Digital Health

Spring 2025

UNIVERSIDAD POLITÉCNICA DE MADRID

#4 eHealth

Hospitals, Clinics, and Physician Offices

Electronic medical records, electronic health records, personal health records, enterprise computing

Agenda

- Questions from last week?
- Learning objectives: Discipline literacy; critical analysis skills; and applied and integrative learning
- Icebreaker: When I was a kid, I wanted to be X when I grew up?
- Guest lecture
- Lecture
- Pitchfest and Vote HIMSS ideas, videos
- Review and discuss reading: GPT-4 in a Cancer Center, NEJM AI 2024; 1(4)
- Next session – Readings, guest speaker

eHealth

a broad term refers to the use of information, processes and technologies in health care

Electronic Medical and Health Records

- 3 Terms – often used interchangeably
- Electronic Medical Record – digital version of a paper patient chart
- Electronic Health Record – same info, all doctors can access it
- Personal Health Record – same as an *EHR* but can be managed by the patient
- https://www.healthit.gov/faq/what-are-differences-between-electronic-medical-records-electronic-health-records-and-personal

Electronic Medical Records (EMRs)

- ***Digital versions of patient paper charts*** in offices, clinics, and hospitals.

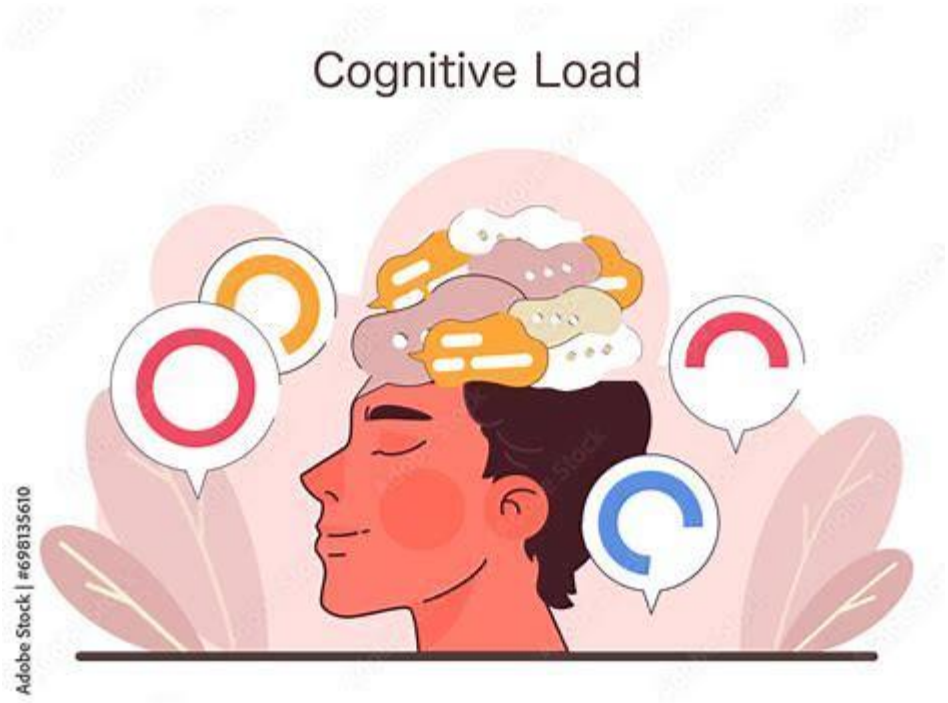
- EMRs contain information and notes collected by and for clinicians (doctors, nurses) and are used for diagnosis and treatment.

Elements/Features (data points) of an EHR

- Patient's medical history
- Diagnoses
- Medications
- Treatment plans
- Immunization dates
- Allergies
- Radiology images
- Laboratory test results

Cognitive burden - **Mental activity imposed on working memory**

- In the ICU in 1975, a physician tracked 7 patient data points
- Today, a physician evaluates 1300 data points contributing to ICU care



Electronic Medical Records

- **Benefits**
  - Legible
  - No universal solution
  - Share data
  - Monitor patients
  - Track trends
  - Offer preventive reminders
  - Data analysis
  - BIG DATA

Drawbacks

- Costly
- Time consuming
- Training intensive
- Clerical tasks shifted to MDs
- Less patient satisfaction

Electronic Health Record (EHRs)

- Built to go beyond standard clinical data collected in a provider's office and are inclusive of a broader view of a patient's care.
- EHRs contain information from ***all clinicians involved in a patient's care*** (eg, therapists, optometrists) and all authorized can access the information.
- EHRs also share information with other health care providers, such as laboratories and specialists.
- EHRs follow patients – to the specialist, the hospital, the nursing home, or even across the country.
- The term EMRs is often used similarly to the term EHRs.

