1. **Storyboard a use case of FHIR in healthcare. Create a Model for the use case.**

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(Storyboarding = writing + data model. The higher the granularity, the better it will

be, and the better your scores will be. We will use our judgment in understanding

the complexity of the use case while evaluating).

I thought of coming up with FHIR-Based Healthcare App that personalizes diet and activity monitoring for diabetes. It uses an RPM (Remote Patient Monitoring) model that integrates continuous glucose monitoring, diet tracking and activity monitoring using wearable devices and apps by collecting the intake of food, meal photos or food diaries. With reference to the current glucose levels, it can provide personal dietary recommendations based on how specific food affects the patient’s glucose levels, share the data with the doctor for vigil anted monitoring, suggesting the best time to checkup (not being late).

**Problem** Storyboarding**:**

**Scenario A (Quick and Hassle-Free Treatment):**

A person looking at a cellphone

Description automatically generated**I**t's Monday afternoon, and 42-year-old Michael, a software engineer at Oracle who lives with Type 2 diabetes, decides to take a break from his work due to feeling slightly faint. He has been using an advanced Remote Patient Monitoring (RPM) system for the past year to continuously track his blood glucose levels through a wearable device. This data is regularly shared with his personal doctor.

Upon experiencing discomfort, Michael quickly opens the app and notices that his insulin levels are outside the normal range. He promptly uses the "Schedule an Appointment" feature to connect with his healthcare expert, Dr. Kristin. She has immediate access to his insulin data and his recent meal history, including the meal from last night’s party.

Dr. Kristin observes that the sweets Michael consumed at the party might have disrupted his insulin levels. She advises him to administer a control dose of insulin and reminds him to adhere strictly to the dietary recommendations provided by the app. Micheal promises to obey her advisory and will use the app for anything he eats to get a suggestion whether he should eat it or not.  
**Scenario B (Ai recommendation):**

After getting treated he strictly holds onto his diet. Now he wanted to have some ice cream due to the high heat outside. So, he wants to know if he can eat it or not? He opens the app on his phone and taps “Check the Food” and snatches the photo of ice cream and its ingredients at the crimp and clicks “OK”. The app uses Ai to quickly analyze the amount of sugar he is going to have per gram of ice cream according to his current Diabetes levels. The app suggests that he could have 10g-15g or ice cream. He then ate ice cream according to the recommendation.

**Scenario C (EMERGENCY🚨):**

Micheal’s mother Mrs. Margret lily had cardiac disease. On Sunday night, after having food, we all went to sleep. Micheal got abruptly disturbed by his phone ring. He picks up. It was his mom, weeping due to chest pain. Micheal runs to her room. He noticed that his mother got some chest pain, so he opened the app and books ambulance after that he books an appointment with the doctor for his mom in the emergency room. Within 30 minutes he gets his mom administered by the doctor. Doctors gives her some injections and his mother feels comfortable after some time. He then thanked to God and the app for quick appointments without withing in the queue for his turn.

**Actors** Involved:

* **Michael/Patient:** The patient with some lifestyle disease.
* **RPM System:** The Remote Patient Monitoring system that continuously monitors Michael’s glucose levels using wearable technology.
* **Wearable Device:** The specific technology worn by Michael that monitors and transmits data on his blood glucose levels.
* **Healthcare App:** The mobile application through which Michael monitors his condition, receives alerts, and schedules appointments**.**
* **Dr. Kristin:** Michael's healthcare expert, who receives and reviews the transmitted health data and provides medical advice and treatment recommendations.
* **Healthcare Data Platform:** The backend system (potentially part of the RPM system) that stores, processes, and allows secure access to patient data for continuous monitoring and analysis.
* **Doctors and Health centers:** These are the centers for the utmost care mainly teir-3 hospitals play a crucial role in emergencies like cardiac arrest, pregnancy, trauma, etc.

