

# FHIR Workshop - Proposed Solution

## Theme:

We selected a non listed theme that we like better:

**Integrating transport services for ambulatory patient referrals and transfer to ensure efficient, safe, and coordinated patient movement between healthcare facilities or to and from their homes for appointments. This includes scenarios like inter-facility transfers, transfers for diagnostic imaging, specialist consultations, or discharge home with transport needs.**

## -----Part 1: Define Which Data Elements Are Needed

**Objective:** Identify the core clinical, demographic, and administrative data elements essential for coordinating patient transport services.

- **Patient Identification and Demographics:**
  - Patient ID (e.g., Medical Record Number - MRN)
  - Patient Name (First, Last, Middle)
  - Date of Birth
  - Gender
  - Contact Information (Phone, Email, Address)
  - Emergency Contact Information
  - Next of Kin
  - Justification: Essential for identifying the correct patient, communication, and logistical planning.
- **Referral/Transfer Details:**
  - Referring Facility/Department/Provider
  - Receiving Facility/Department/Provider
  - Reason for Referral/Transfer (e.g., specialist consultation, diagnostic imaging, inter-facility transfer, discharge home)
  - Urgency/Priority (e.g., routine, urgent, emergent)
  - Requested Date and Time of Transport
  - Justification: Provides the context for the transport, who is involved, and the required timeline.
- **Clinical Information Relevant to Transport:**

- Patient Clinical Status (e.g., stable, vital signs, mobility status - ambulatory, wheelchair, stretcher)
- Special Equipment Needs (e.g., oxygen, IV pump, ventilator, medical escort)
- Infection Control Precautions (e.g., isolation status)
- Known Allergies
- Relevant Diagnoses (e.g., mobility impairment, respiratory issues)
- Medications relevant to transport (e.g., sedatives, pain medication)
- Justification: Crucial for determining the appropriate mode of transport, necessary medical personnel, and ensuring patient safety during transit.
- **Logistical Information:**
  - Origin Address (Street, City, State, Zip)
  - Destination Address (Street, City, State, Zip)
  - Preferred Transport Method (if any, e.g., personal car, ambulance, taxi)
  - Insurance/Payer Information (for billing transport services)
  - Booking Status (e.g., requested, confirmed, dispatched, en route, completed, cancelled)
  - Transport Provider Details (if assigned)
  - Estimated Time of Arrival (ETA)
  - Justification: Enables the actual coordination and execution of the transport.
- **Consent and Authorization:**
  - Patient Consent for Transport
  - Consent for Information Sharing
  - Justification: Legal and ethical requirement for patient care and data exchange.

**Considerations:** Granularity needs to be sufficient to inform transport decisions without overwhelming the transport provider with irrelevant clinical details. Data sources would include EHRs, hospital ADT systems, scheduling systems, and potentially patient self-reported information.

## -----Part 2: Define Which FHIR Resources Should You Use

**Objective:** Map the identified data elements to appropriate FHIR resources and profiles.

Here's how we'd map the data elements to suitable FHIR resources:

- **Patient:** For patient identification, demographics, contact information, and emergency contacts.
  - *Profiles:* US Core Patient profile (for common demographic data).
  - *Example:* `Patient.name`, `Patient.address`, `Patient.telecom`, `Patient.gender`, `Patient.birthDate`, `Patient.contact`.
- **ServiceRequest:** To capture the referral/transfer request, including the reason, urgency, requested date/time, and referring/receiving parties.

- *Example:* `ServiceRequest.subject` (references Patient),  
`ServiceRequest.requester` (references Practitioner/Organization),  
`ServiceRequest.performer` (references Organization for transport provider),  
`ServiceRequest.reasonCode`, `ServiceRequest.occurrenceDateTime`,  
`ServiceRequest.status`, `ServiceRequest.priority`.
- **Appointment/Slot:** To manage the scheduled time and duration for the transport service.
  - *Example:* `Appointment.status`, `Appointment.participant` (including Patient, transport provider, and potentially originating/destination locations),  
`Appointment.start`, `Appointment.end`.
  - *Slot* can be used by transport providers to indicate available transport times.
- **Location:** For capturing the origin and destination addresses.
  - *Example:* `Location.address`, `Location.name` (e.g., "Hospital A Main Entrance", "Patient's Home").
- **Condition:** To represent relevant diagnoses affecting transport needs (e.g., "Mobility Impairment", "Oxygen Dependent").
  - *Example:* `Condition.code`, `Condition.subject` (references Patient).
- **Observation:** For capturing specific clinical status points relevant to transport (e.g., "Mobility Status", "Oxygen Saturation on Room Air", "Isolation Status").
  - *Example:* `Observation.code` (e.g., LOINC code for mobility status),  
`Observation.valueString`/`valueCodeableConcept`, `Observation.subject` (references Patient).
- **AllergyIntolerance:** For any known allergies that might impact transport or require specific precautions.
  - *Example:* `AllergyIntolerance.code`, `AllergyIntolerance.patient`.
- **MedicationRequest:** If specific medications need to be administered during transport or indicate a need for medical escort (e.g., continuous infusions).
  - *Example:* `MedicationRequest.medication`, `MedicationRequest.subject`.
- **Coverage:** For insurance and payer information related to transport billing.
  - *Example:* `Coverage.beneficiary` (references Patient), `Coverage.payer`,  
`Coverage.type`.
- **Consent:** To record patient consent for transport and data sharing.
  - *Example:* `Consent.patient`, `Consent.scope`, `Consent.provision`.
- **Bundle:** To aggregate multiple related FHIR resources (e.g., a "Transport Request Bundle" containing the ServiceRequest, Patient, relevant Conditions, Observations, and Locations). This is particularly useful for sending a complete transport request.