Characteristics of an EHR

- Real-time records
- Automates and streamlines workflow
- Make information available instantly and securely to authorized users
- Add on evidence-based tools such as **drug interaction checking** or antibiotic resistance to make decisions about a patient's care

Many vendors….

- Companies selling electronic medical record systems: Epic, Cerner/Oracle, Siemens Healthineers, Allscripts, Meditech

➢ Let's watch a demo and use of EPIC, a widely used electronic medical record.

➢ Watch this video: https://www.youtube.com/watch?v=oCgpI8TUeps

➢ https://www.youtube.com/watch?v=3tyUZ-N3zBE (4min)

Epic is used by 40% of hospitals in the United States.

Also used in Canada, Norway, UK, Sweden, Netherlands, Singapore, Denmark, Australia.

EHR Companies

Cerner/Oracle *EHR* is used by 22% of hospitals in the United States.

- Cerner has an office in Madrid with UPM graduates working there.
- Cerner Health Facts dataset has 1.3 billion labs and 84 million patient visits over 9 years

Meditech *EHR* is commonly used in Canada, UK, and Ireland.

Intersystems is common in Europe and Middle East.

- Offices in Madrid and Barcelona

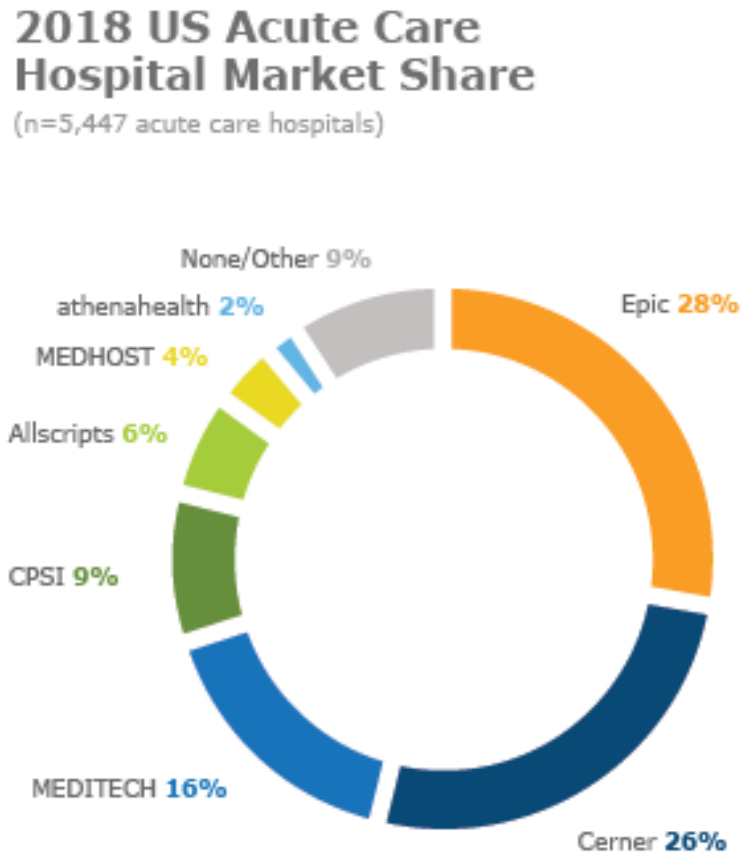
Siemens software (Healthineers) is used in Switzerland (requires EHRs) and 75 other countries, 200 offices worldwide

Check out their recruiting page for graduates https://new.siemens.com/us/en/company/jobs/search-careers.html

- https://www.siemens-healthineers.com/news/mso-digitalizing-switzerlands-healthcare.html
- https://klasresearch.com/report/best-in-klas-2021-software-services/1820

