

Lab III – EMRs & Patient Tools

Exercise 1

Pros & Cons Table

	AWS	Google's HealthCare API	Microsoft's FHIR Server for Azure
HIPAA Compliance ("HIPAA Compliance - Amazon Web Services (AWS)," n.d.)("Cloud Healthcare API Google Cloud," n.d.)	<p>Pros: AWS has its own HIPAA risk management program which is aligned with FedRAMP and NIST 800-53. These two standards correspond to HIPAA Security Rule but at higher security level.</p> <p>Cons: It is the responsibility of customers to ensure what they build on top of AWS meets HIPAA requirements. Customers may have to pay attention all the time in case HIPAA makes any changes.</p>	<p>Pros: Google Cloud Platform was built with more than 700 security engineers involved and it supports HIPAA compliance within the Business Associate Agreement (BAA) scope. They have independent audits to implements their standards and reports are available to customers.</p> <p>Cons: There is no certification for HIPAA. Customers share the responsibility with Google.</p>	<p>Pros: All Azure FHIR services are ISO 27001 certified and meet HIPAA requirements.</p> <p>Cons: All platforms share the same issue of lacking certification. So, customers must be responsible to evaluate the HIPAA compliance of their projects.</p>

<p>Machine Learning Functionality for Prediction</p> <p>("Comparing MLaaS: Amazon AWS, IBM Watson, MS Azure AltexSoft," n.d.)</p>	<p>Pros: Amazon machine learning service is one of the most automated solutions and requires little machine learning experience. Algorithm is determined automatically based on input data. Data could come from one of the sources including Amazon RDS, Amazon Redshift, CSV files etc., and no preprocessing is needed.</p> <p>Cons: Amazon machine learning for prediction can only deal with supervised learning limited to classification and regression. Unsupervised learning algorithms are not supported.</p>	<p>Pros: Users can choose from either Cloud AutoML platform (for newcomers) or ML Engine (for data scientists). The former uses a graphic interface and can get supports from all Google's services including image/video processing, natural language processing which could be useful for health data. The latter supports TensorFlow and have in-built algorithms while having much more flexibility than AutoML.</p> <p>Cons: AutoML is in lack of flexibility. ML engine is still in beta phase and may not be compatible enough with other frameworks except TensorFlow.</p>	<p>Pros: Users can choose from either ML studio which is for beginners, or Bot Services which requires experienced data scientists. The former uses a graphic interface and contains about 100 methods including K-means clustering. The latter supports some popular frameworks such as TensorFlow, Scikit-learn, etc.</p> <p>Cons: The two platforms, ML Studio and ML Services, cannot be cross-integrated. Engineers are required at the beginning to determine which one to choose and it will be hard to change to the other one while developing.</p>
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<p>FHIR Compatibility</p> <p>("Open Source FHIR implementations - HL7Wiki," n.d.)("How Microsoft, Google, Apple, and Amazon are Fueling FHIR — Darena Solutions," n.d.)("Cloud Healthcare API Google Cloud," n.d.)("FHIR Server for Azure: An open source project for cloud-based health solutions - Microsoft Industry Blogs," n.d.)("Start a FHIR® in 60 minutes with Microsoft® Azure API — Darena Solutions," n.d.)</p>	<p>Pros: They provide "Platform as a Service (PaaS)" to customers. Health IT vendors could employ open source FHIR implementations and manage them on the platform.</p> <p>Cons: Amazon does not have FHIR specific offering. Developers must explore other resources on their own.</p>	<p>Pros: Google Could support the mutual transformation between other formats and FHIR. It simplifies the ingestion of data and provides analytics and machine learning solutions with the data.</p> <p>Cons: The API is under construction. Currently, it is still in Alpha phase and only available to limited programs.</p>	<p>Pros: The FHIR server was developed based on an open source project so that it has a mature and active developer community. Microsoft Azure FHIR server fully supports data exchange and management with FHIR specification. All Azure FHIR services are ISO 27001 certified and meet HIPAA requirements.</p> <p>Cons: The development is still in progress. The API can only take data from Azure Active Directory (AAD) so users must integrate data with AAD.</p>
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After comparing pros and cons of these three platforms, I believe I would not consider using Amazon's HIPAA-compliant AWS. The reason is that it cannot deal with unsupervised learning and does not support FHIR. Although I am not sure whether my app will need clustering algorithms, I would not close the door if there is a better choice. The other two platforms have similar HIPAA compliance; however, Microsoft's FHIR Server for Azure contains many algorithms as well as Scikit-learn framework which I am familiar with. As a tradeoff, I must learn how to use Azure Active Directory.

Exercise 2

Differences:

HealthKit is a built-in database in iPhones to store health data. The data is stored securely while apps can access it with user's permission. Data in databases or collected

by some apps can be imported into HealthKit. Therefore, HealthKit can be considered as an iPhone built-in repository. Different from HealthKit, CareKit is not a built-in but an open source technology and available for developers to download for app developments. Parts include the condition tracker and insight dashboard. Apps developed based on CareKit can collect data from users' input (e.g. weight-tracking, step-tracking) and has the potential to output to either doctors directly or some EMR systems.

