Internet of Medical Things: Advent of Digital Doctor

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Abstract - **Disruptive technologies must transform the current healthcare system, but to get there, we need to digitize the delivery of care. The digital world has been in a separate orbit from the medical cocoon, and it's time the boundaries be taken down. Digitization will enable widespread access to improved healthcare. Many face-to-face patient-doctor meetings are not necessary, as they could be solved from home by letting doctors access patient data and interact with them remotely.**

Even though the healthcare industry has been slower to adopt Internet of Things technologies than other industries, the Internet of Medical Things (IoMT) is poised to transform how we keep people safe and healthy especially as the demand for solutions to lower healthcare costs increases in coming years. The IoMT can help monitor, inform and notify not only care-givers, but provide healthcare providers with actual data to identify issues before they become critical or to allow for earlier invention.

Physicians are struggling hard to figure out how best to use this technology in the interests of patients. Physicians are in the best position to weigh information and advise patients, drawing on their understanding of available evidence as well as their training and experience. If anything, the wealth of information on the Internet will make such expertise and experience more essential. The doctor, howsoever; will never be optional.

Most mobile devices are equipped with 'Near Field Communication' and 'Radio Frequency Identification' tags, they can communicate with IT systems. IoMT isn't intended to replace healthcare providers but to provide them with the data gathered from devices for better diagnoses and treatment plans as well as to reduce inefficiencies and waste in the healthcare system.

Keywords: Personalized medicine, Wearables, iRobot, Sensory patches, Medical kiosks, Infant monitors, Cognitive services, Artificial intelligence, Machine learning, Watson Platform for Health

I. INTRODUCTION

CURRENT HEALTHCARE systems are dominated by paper-based processes, which cannot be measured and analyzed as easily as digital ones. And even if a medical system is digitized today, it is fragmented and cannot be simply accessed across systems, platforms and locations.

For thousands of years, only physicians have been able to acquire and access medical data and make medical decisions. This "ivory tower" of medicine was built on the firm knowledge that physicians know best what's good for the patient, and can't benefit from patient input. Patients were just the subjects of healthcare, not partners. Today, health innovation allows patients almost the same opportunities as physicians, but they're not yet equipped to use it responsibly. For the sake of both, physicians must learn to work with patients and treat them as equal partners, while patients must assume more responsibility for their health. This new equilibrium will lead to improved effectiveness and motivation for patients to better managing of their condition.

How do we use technology to deliver new models of care, like precision medicine or telehealth or remote patient monitoring? Disruptive technologies must transform the current healthcare system, but to get there, we need to digitize the delivery of care. The World Health Organization estimates that there is a worldwide shortage of around 4.3 million physicians, nurses, and allied health workers. And care is often unavailable where it is most needed. Worse, with civilizational diseases like diabetes and obesity on the rise, healthcare costs are expected to grow even faster. American health spending will reach nearly $5 trillion, or 20 percent of gross domestic product by 2021. The current practice of medicine is simply unsustainable.

Even though the healthcare industry has been slower to adopt Internet of Things technologies than other industries, the Internet of Medical Things (IoMT) is poised to transform how we keep people safe and healthy especially as the demand for solutions to lower healthcare costs increase in coming years. The IoMT can help monitor, inform and notify not only care-givers, but provide healthcare providers with actual data to identify issues before they become critical or to allow for earlier invention.

We need large amount of data for identifying cause of diseases caused by civilization like Genomes. Genomic data, for example, is only available for a handful of people – no wonder that President Obama launched an initiative to combine a database of 1,000,000 patients' genomes. Once healthcare systems are integrated and digital, smart algorithms like 'IBM Watson' can sift through them, looking for patterns in the data, helping us understand, treat, and even prevent disease.

II. DIGITAL TECHNOLOGY AND HEALTHCARE

The impact of digital technology in healthcare can be transformative:

- integration and interoperability of data for both care and research can provide insights to the whole patient pathway
- understanding the complexities of disease through open access quality data and evidence
- awareness of health and well-being through knowledge empowerment of the patient as a citizen – involving patient in own healthcare management.
- Digital community settings provide choices for people's support or care.
- Efficient/cost effective contact and patient experience through telemedicine and telecare services.

