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Abstract

The age of pestilence and famine was muddled with malnutrition and infectious diseases. Metaphorically we are already sitting on the top of a volcano, the number of diabetics have already affected almost half a billion people. The artificial intelligence (AI) has revolutionized all spheres of life. The discussions on the application of AI in health-care system is omnipresent, this underlies the huge hidden potential of this unique technology in dethroning the enormous burden of several chronic medical conditions. This is an era of Industry 4.0, which is a refabricated concept of smart production and application, that is identified with the 4th industrial revolution and the emergence of cyber-physical systems and this shall govern the future of medicine. The most flabbergasting advances in the application of AI techniques come from data-driven methodologies that learn from large datasets. With AI at hand the diabetes management is headed for an elegant, personalized, custom-made management of therapies, at the level of most minuscule stratum of medical care!

Introduction (from Pestilence to Diabetes)

The age of pestilence and famine was flooded with malnutrition and infectious diseases. The high-fertility rates seeking to explode the living population were dismantled by an equated killing competence of these infirmities. This gradually paved way for the mechanized world with cozy couches and watches devoid of time to engage in any sort of physical activity. This again led to malnutrition, but this time featuring the other end of the spectrum. The resulting epidemic of obesity, hypertension, and diabetes signaled the new age of indolence and metabolic syndrome. Metaphorically we are already sitting on the top of a volcano, the number of diabetics have already affected almost half a billion people.

Cracking Ominous Octet with Artificial Intelligence

The complex interaction of the ominous octet for the causation and feasible interjections, which has to be intervened to diagnose and treat the diabetes has to be envisaged with something equally intelligent. The smart machines that are being made to think and behave in humane manner are transforming the way we manage these complexities. Way back in the 1950s, the fathers of the field Minsky and McCarthy, described artificial intelligence (AI) as any task performed by a program or a machine, which uses human intelligence to accomplish it. The AI has revolutionized all spheres of life. The discussions on the application of AI in health-care system is omnipresent, this underlies the huge potential of this unique technology in deforesting the enormous burden of several chronic medical conditions. At present diabetes appears to be the brand ambassador for its application in health care for a number of reasons. This is an era of Industry 4.0, which is a restructured concept of smart production and application, that is identified with the fourth industrial revolution and the emergence of cyber-physical systems and this shall govern the future of medicine. Intelligent algorithms are utilized extensively in
the data driven methods to sustain sophisticated analysis and provide specific medical aid. This is being harnessed by a number of healthcare-related companies.2

Information: The Key to Intelligence

Acquisition of information is the key input required for exhibition of intelligent behavior. Because learning is an effectual way to instigate such knowledge, most AI applies such learning techniques. The chief aim of learning from knowledge is to let computers become skilled robotically without human interference or aid. The unearthing of knowledge revolves around the investigation and conception of algorithms for retrieving potential information from databases; this is commonly known as knowledge discovery in databases. Its prime purpose is to identify valid, potentially useful, and comprehensible information. The AI has already begun to revitalize the strategies to control blood glucose, the timely and correct prediction of blood glucose level, the detection of severe glycemic events, the life style support, the meal detection, and calculation of the confusing insulin boluses.

The Long Held Dream of an Artificial Pancreas

Creation of an artificial pancreas has been frantically attempted over the past decade. It consists of a mechanized system that has been made to mimics the physiology of islet cells, which include a sensor for glucose, a closed-loop management algorithm, and an infusion device for introduction of insulin. The eventual objective of this system is to perk up overall diabetes management and to trim down the frequency of life-threatening events associated with insulin dependent diabetes. The algorithms used by the artificial pancreas to compute the dosage of insulin have been thoroughly investigated, either by means of data from patients or processor created virtual patients. The foremost candidate algorithms are obtained from conventional control engineering theory; however, AI has become more time-honored over the past few years and could, in due course, provide better candidates to congregate the challenges of an artificial pancreas.3,4 In a recently concluded trial which involved the evaluation of the remote patient monitoring of the fuzzy logic controller, the artificial pancreas was tested on 75 patients with insulin dependent diabetes for four successive nights. The results verified safe and competent glycemic control.5 The fuzzy logic uses a method of reasoning that mimics human intelligence.

Conducive Insulin-Glucose Dynamics!

