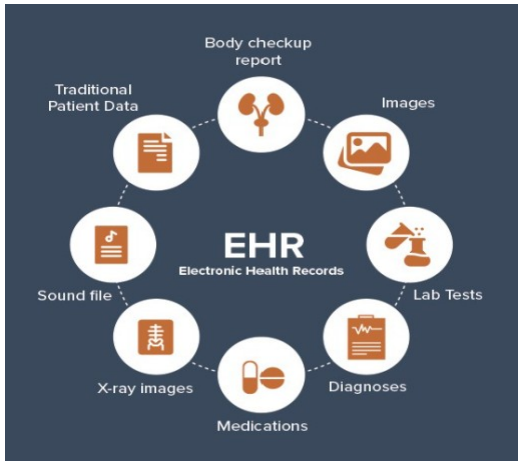
AI in Health

Introduction

Goal of AI in Health: to Deliver High Quality Care

- Quality Care is the evidence-based care that is based on sound scientific study identifying the best treatment possible.

- Quality care is safe, effective, efficient, equitable, patient-centered, and timely



PubMed

ClinicalTrials.gov

Excellence of US Healthcare

- The leading healthcare research in the world, assembling the world ultra best and most dedicated medical researchers, labs, and universities
- Owning the world finest and well equipped hospitals and facilities
- Creating most of medical miracles

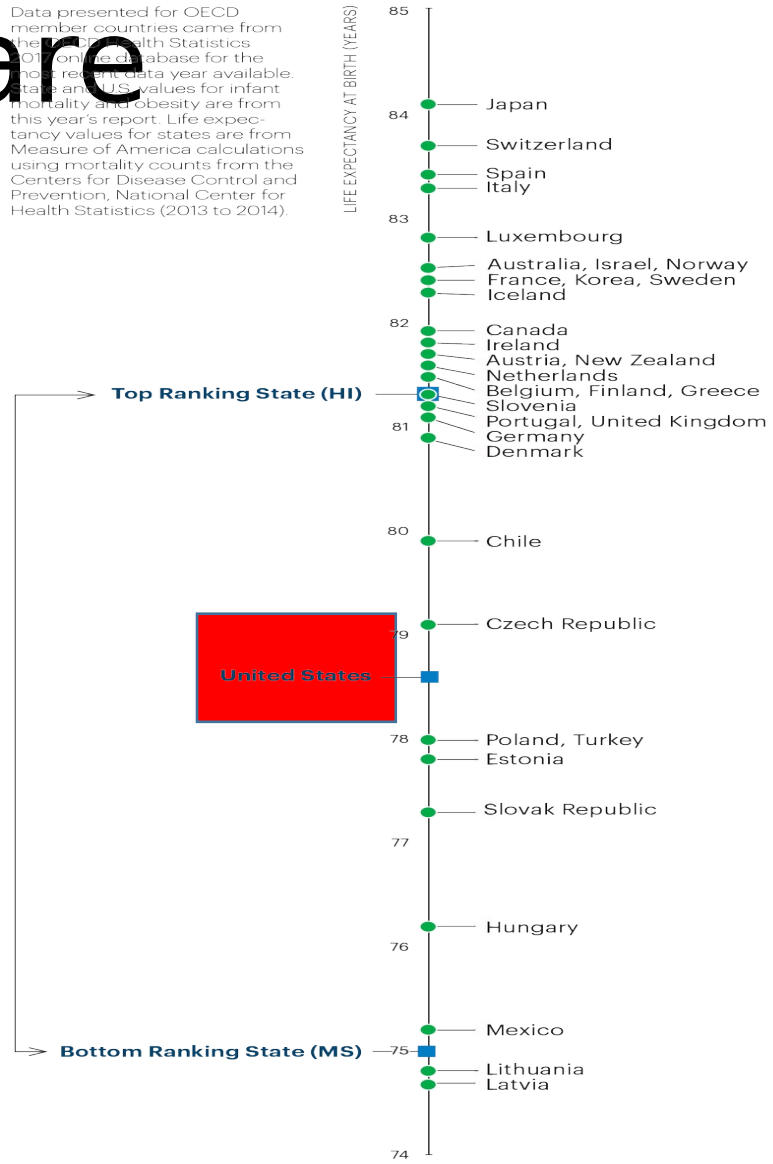
THE UNIVERSITY OF TEXAS
MD Anderson
Cancer Center
Making Cancer History®