Apps built upon ResearchKit collect data from large populations to help research activities. They will ask users for authorization to access databases (interaction with HealthKit) or taking a survey for collection of other related information. Then the data collection may be performed by tests. In all, HealthKit is a tool to manage data. The other two kits are collecting data while CareKit is about personal care and ResearchKit is supporting research studies (“(315) How Apple's HealthKit, CareKit, & ResearchKit Are Changing The Way We Manage Our Health - YouTube,” n.d.).

Examples:

- **HealthKit Use Case:** HealthKit can be used to build apps that track running and cycling. Users can personalize routes, review stats on runs (e.g. distance, speed, elevation) and probably send data to other apps.
- **ResearchKit Use Case:** Research Kit can help to develop a tool to detect autism in children. The application shows the child videos and uses the front phone camera to record the child's reactions. The built in algorithms can tell the child's emotions and behaviors (“ResearchKit and CareKit - Apple,” n.d.).
- **CareKit Use Case:** CareKit can help to build a pregnancy tracker. Users can input information on a daily basis, then alerts and insights on the data can be presented to them. Moreover, pregnancy articles or suggestions may be provided based on the analysis of user's input.

Exercise 3

Allscripts:

- What is the application's name?
dbMotion
- What problem does it solve?
It enables sharing data assets among organizations. This is useful when patients seek healthcare in multiple clinics or hospitals.
- What is something novel that you found on how they solve that problem?
Many health information applications require users to leave their current workflow if they want to get patients information that is not in their HER. However, dbMotion manages to represent all information in one place.

Cerner:

- What is the application's name?
Cerner Camera Capture
- What problem does it solve?
It enables acquiring and storing clinical images on mobile devices. In that case, patients can share pictures of concerned areas (e.g. rashes, bump) without physically presenting to the clinic. This solve the problem that physicians cannot examine patients' condition during E-visit.
- What is something novel that you found on how they solve that problem?
Cerner Camera Capture provides users with secure access to EHR system. The images that patients have shared with physicians can be archived into the system for future reference.

eClinicalWorks:

- What is the application's name?
TeleVisits
- What problem does it solve?
TeleVisits delivers medical care with same quality as in office visits. Since the location will not be concerned while scheduling an e-visit, patients have higher chance to get a much earlier appointment. This is very useful in flu season when clinics are crowded, and patients get cross infection easily.
- What is something novel that you found on how they solve that problem?
TeleVisits provide lab interfacing and electronic prescribing. It is compatible with all browsers without any need of installation and comes with technical assistance.

Epic:

- What is the application's name?
MyChart
- What problem does it solve?
It enables patients to schedule/reschedule appointments, access their medical records, view lab results without calling or physical visiting. Moreover, patients can send messages to physicians for some non-emergency cases.
- What is something novel that you found on how they solve that problem?
Some key words can be detected immediately when patients make appointments and patients will be contacted to check their condition. For example, "irregular heartbeat" or "difficult breathing" will definitely trigger a warning and a nurse will contact the patient for safety purpose.

References

(315) How Apple's HealthKit, CareKit, & ResearchKit Are Changing The Way We Manage Our Health - YouTube. (n.d.). Retrieved January 24, 2020, from <https://www.youtube.com/watch?v=xRBE7FJqJjc>

Cloud Healthcare API | Google Cloud. (n.d.). Retrieved January 23, 2020, from <https://cloud.google.com/healthcare/>

Comparing MLaaS: Amazon AWS, IBM Watson, MS Azure | AltexSoft. (n.d.). Retrieved January 23, 2020, from <https://www.altexsoft.com/blog/datascience/comparing-machine-learning-as-a-service-amazon-microsoft-azure-google-cloud-ai-ibm-watson/>

FHIR Server for Azure: An open source project for cloud-based health solutions - Microsoft Industry Blogs. (n.d.). Retrieved January 23, 2020, from <https://cloudblogs.microsoft.com/industry-blog/health/2018/11/12/fhir-server-for-azure-an-open-source-project-for-cloud-based-health-solutions/>

HIPAA Compliance - Amazon Web Services (AWS). (n.d.). Retrieved January 23, 2020, from <https://aws.amazon.com/compliance/hipaa-compliance/>

How Microsoft, Google, Apple, and Amazon are Fueling FHIR — Darena Solutions. (n.d.). Retrieved January 23, 2020, from <https://www.darenasolutions.com/blog/how-microsoft-google-apple-and-amazon-are-fueling-fhir>

Open Source FHIR implementations - HL7Wiki. (n.d.). Retrieved January 23, 2020, from https://wiki.hl7.org/index.php?title=Open_Source_FHIR_implementations

ResearchKit and CareKit - Apple. (n.d.). Retrieved January 23, 2020, from <https://www.apple.com/researchkit/>

Start a FHIR® in 60 minutes with Microsoft® Azure API — Darena Solutions. (n.d.). Retrieved January 23, 2020, from <https://www.darenasolutions.com/blog/start-a-fhir-in-60-minutes-with-microsoft-azure-api>