Digitization will enable widespread access to improved healthcare. Many face-to-face patient-doctor meetings are not necessary, as issues could be solved from home by letting doctors access patient data and interact with them remotely. The American Medical Association showed that roughly 1 billion doctor visits occur each year in the United States, and of those, 70 percent are unnecessary and could be avoided by consulting with a physician by phone, email or text. What's more, a local GP or clinic cannot treat many complex or rare diseases which require expertise only available hundreds of miles away. The combination of telemedicine services and data from health trackers will make this a possibility in the next few years. The rise of remote diagnosis and medicine would not mean the end of the "human touch" in medicine, as many fear. On the contrary, with digital data, it's easier to share, consult and crowd-source, opening the way for truly personalized care where it is most needed.

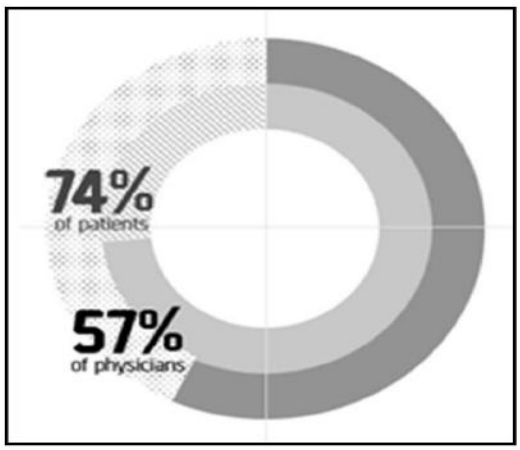


Figure 1. About 74% of patients and 57% of physicians in the U.S. would use telehealth services.

III. PATIENTS IN THE CENTRE OF HEALTH CARE-PERSONALISED MEDICINE

Medicine has been built on a long history of innovation, from the stethoscope and roentgenogram (X-ray) to magnetic resonance imaging and robotics. Doctors have embraced each new technology to advance patient care. But nothing has changed clinical practice more fundamentally than one recent innovation: The Internet. Its profound effects derive from the fact that while previous technologies have been fully under doctors' control, the Internet is equally in the hands of patients. Such access is redefining the roles of physician and patient.

Information traditionally flowed from doctor to patient; the physician explained the genesis and course of a disease and the options available for treating it. Often, pamphlets were provided to reinforce the doctor's explanation and advice. The patient might then receive additional input from family and friends, usually in the form of anecdotes about people who faced similar clinical situations.

The Internet has upended that scenario. The Web offers virtually unlimited amounts of information. Everyone can now visit many of the sites that inform and educate doctors. Popular search engines such as Google and Yahoo provide portals to primary data published in scholarly journals as well as critical analyses of these studies, slide presentations from grand rounds, videos of surgical procedures, and guidelines from professional societies. The voices that patients hear have multiplied wildly as chat rooms and blogs filled with testimonials have proliferated. Patients frequently encounter conflicting advice and opinions.

Patients whose diseases have no ready cure are drawn to chat rooms and Web sites that may make unsubstantiated claims — assertions that macrobiotic diets cure aggressive lymphoma, that AIDS can be treated with hyperbaric oxygen, that milk thistle remedies chronic hepatitis, and myriad other fallacious claims. Falsehoods are easily and rapidly propagated on the Internet: once you land on a site that asserts a false rumor as truth, hyperlinks direct you to further sites that reinforce the falsehood. Material is perceived as factual merely because it is on a computer screen.

Figure 2. Personalized medicine is here to stay.

We sometimes find ourselves in the uncomfortable position of trying to dissuade desperate and vulnerable patients from believing false testimonials. Doctors may be perceived as closed-minded, dismissive, or ignorant of "novel therapies" when they challenge such Internet rumors.

Patients also consult the Internet in search of self-diagnosis. Sometimes, doing so leads them to seek medical attention rapidly and to suggest what turns out to be a correct diagnosis. But the Web is perilous for anyone prone to hypochondria.

Hospitals may inadvertently contribute to such Web-inspired worry. Many medical centers have secure Web portals that allow patients to view their laboratory, radiology, and pathology results remotely. This technology is efficient, averts the need for multiple phone calls and the mailing of information, and is welcomed by many patients. The benefits, though, must be weighed against the potential negative effects of receiving clinical data without context. Patients and families may be confused by results and worried that minor abnormalities might portend serious consequences.

Doctors now routinely consult the Web in search of diagnoses. In 2006, two Australian specialists tested the diagnostic accuracy of Google searches by entering symptoms and signs from 26 published case records. The search revealed the correct diagnosis in 15 cases. Internet searching was more effective for conditions with unique symptoms and signs; complex diseases with nonspecific symptoms or common maladies with rare presentations were less likely to be diagnosed this way. The specialists partially attributed their high success rate to their expert knowledge, which enabled them to choose the correct diagnosis when presented with a list of possibilities.