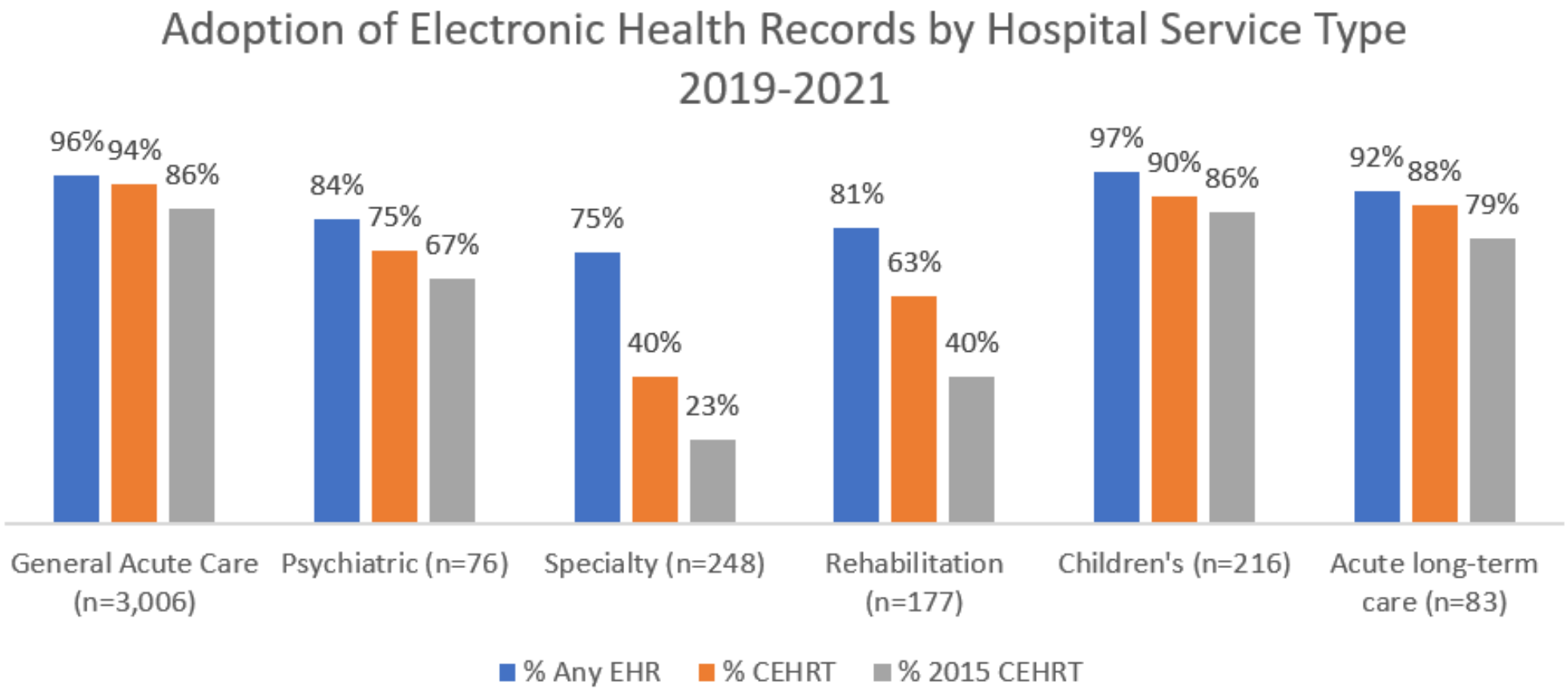
Market share of Hospital EHR Vendors in the U.S.

VENDOR	Market Share 2024
Epic Systems	38%
Cerner/Oracle	22%
Meditech	13%
Evident, CPSI Company	7%
Altera	3%
Proprietary Systems	1%



Hundreds of vendors in the U.S.

U.S. Adoption of EHRs



https://www.healthit.gov/data/quickstats

Germany EHR Adoption

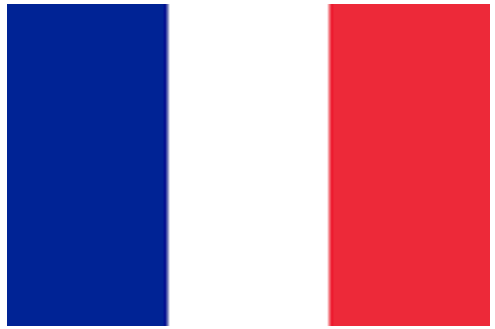
- Germany introduced a national EHR system in 2021 after legislation in early 2004/2006. With an opt-in policy for patients, further adoption is needed to ensure widespread use.
- EHRs are mandatory for all doctors and healthcare providers in Germany. Via an integrated care document, they track patient information and communicate with other healthcare providers.
- Key vendors: Siemens Healthineers, Cerner, Allgeier, CompuGroup Medical, Agfa HealthCare, T-Systems, Medatixx, medavis, Arvato Systems, CompuGroup Medical

- https://www.insights10.com/report/germany-electronic-health-records-market-analysis/

EMRs in Spain

- Each autonomous community manages its own health services.
- IANUS – electronic medical record
  - Connects all public and private hospitals, pharmacies, and health centers, allowing medical staff to access a patient's health history, allergies, treatments, and nursing care programs.
  - IANUS also connects to the Spanish National Health Service, allowing access to medical information from other regions

