

DEFINITIONS

- Augmented reality
 - o a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view.
- Bioinformatics
 - o Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data. As an interdisciplinary field of science, bioinformatics combines computer science, statistics, mathematics, and engineering to analyse and interpret biological data.
- Clinical decision support system (CDSS)
 - o “Clinical decision support systems link health observations with health knowledge to influence health choices by clinicians for improved health care” - Robert Hayward of the Centre for Health Evidence
- Computed tomography scan (CT scan)
 - o A CT scan makes use of computer-processed combinations of many X-ray images taken from different angles to produce cross-sectional (tomographic) images (virtual "slices") of specific areas of a scanned object, allowing the user to see inside the object without cutting.
- Diagnosis decision support system (DDSS)
 - o A DDSS requests some of the patient's data and in response, proposes a set of appropriate diagnoses. The doctor then takes the output of the DDSS and determines which diagnoses might be relevant and which are not, and if necessary orders further tests to narrow down the diagnosis.
- Electronic health record (EHR)
 - o An electronic health record (EHR) is a digital version of a patient's paper chart. EHRs are real-time, patient-centered records that make information available instantly and securely to authorized users.
- Fuzzy logic
 - o Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based.
- Genomic bioinformatics
 - o In experimental molecular biology, bioinformatics techniques such as image and signal processing allow extraction of useful results from large amounts of raw data. In the field of genetics and genomics, it aids in sequencing and annotating genomes and their observed mutations.
- Inference engine
 - o An inference engine is a tool from artificial intelligence. The first inference engines were components of expert systems. The typical expert system consisted of a knowledge base and an inference engine. The knowledge base stored facts about the world.

- Internet of health things (IoHT)
 - o The Internet of health Things 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 IoHT.
- Knowledge base
 - o a store of information or data that is available to draw on. / the underlying set of facts, assumptions, and rules which a computer system has available to solve a problem.
- Medical imagery
 - o Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues.
- Magnetic resonance imaging (MRI)
 - o Magnetic resonance imaging is a type of scan that uses strong magnetic fields and radio waves to produce detailed images of the inside of the body. An MRI scanner is a large tube that contains powerful magnets. You lie inside the tube during the scan.
- Near field communication (NFC)
 - o Near-field communication (NFC) is a set of communication protocols that enable two electronic devices, one of which is usually a portable device such as a smartphone, to establish communication by bringing them within 4 cm (1.6 in) of each other.
- Pattern recognition
 - o Pattern recognition is a branch of machine learning that focuses on the recognition of patterns and regularities in data, although it is in some cases considered to be nearly synonymous with machine learning.
- Predictive diagnosis
 - o Predictive medicine is a field of medicine that entails predicting the probability of disease and instituting preventive measures in order to either prevent the disease altogether or significantly decrease its impact upon the patient (such as by preventing mortality or limiting morbidity).
- Radio-frequency identification (RFID)
 - o Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves.
- Robotic controlled surgery
 - o Robotic surgery, computer-assisted surgery, and robotically-assisted surgery are terms for technological developments that use robotic systems to aid in surgical procedures. Robotically-assisted surgery was developed to overcome the limitations of pre-existing minimally-invasive surgical procedures and to enhance the capabilities of surgeons performing open surgery.
- Sonogram
 - o a graph representing a sound, showing the distribution of energy at different frequencies. / a visual image produced from an ultrasound examination.

- Telemedicine
 - o the remote diagnosis and treatment of patients by means of telecommunications technology.
- Telesurgery
 - o Remote surgery (also known as telesurgery) is the ability for a doctor to perform surgery on a patient even though they are not physically in the same location. It is a form of telepresence.
- Transducer
 - o a device that converts variations in a physical quantity, such as pressure or brightness, into an electrical signal, or vice versa.
- Ultrasound
 - o An ultrasound scan, also referred to as a sonogram, diagnostic sonography, and ultrasonography, is a device that uses high-frequency sound waves to create images of the inside of the body. Because sound waves are used instead of radiation, ultrasound scans are safe.