Internet also provides physicians with immediate access to current information, including primary source data. Journal articles can be obtained within seconds, and experts' evidence-based analyses are readily available on the sites of professional societies and in compendiums. Sometimes, patients ask about novel therapies which are not heard of, but doctors search on internet and get details. Primary care physicians now have easy access to many guidelines whose reach was previously limited to specialists; such access may ultimately blur the line between generalists and specialists and could reduce the volume of referrals to some types of specialists.

Many patients feel free to e-mail not only their own doctors but also specialists around the world. Many doctors also take the initiative and inform their patients of test results by e-mail — an efficient practice that will probably be favored under health care reform. Nevertheless, sending e-mail is quite different from speaking with a patient face-to-face. It's impossible to judge the effect on patients of information transmitted through cyberspace: the doctor can't observe grimaces, tears, or looks of uncertainty.

The physicians are struggling hard to figure out how best to use this technology in the interests of patients. Physicians are in the best position to weigh information and advise patients, drawing on their understanding of available evidence as well as their training and experience. If anything, the wealth of information on the Internet will make such expertise and experience more essential. The doctor, howsoever; will never be optional.

Current digital health technology like health trackers provides raw data that needs the expertise of trained physicians to be actionable. Instead of raw data, innovators should be focusing on helping patients make decisions about lifestyle. Even more important is that though vast amounts of information is available online, much of it is biased or faulty. Patients searching online can as easily stumble upon pseudo-scientific rambling information in place of relevant information. Without proper training, it's often hard to distinguish between the two. Finally, most healthcare processes were designed decades ago, "suffering" patients instead of focusing on them. Involving patients in designing the delivery of care was not even considered until Dr. Tom Ferguson published his e-patient white paper in the early 2000s.

Shift Focus from Treatment to Prevention: We have never before understood medical conditions and their underlying causes like we do now. Complex phenomena like the biology of cancer or the causes of diabetes have been documented for the first time in the past few decades by analyzing the ever growing amount of medical data. But the general population has a hard time sifting through the tons of health advice to find reliable advice on living a healthy life. Many are still unaware of well-understood, unhealthy habits like a mostly sedentary lifestyle, the lack of exercise, or excessive alcohol consumption. Changing behaviour has proven difficult. We just need to look at how enduring smoking is in much of the world, even after it has been proven to be a strong cancer-causing habit.

Figure 3. We know smoking causes numerous types of cancer, but still many people smoke worldwide.

Gamifications in health care: Gamification can drive healthy habits – like how the Wellapets app changed asthma monitoring for kids by making it a game instead of a chore.

Gamification can be defined as a process for enhancing a service

with opportunities for gameful experiences in order to support the user's overall value creation. Gamification is increasingly being applied to many industries, including digital health, create fun and engaging experiences, converting users into players.

Figure 4. Digital Health: portable diagnostic devices.

In the context of digital health, gamification is typically employed in health and wellness apps, related to self-management, disease prevention, medication adherence, medical education-related simulations and some 'telehealth programs'.

In most self-management, medication adherence, weight loss and other health and wellness apps, gamification typically works in the following three ways:

- By using progress bars to measure success – therefore, the perceived value of the service is increased by invoking progress-related psychological biases (*e.g.* Weight loss apps, medication adherence programs, health education, etc.).
- By allowing users to share progress and results with their friends or other users of the service – therefore, a competitive spirit is created to elicit more or better use of the service. (*e.g.* Fitness apps, weight loss apps, etc.) The best example is sharing data on Fitbit App which allows to share the data with friends.
- By giving badges, medals, stars or other virtual gifts during each stage of progress – therefore, a sense of achievement is created to increase motivation levels. (Ex: Weight loss apps, fitness apps, chronic disease management apps, etc.). Blue shield California, a not-for-profit health insurer, attempts to make wellness fun via social media. Participants earn points, badges, status, and see their progress. Blue Shield claims that 80 per cent of its employees have participated and had a 50 per cent drop in smoking prevalence.

In more advanced medical applications, various gamified exercises for older people, individuals with movement impairments, and people suffering from back pain have been created using real-time biofeedback from motion-capture sensors and gesture-control technology. Additionally, using a story-telling approach and 2D & 3D comics, explanations are provided about health literature related to diagnoses, medical procedures and patient behavior.

Gamification is an application that's also used in some telehealth programs to educate patients, health workers and the general populace in remote and rural areas.