The reality of US Healthcare

- The collapse of our healthcare system has been persistent and pervasive
- Our healthcare spending ranks No. 1 in the world (16% of GDP), but the output of such spending is shocking [healthranking, 2017]:
  - For infant mortality rates, we are mediocre, worse than Slovenia, better than Chili.
  - For life expectancy: USA is ranked No.28 out 36 OECD countries

Figure 64
Life expectancy at birth in OECD countries and top and bottom ranking states in the U.S.

Data presented for OECD member countries came from the OECD Health Statistics 2017 online database for the most recent data year available. State and U.S. values for infant mortality and obesity are from this year's report. Life expectancy values for states are from Measure of America calculations using mortality counts from the Centers for Disease Control and Prevention, National Center for Health Statistics (2013 to 2014).



Medical Errors

- More than 250,000 **people** in the United States **die** every year because of **medical mistakes**, making it the third leading cause of **death** after heart disease and cancer , 9.5% of total yearly hospitalizations – Feb 2018 [CNBC, 2018]
  - The number can go higher to 440,000 as human errors are often not reported in the death certificates
  - These mistakes are inherited in the fragmented and poorly designed healthcare system which leads to misuse, overuse, and underuse of healthcare.

- 80% of medical care solutions have not been scientifically tested
- It takes 17 years for one medical scientific discovery being delivered to patients [Chasm 2001]

Case

- Emily Jerry
  - Two years old died of human errors of pharmacy technicians who routinely compound patient’s IV medications. Emily was killed by an overdose of sodium chloride in her chemotherapy IV bag. – Emily Jerry Foundation

https://emilyjerryfoundation.org/

Betsy Lehman

- In 1994, Betsy Lehman, a reporter of Boston Globe and mother of two young girls, was battling advanced stage of breast cancer. She was killed by the four times the intended dose of a powerful chemotherapy drug at Dana-Farber Hospital (the world premier cancer center). – Betsy Lehman Center

https://betsylehmancenterma.gov/

Jeanne Ellis

- Radiologist mistreated her in 2016 who failed to identify obvious tumor in her X ray, lead to her death of two years later with the cancer advanced in her lung, kidney, and bone. Dr. Peter Clarke of Brigham and Women's Hospital, who is the radiologist, does not have her EMR and medical history, and family member died of lung cancer before. [Boston 2014]
- https://www.bostonglobe.com/metro/2014/06/29/overlooked-lung-cancer-results-million-verdict-against-radiologist/rbFZ4e94nIeH57r46ixVSL/story.html
- A jury has awarded $16.7 million to the daughter of Jeanne Ellis

Types of Errors

Diagnostic

- Error or delay in diagnosis
- Failure to employ indicated tests
- Use of outmoded tests or therapy
- Failure to act on results of monitoring or testing

Treatment

- Error in the performance of an operation, procedure, or test
- Error in administering the treatment
- Error in the dose or method of using a drug
- Avoidable delay in treatment or in responding to an abnormal test
- Inappropriate (not indicated) care

Preventive

- Failure to provide prophylactic treatment
- Inadequate monitoring or follow-up of treatment

Other

- Failure of communication
- Equipment failure
- Other system failure

SOURCE: Leape, Lucian; Lawthers, Ann G.; Brennan, Troyen A., et al. Preventing Medical Injury. *Qual Rev Bull.* 19(5):144–149, 1993.