France EMR Adoption



- Although most providers in France used some form of electronic medical records, a national EMR—the Dossier Médical Partagé (DMP) was enacted in 2016 and implementation is underway. The DMP is a centralized record using the opt-in consent model. Physicians push their EHRS into the DMP. Government initiatives help promote the slow adoption.
- COMPETITIVE LANDSCAPE
  - Medasys (FRA)
  - Infor (FRA)
  - GCS (FRA)
  - Cerner
  - Siemens Healthineers
  - MEDITECH
  - NextGen Healthcare
  - Epic Systems

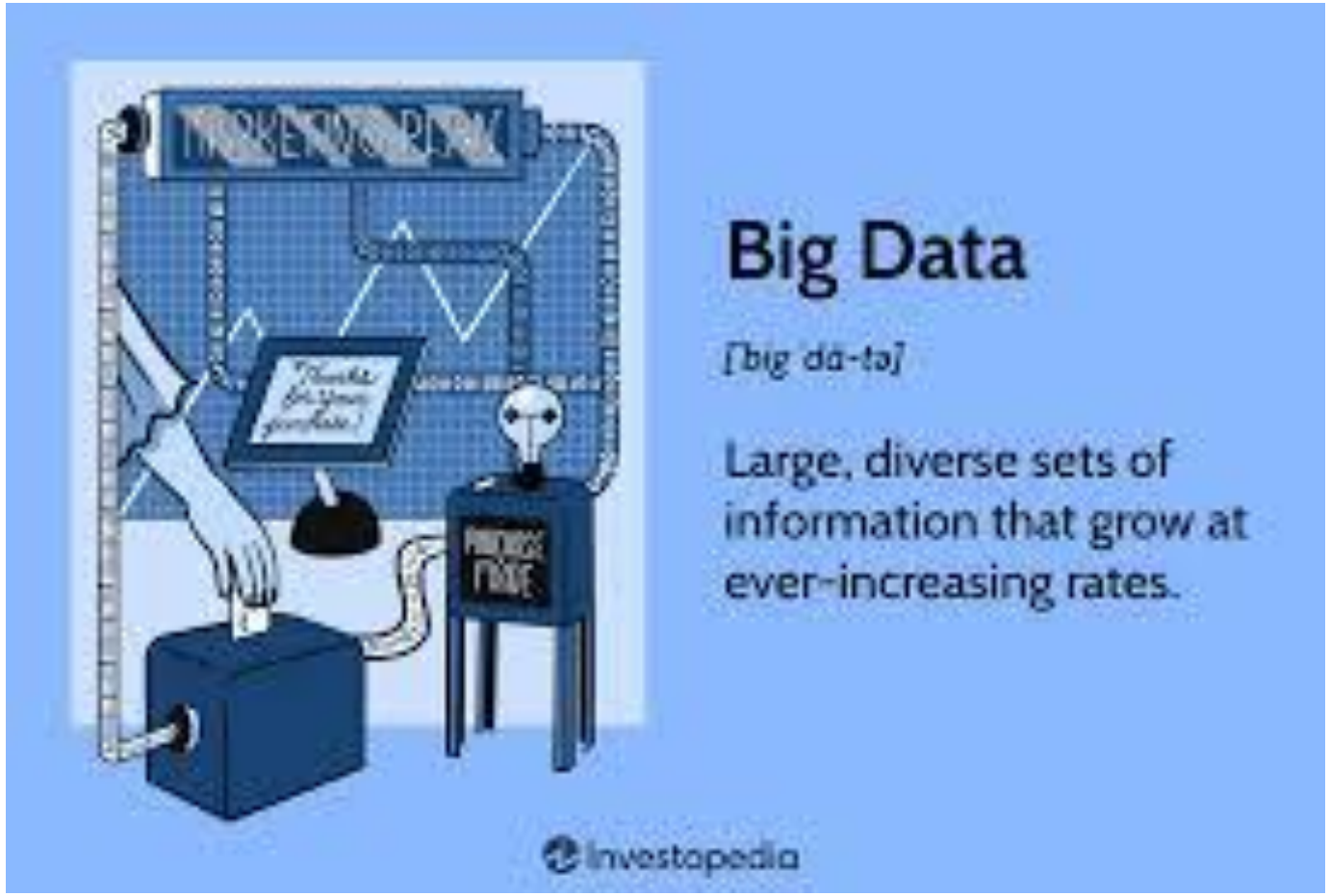
EHR Vendors in Europe

- Denmark: CompuGroup Medical SE, Constellation Software and Leidos
- Portugal: Cerner/Oracle, Concentrix, Leidos
- Italy: Cerner/Oracle, Allscripts, Concentrix,
  - CompuGroup Medical, Constellation, Leidos
- Austria: ELGA (electronic health record Austria) Siemens Healthineers

Europe Electronic Health Records (EHR) Market is predicted to grow at a CAGR of 3.44% from 2023 to 2028.