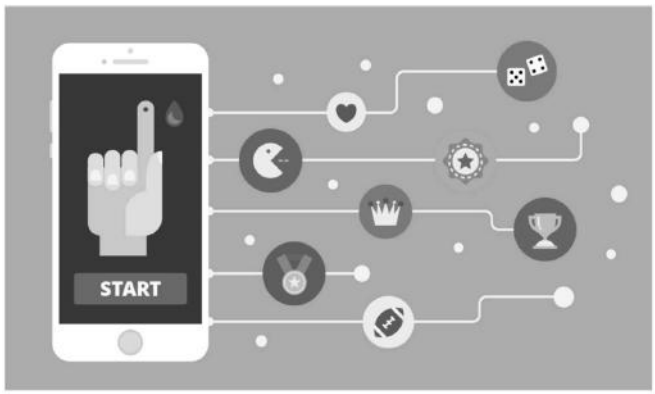


Figure 5. Gamification is quite popular with patients.

IV. THE INTERNET OF MEDICAL THINGS

The Internet of Medical Things refers to the connected system of medical devices and applications that collect data and provide to healthcare IT systems through online computer networks.

IoMT can provide a better way to care for our elderly and has a tremendous potential to help deal with the rising costs of care. IoMT devices can help track vitals and heart performance, monitor glucose and other body systems, and activity and sleeping levels. Seniors often forget to take their prescribed medication on time, and IoMT devices can help remind them to take it and document what time they took medication.

Additionally, portable diagnostic devices can make routine blood and urine tests easier on our aging population—a group of individuals where mobility is more challenging and who need to complete these tests more frequently than for younger patients. Portable diagnostic devices can analyze and report the findings of these tests without requiring a visit to the doctor's office. There is a lot of opportunity for IoMT to help remote caregivers ensure the safety of their loved ones with wearable devices that learn the regular routines of the person who wears the device and can issue a warning if something seems amiss as well as alert if seniors have breached their boundaries which is often of concern for memory-care patients.

IoMT isn't intended to replace healthcare providers but to provide them with the data gathered from devices for better

diagnoses and treatment plans as well as to reduce inefficiencies and waste in the healthcare system. IoT can help, assist, and augment the existing systems or create new ways to make sure the patient gets the best care, and the job of nurses, doctors, and staff becomes easier, efficient, economic and safer.

IoMT requisites are as follows:

- Design smart algorithms to support decision-making, prescribe personalized treatment and ensure compliance with therapy.
- Develop integrated systems that can store and analyze it, growing our understanding of disease and measuring physician performance.
- Ensure that access to care is available from home, not just the clinic.
- Make access to someone's own health data a basic human right.
- Make devices and sensors that record health data widely available.
- Protect health data and privacy of patients to avoid misuse of information.
- We must digitize healthcare and ensure everyone has access to quality, affordable care, while avoiding the threat of ubiquitous access to private health data.

Rising deployment of smart sensor technology in various systems enhances the capability of IoT healthcare market devices to collect more data associated with patients' health. The gathered data is used to enhance the patient monitoring process and analyze it to discover new treatments for various other diseases. These technological solutions therefore help bridge the gap between the physical and the digital world.

The Internet of Medical Things (IoMT) is the collection of medical devices and applications that connect to healthcare IT systems through online computer networks. Medical devices equipped with Wi-Fi allow the machine-to-machine communication that is the basis of IoMT. IoMT devices link to cloud platforms on which captured data can be stored and analyzed.

Even though the healthcare industry has been slower to adopt Internet of Things technologies than other industries, the Internet of Medical Things (IoMT) is poised to transform how we keep people safe and healthy especially as the demand for solutions to lower healthcare costs increase in the coming years. The IoMT can help monitor, inform and notify not only care-givers, but provide healthcare providers with actual data to identify issues before they become critical or to allow for earlier invention.

Dramatic Growth in IoMT Devices Predicted: A report by Allied Market Research predicts that the IoT healthcare market will reach $136.8billion worldwide by 2021. Today, there are 3.7 million medical devices in use that are connected to and monitor various parts of the body to inform healthcare decisions.

There are several realities that enabled this dramatic growth including the accessibility of wearable devices and the decreasing costs of sensor technology. Now that most consumer mobile devices are equipped with Near Field Communication (NFC) and Radio Frequency Identification (RFID) tags, they can communicate with IT systems. In addition, the rates of chronic diseases are on the rise and the demand for better treatment options and lower healthcare costs makes it more appealing to dabble with new innovations that could provide better healthcare outcomes and efficiencies. High-speed internet expansion and access, as well as favorable government regulatory policies, have also contributed to the growth of IoMT adoption.