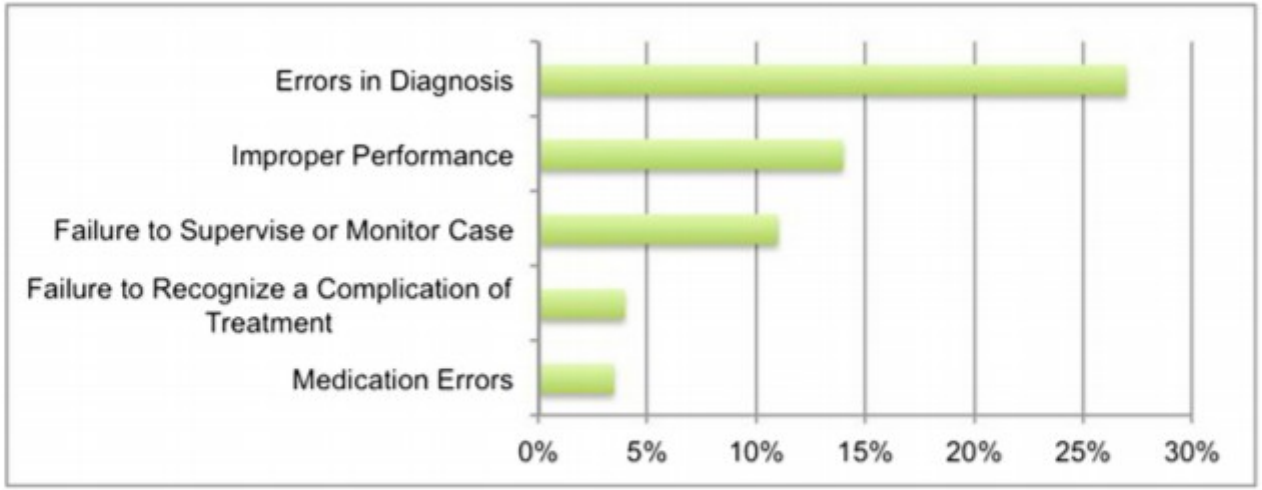


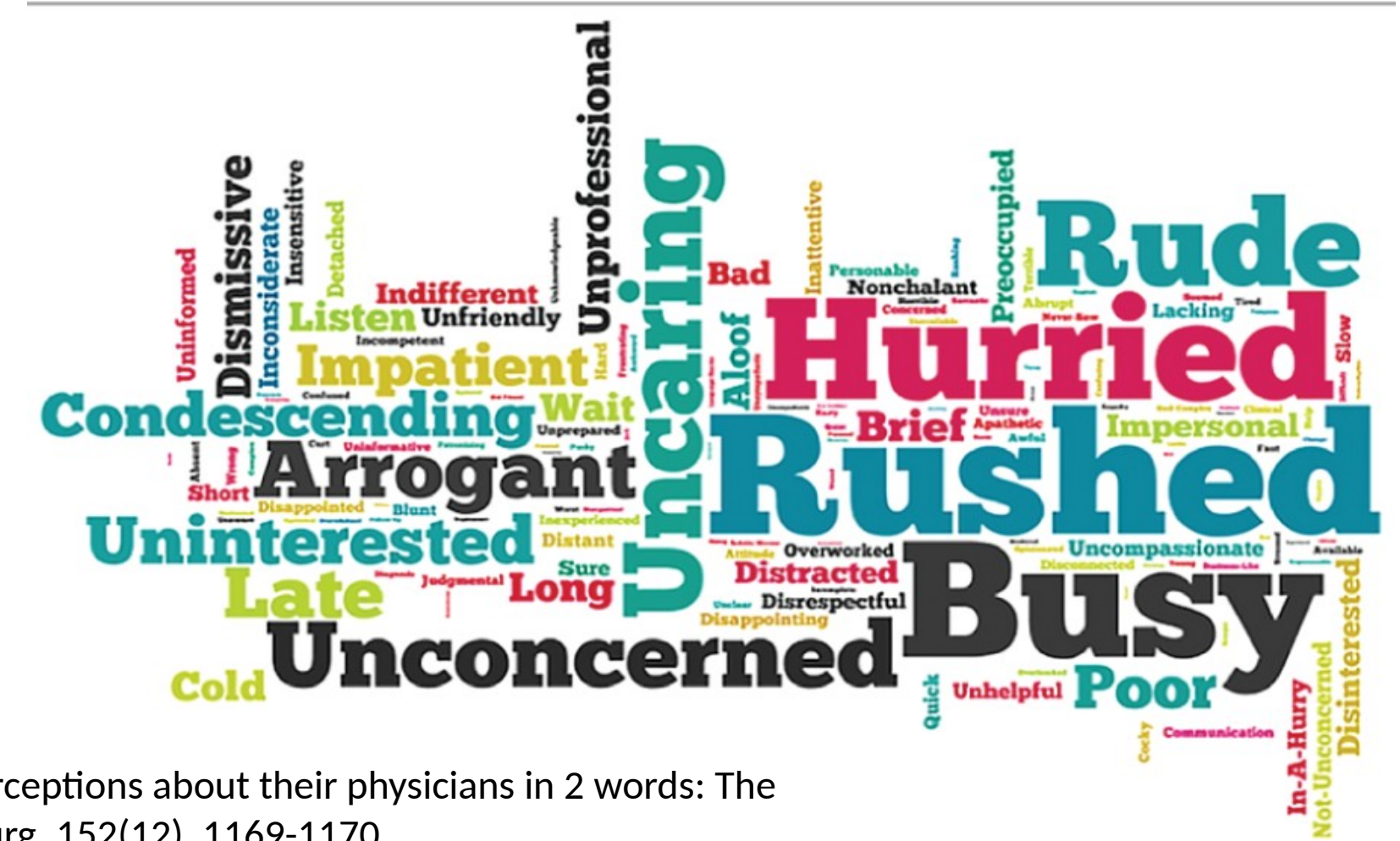
Figure 1 Top alleged medical error named in claims where the patient expired (Physician Insurers Association of America (PIAA) Data Sharing Project Data 1985–2009, Physician Insurer, Vol 55, 2010).