RELEVANT SHIT TO THROW IN THERE

Research on challenges

- The feasibility and consequences of developing a coherent EHR system;
- The effect of technological developments on health carers;
- Development and implication of bioinformatics for predictive diagnosis;
- Combining electronic and human resources to get health services to those in remote or underdeveloped areas.

Challenge	Fact	Source
1	HealthConnect has completed 2 years of pilot testing. It is estimated that the system will save AUD \$300 million per year by reducing errors and duplication of effort.	Journal of Medical Internet Research
1	MD Anderson Cancer Centre cut 900 jobs due to losses from HER implementation	Modernhealthcare.com (6th January 2017)
1	2 major health systems reported their HER implementation projects were projected to exceed the \$1 billion mark.	Beckershospitalreview.com (23rd May 2016)
1	EHR attributes to a \$160.5million decrease in their budget	Beckershospitalreview.com (23rd May 2016)
1	EMR system takes considerable time to implement	Corepoint Health
1	Practices able to cover cost of the EHR in approximately 2.5 years – receive an average of \$23,000 per year per full-time employee in net benefits due to the EHR	Divan Dave at Physicians Practice
1	\$162,000 implementation cost of EHR system with a maintenance cost of \$85,500 per year 30 clinics in North Texas	Medical Economics
1	On average 134 hours for physicians to become familiar with systems, in North Texas	Medical Economics
1	Estimated savings of \$ 4.64 billion in prevention of adverse drug event related hospitalizations and outpatient visits	Health Affairs
1	EHR allows you to make better well-informed health decisions quickly and safely. It also improves care coordination.	Healthit.gov
1	The Denmark HER system contains data on 85% of the population.	Denmark Government
1	EHR adoption in the US has been relatively limited. One study found 17% rate adoption of basic or complete EHRs by ambulatory physicians across the country in 2008.	Ncbi.nlm.nih.gov

1	Medical errors cost \$19.5 billion a year, and maybe as much as a staggering \$1 trillion a year when accounting for lost productivity. Therefore, EHR systems are recommended.	https://www.boxer.senate.gov/press/release/boxer-releases-new-report-on-medical-errors/
1	Medical errors are the third leading cause of death in the United States, after heart disease and cancer.	https://www.boxer.senate.gov/press/release/boxer-releases-new-report-on-medical-errors/
1	In 2015, spending on electronic systems by providers could grow 88%, to an estimated \$37 billion.	http://www.practicefusion.com/brown-wilson-black-book-rankings/
1	67% of providers reported not liking the functionality of their EHR systems.	http://medicaleconomics.modernmedicine.com/medical-economics/news/physician-outcry-ehr-functionality-cost-will-shake-health-information-technol?page=0,0
1	More than 40% of hospital executives are either indifferent or dissatisfied with their current EHR system.	http://www.fierceemr.com/story/survey-more-40-hospital-execs-unhappy-their-ehrs/2014-06-02
1	The use of HER was time efficient – it reduced the time per patient by up to 45.5%.	US National Library of Medicine
1	REC (regional extension centers) serve 157,000 users and 93 of them use HER. 116,000 of them help clinics convert to using HER efficiently	healthit.gov
1	Consequences of developing a feasible EHR system include increased demand for system changes (up to 35% increase), increased dependence on technology and unfavourable workflow changes	Healthit.gov
1	No EMR System on the market now that offers the capabilities needed for physicians to become meaningful users.	Chris Silva of American News
1	Some challenges that would impede the implementation of EHR in a Ghanaian hospital are the initial huge start-up costs, poor computer skills of healthcare professionals, poor maintenance culture, and people embedding political meaning(s) into the system	Implementing EHR in a developing country Tanko Abdulai
2	Helps to observe the elderly for home care.	Researchgate.net
2	Helps to alleviate pressure from hospitals and health carers, because technology can take care of some of the workload.	Ubiquitypress.com
2	168% increase in care workers and home carers between 1992 and 2014	Katie Allen, The Guardian 2015