Medical devices/ Wearables: All Pharma companies as well as startups are considering the advent of new opportunities in the health sector innovations. A few examples are given below to give an idea to the reader:

- Smart Health Monitoring sensor devices as well as wearables are connected to get the on-line health status as well as heart rate and blood pressure and enable to provide remote health care services. Heart monitors, that transmit data in real time to cardiologists, are now enabling them to determine the onset of heart problems with the information they receive. Patches that monitor heart conditions, using the data flowing from devices to ensure that its treatments work as intended and better understand usage patterns and the probable onset of heart disease.
- Patient personal medication system shows the picture of all the medicines which the patient is asked to take and also the detailed information and usage details. Ingestible sensors keep track of the regularity of consumption of the medicines and display trends based on usage on the connected mobile device. Ingestible sensors, when reacted upon by stomach fluids, transmits data to the connected device in real time, allowing for analysis of consumption trends, and effectiveness.
- iRobot, a healthcare robot which is located at the patients home, monitors movements of the patient within his home and is connected with sensors to give information to the servers. The information can be shared with doctors with permission of the patient. The robot may interact with the resident, reinforce compliance with medication. Sensors developed for patients with chronic illnesses, that allows them the luxury of staying at home while their doctors and nurses get constant updates on different aspects of their well-being. Sensory patches targeted at chronic illness patients and the elderly transmit data of their well being and the condition of the vital signs to their respective doctors.

- Medical Kiosks and Health spot: Several kiosks are provided in residential colonies that are equipped with diagnostics. The attendant is trained to provide basic medical needs and also the doctor can remotely see the data and advise accordingly.
- Infant Monitors: Monitor your most valuable possession with connected sensors dispatching information to your smart device in real time. Infant monitors send parents information in real time of the baby's breathing, skin temperature, heart rate, perspiration and other vital signs

Artificial intelligence (AI) and machine learning are two vital tools for insights. Without an AI engine, the data from a wearable would lack any value to the vendor as well as the user. That's the reason why, wearable app developers are increasingly adding AI Engine inside wearable health apps and wearable health solutions. Moreover, AI assisted data mining is also essential to the success of an intelligent healthcare platform that ties many smartphones, website, IoT devices and wearables together to gather data and return intriguing health insights of an individual.

Many International companies are working on IoT devices for health services. A few examples are given in the box below:

IoT Devices already on the market Hexoskin's sensor-packed T- shirt, Throatscope Smart sock from Owlet Baby Care, Preventice's smart bandage, Fraunhofer's glucose, lactate and cholesterol sensors, pulse oximeter to detect biomarkers, Breast lumps self-exams (mammogram) sensor from Eclipse Breast Health Technologies, iSonea personal asthma wheeze monitor, Shake stabilized spoon for Parkinson disease patients from Lift Labs, Breast-cancer killing chip from Northwestern University, Ultrasound scanner from Mobisante.

Source: JanuszBryzek, Trillion Sensor Summit, Stanford University, October 23-25, 2013

Aging World Population will Continue to Burden the Healthcare System: The IoMT might be the silver bullet for our communities to address a burdened healthcare system that will only be under more stress as our population continues to age. By 2025, 1.2 billion of the 8 billion people on earth will be elderly; equivalent to the population of India. Elderly people tend to have more healthcare issues, therefore increasing costs. So, as life expectancy rises, it is expected that healthcare costs will follow suit.

IoMT can provide a better way to care for our elderly and has a tremendous potential to help deal with the rising costs of care. IoMT devices can help track vitals and heart performance, monitor glucose and other body systems, and activity and sleeping levels. Seniors often forget to take their prescribed medication on time: IoMT devices can help remind them to take it and document what time they took medication.

Additionally, portable diagnostic devices can make routine blood and urine tests easier on our aging population—a group of individuals where mobility is more challenging and who need to complete these tests more frequently than for younger patients. Portable diagnostic devices can analyze and report the findings of these tests without requiring a visit to the doctor's office. There is a lot of opportunity for IoMT things to help remote caregivers ensure the safety of their loved ones with wearable devices that learn the regular routines of the person who wears the device and can issue a warning if something seems amiss as well as alert if seniors have breached their boundaries which is often of concern for memory-care patients.