- What is happening in your country?

The healthcare industry is responsible for about 30% of the world's data

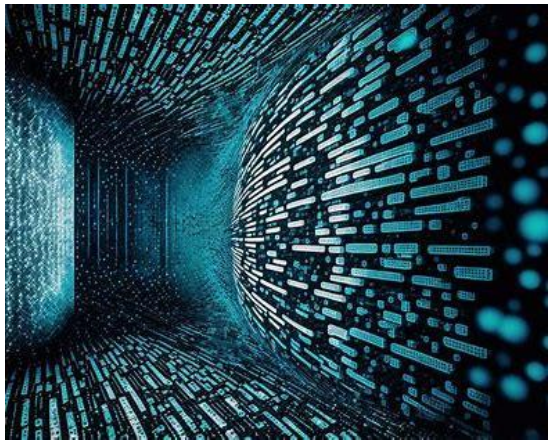


Disruptors

- More than 70% of healthcare organizations are pursuing generative AI proofs-of-concept or already implementing generative AI solutions for workflow processes.

(McKinsey Survey, 2024)

Big Data from EMRs



- Structured data
  - Examples – age, oxygen levels, lab values, drugs administered
  - Tables, SQL, R
  - Data concerns – normalizing, missing data, redundancy, imputed values, proxies
- Unstructured data
  - Examples – patient's history, clinical text in patient notes, xray images
  - Data concerns – anonymization, de-identification, negation, jargon, abbreviations

Big Data from EMRs

- Risk prediction models
  - Opportunities and challenges in developing risk prediction models with electronic health records data: a systematic review, Goldstein, BA, doi: 10.1093/jamia/ocw042 Median: 27 variables and 26,000 sample size
  - University of California San Francisco and Google
    - Which patients will die, which patients will be readmitted to the hospital, what are the diagnoses? Who will get Alzheimer's? What are drug prescribing patterns?
  - Towards interpretable, medically-grounded, EMR based risk prediction models Twick, Sci Rep. 2022, doi: 10.1038/s41598-022-13504-7
    - Who will get a post-operative complication?

Big Data Failed Machine Learning Models - 2017

- Predict serious complications in patients with pneumonia
- Created a model using a dataset of ¾ million patients in 78 hospitals across 23 U.S. states.
- Neural network predicted that patients with pneumonia and asthma had better outcomes that patients without asthma
- Dangerous medical nonsense.
- What went wrong? Expertise and context.
- Better care because patients with pneumonia and asthma were immediately admitted to an ICU.
- Model metrics were correct and never deployed clinically

- Mbadiwe, T (2017) The Potential Pitfalls of Machine Learning Algorithms in Medicine. Pulmonology Advisor

Big Data from EMRs - Informed Consent

- Has the patient signed a consent form for single use of their data?
- Has the patient been told about any risks of using the data?
  - Genetic data is a special category that requires increased privacy protection
  - Genomic data can be re-identified with relative ease
    - Venkatesaramani, R. et al: Re-identification of individuals in genomic datasets using public face images. Science Advances 2021 Vol 7, Issue 47 DOI: 10.1126/sciadv.abg3296
- Have future uses of the data been anticipated and the patient informed?
- Will the data be used for profit?
- Will the knowledge gained by any research be shared with the patient?

Big Data from EMRs – Discussion questions

- Using EMR data, what research question would you like answered?
- Are records complete and data normalized?
- Who owns the data? Who has access to the data?
- How is quality guaranteed? Is the data model documented?
- Has bias been introduced?
- Are the known limitations or errors revealed?

Story of the day

- In the U.S., physicians spend nearly 2 hours on electronic health record (EHR) tasks, per hour of direct patient care.
- Clinicians spent nearly six (6) hours of an 11-hour day working on electronic health records.

