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CS6440 - Lab #1 Exploring the Current State of Healthcare

**Part I - US Healthcare, Policy & Informatics**

**Burdens of Healthcare**

1. What are some of the greatest challenges in U.S. Health Care today? Detail at least 5.

-Pandemic de-escalation: inadequate response to modern-day pandemics.

-High healthcare costs: lack of access to healthcare coverage due to high costs.

-Healthcare waste: caused by negligent care delivery and unnecessary services.

-High medication costs: the increased price of drugs prevents people from obtaining necessary medication

-Protecting patient health data: internet-connected medical data causes an increase in cyber-attacks.

2. What are some of the advantages of U.S. Healthcare compared to the rest of the world? Disadvantages?

Disadvantages of U.S. healthcare compared to the rest of the world includes lack of healthcare access due to high costs, insurance premiums have been on the rise since the early 2000s, minority and impoverished communities are deprived of proper healthcare insurance. Advantages include low-cost access to preventative care, more options available for individual health insurance, and regulations that improve access and affordability.

3. What accounts for the majority of healthcare costs? Why?

The majority of healthcare costs are administrative costs. These costs include BIR (billing and insurance-related), hospitals, and professional care. The United States spends twice the amount of money on BIR costs as it needs, according to CAP's (Center for American Progress) calculations. BIR is not just included in insurance premiums, but administrations need to manage medical records, hospitals, and care quality. Labor costs are also included in high administrative costs. Hospitals in the United States make up 33% of all healthcare costs.

4. In your own words, describe how laws, regulations, and policies have impacted the US Healthcare system as we know it.

The Affordable Care Act provides free preventative care and offers affordable healthcare for millions. It also added more regulations to insurance companies that protect the consumer. The ACA has allowed for children and young adults (under 26) to stay on their parent's health insurance plan.

**Chronic Illnesses**

1. What is the CDC? What purpose does it serve?

The CDC is the Centers for Disease Control and Prevention. Their purpose is to improve people's health in the U.S. by disease control and prevention, promoting health education and environmental health.

2. What are chronic illnesses, and why are they important to know from a health information technology perspective?

Chronic illnesses are a condition that lasts longer than a year and requires ongoing medical assistance. Information and communications technology (ICT) is used for chronic illness management. These technologies include Electronic Health Record (EHR), an electronic version of a patient's medical history. The EHR has critical data like progress notes, problems, medications, etc. Other ICTs are used to monitor patients in the comfort of their own homes, saving them money and allowing the nurses to scan more patients. For example, a smart scale sends the nurse the patient's weight data to help monitor Congestive Heart Failure.

3. What are some examples of acute conditions? How are acute conditions different from chronic illnesses?

Acute conditions are typically ones that occur suddenly or have immediate developing systems. They are usually brief and resolved in less than six months. They are different from chronic illnesses in that they persist beyond six months, and the symptoms can have a slow onset and potentially worsen over time. Some examples of acute conditions are asthma attack, a broken bone, common cold, heart attack.

4. What are the differences between a PCP and Specialist?

A PCP is a primary care provider. They can help diagnose a wide variety of conditions and help keep track of the patient's health over time. They perform annual physicals and are go-to's for non-emergency health situations. A PCP can

refer a patient to a specialist. A specialist is a doctor that has advanced training in a specific brand of medicine.

5. Describe the value of a PCP.

A PCP is essential because they provide patients with most of their medical needs. They can help manage patients that are seeing multiple specialists and taking different medication/treatments. Having a PCP keeps people healthy because they have more routine checkups and physicals, so the PCP can monitor a patient's health over time and spot worrying symptoms early on.

6. How can information technology be used to help PCP's with care coordination?

PCPs use information technology on an everyday basis. They use health information exchange (HIE) to share information about patients with different sources and specialists. Not only does it allow information sharing, but providers can communicate with one another about a patient or transfer the care, given that someone is switching to a different provider. There are also applications for PCPs to track their patients' health over time.

**Learning Health Systems**

1. In your own words, describe the good, the bad, the ugly of the US Healthcare system. You are not limited to the articles provided; in fact we highly encourage you to do a bit of research to get a better understanding.

The good of the U.S. Healthcare system is good with medical discovery and research. For example, treatments of AIDS were created in the United States. The bad is the quality of healthcare. According to the CDC, there are about 1.7 million infections and 99,000 deaths per year from diseases contracted at hospitals. The ugly of the U.S. healthcare system is that minority and low-income communities do not have access to necessary healthcare.

2. In your opinion, how are learning health systems impacting the US Healthcare system? Good or Bad.

Learning health systems are impacting the US healthcare system. The knowledge learned helps improve daily healthcare. With the rise of technology, large datasets benefit the healthcare system because we can see the trends over time and see how the system can be improved accordingly. There is also constant research being done to improve care.

## Part II - EMRs & Patient Tools

**Exercise 1 -** Compare the following cloud platforms: AWS, Google's HealthCare API, and Microsoft's FHIR Server for Azure in terms of general usability (from a developer's perspective), HIPAA Compliance, machine learning functionality for predictions, FHIR compatibility. This should be at least ~2-4 sentences for each combination. Then, in one paragraph, determine what tool you think would be the best to select for the backend of your app. You have the following cloud platforms to choose from:

- Microsoft Azure API for FHIR

In terms of general usability, Microsoft Azure API for FHIR allows one to create and deploy a service in just a few minutes. It is made for rapid performance no matter how large the size of the dataset. Microsoft Azure API for FHIR is a managed FHIR service and allows storage in FHIR format. Users can connect to data sources, EHRs, and research databases and apply machine learning. Azure API for FHIR meets the HIPAA regulatory requirements and more than 90 compliance certifications.