Adhering to Doctor's Orders: While you might think that IoMT would help diagnose patients, currently the biggest use—and impact—of IoMT is to ensure adherence to doctor's orders. IoMT isn't intended to replace healthcare providers but to provide them with the data gathered from devices for better diagnoses and treatment plans as well as to reduce inefficiencies and waste in the healthcare system. Healthcare facilities also currently use the Internet of Things to help with workflow optimization, inventory management and medical device integration.

A connected medical device provides objective reporting of actual activity, whereas without its reporting providers must rely on subjective patient reports to detail how they feel. Similarly, IoMT devices help to monitor patient behaviour and activity away from the office, so the provider will have actual data to refer to regarding compliance to patient therapy recommendations and what transpires after a patient leaves a medical facility.

There are some connected devices that allow internal surveillance in a way that's never been available before and smart technologies added to medical devices such as pacemakers. This helps a medical team monitor the progression of a disease and learn things that could impact future care guidelines and patients.

From creating customized pharmaceuticals to determining care guidelines based on the unique biological systems of a particular patient, IoMT opens the door to more personalized healthcare for each individual.

As the number of connected devices increases IT systems will need to determine how to handle the data load securely. In order for the IoMT things to truly be transformative, healthcare organizations will need to figure out how to turn all the data it collects into insights that can inform action. While the momentum of this transformation is increasing, it will

require hospital administrators, manufacturers and vendors to work together to drive healthcare's cultural metamorphosis. This is happening so rapidly that the amount of data which exists is doubling every two years, and this growth (and the opportunities it provides) is what we call Big Data.

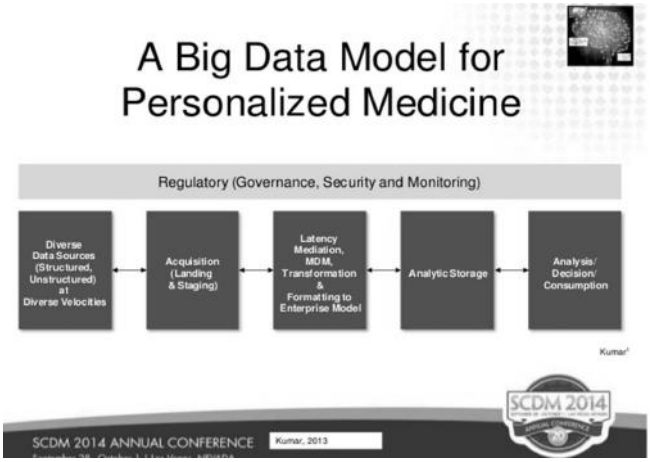


Figure 6. Personalized medicine is here to stay.

V. CHALLENGES

- Presently there are no interworking standards in place. Data from one place to another is going on proprietary standards which is not a healthy situation. There are some international bodies like IHE, HL7, CDISC etc. that can help in standardization process. Further integration of clinical and personal databases, from Primary care to acute and secondary care have to be taken care of.
- The interpretation of digitally available data need to be understood by each and everyone in the medical domain.
- There is a need for Universal online professional access to record solutions, empowering the concept of shared care.
- Feedback from citizens will help in shaping the future planning of the digital healthcare landscape
- All younger generations professional working in the medical field should be given opportunity to work with other communities of professionals, academics, researchers and enthusiasts.

A challenge is data integration, gathering across dissimilar data sets. The connection between various schemas must be unstated before the data in all those tables can be joined. Moreover, AI mobile app developers are increasingly using both SQL and NoSQL, structured or unstructured relational database, formats for data storage in accordance to the AI-friendly wearable application development protocols.

Artificial intelligence, deep learning and cognitive computing are the real challenges and lot of work needs to be done by Software and API companies. 'IBM Watson' is doing a lot of work in medical field (cancer research) and other industrial applications.

The platform should contain data points from various medico-sources such as manuals, journals, and public health data to emulate a doctor's knowledge. Upon adding patient-specific data, effects of time and location to the platform's enormous data set, the machine learning system can generate a clinical model of a patient. Compatible medical wearables and IoT devices can interface with the platform's API and can be made to exert interesting insights about the data received from the devices.

The challenge of Inter-operability: Interoperability requires clear National Technology Standards as well as National Data Standards for the structure and content of health records.

Effective health information sharing is needed for effective treatment of patients on a national basis. The information from the servers or information banks (silos) will have to be given to multiple, different people and services across health, social care and wider market that can share openly.

VI. FUTURE OF MEDICARE

2018 will be an exciting year for technological innovations that will leverage big data, the Internet of Things (IoT), machine learning AI, speech and natural language interfaces, and block chains tools to transform and improve the world we live in.