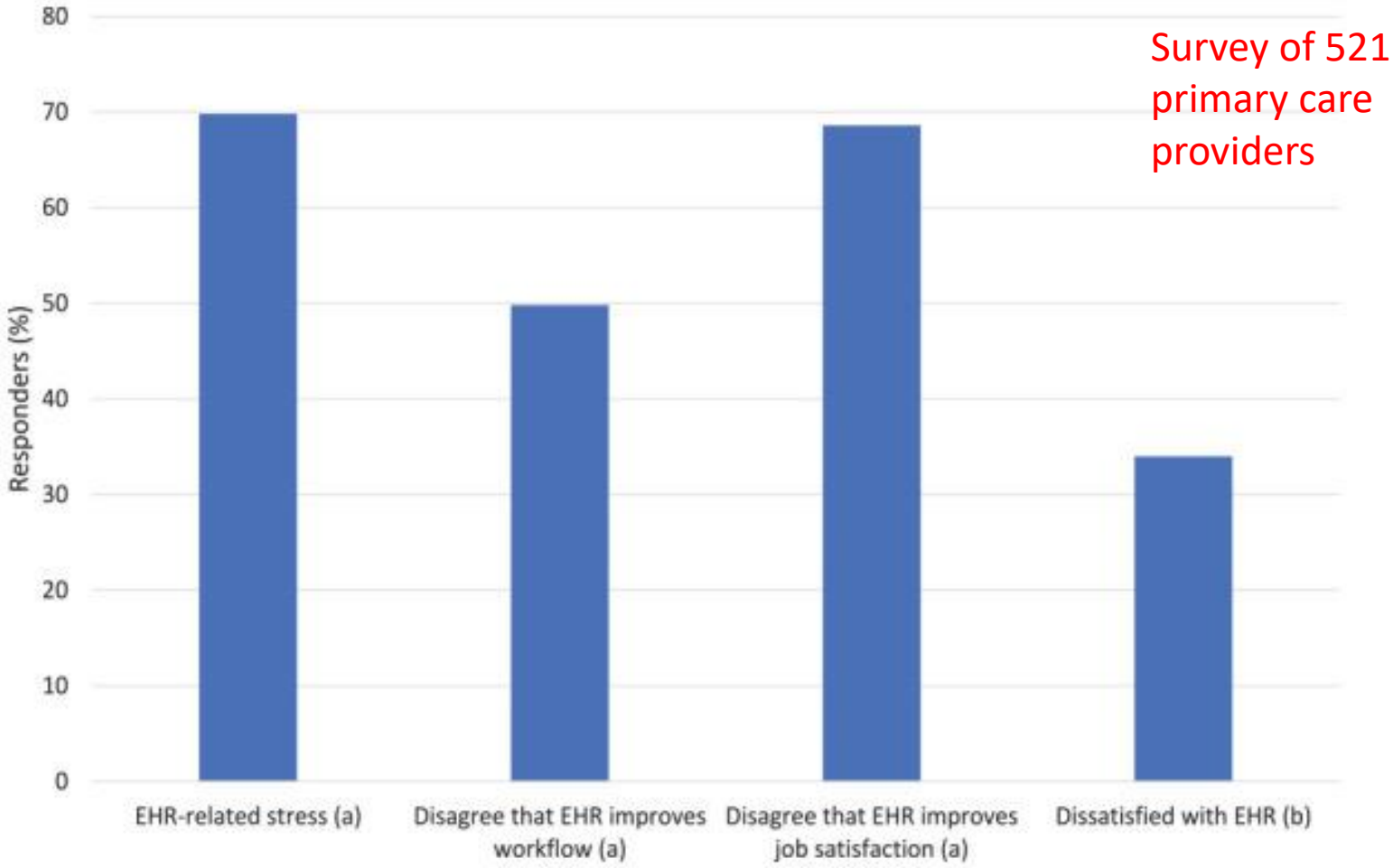
Story of the day

- In the U.S., the EHR has been identified as major contributor to physician burnout. Research conducted by the American Medical Association (AMA) identified EHRs as the leading cause of physician dissatisfaction, emotional fatigue, depersonalization, and lost enthusiasm for the job.
- Burnout is related to time demands, documentation and clerical burdens, complex usability, cognitive load, and email volumes.