2	Text message reminders have reduced missed appointments by 30-50%, saving the NHS £240 – 370 million a year (2006)	Kings Fund
2	The use of tele access clinicians has reduced local hospital admissions by 45% in Airedale, West Yorkshire (a care home)	Gov.uk
2	Currently, 96% of GP practices use HER systems in the UK. However, only 4% of patients have accessed these records.	Gov.uk
2	There is little or no electronic exchange of information about the 150,000 patients cared for in nursing homes and hospices.	Gov.uk
2	pharmacogenomics could have an impact on the care of more than 15% of patients by 2018	www.nphs.wales.nhk.uk:8080
2	The use of advanced imaging technology has more than tripled over the last decade, from just 5% to 17%.	http://www.cdc.gov/nchs/data/hus/hus12.pdf
2	Fully 94% of physicians use mobile reference apps like Epocrates while working.	http://www.emrthoughts.com/files/2011/07/DoctorsToolboxLrg.jpg
2	68% of consumers would wear employer-provided wearables streaming anonymous data to an information pool in exchange for lower health insurance costs.	http://www.pwc.com/us/en/press-releases/2014/wearable-technology-future.jhtml
2	The annual smart wearable healthcare market volume will grow from \$2 billion in 2014 to \$41 billion in 2020, a compound annual growth rate of 65%.	http://www.soreonresearch.com/wp-content/uploads/2014/09/Extract-Soreon-Research-Report-The-Wearable-Health-Revolution.pdf
2	68% of consumers would wear employer-provided wearables streaming anonymous data to an information pool in exchange for lower health insurance costs.	http://www.pwc.com/us/en/press-releases/2014/wearable-technology-future.jhtml
2	The annual smart wearable healthcare market volume will grow from \$2 billion in 2014 to \$41 billion in 2020, a compound annual growth rate of 65%.	http://www.soreonresearch.com/wp-content/uploads/2014/09/Extract-Soreon-Research-Report-The-Wearable-Health-Revolution.pdf
2	Ninety percent of healthcare leaders reported their organizations have begun developing or implementing a telemedicine	Becker's Health IT and CIO Review

2	Retraining (\$166,000 per doctor) Robotic assistance robots by anybots.inc improve the efficiency of healthcare as robots are always available. With proper safe guards, they can make more accurate decisions about the patient on the go.	CBS
2	As technology can enable better communication between patients, their carers and their families, it could be argued that technology should play an increasingly important role in patients' relationships with their carers and families in the future	King's Fund
2	Some practitioners fear that technology can interfere with the doctor-patient relationship	The Royal Society
2	NHS data loss: paper documents of patient information lost when transferred from warehouse to GP.	The Guardian
3	While there was good agreement that identities of greater than 35% over 80 or more amino acids (found via bioinformatics predictive diagnosis) is quite conservative, the conclusion was that additional data or studies would be needed to justify changing this criterion as there is some evidence that some individuals sensitized to proteins in evolutionarily conserved protein families may experience cross-reactions to proteins sharing approximately 40% identity.	https://www.ncbi.nlm.nih.gov/pubmed/16810734
3	Current bioinformatics tools recently applied to microarray data have shown utility in predicting both cancer diagnosis and outcome.	AACR Publications Cancer Research
3	99% success rate in detecting ovarian cancer using bioinformatics	S and G's Oxfordjournal paper in 2010
3	Identify relationship between biological mechanisms in over 500 known diseases.	Biomedcentral.com
3	Every baby born in Australia is offered screening for about 30 genetic conditions in the Guthrie test, and more than 300 tests for genetic disorders are available through the health care system.	https://www.mja.com.au/journal/2014/201/1/impact-genomics-future-medicine-and-health
3	Inevitably, personal genome sequences, likely obtained at birth, will become an integral part of a patient's electronic health record (EHR), where this information will be integrated with other clinical and environmental data and interrogated throughout the individual's lifetime. Clinicians and patients may then query the sequence to accurately prescribe treatments, determine disease susceptibilities and identify drug sensitivities, and to determine a course of action to monitor, manage, ameliorate risk of or prevent the disease.	https://www.mja.com.au/journal/2014/201/1/impact-genomics-future-medicine-and-health