https://qualitysafety.bmj.com/content/qhc/22/Suppl_2/ii21.full.pdf

2 words about doctors from patients

Length of clinical visit:

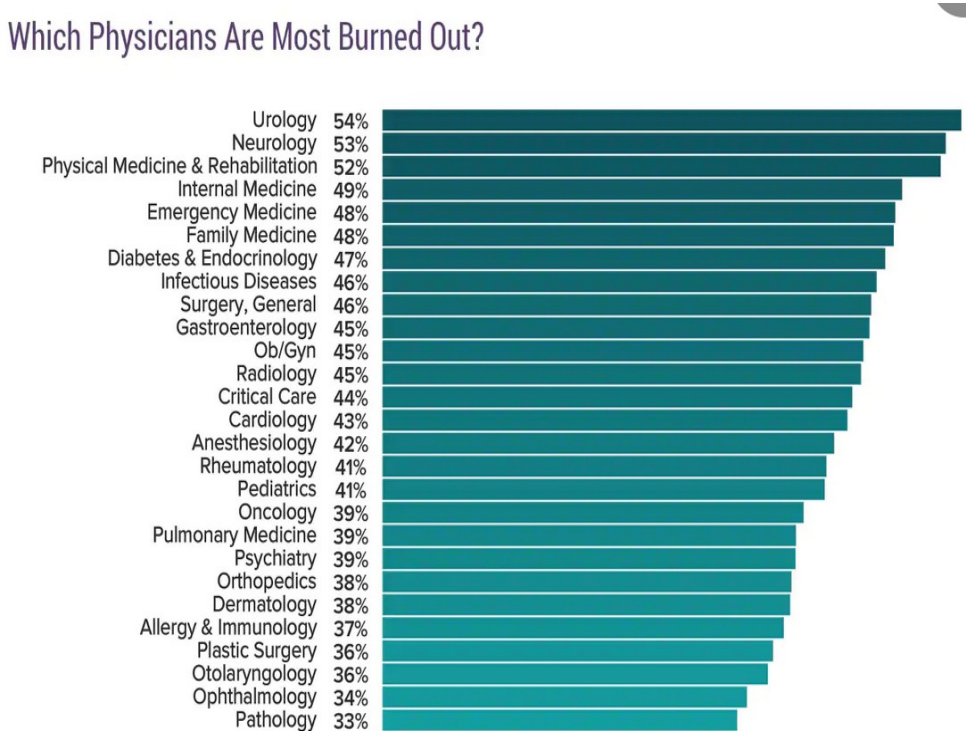
- US: 7mins (12mins for a new patient)
- Korea: 2mins