Harmonizing with the advances in control algorithms, efforts are being applied to progress with the models that can crack the insulin-glucose dynamics. Focus in applying neural networks for identification and control of nonlinear systems has garnered great attention. Zarkogianni et al, developed a neural network skilled with a synchronized learning algorithm that models the blood glucose kinetics of diabetic patients and foretells the glucose levels using information obtained from meal, glucose measurements, and the amount of insulin infused.6-8 The aptitude to predict the blood glucose fluctuations would be a blessing, because it shall provide the early warnings concerning futile or poor treatments being given to the patient. Although the real-time anticipation of the glucose levels is quite challenging, pertaining to the number of physiological factors involving in the tug of war to maintain it, such as delays allied with assimilation of food and insulin, the wider variations in food intake and inadvertent stress situations which can dismantle the hemostat, but AI can take many of these variables into account to cut down the possible fallacies associated with the measurements.9 As with blood glucose anticipation, AI has been put to use for real-time prediction of adverse glycemic episode and this involves a set of tools that deal with the convolutions of effective glucose control. These paraphernalia facilitate to spot the incidence of adverse glycemic events and give ample time to respond swiftly to their effects. This analysis takes into account the continuous glucose monitoring, self reported glucose monitoring, the EEG using the neural-fuzzy interference system to interpret and analyze the data.10-12

The Tedious Task for Glycemic Harmony

The most widespread insulin therapies for diabetics, the dosing computation for subcutaneous insulin and multiple daily insulin injections run based on similar doctrine.13 The estimation of desirable insulin doses and the evaluation of the amount of calories gulped in a diet is a regular hurdle in the life of many patients dependent on insulin for their sugar management. Bolus dose advisors base their calculations on
Insulin doses being already used
Measurement of blood glucose level
Premeditated carbohydrate estimates
Insulin-to-carbohydrate ratio
Insulin sensitivity

Manual calculation of bolus doses and counting calories can be multifarious and exigent because individuals must Mull over multiple parameters to attain pleasing glucose control, and blunder of these values, if any, might very well turn the tide against harmony. To bear caloric assessment and determination of insulin doses, tools for providing bolus recommendations and carbohydrate estimates are being adopted progressively. These tools seek to boost the precision of insulin doses. Researchers at the Imperial College of London carried out an all-embracing study of an insulin doses calculation by means of case-based reasoning methodology.14-18 The approach that they applied, which takes into account an assortment of enthusiastically optimized diabetes scenarios, was verified to be a secure decision-making algorithm. At the University of Bern, The Center for Biomedical Engineering Research carried out more than a few imperative and all-embracing studies15-19 to explore the GoCARB system, which puts forth dietetic counsel to diabetic patients based on mechanical carbohydrate counting. Pilot studies identify it to be a brilliant assistive tool.

One Touch Personalized Care

Treatment of diabetes is influenced by bundle of inexorable factors, incorporating high intra- and interpatient inconsistencies that can spectacularly impact quality of life and undercut the medication adherence even when patients follow their treatment regime austerely. Such unpredictability sternly confines the use of universal models, which cannot incarcerate the specific physiologies. Thus, an imperative step en route for better risk recognition and intrusion is personalization of the system. Over the past decade, foremost investigative efforts have been loyal to developing administrative tools capable of stratifying patients in different segments of the population. Algorithms proficient in early uncovering of grave events affecting glycemic control, such as an infusion set failure, are critical for systematic automation. Physical activities offer multitude of benefits for diabetic patients, but these can also set hurdles in the management of diabetes. Systems and tools focused on programmed detection of exercise could develop the precision of treatments. Jacobs et al. anticipated a regression model to mechanically detect exercise in patients who carry an accelerometer and a heart rate sensor.24 Turksoy et al. have worked on the development of a meal recognition structure based on scrutiny of continuous glucose monitoring signals using a fuzzy system to approximate the calorie content,20-24 it revealed a sensitivity of 91.3% and an error of 23.1% in carbohydrate inference. Recently, Everett et al. offered a data system using a machine learning to endorse submission to physical activity and weight reduction. Insulin pump malfunction may upshot a protracted hyperglycemia or diabetic ketoacidosis. Detection in the early hours of failure could curtail the connected risk. Cescon et al. projected the exploitation of autoregressive model to develop a patient vigilance system. Miller et al. used a machine learning modus operandi to haul out information from drug prescriptions from electronic health record data and categorize factors tied with patient care flaws. Moreover, tools have been developed to scrutinize clinical schedules, prescriptions, and therapy adherence.

Conclusion

Transition from intelligent caretaker to intelligent care!
Beginning with the time of diagnosis, patients are obligated to optimize their lives to deal with complications and other comorbid state of affairs, with the overall goal of enhancing their own care. Time tested technologies and data warehouses bring-in-hand the solutions that replicate the data system and make eminent decisions based upon them. The most awe-inspiring advances in the application of AI techniques come from data-driven methodologies that learn from large datasets. With AI at hand the diabetes management is headed for an elegant, personalized, custom-made management of therapies, at the level of most minuscule stratum of patients or even individuals.