3	Express Scripts, a large pharmacy benefits company, uses analytics to identify those not adhering to prescribed treatments, resulting in a savings of \$1,500 to \$9,000 per patient.	https://www.sas.com/en_us/insights/analytics/predictive-analytics.html
3	Bioinformatics helps to eliminate false positives, saving time and money pursuing false leads.	Nature.com
3	Biomedical research aims to further the understanding of disease, and to find new diagnostic and treatment strategies including drug discovery. With the completion of the Human Genome Project, it is now easier to identify genes that control diseases.	Gate2Biotech
3	Emerging technologies enable researchers to identify and analyze genes and proteins with phenomenal speed-thereby pinpointing the exact nature of different diseases and predicting individuals' responses to drugs.	Gate2Biotech
3	Even using conventional DNA and protein analysis technologies, researchers have already taken some first steps toward personalized medicine. Over the past decade, advances in technology have notably increased achievements in new and precise medical measurements and treatment, and in the understanding of biological processes. Modern biotechnology, with its focus on molecular biology and its concern for increasing human health and life spans, is all about the future.	Gate2Biotech
3	Can be used to identify thyroid nodules, which can be used to find their DNA sequences quickly	Application of a bioinformatics method on detecting the biomarkers to predict thyroid nodules diagnosis – Cheng Zhi-long
3	About 90% accuracy in predictive diagnosis when using bioinformatics and genetic marking.	Academic.oup.com
3	'Gene sequencing' technologies may be able to help people who have symptoms with no clear cause with a diagnosis. What normally takes weeks with gene analysis takes hours-days with the EDGE (Empowering the Development of Genomics Expertise) system.	http://www.nature.com/news/how-bioinformatics-tools-are-bringing-genetic-analysis-to-the-masses-1.21545
4	They can support a health worker performing clinician duties where there are no doctors and can help keep track of patients in HIV programs where the loss rate (patients who drop out of treatment) can be as high as 76 percent	http://content.healthaffairs.org/content/29/2/244.full

4	In South Africa, infant mortality rates in rural areas are 1.6 times that of urban areas. Rural children are 77% more likely to be underweight or under height for age; 56% of rural South Africans live >5 km from a health facility; and 75% of South Africa's poor people live in rural areas.	Oxford University Press
4	50% of countries reported scientific institution are currently involved in the development of telemedicine solutions.	World Health Organisation (WHO).
4	Telehealth includes: Video conferencing, storing and accessing patient data, remote patient monitoring, mobile health applications This allows small rural hospitals to keep quality health care costs low. This can be seen Project ECHO in rural New Mexico has allowed better chronic disease management.	Ruralhealthinfo.org
4	As of August 2014, 60% of Primary Medical Health Professional Shortage Areas were located in non-metropolitan areas	https://www.ruralhealthinfo.org/topics/healthcare-access
4	Nearly 5 million patients were remotely monitored across the globe in 2015, a 51 percent increase from the previous year. Berg Insight estimates the number of remotely monitored patients will grow at a compound annual growth rate of 48.9 percent through 2020, reaching an estimated 36.1 million patients.	http://www.beckershospitalreview.com/healthcare-information-technology/4-key-statistics-on-remote-patient-monitoring-growth.html
4	Via the United Kingdom's Department of Health, correctly using telehealth, or remote monitoring technology, can reduce the risk of patient mortality by up to 45%, as well as reduce emergency admissions by 20%.	https://www.gov.uk/government/publications/whole-system-demonstrator-programme-headline-findings-december-2011
4	Studies show that 3 million patients worldwide are connected to some form of remote patient monitoring. That number is estimated to top 19 million in 2018.	http://medcitynews.com/2014/06/biggest-market-remote-patient-monitoring/
4	According to EHR Intelligence, Partners HealthCare used telehealth to aid a group of 1,256 cardiac patients. Following the program, they saw a 51% reduction in hospital readmissions related to heart failure, and a total savings of \$10.3 million.	http://ehrintelligence.com/2013/02/06/study-telehealth-raises-satisfaction-reduces-hospital-stays/
4	According to FierceHealthIT, over 70% of survey respondents are receptive to using remote health monitoring devices such as toilet sensors, prescription bottle sensors or swallowed monitors to collect personal health data.	http://www.fiercehealthit.com/story/patients-want-technology-provide-personalized-care/2013-12-09