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10134123/

Burnout related to EHR use in Primary Care

J Prim Care Community Health Jan-Dec; 14: 21501319231166921.
Published online 2023 Apr 19. doi: 10.1177/21501319231166921



Ambient listening

- Ambient listening (**AI**)**-powered voice recognition technology – transcribes conversations between patients and healthcare providers in real time. It extracts medically relevant information and generates notes to meet billing and coding requirements.**
- Vendors including Microsoft's Nuance, Amazon Web Services, Suki, eClinicalWorks' Sunoh.ai, DeepScribe, Abridge, Ambience and Augmedix.
- **Adoption occurring (costs, privacy, integration) are concerns.**

Personal Health Record (PHR)

- A PHR is a long-term record of a patient's medical history and overall health
  - Whereas an electronic health record is a narrower view of episodes of care
- A personal health record can be managed and accessed by the patient
- An EHR originates and is controlled by doctors, hospitals, and pharmacies
- A PHR is managed by the patient and can include a collection of information pertinent to a patient's health such as an allergy list, immunization history, family medical history

Personal health record

- Available from employers, insurers, physicians or directly as an app or from the Internet.
- Check out these tools.
  - Example: Healthspek – free app https://www.healthspek.com/
  - Example: Capzule. https://www.capzule.com/

Enterprise computing

(Enterprise resource planning ERP)

- Hospital and physicians need electronic medical records to manage their patient data but also technology to manage all aspects of the business.
- Business management solutions for healthcare
- MORE BIG DATA!
  - Predict risk - What patients will cost the insurance company the most?
  - Truven Analytics MarketScan
    - Largest claims (billing) database for research purposes

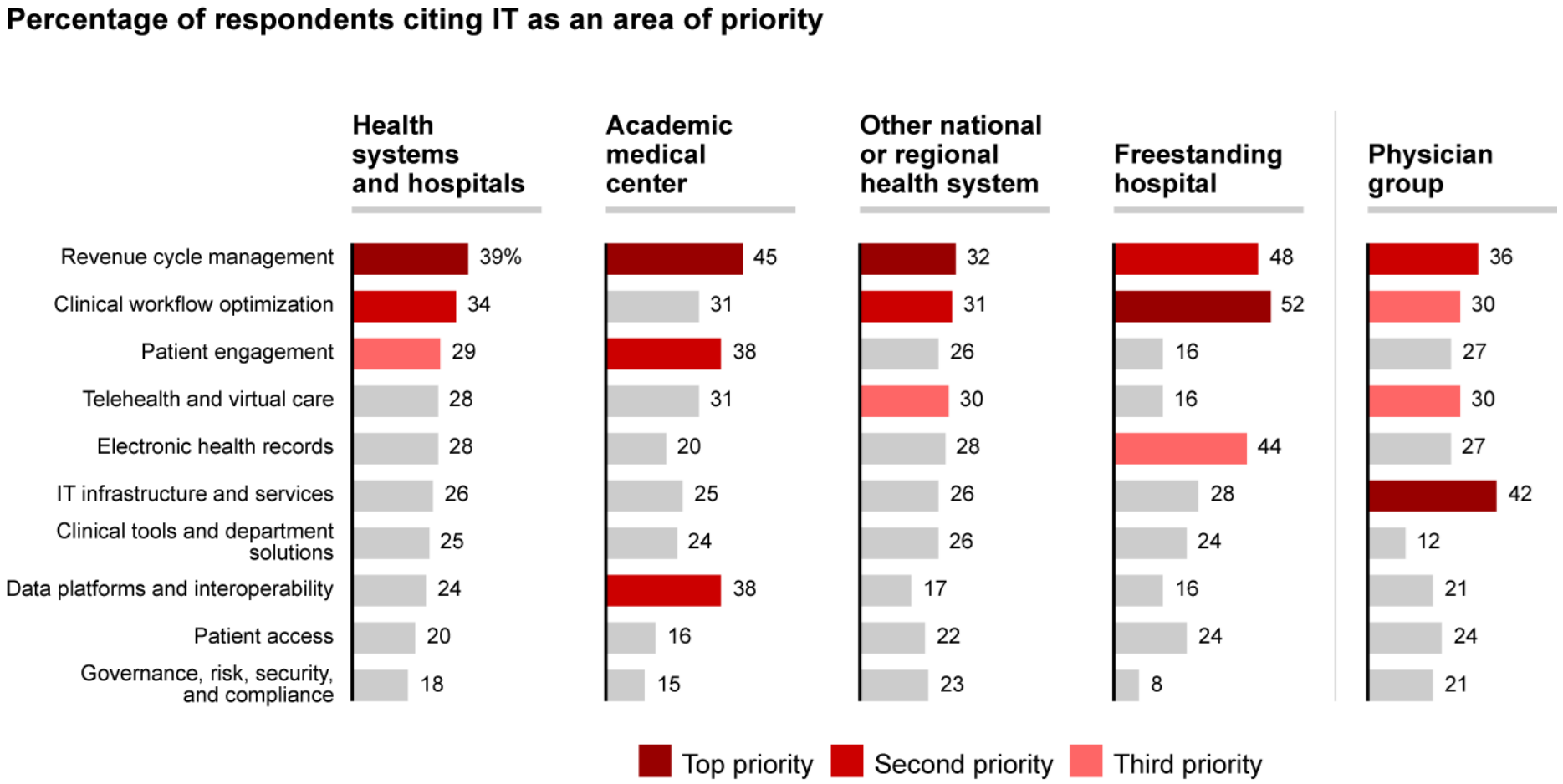
Enterprise computing in healthcare

- Patient scheduling
- Staff scheduling
- Time management
- Inventory management
- Supply chain management
- Finance and billing
- Compliance management
- Revenue cycle management
- Reporting and analysis