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References


Abstract

Smartphones have gained the position of personal assistant and full time companions for us. They are featured with numerous properties that can be used in various ways in our personal and professional life. Smartphone applications have several utility features that can be used to manage patients at clinics, hospital, and even from home. Applications can also be used for patient appointments, tracking medical records, diagnosing disease, planning treatment, follow-up care, real-time treatment monitoring, risk calculation, and training and education. Using applications not only saves time at clinic but also accuracy of treatment plan improves significantly. Treatment and management methods are changing rapidly in the modern world, due to which a clinician must be aware of these technologies. A judicious use of these applications can effectively change the way of our clinical practice.

Introduction

Smartphone is greatest invention of this decade which has transformed our life both in good and bad ways. Their judicious use not only gives a better way of living but also have favorable effects on our physical and mental health. Utility applications in smartphones are the key of their success and worldwide acceptance in every professional field. In different ways, these applications have changed the tradition of clinical practice both at basic and advance level. But actually, these applications are not used in their full strength and their awareness among medical fraternity is minimal. Ignorance, lack of confidence for their use, and firm belief over traditional methods of practice are the main reasons for their under use. These applications can assist health care professionals (HCPs) for clinical judgment making, maintaining severity score, and follow-up on records, medical education and research, e-consultations and e-clinics, ready references and drug dose calculations, and legal consultations. Smartphone can never be a replacement of clinician. They are just clinicians assistant which help them to deliver better health care.

What are “Apps”?

Smartphone Applications are simple software programs designed to run on them to accomplish a specific and targeted task. Smartphone applications are of three types:

Native mobile apps: These apps are developed for one platform and are "native" to smartphone. They are preinstalled in your phone when purchased.

Hybrid mobile apps: They are downloaded from application marked and after installation they work like native apps, but they need internet and run on web browsers.

Web apps: New technology in app developed makes website to change its shape size and design according to screen size. These responsive websites thus can be accessed from different devices with extreme ease to use. Similarly, latest self adaptive web applications scale themselves to fit the different screen sizes of smartphone and similar devices.
Utility of Smartphone Devices for Health-Care System and Professionals

Features of Smartphones

Smartphone devices are featured with both different modes of communication and are useful for computing also. Because of handy size and ease of use they can be used as point of care (POC) anywhere and anytime. Besides voice calling and texting new generation devices are also having several hi-tech functions, such as browsing, GPS, ultra high quality/megapixel cameras with high definition modes, and voice/sound recorders.

Need for all Purpose Use of Smartphone Applications at POC

Broad categories of uses of smartphone applications at a POC under which we can utilize them are listed below:

- **Communication**: Voice calling, text messages & social media chatting/video calling applications, video conferencing, e-mail.
- **Hospital information system (HIS)**: E-medical record (EMR), clinical decision support system (CDSS), picture archiving & communication system (PA&CS), laboratory information system (LIS), and e-health record (EHR).
- **Informational resources**: e-journals, textbooks, guidelines, medical literature, drug references.
- **Clinical software applications**: Disease diagnosis aids, medical calculators, risk assessment calculators, drug dose calculators, etc.

Apps for Data Management and Education

HCPs use smartphone apps for several purposes. A few of popular applications are mentioned in Table 1.

Recording and Sharing Data and Daily Schedules

Applications are often used for gathering and recording information, time management, and planning daily schedule. Evernote, Notability, and Gboard, assists user to dictate and/or write text and prepare notes, audio files recording, store and store photographs, and systematize different files into category contained by a searchable e-database. Few apps develop modify the text from literature in such a way that it looks like a book. Most preferred E-book reader apps are GoodReader, iAnnotate, and Kindle. They make possible users to underline and highlight text as we do in books. Text and pictures can be enlarged also. Cloud enabled storage and file-sharing services such as Dropbox, and Google Drive, are used to store, update, and share documents or photographs with others without physically exchanging a flash drive or compact discs.

Communication and Consulting

While working in existing health-care systems HCPs often have to visit different places in a day like clinics, wards, emergency department, operation theaters, laboratories, ICU, etc. Our health-care system is very diverse and without moving to these places giving adequate care is not possible. So, HCPs not only need to be keep themselves mobile but also need to be able to communicate and collaborate with people in these different locations. Social networking apps like whatsapp, telegram, etc. are utility tools for enabling consultations while they are on move.

Medical Search Engines

PubMed/MEDLINE apps are equipped with powerful search engines facilitate searches of medical literature databases to identify published medical information. Smartphone medical literature search apps useful for HCPs are: PubSearch, Medscape, and MEDLINE Database on Tap. Articles on NEJM, The Lancet, and BMJ apps can be viewed on smartphone devices.

