.
4.	Earphones	Bose Sleepbuds II Earphones	Specifically design to initiate sleep and monitors diet plan.
5.	Others	Core Body Temperature Sensor	Monitors body heat and provides suggestions especially for athletes. It's a modern technology.
		Airofit Pro Breathing Trainer	For betterment of lung function specifically in athletes, trainers and COVID patients.

Adapted from: Tom Gerencer (2021) and 42Gears Team (2021).

9. Technology 3D printing

3D printing refers to producing our required biological matter by the use of natural or synthetic materials (i.e.) bioink in laboratory conditions. According to Medical futurist (2021), drugs could be produced as our recommendations by just

providing the raw materials. One such example is FabRX, an FDA approved drug that has been 3D printed and awaiting commercialization.

The same way, 3D printing of organs such as Corneas, bones, skin and ears are at its infancy. Once the image of the organ that need to be printed is created with perfect resolution, the materials for the printing of organ is provided. It is better to use the tissue of the patient to avoid rejection at the time of surgery. Further simulation is carried out to confirm the efficiency of organ developed (Oleksii, 2022).

10. Reality based technologies

These are the technologies where the digital or virtual world is interlinked with the real world in which the person interacts. It involves three concepts depending upon the depth of the virtual creation such as Virtual reality (VR), Augmented reality (AR) and Mixed reality (MR). In the current digitalized world, reality-based technologies have taken a stand in the field of medicine due to their exclusive benefits, such as training programs, detecting veins in patients, treating patients with phobias (Oleksii, 2022), psychological concerns, anxiety, mental strength development (Robbie, 2022), cancer, eye care (CogniHab, 2021) and moreover in autistic children it is used effectively to inculcate them with better food habits (Banire *et al.,* 2020).

Based on its uses and effects its demand is expected to raise annually between 2017 to 2025 up to 30.7%. According to Oxford VR document it concludes that 68% of patients treated through reality-based technology show rapid development after treating for just 2 hours. Similarly, in comparison with conventional training for medical students, those that acquire reality based are 20% more quick in acquiring knowledge. Based on its development the market rate is expected to strike 34 billion dollars by 2027 which was just 2 billion dollars in 2019 (Robbie, 2022).

11. Technological role in biomedicine

Biomedical technology is not any less, in advancements in the field of medicine compared to computational technology. The two broad concepts of biomedical technology include Omics and Bioinformatics, without which the current medicinal development is merely impossible.

11.1 Omics approach

“Omics” is a blanket term referring to multiple technologies such as Genomics, Transcriptomics, Proteomics, Metagenomics, Metabolomics, Flux omics etc. Omics plays

a vital role in medical services by analysing the DNA, protein, RNA, enzymatic level variations etc., It involves different approaches towards medical services such as biomarker development, diagnosis, therapeutical approach that acts as a great boon. As well there are certain challenges that needs to be faced such as Data processing, analytical assumptions, statistical interpretations etc. It also possesses multiple tools that involve in diagnosis of various diseases such as Cancer, Infectious diseases, Immunity etc (Misra *et al.,* 2019). Depending on these specifications, Omics is considered, one among the recent technologies that lifts medicine, a step forward.

11.2 Bioinformatics

Bioinformatics is a technology where computer is used to access massive information of biological conditions. Human intervention alone in analysing and consolidating the biological information is extremely challenging, here arises the use of bioinformatics tool that prevails good in interpreting and providing simulations of biological concepts.

Based on these simulations numerous benefits are obtained in medicinal fields which includes:

(i) Docking of the disease-causing protein with the possible ligands, which provides a simulation report based on which effective drugs could be designed.

(ii) By analysing the genetics of a patient, these tools predict the possible constrains that could arise in the patient's health, by which the medicine could be easily personalized for them.

(iii) Screening strategies of these tools are widely used in determining the disease or its cause at a very early stage, thereby paving way for easy treatment methods.

(iv) Gene therapy could be carried out much effectively by analysing the genetic profile of patients (Ravichandran, 2020).

12. Pros and Cons

E-medicine is the chief development in medicine, yet it contains some demerits as well which need to accepted and steps should be initiated to overcome all the hindrances. Thus, the pros and cons of telemedicine is further discussed below:

12.1 Merits

(i) In developing countries like India, the accessibility towards doctors is not that easy especially in rural areas. Above 75% of doctors are found to practice in

developed regions and only 2% are estimated to be present in underdeveloped regions, whereas, more than 1 billion of the population survive in rural areas. In these conditions e-medicine is found much effective (Sathya and Ramakrishnan, 2011).

(ii) In circumstances of pandemic, telemedicine actually, rocked as it was a best source to mitigate the spread of infections.

(iii) It is user friendly, access big data in a short period of time and more accurate.

(iv) It saves loads of time and effort of doctors.

12.2 Demerits

(i) E-medicine is not much convincing among doctors as it looks as if they could not provide their cent percent.

(ii) Patients are not that confident regarding telemedicine.

(iii) Cybercrime and lack of Confidentiality are major threats.

(iv) Implementation of technology requires financial sustainability, which lacks in India.

(v) Technological development should be carried out involving network issues, software and hardware facilities.

(vi) Most of the Indian population lack English literacy, which hinders their accessibility greatly (Sathya and Ramakrishnan, 2011).

13. Future recommendation

Digitalization and Technological advancements are reaching its peak, in the contemporary world. Its utilization has drastically increased in almost all the fields, where medicine is considered the foremost part. Therefore, in the future government support and technical development will be highly recommended to take it to next level.

Conclusion

It clearly states that the enhancement of technological development is a boon to both medical practitioners and patients. Though certain constrains are faced, it could not be considered a hindrance, rather measures should be implemented to overcome all those and improve the technological efficiency to its core.

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