4	LeadingAge revealed results from a study focusing on telehealth's impact, which concluded that RPM has the potential to prevent between 460,000 and 627,000 heart failure-related hospital readmissions each year.	http://www.leadingage.org/uploadedfiles/content/about/cast/resources/2013_cast_telehealth_and_rpm_for_long-term_and_post-acute_care_whitepaper.pdf
4	91% of sub-saharan African countries reported some use of Open Source healthcare software.	US National Library of Medicine
4	Barriers to adoption of EHRs in Sub-Saharan Africa include high cost of procurement and maintenance, poor network infrastructure and lack of comfort among health workers with electronic medical records.	US National Library of Medicine
4	Open Medical Records System (OpenMRS) was the most used open source health software and was used in 60% of centres involved in HIV and 27% of non-HIV related programs in Sub-Saharan Africa.	US National Library of Medicine
4	Internet access in Africa has grown by 2,357% from 2000 to 2010, but primarily in urban areas, so this inequitable distribution has affected the realization of the full benefits of EHRs in Sub-Saharan Africa.	US National Library of Medicine
4	Approximately one half of the global population lives in rural areas, but these areas are served by only 38% of the total nursing work- force and by less than a quarter of the total physician workforce	WHO
4	Half the world's population live in rural areas but only 24% of Physicians live in rural areas	World Health Organisation
4	[Difficulties of implemented e-health systems:] properties of the technology including technical immaturity, lack of interoperability, and the extent to which potential adopters believed the benefits outweighed the risks; ii) staff concerns about workload and the ethics of sharing confidential information using an implied consent model;	Report developed by The Evidence Centre for Skills for Health
4	Sometimes even well-rehearsed procedures to combat emergencies and epidemics are called in too late simple for lack of a well-functioning communication system.	GHANA E-HEALTH STRATEGY
4	Telemedicine in USA healthcare system could save \$4.28bn from reducing transfers of patients	Uniteforsite.org

4	24 hospitals in four rural states in the Midwest including Kansas, Oklahoma, Arkansas, and Texas found that telemedicine brought an annual economic impact of at least \$20,000 per year, with an impact of up to \$1,300,000	Becker's Hospital Review
1 & 4	EHR records in developing countries, used to track HIV/AIDS and tuberculosis Mosoriot Medical Record System implemented in rural Kenya in November 2001. 60,000 patients, 150,000 visits in 4 years, 8,000 HIV patients tracked. System supports 8 remote clinics. Used to record the health history and treatment of each patient, useful to detect risk of mother to baby diseases. Data also used for research, contributing to the scientific community. Patient wait times reduced by 38%. Provides people living remotely with efficient and quick access to healthcare.	British Computing Society Paper – 'Implementing electronic medical record systems in developing countries'
1 & 4	Almost 70% of countries indicated the need for more information on the cost and cost-effectiveness of telemedicine solutions	WHO Telemedicine Opportunities and developments
2 & 3	'eMoods Bipolar Mood Tracker' is a smartphone app that tracks a patient's mood, sleep, anxiety levels and generates reports to a care giver	mHealth for Mental Health: Integrating Smartphone Technology in Behavioural Healthcare'