Drug References

These groups of applications are used to get drug information like drug name, indication, dosage, side effect and interactions, contraindications, cost, and dose calculators. The most frequently used smartphone drug reference apps include: Epocrates, Micromedex, and RxDrugs.

News and Updates

MedPage Today provides breaking medical news with facility to organize news by significance, and obtaining CME credit hours.

Apps Dedicated for Patient Management

Clinical Decision-Making

Smartphone are easy way to access the diagnostic clues for any disease and also let you know the differential
## TABLE 1

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<tr>
<th>Basic purpose of application</th>
<th>Examples</th>
<th>Utility</th>
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<tr>
<td>Data collection, Data storage, and sharing</td>
<td>Evernote</td>
<td>Taking notes, vocal typing, and organization</td>
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<td>Notability</td>
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<td>iAnnotate</td>
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<td>Communication and Consulting</td>
<td>Clinked</td>
<td>Social communication/networking site for HCPs</td>
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<td>Read reference and Information seeking</td>
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<td>Medical reference and drug detailing</td>
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<td>Tracking patient care and management and Monitoring health</td>
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market which can be downloaded free of charges. Thus, HCPs only need to enter the parameters in applications to quickly produce a reliable result. Popular medical calculators are MedCalc, Mediquations, and Calculate.

**Patient Tracking and Monitoring**

Smartphone apps play a wonderful role to monitor vital stats, general health, and location of patients with chronic diseases or conditions even from remote places. iWander monitors and tracks patients with Alzheimer’s disease who are prone to lose the way to or fro from home using the smartphone device GPS. Highly sensitive microphone of smartphone is used as sensor to record and analyze cardiac sounds by app iStethoscope. Few apps in smartphone devices have also been used to track heart rate and rhythm by precision.

**Medical Education and Training**

Technology enabled medical studies is a real need of future. Development of mammoth sized data from various researches and studies is not possible to carry in books and hard copies of journals. Also quick ease of availability of any small information from sea of literature can be easily accessed using simple applications. Thus, smartphone devices are used by medical students to log their experiences, to access information about drugs and diseases, to perform calculations, and to make basic notes. Several smartphone apps for medical students can be used for knowledge assessment, such as case study quizzes.

**Benefits Provided by Smartphone Devices and Apps for Health-care Professionals**

Advanced smartphone gadgets and applications have given numerous advantages to HCPs, permitting them to settle on more fast choices with a lower mistake rate, expanding the nature of information the executives and availability, and improving practice proficiency and information. These and different advantages advanced smartphone gadgets are.

**Convenience**

Medical care experts get various comforts with utilizing a smartphone and PDA gadget in clinical practice, for example, transportability, and fast admittance to data and sight and sound assets, adaptable correspondences. Despite the fact that there will never be an option in contrast to conventional books; however, now clinical understudies no longer need to convey thick reference books.¹

**Better Clinical Decision-Making**

Numerous clinical applications make advanced mobile phone gadgets priceless instruments that help clinical dynamic at the purpose of care. This quality is significant when rehearsing proof based medication, since clinicians may not generally look for answers to every clinical inquiry while doing assessment a case.

**Improved Accuracy**

More precise diagnostic coding, more successive documentation of symptoms, and expanded prescription wellbeing through diminished clinical blunders is conceivable with advanced mobile phone applications. Convenient correspondence inside emergency clinics has additionally been resolved to lessen clinical mistakes, particularly in basic consideration conditions.

**Increased Efficiency**

The utilization of smartphones has been appeared to give HCPs various upgraded efficiencies, including: expanded nature of patient documentation through less mistakes and more complete records, more fast admittance to new data, and improved work process designs. Physicians have reported that the use of a smartphone device for retrieving information from a drug database led to more efficient decision-making and patient care.²

**Enhanced Productivity**

Work process speed is likewise a significant part of treatment while thinking about the colossal populace in line for treatment. This requires expansion of efficiency with more exactness of medical care framework. For example, advanced mobile phone applications help increment pharmacist profitability by permitting significant medication data like contraindications and interactions, to be checked rapidly, bringing about fast handling of prescriptions.⁶