Huge advances are being made in predictive analytics using genomic data by players including Helix, 23andMe, Myriad Genetics, BK Biobank and the Broad Institute. This is making it possible to predict chances of diseases such as cancer, or even IQ, by analyzing genetic data. This promises to be the next quantum leap in public health protection, but also raises huge ethical concerns, including the risk of genetic discrimination.

"Genetic fortune telling will make it possible to predict the chances that you'll be smart or below average in intelligence. It will also make it possible to predict behavior traits. But how will we use that information? Will it change how we educate children and judge their potential?"

Wearable devices: Lot of Innovation is expected in the field of Wearable devices. Companies like Google Healthcare are working on newer technologies for wearable devices. Wearables for preventive health: Google wants to inject nanobots in your arteries. Don't be scared already. If they could find a way to take them out, Google X could be the next breakthrough in medtech. Once injected via capsules, nanoparticles proactively detect and diagnose diseases, cancers, impending heart attacks or strokes based on changes to the person's biochemistry, at the molecular and cellular level.

The patient then can use a wearable like a wristwatch clamped on his wrist to receive reading from nanoparticles (nanoparticles

are actually IoT devices). The wearable then feeds the data to the AI engine of the platform and utilizes its machine learning capabilities to detect abnormalities if any in the wearer's body. If detected, the wearable reports a potential condition like blocked arteries that could lead to heart stroke or cancerous tumor at a very early stage.

On detection of an abnormality, the patient can report them to their consulting physician or an AI doctor. An AI doctor is generally a standalone neural network with deep learning algorithm that can detect ailments faster than an actual doctor can. Deep learning algorithm ensures the platform makes minimal mistakes and maximum detection through a self-learning module (Chatbot Development). While it shares the same data as the platform, the machine learning algorithms are stronger in nature, delivering detailed reports.

The AI based doctor may prescribe you medication. Under the surface, the neural network that powers the AI doctors upon detection connects to the platform to gather required medical data and prescribe medications to the patient. The prescription is then sent to the patient's wearable which he can refer to or even order the medication over using the integrated contact-less payment system with the NFC chip embedded in the wearable. A wearable health app can even remind you when it is time to take a medicine.

It's been predicted that by 2020 half of online searches will be carried out by voice – and 30% of them will be made using devices which have no screen at all.

Watson Health Care Systems: Watson Health has a unique approach to the application of data driven technology in the market. It is the combination of our data, our cloud, and our AI services that build cognitive offerings for our partners and clients.

The healthcare and life sciences industries have a unique need for cognitive services. Cognitive models designed specifically for health can help speed time to insight from health data. Understanding unstructured medical data requires specific terminology, taxonomies, and targeted uses, all of which must be delivered in compliance with regulatory requirements. Watson Software systems are designed with cognitive computing in mind.

'Watson for Oncology' is a decision support tool that is trained by top oncologists at Memorial Sloan Kettering. Watson for Oncology ranks the treatment options, linking to peer reviewed studies that have been curated by MSK. It also provides a large corpus of medical literature for a physician to consider, drawing on more than 300 medical journals, more than 200 textbooks, and nearly 15 million pages of text to provide insights about different treatment options.

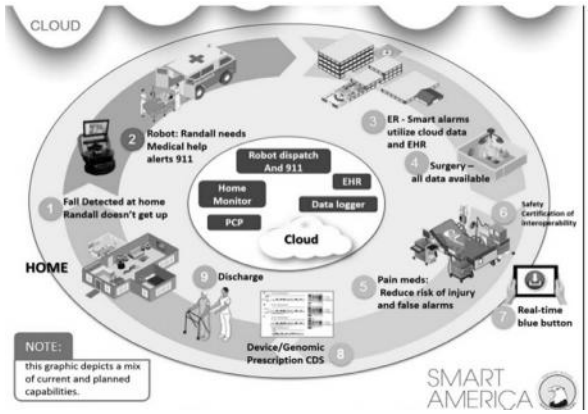
Watson for Oncology now allows client institutions to add localized treatments and dosing to their system, and to identify treatments that are unavailable in their geography.