**Scope of the Model:**

**I**n everyday life, choosing the right foods can be challenging, and for individuals with diabetes, making the right dietary choices is critical, as the wrong foods can have harmful effects. It can also tell the user (if he inputs the photo/prompts the name of the food) whether he/she should eat it or not using Ai. This model integrates continuous glucose monitoring, dietary tracking, and direct doctor-patient communication through a Remote Patient Monitoring (RPM) system. It leverages wearable technology data and dietary inputs, coupled with real-time medical guidance, to provide timely and personalized diabetic care. This comprehensive approach significantly enhances patient compliance and health outcomes, ensuring that individuals with diabetes can manage their condition effectively and safely.

**System** **Workflow and utilization:**

1. **Patient Registration:**

* **Action: Patients register through the Healthcare App.**
* **Data Involved: Patient details, FamilyMemberHistory.**
* **Outcome: Patient data is stored in the Healthcare Data Platform and retrieved in need.**

1. **Medical Consultation:**

* **Action: Patients schedule appointments using the Healthcare App.**
* **Data Involved: Appointment, Practitioner details (category, timings, free schedules etc.).**
* **Interaction: During the consultation, the Practitioner may:**
  + - **Prescribe Medications**
* **Order tests that generate Diagnostic Reports.**
* **Make clinical Observations.**
* **Outcome: All data generated (Medications, Diagnostic Reports, Observations) is recorded in the Healthcare Data Platform.**

1. **Remote Monitoring:**

* **Action: Patients use special wearable Devices provided by the organization to monitor health parameters specially (BP, Glucose and other important criterions).**
* **Data Involved: Device data encoded using Code System, resulting in Observations.**
* **Outcome: Observation data is remotely accessible by Practitioners via the Healthcare Data Platform for monitoring and analysis.**

1. **Affiliation with Medical Institutions:**

* **Action: Referrals to Organizations for further services (e.g., lab tests, specialist consultations).**
* **Data Involved: Referral details, Organization information.**
* **Outcome: Coordination between different healthcare services providers.**

1. **System Consistency:**
   * **Action: Use of Code System for standardizing medical data encoding.**
   * **Data Involved: Code System ensures consistent data interpretation across Observations, Diagnostic Reports, and Devices.**
   * **Outcome: Unified and standardized healthcare data across the platform.**
2. **Treatment and Analysis:**

* **Action: Practitioners review collated data to provide feedback, adjust Medications, or schedule follow-up Appointments.**
* **Data Involved: Patient health data, Medication adjustments, Appointment scheduling.**
* **Outcome: Personalized treatment plans and scheduled medical follow-ups.**

1. **Continuous Monitoring:**

* **Action: Continuous data recording and transmission by Devices.**
* **Data Involved: Continuous health data feeds.**
* **Outcome: Practitioners receive up-to-date health data, enabling timely medical interventions.**

**Appropriate FHIR resources and artifacts to implement the model:**

**The Resources are referenced from website of FHIR** <https://www.hl7.org/fhir/resourcelist.html>

* [Patient](https://www.hl7.org/fhir/patient-definitions.html#Patient) **(**<https://www.hl7.org/fhir/patient.html>**)** 
  + **This stores all the patient’s personal data like name, age, sex, orientation type etc.**
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
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  + [telecom](https://www.hl7.org/fhir/patient-definitions.html#Patient.telecom)**:** [ContactPoint](https://www.hl7.org/fhir/datatypes.html#ContactPoint) **0..\***
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* [Practitioner](https://www.hl7.org/fhir/practitioner-definitions.html#Practitioner) (<https://www.hl7.org/fhir/practitioner.html>)
  + This stores information about the medical care experts like doctors, nurses and their work specifications.
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
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  + [name](https://www.hl7.org/fhir/patient-definitions.html#Patient.name)**:** [HumanName](https://www.hl7.org/fhir/datatypes.html#HumanName) **0..\***
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* [Permission](https://www.hl7.org/fhir/permission-definitions.html#Permission) (<https://www.hl7.org/fhir/permission.html>)
  + This stores information about what the list of permissions the user has allowed to share and what not. It is useful in protecting the privacy of the user.
  + [status](https://www.hl7.org/fhir/permission-definitions.html#Permission.status): [code](https://www.hl7.org/fhir/datatypes.html#code) 1..1 Value Set: Binding: [Permission Status](https://www.hl7.org/fhir/valueset-permission-status.html) ([Required](https://www.hl7.org/fhir/terminologies.html#required))
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| [RelatedPerson](https://www.hl7.org/fhir/relatedperson.html) | [HealthcareService](https://www.hl7.org/fhir/healthcareservice.html)) 0..1