**Future Trends for Smartphone Devices and Apps in Health Care**

As it is happening in various different fields identified with way of life, routine works, and diversion, advanced
smartphone applications are assuming a significant function in medical care framework too. Positive and game changing patterns with respect to the utilization of advanced smartphone gadgets and applications in medical services have been anticipated for what’s to come. As better physical and emotional wellness upkeep become the possible objective of the medical services framework, applications will be expected to satisfy that reason. The prevention and management of chronic health conditions, such as diabetes, obesity, and heart disease, is biggest challenge for HCPs and health-care governance system. Patient care management and compliance are other difficult challenges, especially in Indian scenario where doctor-patient ratio is far below the target. Smartphone/ PDA and its applications, which can illuminate a few comparative purposes and effectively address these issues are required and anxiously anticipated. Accessibility of monetary and moderate advanced mobile phones builds its possession in each financial class of licenses, which is beyond the realm of imagination with PC Future applications will likewise have capacity to synchronize with medical clinic information base so HCPs can get to any patient record. These applications will likewise assist HCPs with observing the indoor patients continuously. Such measures will enable HCPs to use smartphone apps in a more meaningful way that hopefully leads to improved patient care. Medical services instruction as on when required is additionally a significant field to advance in future. As the utilization of clinical gadgets and applications grows, more instructive medical care programs are required to incorporate them into clinical educational plan. With the rapidly changing world, a need of full time companion who can assist in clinical practice is a need of future. Smartphone and mobile applications could serve this purpose of HCPs and effectively and easily. Some HCPs are still turn down to adopt their use in clinical practice probably due to fear of errors and lack of confidence. Medical devices and apps inarguably provide the HCP with many advantages still they are used without a methodical understanding of their associated risks. Among the worries raised with respect to advanced smartphone gadgets are: their trustworthiness for settling on clinical choices; quiet information security and protection; sway on the specialist persistent relationship; and appropriate mix into the work environment. HCPs, unexposed or uninterested in new advancements, might be off guard if the utilization of PDA gadgets turns into a necessity inside the medical care fields. Guidelines for best-practice techniques for clinical application engineers and clients additionally should be set up to keep up culture ethnical practice. Barely any applications are accessible from just about 10 years yet due to under use they are not creating information. Make sure to have a compelling and touchy application we need vigorous information, which can be utilized to create calculations and create and update them. As more information becomes accessible, this will prompt a more valuable determination of approved PDA clinical applications for HCPs. Consequently increasingly more application uses will grow better applications in future.

Conclusion

With the quickly evolving world, a need of full time buddy who can aid clinical practice is a need of future. PDA and portable applications could fill this need of HCPs and successfully and without any problem. Some HCPs are still go down to receive their utilization in clinical practice likely because of dread of blunders and absence of certainty. Clinical gadgets and applications inarguably give the HCP numerous points of interest still they are utilized without a deliberate comprehension of their related dangers. For all legitimate purposes broad assessment, confirmation, and the improvement of best-practice guidelines for clinical applications are compulsory to guarantee a degree of value and security when these apparatuses are utilized. These measures will satisfy the motivation behind improvement of these applications to give noteworthy, exact, and reasonable data and direction to the HCPs to serve the sacred expectation of accomplishing persistent results.

References

CHAPTER 237

Basic Computer and Smartphone—Technology for Practicing Physicians in COVID-19 Era

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Abstract

Technology has made a great impact on the health-care outcomes in the recent years. Starting with simple apps or peripherals which can be attached to a smartphone or basic clinical evaluation equipment. The research process has advanced due to faster access to the literature and research papers. Many new concepts like augmented, virtual, mixed, and immersive reality will be changing the spectrum of health care. Same applies for augmented artificial intelligence, big data, cloud computing, data mining, and retrieval. Telemedicine, Electronic health records, and virtual visits have made a sea change in patient management in the COVID-19 era. Many unexplored vistas of the new modality need to explored and utilized.

Introduction

The influenza pandemic a century ago was in a very different era but caused a catastrophic loss. With the onset of the COVID pandemic, the world has faced its greatest health crisis in the 21st century. There could not be a more opportune time for us to realize the value and implications of technology and there is a golden moment to radically transform health care via the use of basic smartphones and computers.

This working group has been advocating the same since the last 10 years. The basics of technology including hardware/software, world of apps, including challenges and issues not covered as quoted in our earlier publications.1

Specific approaches to smartphone applications include:2

- For Doctors: Developer, Content, Accessibility, Purpose, Cost
- For Patients: Integration, Electronic presence, Patient-doctor relationship, Outcome, Cost

Non-communicable diseases like diabetes have always been a focus of most developers and care of these patients has now been adapted and integrated via interventions at community level and social media. Besides blood glucose monitoring, data recording, control and tracking, futuristic parameters like electronic fall detectors and remote vitals monitoring are now in our reach. Exercise and fitness promotion with specific apps targeted for diabetic patients are now being absorbed for good holistic patient management.3,4

Medical calculators, bundled apps like Medscape and UpToDate, and specialty-specific apps are the essentials to have on a physician’s smartphone. As we embrace technology especially for electronic health records, data safety, and privacy too are real concerns but must be addressed thoroughly with a simple approach of audit trails, password protection and data encryption.5

Artificial Intelligence (AI) is not science fiction anymore and evidence-based medicine is now taking evolutionary steps with fundamentals rooted in pattern recognition, deep learning, cloud computing, and big data. From the
decade old story of IBM’s Watson, now Internet of the Things (IoT) is actually here. The future of medicine will be founded on ‘The Big Five’:7
- Artificial Intelligence
- Big Data
- Cloud Computing
- Data Mining, Retrieval, and Analysis
- Electronic Medical Records

**Technology and the Primary Physician**

While emphasizing that the physician’s touch and clinical acumen can never be replaced, technology when used aptly can transform one’s practice significantly... and, it is here to stay; and evolve, at the same pace as medicine itself!