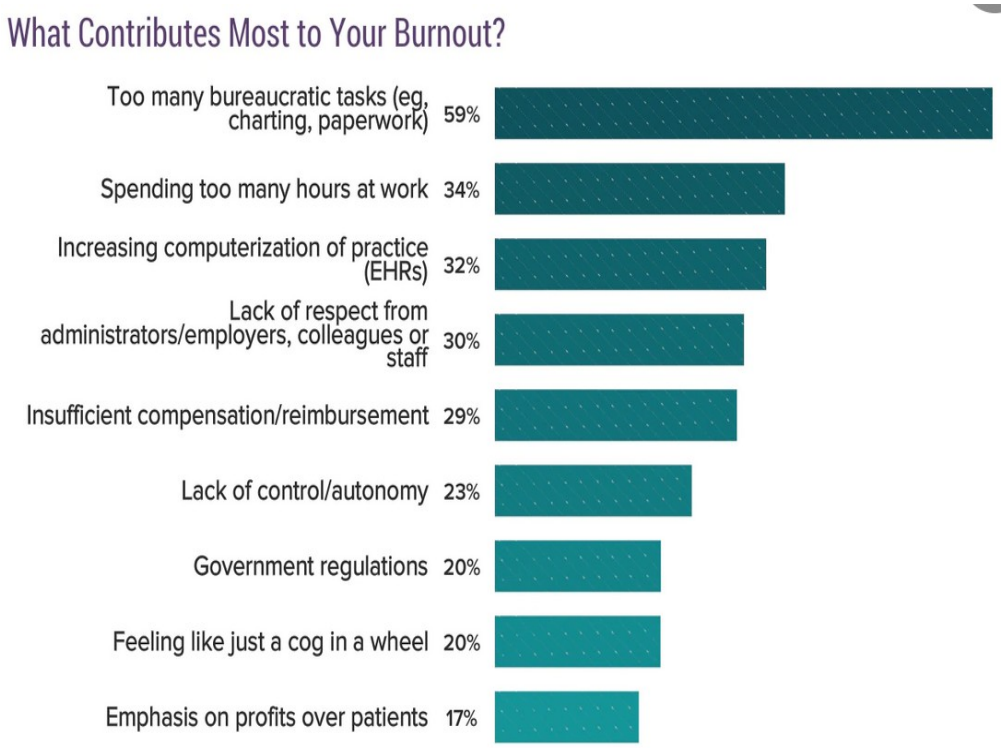


B. Singletary et al. (2017). Patient perceptions about their physicians in 2 words: The good, the bad, and the ugly. JAMA Surg, 152(12), 1169-1170.

Physicians: burnout and depression

- 50% of doctors practicing in the US have symptoms of burnout, and there are hundreds of suicides per year.
- https://www.medscape.com/slideshow/2019-lifestyle-burnout-depression-6011056#6





What went wrong

- The delivery of healthcare:
  - a large gap/chasm in the quality and outcomes that health services being delivered. Unwarranted variation in medical treatment, cost, and outcomes suggests a substantial area for improvement and savings in our health care system.
  - Statistical findings show that "patients in the highest-spending regions of the country receive 60 percent more health services than those in the lowest-spending regions, yet this additional care is not associated with improved outcomes.