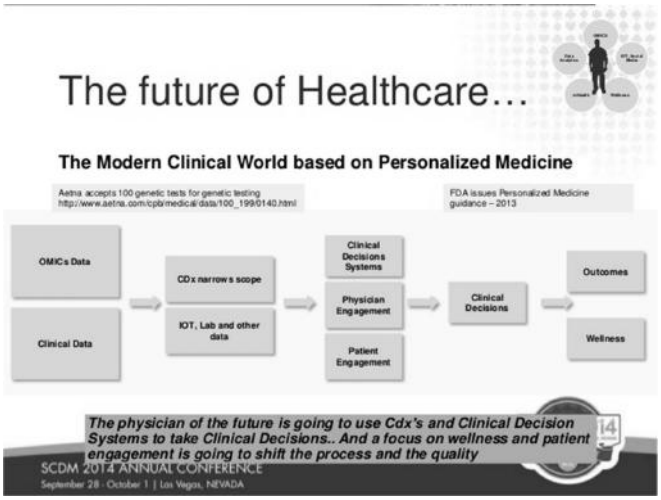
Data alone does not provide optimal insight. Watson spends a tremendous amount of time cleaning, curating, and normalizing data. Watson collates, designs, and infuses risk & severity adjustment methodologies to create actionable and useful information. This makes the data ready to be analyzed and paired with AI services to prioritize and solve healthcare challenges. It has analytical power to help clients create rich population health and value-based care programs. With proprietary models to approach challenges like cost of care and disease staging, it can find answers to complex questions like drivers of risk, predictors of healthcare expenditures, and risk adjusted mortality.

The Watson Platform for Health is specifically built for health, and it enables the users to focus on what's important: health data analysis and discovery. It is built on the power of the IBM Cloud. In the Health cloud, data is protected by privacy regulations in every country where Watson has offices.The IBM Cloud combined with the Watson Data Platform helps to maintain ownership and helps to protect data. Watson Technologies work on Cognitive computing and AI Services.

Watson Platform for Health does so through:

- Open data frameworks and standards for interoperability
- Security and identity management protocols that integrate with systems the customer may be using on-premise today (LDAP directories, SAML-based authentication)
- Support for common consumer identity provider protocols such as Open Authentication (OAuth) or Open ID identity providers
- Application Program Interfaces (APIs) and specific services that are required for health-specific applications — such as patient and provider registry and medical ontology
- Program interfaces and gateways to help data move in a secure manner to and from the cloud data stores
- Integrated open source data analytics tools, such as Jupyter Notebook, R, Python.





VII. CONCLUSION

Medical conditions linked to unhealthy lifestyle cause an economic burden to society. Healthcare must transform from paper based to digital. Current healthcare systems are dominated by paper-based processes, which cannot be measured and analyzed as easily as digital ones. And even if a medical system is digitized today, it is fragmented and cannot be simply accessed across systems, platforms and locations. The American Medical Association estimates that over $300 billion is wasted through failures of care delivery and outmoded treatments that don't benefit patients. The United States National Academy of Sciences estimated in 2005 that "between $.30 and $.40 of every dollar spent on healthcare is spent on the costs of poor quality.

An organisation will have to be created for smooth flow of health information on selective basis between the stakeholder who will need this information for betterment of health services to the community. In some places it is called Health Information Exchange (HIE).

A Health Information Exchange (HIE) assists with the transfer and sharing of health related information that is typically stored in multiple organizations, while maintaining the context and integrity of the information being exchanged. An HIE provides access and retrieval of patient information to authorized users in order to provide safe, efficient, effective, and timely patient care. Formal organizations have been created in a number of states and regions that provide technology, governance, and support for HIE efforts. Those formal organizations are termed Health Information Organizations (HIO) or Regional Health Information Organizations (RHIO).

Disruptive technologies must transform the current healthcare system, but to get there, we need to digitize the delivery of care. The World Health Organization estimates that there is a worldwide shortage of around 4.3 million physicians, nurses, and allied health workers. And care is often unavailable where it is most needed. The Internet of Medical things, wearable devices and connected healthcare ecosystem will make healthcare available to all at low cost.

REFERENCES

[1] The Guide to the Future of Medicine: Technology and The Human Touch – by BertalanMesko (Dr.BertalanMeskó, is The Medical Futurist. A geek physician with a PhD in genomics and Amazon Top 100 author, he envisions the impact of digital health technologies on the future of healthcare, and helps patients, doctors, government regulators and companies make it a reality.

[2] Watson technologies for improved health. Google IBM Watson.

[3] Bernard Marr, contributor / Opinions expressed in Forbes Magazine.

[4] A new Ubiquitous Form Factor for Health Care Source: Wikipedia Source:

[5] Images obtained from the Google Search just for illustration

[6] Implementing AI in wearable Health APPS for better tomorrow. info@qsstechnosoft.com

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