**Teleconsultations/Virtual Visits**

The west was rapidly able to evolve quickly due its past adaptation to modern technology but the COVID-19 pandemic has proven and given a boost to Tele-Health in India too. Inculcating it in our regular practice will become the new normal, with guidelines and regulations made for its practice and use. International response was swift to promote telesolutions. MoHFW, India, already released guidelines for the practice of Telemedicine on March 25, 2020.10

Clinic software management companies have quickly adapted to it to include it as one of the essential features in their software besides
- Ease of access
- Lesser wastage of time
- Cost-effectiveness

The goal is for the patients despite being far away still get the best out of the physician. Additional principles must be adapted to avoid repeated flaws we face.
- Distinguishing between need of virtual and physical visit
- Good documentation
- Observing guidelines (laid down by that country’s legislation/rules)
- Well-communicated session

**Clinic Management Software**

Challenges:
- Difficulty for a traditional physician to shift to technology-assisted practice
- More than 50 software options available online (Table 1)
- Confusion, viz. cost vs. features vs. “the latest one"

Essential features and how to choose“
- Cloud-based system for easy accessibility
- Better data security and storage
- Appointment management, billing, and invoice generation
- Multiple online payment options
- Printed prescription
- Easy EHR (Electronic Health Record) management system

All these also provide smartphone-based app extension for their software which helps manage things “on the go.” The physician has to choose according to individual needs. There are also specialty-specific software solutions available, which are further fine-tuned according to the specific specialty requirements (e.g., Crystal pm, Ehnote, NETRA clinics for Ophthalmology).

**Table 1** Comparison of three common EHR platform providers

<table>
<thead>
<tr>
<th>Examples</th>
<th>Practo</th>
<th>Docon</th>
<th>Doxper</th>
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<tbody>
<tr>
<td><strong>Strengths</strong></td>
<td>Digital presence</td>
<td>Easy &amp; fast prescription system</td>
<td>Good old ‘pen &amp; paper technique’, digitized EHR of what is written on notes</td>
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<tr>
<td></td>
<td>Good appointment management</td>
<td>Quick turnover time</td>
<td>Good prescriptions, option of additional customized audio/video advice</td>
</tr>
<tr>
<td></td>
<td>Patient feedback rating linked</td>
<td>Helpful for ‘not-so-tech-savvy’ physicians</td>
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<tr>
<td><strong>Challenges</strong></td>
<td>Complicated billing</td>
<td>Minimal online presence</td>
<td>Limited presence</td>
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<td></td>
<td>Weak prescription system</td>
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<td></td>
<td>Risk of commercialization?</td>
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But is that enough? We actually need a SINGLE clinic management software, which integrates and accepts readings from various clinic equipment like a Bluetooth stethoscope, a Bluetooth pulse oximeter, an ECG machine, a Bluetooth weighing machine, a BP monitor, wirelessly transmitting the patient’s data to this desktop software; and the physician can use this not only for better patient management but also for extrapolating, analyzing and doing research from this data in the long run. An IDEAL software will be the one having all the features mentioned above; yet simple enough to finish the physician’s work with a minimal “click count.”

What’s the future? The future is newer software with voice recognition and recording system, having predictive investigation and treatment algorithms, and much more beyond it. And all this is already happening today (e.g., Augmedix) and the same is an inevitable future, and the faster a physician adapts to it and uses it, the better.

**Teleconferencing Solutions**

Telehealth, teleconsultation, and telemedicine are also deeply connected with the original simple communication platforms, which have now made remote networking very easy. Besides its role in essential conferencing, these tools are now being increasingly adapted for tele-education, teleconferencing, and continues professional development.12-14

Various platforms are available:

Big players/professional ones:

- **Zoom**, Microsoft **Teams**, Google **Meet**, Skype, CISCO Webex
- UberConference, TrueConf Online, FreeConference, Appear.in, Slack Video Calls, Facebook Live, YouTube Live

**Zoom**, originally created for businesses is the world leader today with >200 million daily users, the best current product in the market as it was designed as a dedicated conferencing product through easy adoption with WebRTC technology.