Studies show that individuals with diabetes should have blood lipids monitored regularly, yet patients in Chicago are 50% less likely to receive these tests than patients in Fort Lauderdale. A patient with heart disease in Bloomington, Indiana, is three times more likely to have bypass surgery than a similar patient in Albuquerque. In Miami, where medical services are abundant, Medicare pays more than twice as much per person per year as it does in Minneapolis, with no discernible difference in overall health or life expectancy

What patients will do

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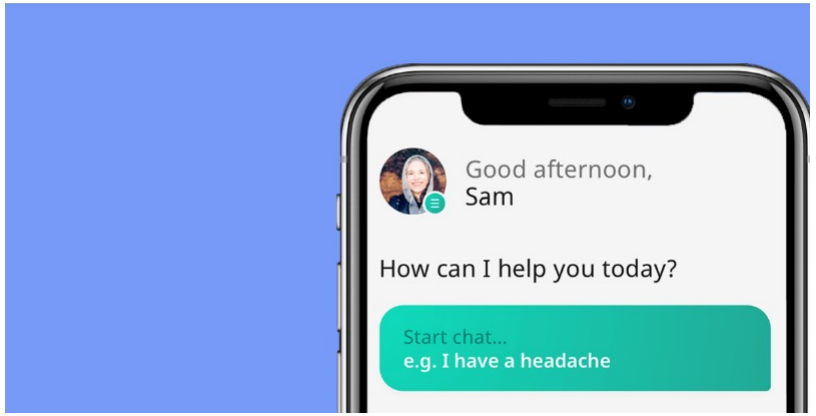
Your.MD



Step 1: Tell us about y

Symptom details

How old are you?

babylon

Chat with Buoy

Buoy listens to you, asking questions to better understand your concern.

Get answers

Buoy helps you make sense of your health concern and identify what's wrong.

Form a plan

Buoy lets you know what to do next, guiding you to the right care.

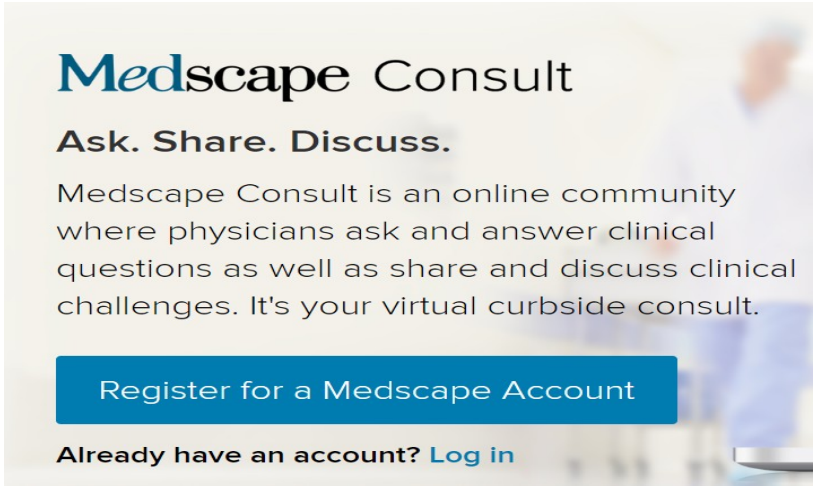
https://nhcps.com/online-symptom-checkers-evolution-of-self-diagnosis-is-upon-us/

Second opinions for doctors

- Doctors can crowdsource data with their peers to find help with diagnostic work.

THE HUMAN DIAGNOSIS PROJECT

One open system. For all of humankind. Together.



CrowdMed

Post the Case

Patients share their case with the CrowdMed community by answering our online questionnaire that covers their medical history, current symptoms, and personal story.

CrowdMed Community Gets To Work

Medical Detectives lend their unique sets of expertise to work together and provide patients with information to solve their case.