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  + [rule](https://www.hl7.org/fhir/permission-definitions.html#Permission.rule): [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) 0..\*
* [FamilyMemberHistory](https://www.hl7.org/fhir/familymemberhistory-definitions.html#FamilyMemberHistory) **(**<https://www.hl7.org/fhir/familymemberhistory.html>**)** 
  + **These are the family member’s health records playing a vital role in some infectious disease outbreak or to monitor genetic diseases like diabetes and cardiac disease status reports. It stores the vital information of all the family members and maintains a family health history.**
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
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[OperationDefinition](https://www.hl7.org/fhir/operationdefinition.html)) 0..\*

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  + This helps to understand prescription needs of patients.
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  + **This helps to book an appointment between the user and the patient if the user is not well. It will also store all the previous appointments and their prescriptions.**
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* [DiagnosticReport](https://www.hl7.org/fhir/diagnosticreport-definitions.html#DiagnosticReport) **(**<https://www.hl7.org/fhir/diagnosticreport.html>**)** [DiagnosticReport](https://www.hl7.org/fhir/diagnosticreport-definitions.html#DiagnosticReport)
  + **It stores date when the diagnostic was done along with the past diagnostics. It will also store the report generated by the doctor after the assessment of the patient.**
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
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[Medication](https://www.hl7.org/fhir/medication.html) | [Substance](https://www.hl7.org/fhir/substance.html) | [BiologicallyDerivedProduct](https://www.hl7.org/fhir/biologicallyderivedproduct.html)) 0..1