Features which must be considered are—All device access (phone/PC, etc.), it is encrypted at both ends & secure, must have an easy to operate screen share feature, accessible via audio/(HD) video calls, flexible number from 10-1,000 participants via video can join, legal permissions for users role-based, easy to remember quick Google/Outlook calendar integration, recording/transcripts is very simple & at multiple locations Cloud or Local disk options (important for medico-legal purposes), Team chat is a boon, extra features as per our demands are available with paid versions which are not that costly. However, few lacunae like inability to display the live captions on screen as in Google meet, or tracking by word as in Ted talks, with an underline to it.

**The Fourth Dimension of Evaluation in Clinical Medicine**

Future of clinical medicine is going to be exponentially explored by these four technologies:

- Virtual Reality (VR)
- Augmented Reality (AR)
- Immersive Reality (IR)
- Mixed Reality (MR)

VR is the computer-generated simulation-reorganization of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, called as Head Mount Unit (HMD) like a helmet with a screen inside or gloves fitted with sensors or other accessories VR head-mounted displays (HMDs), costly as HTC Vive or Oculus Rift, experience a high degree of immersion.

On low end HMDs for mobile devices, such as Samsung Gear VR and Google Cardboard, enable everyone to experience immersive virtual environments. The HMD market is expected to be valued at USD 25 billion by 2022.

It has applications exist in order to offer a higher quality of care and efficiency to patients and medical professionals alike.

VR is used in surgical preparation—check lists to patient illness, education, and therapy.

Examples:

- Embodied labs using VR simulations for attendants of Alzheimer’s disease to understand the disease better, even the consequences visualized softly to understand the need of care
- Floreo technique—virtual reality to teach multifactorial social and communication skills to patients of autism, contexts include games and activities that explore social connections, situational training preparedness and calming-pacifying or even awarding techniques, meditation training for pain relief, writers cramps and...
cognitive behavioral therapy for perimenopausal hot flashes & many varied symptoms difficult to manage.

- **SyncThink** has VR goggles with eye-tracking abilities to test for optic deficiencies and **Eye-Sync platform** (a breakthrough device designation awarded by FDA) helps test for concussions soon after a person sustains a bad blow to the head. Useful in unrecognized head injuries like hypoglycemia, alcoholism, mass gatherings, or high intensity sports.

  **AR technology that superimposes a computer-generated image on a user’s view component, the real world around him, thus providing a composite-interactive view in medical teaching training.**

- **Augmedix** (**AR-BASED MEDICAL RECORDS**) uses **Google Glass** allows access to a patient’s electronic health records. EMR relays information, like previous personal or video visits and current medications. An addition of Google Glass also acts as a scribe that records, vital information, eases in to a more natural doctor-patient interaction, saving time, money, and displays no errors on the side of past medical records, procedures, or drug history.

  The new powerful, next generation, interactive headsets & AI based software AR-VR will be the new normal of clinical evaluation. Accepted by healthcare professionals to provide them with hands-free working environment, greater flexibility with overlaying information, and data processed by the camera. ID Tech Ex, an investment consultant organization predicts this market to be over $20 billion.

  **MR** is the future of real and virtual worlds to have a unique new environments and visualizations, here physical and digital objects coexist simultaneously interact in real time.

  Many educative, training, & operative possibilities exist here. This happens not in either the physical or virtual world, but is a hybrid of reality and virtual reality, encompassing both augmented reality and augmented virtuality via immersive technology. A technology concept that is difficult to imagine right now.

  We users experience a virtual three-dimensional representation of real objects embedded into the physical surroundings. **Microsoft HoloLens** and **Google Glass** are examples of MR devices with different technologies that demonstrate the most prominent emerging technologies.15 India will soon have Jio Glasses as their competitors.

  Around INR 14,000, Snap Spectacles 3 was launched in India at a price point of around INR 30,000. Microsoft HoloLens retails at a sky-high price of INR 2,63,000.

  As the number of consumers grows, the cost will be still more affordable.

  All this will make a sea change in medical education systems and learning right from our formative years in anatomy without the smell of formalin in the dissection halls.16

  It has been proved even in training of paramedics and volunteers for life saving procedures hands on training like pediatric cardiopulmonary resuscitation.17

  Utility of the same in psychiatry is recently been evaluated in this meta-analysis with immense practical positive outcomes.18

  In the present dreadful COVID era, it has been very usefully in protection of HCW, in minimizing exposure to nosocomial infection, optimizing the use of PPE, and enhancing aspects of care. Deploying such **hologram augment technologies** at pace requires context-specific information security, infection control, user experience, and workflow integration led by clinical end-users setting up an entirely new field for exploration.19

  **Immersive virtual reality (IVR)** has endless permutations combinations, which exist for application in health care. We can now immerse their patients in environments to achieve exposure to a specific clinical situation like Hypoglycemia, Bowel movement irregularities as in IBS, whether constipation type, diarrhea type or mixed pattern & patients correlation with feeling of bloating, blocked or urge as his experience. After the evoked targeted physical & emotional responses, in therapy we can inspire, acclimatize, or distract from an experience occurring in reality. Best example being a patient of Agoraphobia or Claustrophobia gives instructions or commands from HMD special goggles-lenses.