The Post Case Report

Based on the information provided by the community, patients receive a report with the top diagnostic and solution suggestions to take to their physician for testing.

Aim of U.S. Healthcare

- Current U.S. healthcare needs the system wide changes -- RAND
- Aim:
  - Providing safe, timely, effective, and affordable patient-centered care for everyone.
  - Making medical miracles accessible to all
  - Every doctor’s office is a center of clinical excellence
  - All patients should receive **evidence-based care**.
  - Americans should be able to count on receiving care that meets their needs and is based on the best scientific knowledge.

To achieve quality care

Evidence-Based Care (EBC)

- Evidence-Base Care
    - Doctors should make diagnosis based on the medical history of the patient, treatments of similar patients, and related and latest scientific discoveries/literature
    - Patients should be able to access and understand the summarized report of their EMRs, and be informed with the latest scientific literature presented in a way that is easy to understand.

EBC enables a system that synthesizes TECHNOLOGY, SCIENCE, and PEOPLE to realize our highest aspirations for healthcare

Evidence-Based Care (EBC)

- “No doctor – no matter how brilliant, dedicated and skilled – could possibly keep abreast of all the latest medical advances … to ask an individual practitioner to rely on his or her memory to store and retrieve all the facts relevant to patient care is like asking a travel agent to memorize airline schedules.” – [Chasm Report]

- The three pillars of EBC are: Patient Values, Clinical Expertise and Relevant Research

AI in Medicine System Requirement: wish list

- is a **representation** over time of health and health issues, treatment, preventive management, and health outcomes gathered from appropriate sources, including the patient, clinician, and laboratory and other tests;
- **supports clinical workflow and real-time decision making**, and facilitates management of acute and chronic conditions, disease prevention and wellness; the review of overall health status; and the provision of patient education;
- **enables on-the-fly, actionable views of information** that can be easily interpreted by clinicians as well as the patient and caregiver;
- facilitates **use of data to support** registries, research, quality improvement, education, risk assessment, team function, value-based care, billing, compliance, and population health;
- allows for **visualization** of meaningful and actionable cost and coverage rules to reduce administrative burden and **facilitate shared decision making**, thus enabling efficient and effective health care delivery;
- has a data structure that allows for the capture of the **lifelong patient record**, including integration of information from all members of the clinical care team, the patient, and caregivers;
- **connects to all relevant health applications and devices**, delivered through audio, video, data, imaging, and other approaches;
- includes relevant genetic, behavioral, social, and environmental **determinants of health**; and
- is interoperable and secure, and has the ability to support **seamless information flows** when desired and/or appropriate, regardless of its storage location.[NAM, 2018]

Now what!

- Future is already here, it is not just evenly distributed – William Gibson
- For us: Future is already here, it is not just evenly delivered.

- AI powered automated integration is the key
  - Integrating patient encounters, lab results, vitals, and more
  - Integrating and summarizing cohorts with similar treatments, outcomes
  - Integrating and summarizing scientific outcomes to educate patients
  - Recommending related scientific achievements to doctors

References

- [CNBC 2018]: https://www.cnbc.com/2018/02/22/medical-errors-third-leading-cause-of-death-in-america.html
- [NAM 2018]: Horvath, K., P. Sengstack, F. Opelka, A. B. Kitts, P. Basch, D. Hoyt, A. Ommaya, P. Cipriano, K. Kawamoto, H. L. Paz, J. M. Overhage. 2018. A vision for a person-centered health information system. *NAM Perspectives*. Discussion Paper, National Academy of Medicine, Washington, DC. https://doi.org/10.31478/201810a. https://nam.edu/a-vision-for-a-person-centered-health-information-system/
- [Healthranking 2018]: https://www.americashealthrankings.org/learn/reports/2018-annual-report/findings-international-comparison
- [Chasm 2001]: http://www.nationalacademies.org/hmd/~/media/Files/Report%20Files/2001/Crossing-the-Quality-Chasm/Quality%20Chasm%202001%20%20report%20brief.pdf