Enterprise computing

- Some of the most popular healthcare industry options are Epic/FHIR, Cerner, WebPT, G2 Deals, NextGen Healthcare, eClinicalWorks, Kareo, Centricity, Practice Solution, Practice Fusion, Meditech Expanse, Allscripts EHR, and Advanced MD.

In the U.S. healthcare system, the focus of IT enterprise systems is revenues



Source: Bain-KLAS 2023 Provider Executive Survey (n=201)

GPT-4 in a Cancer Center, NEJM AI 2024; 1(4)

Dana-Farber
Cancer Institute

GPT-4 in a Cancer Center, NEJM AI 2024; 1(4)

- Founded in 1947 in Boston, Massachusetts, USA, Dana-Farber is a teaching affiliate of Harvard Medical School and federally designated Comprehensive Cancer Center that develops and disseminates innovative patient therapies and scientific discoveries through-out the world.

GPT-4 in a Cancer Center, NEJM AI 2024; 1(4)

- Interesting facts:
- Surprises:
- Ideas for the cancer center for next steps:

GPT-4 in a Cancer Center, NEJM AI 2024; 1(4)

- Use of software tools based on AI large language models (LLMs)
  - Generate clinical documentation
  - Extract structured data from medical records
  - Perform on medical board/licensing examinations
- Goals of this project:
  - Improve patients' outcomes
  - Enhance the well-being of clinicians and staff
  - Increase the equity of clinical care and research
  - Be cost effective
  - Comply with laws and policies, manage risk
  - Establish a community of early adopters of LLMs

GPT-4 in a Cancer Center, NEJM AI 2024; 1(4)

- Challenges
  - Patient data privacy and security
  - Direct negative consequences of errors and biases
  - Need for model interpretability and supporting evidence
  - Safeguarding intellectual property and proprietary data
  - Difficulty of modifying clinical and operational workflow
- Need for
  - Clear policy guardrails
  - Secure technical environment
  - Patient and human-centric decision-making
  - Sponsors
  - Socialization of adopters
  - User feedback
  - Ongoing support and training

HIMSS

Health Information and Management Systems Society (HIMSS)

Founded in 1961

Annual conference: 34,000 US attendees, 90+ Countries, 1,100 Vendors

Attendees: Exhibitors, Providers, Innovators and Market Suppliers

HIMSS Europe 2025 European Health Conference & Exhibition Paris, June 10-12

- 2024 Conference welcomed over 3,000 healthcare leaders and 200 speakers
- https://www.himss.org/news/innovative-digital-health-solutions-showcased-himss24-europe-startup-pitchfest-competition
- Look at the winners of HIMSSEU24 Startup Pitchfest
- Medaia, Ventriject, Briya, Spryt, Avegen, Stethome
  - (Worksheet DigHealth2024PitchfestDQs)

Working and networking in ehealth

- Healthcare IT vendors, eg, Siemens Healthineers
  - https://jobs.siemens-info.com/jobs?stretch=0&stretchUnit=MILES&location=Spain&woe=12&page=1&brand=Siemens%20Healthineers
    - Based in Erlangen, Germany, with over 70,000 employees worldwide
- Explore associations
  - EIT Health Summit – 2024 Rotterdam, 2025 to be determined – bootcamps, fellowships, student work
  - Digital Health News. https://www.ehealthnews.eu/jobs
- Read industry articles, participate in blogs
  - HealthITNews – Europe edition

Summary and questions to think about

- Uses and data available from an EMR/EHRs. Benefits and challenges of their use.
- Commonalities among countries – similar issues and concerns of EMR/EHRs.
- Big data from EMRs and the research questions it could answer.
- How could the data in EMRs benefit mankind?
- In 20 years, what will EMRs look like? Optimistically? Pessimistically?

Next Session

- Telehealth and telemedicine
  - Read https://www.oecd.org/coronavirus/policy-responses/the-future-of-telemedicine-after-covid-19-d46e9a02/