  **IVR** is a future in health care, research, practice, education, and profitable components with many studies exploring its feasibility for acute treatment of health conditions; however, evidence of its effectiveness needs further research.20

**AI in Health Care—The Rising Horizons**

AI makes medicine more *pre-emptive, predictive, & personalized.*
Today, AI and related technologies in health care are rather much more advanced and developing rapidly with the help of Big Data. These technologies have the potential to transform many aspects of patient care, administrative processes within the provider, health-care insurance and pharmaceutical organizations.21

The most tried AI tools in health care so far are AI-driven diagnostic tools that are helping physicians in clinical decision-making and helping with disease diagnostics. The spectrum of AI solutions like natural language processing (NLP), image analysis, and predictive analytics based on machine learning-neural networks and deep learning are widely used for diagnostics in clinical medicine.

AI-led telemedicine services are disrupting the entire value chain practice and patient care. AI is empowering telemedicine making a better diagnosis, assisting eldercare, and remote patient monitoring. As health care becomes more technology-driven, IoT and Telemedicine could offer quality service options at a reasonable cost, just by increasing the number and frequency of consumers components of IoT or IoMT has several component sensor conducted bio signals, Gyroscope mediated motion linked data as in fall detectors or exercise Apps, contextual data components like locations, supermarket visits humidity or temperatures.

Ethical, legal, and social implications will need to be considered for use of AI in health care. The use of smart machines to make or assist health-care decisions raises issues of privacy, permission, transparency, and accountability.21 Also, ensuring the use of capable and useful AI technologies in the health-care domain in daily clinical practices remains a challenge.

Undoubtedly, AI has a great future in health care. With the help of smart devices and health-care apps, they can act as a personal health assistant for common people. Apart from early diagnosis, fast and accurate clinical decision-making, cost reduction in health care, AI techniques like machine learning have the capability behind the development of precision medicine.

**Technology and India during COVID-19**

We as Indians are less jubilant as far as use of technology is concerned compared, to either eastern or western users. But there was tremendous surge in uses of smartphones and its applications during this initial COVID-19 pandemic time. Some sources report to have increased by 120% within initial couple of months of lockdown. Some sources which have collected data, line Cybermedia Reserch Surveys that more emphasis was on different content creation which was spread out by users to others. Also there was significant increase usage of video calling applications.

Gradually as the lockdown curbs were eased and online sales platform started activities for non-essential goods. People had obviously picked up the activities on these applications for ease and to maintain restrictions. Most people had upgraded their devices like smartphones and laptops. People tried different applications and processes that were supported by faster internet connections and such devices. But the usage of such processes although was very significant was limited to knowledge of government schemes and other information like epidemic progression and whether forecasting. Although usage of Aarogya Setu app was increased overall usage for health-care benefit was not that significant.22

There is a resolute demonstration by the people of India to accept technology. The health-care sector must embrace this opportunity to radically adapt technology.

Simple starting steps would be use of the basic apps, which would assist greatly with health care during the pandemic:

- Apps like Calculate by QxMD for risk-stratification and management, which can be used for COVID including CURB-65, qSOFA, NEWS, ROX-index.
- Apps for infusion management of vasopressors and glycemic control like IV Infusion calc and InsPro are extremely helpful in these manpower-resource-limited times
- Drug-drug interactions especially when COVID-cocktail therapy is being practiced can be evaluated by simple apps like Epocrates
- Peripheral smartphones add-ons like pulse-oximeters and digi-stethoscopes are already commercially available now
- Medscape and UpToDate still remain the best bundled apps with continuous rolling updates about the pandemic from verified sources.
Conclusion

The pandemic has brought the world to its knees but given all of us a chance to rise up to this once-in-generation challenge. The government too has set off a pace of reforms for enhancing the use of technology in medicine with significant resolve in areas of telemedicine and concept of Unique-health-ID with a promise of complete horizontal and vertical cross-integration. The future has arrived for technology in health care.

While understanding its tremendous power and scope for exponential promises in thrust areas of AI and the four realities (AR/MR/VR/IR); the physician needs to start with the simple steps of using telemedicine and basic apps in their practice for a simple reason… The best interest of the patient!

References