- Google Cloud Healthcare API

In terms of general usability, Google Cloud's Healthcare API is easy to use, scalable, and managed development environment for building clinical solutions on Google Cloud. Healthcare API uses an AI platform for machine learning. It allows users to construct portable machine learning pipelines using KubeFlow, machine learning on Kubernetes. Users can use TensorFlow tools as they deploy their application to production. Healthcare API is HIPAA compliant and has other compliance certifications. FHIR supports Google's API; in fact, Google has a FHIR de-identification that helps prepare data for analytical solutions.

- AWS on FHIR

In terms of general usability, AWS allows users to extract clinical entities and convert the data into an open format (like FHIR) and make it available to other parties. Users can use Amazon Comprehend Medical (NLP service) to extract relevant medical information from raw clinical notes. AWS provides over 100 HIPAA compliant features and services and other certifications; Amazon Comprehend Medical is HIPAA compliant. Amazon Comprehend Medical uses

ML models to identify critical information and determine the relationship with each other.

I believe Amazon Comprehend Medical would be best to use for the backend of my application. It is the simplest to use by just making a simple API call. It also does not require machine learning expertise so anyone can implement it and follow what is going on. Amazon Comprehend Medical would also allow me to train models using my data to identify specific items such as policy numbers.

**Exercise 2 -** Explain the differences between Apple's HealthKit, ResearchKit, and CareKit (at least 3 paragraphs).

For each of these three solutions provide an example healthcare problem that these technologies can help solve. For example, ResearchKit can help clinicians understand Parkinson's disease by measuring dexterity and memory. (at least ~2-4 sentences for each):

- Healthkit Use Case
- ResearchKit Use Case
- CareKit Use Case

Apple's HealthKit is a service that allows users to share health data between compatible apps and services. HealthKit can help people with diabetes by consolidating data from other apps to make it convenient for them to see their data in one app (HealthKit). For example, one can check their glucose, insulin dose details, carbohydrate history, etc. instead of opening several apps to see it.

ResearchKit is used for medical researchers to build apps and enroll participants to conduct studies to gain insight into battling diseases. For example, some researchers are trying to understand postpartum depression and whether there is postpartum depression by using a DNA sample collection.

CareKit allows anyone to manage their medical conditions by tracking symptoms and medicine. Users can share the information with their providers to monitor the patient's health outside of office visits. For example, CareKit can allow people to easily track their recovery after a heart attack by monitoring physical activity and necessary vitals.

**Exercise 3 -** The below companies are the top EMR vendors in the market:

- Allscripts
- Cerner
- eClinicalWorks

- Epic

Research and explore various applications each of these companies provide. Answer the following questions for each EMR vendor based on an application you found. Make sure you answer the below three questions for each of the 4 vendors (at least ~2-4 sentences each) :

- What is the application's name? Allscripts - Sunrise
- What problem does it solve? Allscripts' Sunrise EMR solves the problem of long downtimes. They also provide IT resources that help support the EMR instead of leaving the organization's burden using its service.
- Does it have a developer sandbox? Is it FHIR enabled? Allscripts has a variety of sandboxes for developers to test their application. FHIR is allowed for any developers wanting to use their APIs.
- What is something novel that you found on how they solve that problem? I discovered that Allscripts follows an enterprise solution involving a reduced implementation timeline that provides users with less downtime for their EMR. Allscripts also provides ongoing system maintenance and configuration for their users to ensure that the organization has the most up-to-date application without worrying about hiring application experts to assist.

- What is the application's name? Cerner - Millennium
- What problem does it solve? Millennium helps solve the medical staff's problem, not being able to handle images and media content within one centralized system.  Millennium also solves the problem of not seeing data in the correct format within the EHR.
- Does it have a developer sandbox? Is it FHIR enabled? Cerner has a developer sandbox for developers to test their applications with Cerner platforms. It is FHIR enabled.
- What is something novel that you found on how they solve that problem? Millennium provides an imaging feature within their EHR. This allows medical staff to have images and media content within a patient's record. For example, cardiovascular and radiology imaging is included in their workflow, improving end-to-end operations within different departments. Millennium also can integrate with over 1,000 medical devices, so this ensures that the correct data formats are displayed in a patient's record.

- What is the application's name? eClinicalWorks - V11
- What problem does it solve? V11 solves the issue of the patient's inability to come into the doctor's office because of their age, condition, distance, or during a crisis. They also solve the problem of losing context or interrupting the workflow within an EMR/EHR.
- Does it have a developer sandbox? Is it FHIR enabled? They do not have a developer sandbox currently. However, as part of their interoperability solutions, they introduce an API partner program that will allow users to activate SMART (Sustainable Medical Applications and Reusable Technologies) on FHIR apps.
- What is something novel that you found on how they solve that problem? V11 is fully integrated with healow TeleVisits, allowing patients to connect with their provider at the comfort of their own home or office remotely. V11 also includes a virtual assistant (Eva), which will enable clinicians to see progress notes, flowsheets, account balance, patient history, book appointments, and other resources. This allows the clinician to get the information they need without disrupting any workflows.

- What is the application's name? Epic - Epic EMR
- What problem does it solve? Epic's EMR solves the problem of clinics making misinformed decisions. Their EMR also helps clinics improve and accelerate their research.
- Does it have a developer sandbox? Is it FHIR enabled? Epic does have a developer sandbox to test custom web services. It is FHIR enabled.
- What is something novel that you found on how they solve that problem? Epic's solution to help clinics make the right decision is their integrated AI and Analytics. Epic allows users to build dashboards and reports using their data. Epic also offers advanced machine learning algorithms for augmented decision making. Using Epic's benchmarking and discovery capabilities, clinics can process benchmarks, conduct research, and collaborate with others to improve clinics.