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* [Organization](https://www.hl7.org/fhir/organization-definitions.html#Organization) **(**<https://www.hl7.org/fhir/organization.html>**)** [DomainResource](https://www.hl7.org/fhir/domainresource.html)
  + **This stores all the information about the organizations, institutions, companies that are involved in healthcare settings.**
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
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* + [qualification](https://www.hl7.org/fhir/organization-definitions.html" \l "Organization.qualification)**:** [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) 0..\*
  + [partOf](https://www.hl7.org/fhir/organization-definitions.html" \l "Organization.partOf" \o "Organization.partOf : The organization of which this organization forms a part.): [Reference](https://www.hl7.org/fhir/references.html#Reference)([Organization](https://www.hl7.org/fhir/organization.html)) 0..1
* [CodeSystem](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem) **(**<https://www.hl7.org/fhir/codesystem.html>**)** [DomainResource](https://www.hl7.org/fhir/domainresource.html)
  + **This code system enables app to monitor the blood sugar level of the user all the time and generate alerts if needed.**
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
  + [url](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.url): [uri](https://www.hl7.org/fhir/datatypes.html#uri) 0..1
  + [version](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.version): [string](https://www.hl7.org/fhir/datatypes.html#string) 0..1
  + [copyright](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.copyright)**:** [markdown](https://www.hl7.org/fhir/datatypes.html#markdown) **0..1**
  + [name](https://www.hl7.org/fhir/patient-definitions.html#Patient.name)**:** [string](https://www.hl7.org/fhir/datatypes.html#string) **0..1**
  + [status](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.status): [code](https://www.hl7.org/fhir/datatypes.html#code) 0..1
  + [date](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.date): [dateTime](https://www.hl7.org/fhir/datatypes.html#dateTime) 0..1
  + [filter](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.filter): [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) 0..\*
  + [concept](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.concept): [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) 0..\*
  + [contact](https://www.hl7.org/fhir/codesystem-definitions.html#CodeSystem.contact): [ContactDetail](https://www.hl7.org/fhir/metadatatypes.html#ContactDetail) 0..\*
* **Observation (**<https://www.hl7.org/fhir/observation.html)> [DomainResource](https://www.hl7.org/fhir/domainresource.html)
  + **This component stores information such as height, weight, or other parameters that are vital to the**
  + **Patient’s disease. It also stores clinical information after assessment and identified symptoms.**
  + [identifier](https://www.hl7.org/fhir/patient-definitions.html#Patient.identifier)**:** [Identifier](https://www.hl7.org/fhir/datatypes.html#Identifier)0..\*
  + [instantiates[x]](https://www.hl7.org/fhir/observation-definitions.html#Observation.instantiates_x_): [canonical](https://www.hl7.org/fhir/datatypes.html#canonical)([ObservationDefinition](https://www.hl7.org/fhir/observationdefinition.html)) [Reference](https://www.hl7.org/fhir/references.html#Reference)([ObservationDefinition](https://www.hl7.org/fhir/observationdefinition.html)) 0..1
  + [triggeredBy](https://www.hl7.org/fhir/observation-definitions.html#Observation.triggeredBy): [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) 0..\*
  + [status](https://www.hl7.org/fhir/observation-definitions.html#Observation.status): [code](https://www.hl7.org/fhir/datatypes.html#code) 1..1
  + [referenceRange](https://www.hl7.org/fhir/observation-definitions.html#Observation.referenceRange)**:** [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) **0..\***
  + [component](https://www.hl7.org/fhir/observation-definitions.html#Observation.component): [BackboneElement](https://www.hl7.org/fhir/types.html#BackBoneElement) **0..\***
  + [telecom](https://www.hl7.org/fhir/patient-definitions.html#Patient.telecom)**:** [ContactPoint](https://www.hl7.org/fhir/datatypes.html#ContactPoint) **0..\***
  + [code](https://www.hl7.org/fhir/observation-definitions.html#Observation.code): [CodeableConcept](https://www.hl7.org/fhir/datatypes.html#CodeableConcept) 1..1
* [Medication](https://www.hl7.org/fhir/medication.html) **(**<https://www.hl7.org/fhir/medication.html>**)**
  + **This stores all the medicinal data or medicine codes that the doctor prescribes to the patient.**
* [Device](https://www.hl7.org/fhir/device.html) **(**<https://www.hl7.org/fhir/device.html>**)**
  + **The device stores the code Systems and other data files that are crucial to monitor, assess, analyze and share the data. It also stores the test reports generated by the clinics.**
* [SearchParameter](https://www.hl7.org/fhir/searchparameter-definitions.html#SearchParameter) **(**<https://build.fhir.org/searchparameter.html>**)**
  + **This enhances the accuracy to find the nearby hospitals, clinics or healthcare centers according to the customizations provided by the users over the parameters like, location, specialty, and/or budget.**
* [Location](https://www.hl7.org/fhir/location.html) **(**<https://www.hl7.org/fhir/location.html>**)**
  + **This resource gives information about the user’s and hospital’s location.**
* [Schedule](https://www.hl7.org/fhir/schedule.html)  **(**<https://build.fhir.org/schedule.html>**)**
  + **It helps to schedule an appointment with a doctor or healthcare provider.**
* [Slot](https://www.hl7.org/fhir/slot.html) (<https://www.hl7.org/fhir/slot.html>)
  + This resource confirms the slot of a patient to avail any services.
* [VerificationResult](https://www.hl7.org/fhir/verificationresult.html) (<https://www.hl7.org/fhir/verificationresult.html>)
  + This resource gives information about the user’s and hospital’s verification status.
* [ServiceRequest](https://www.hl7.org/fhir/servicerequest.html) (<https://www.hl7.org/fhir/servicerequest.html>)
  + This resource stores information about the services requested by the patient.
* [PaymentNotice](https://www.hl7.org/fhir/paymentnotice.html) (<https://build.fhir.org/paymentnotice.html>)
  + This resource manages **Represented** secure payment within the app.
* [Subscription](https://www.hl7.org/fhir/subscription.html) (<https://www.hl7.org/fhir/subscription.html)>
  + It stores the subscription status of the end user.

**Link To Shared Data Diagram (Figma):** [Click Here 👆](https://www.figma.com/board/5vG9jx0lHiEzw4PskY4Tsu/Use-Case-Diagram?node-id=0-1&t=0TuH66fOC7Cj74LX-1)

**Note: I have also tried to implement UML you can see it over the over Figma link.**

**IMPORTANT: Data Model is Given in Separate PDF.**