## FHIR Profile Considerations:

- **US Core Profiles:** Highly applicable for demographic data (Patient), clinical data (Condition, Observation, AllergyIntolerance). These provide a baseline for interoperability within the US.
- **Custom Profiles/Extensions:** If certain granular transport-specific data elements don't fit into existing FHIR attributes, custom profiles or extensions might be necessary (e.g.,

specific vehicle type requested, number of escorts required beyond a simple boolean).  
However, prioritize standard FHIR elements first.

**Example of Representation (Simplified ServiceRequest for Transport):**

```
{
  "resourceType": "ServiceRequest",
  "id": "transport-request-123",
  "status": "active",
  "intent": "order",
  "category": [
    {
      "coding": [
        {
          "system": "http://terminology.hl7.org/CodeSystem/service-type",
          "code": "trans",
          "display": "Transport"
        }
      ]
    }
  ],
  "subject": {
    "reference": "Patient/example-patient-456"
  },
  "occurrenceDateTime": "2025-07-01T10:00:00-05:00",
  "requester": {
    "reference": "Practitioner/dr-smith"
  },
  "performer": [
    {
      "reference": "Organization/city-ambulance-services"
    }
  ],
  "reasonCode": [
    {
      "coding": [
        {
          "system": "http://snomed.info/sct",
          "code": "308292003",
          "display": "Transfer of patient (procedure)"
        }
      ]
    }
  ],
  "text": "Transfer to specialist clinic for cardiology consultation"
}
```

```

"locationReference": [
  {
    "reference": "Location/hospital-a-emergency-exit",
    "type": "origin"
  },
  {
    "reference": "Location/specialist-clinic-front-desk",
    "type": "destination"
  }
],
"note": [
  {
    "text": "Patient is wheelchair bound and requires oxygen during transport. Needs medical escort."
  }
]
}

```

## -----Part 3: Define Which Medical Terminologies Should Be Applied for the Coded Elements

**Objective:** Specify the standardized medical terminologies and code systems to be used for coded data elements.

### Tasks:

For coded data elements identified in Part 1 and mapped to FHIR resources in Part 2, we will apply the following standardized medical terminologies and code systems:

- **Diagnoses and Reasons for Referral/Transfer:**
  - **SNOMED CT (Systemized Nomenclature of Medical Rationale):** A comprehensive, clinically-relevant terminology for diagnoses, procedures, and other clinical concepts. Widely used in EHRs and for clinical data exchange.
    - *Justification:* Provides granular and standardized codes for a vast range of medical conditions and reasons for transfer, supporting detailed analysis and interoperability.
    - *Example:* Using SNOMED CT codes for specific diagnoses (e.g., "Fracture of femur," "Acute myocardial infarction") or reasons for transfer (e.g., "Transfer of patient," "Referral to specialist").
- **Procedures and Services (e.g., Transport Type):**

- **CPT (Current Procedural Terminology):** Primarily used in the United States for billing medical procedures and services. While not strictly a medical terminology for clinical content, it can be relevant for coding the *type* of transport service provided if it aligns with billing codes.
  - *Justification:* Relevant if the solution needs to integrate with billing systems that use CPT codes for transport services.
- **SNOMED CT:** Can also be used for coding procedures related to patient transport (e.g., "Ambulance transport").
  - *Justification:* Provides a clinical perspective on the transport procedure itself.
- **Medications:**
  - **RxNorm:** A standardized nomenclature for drugs and drug products in the United States.
    - *Justification:* Essential for accurately identifying and exchanging information about medications relevant to patient transport.
  - **unii (Unique Ingredient Identifier):** Provides a unique identifier for the active ingredients of medications.
    - *Justification:* Supports precise identification of drug components.
- **Lab Results and Observations (e.g., Mobility Status, Oxygen Saturation):**
  - **LOINC (Logical Rationale Identifiers Names and Codes):** A universal standard for identifying medical Rationale, observations, and clinical measurements.
    - *Justification:* Provides standardized codes for various observations and measurements taken during or relevant to transport, ensuring consistent interpretation of data.
    - *Example:* Using LOINC codes for "Mobility Status," "Oxygen Saturation," "Blood Pressure."
  - **SNOMED CT:** Can complement LOINC for coding the *values* of observations (e.g., SNOMED CT code for "Wheelchair bound" as a value for a LOINC "Mobility Status" observation).
    - *Justification:* Provides clinical context for the observation values.
- **Allergies:**
  - **SNOMED CT:** Used for coding specific allergens.
    - *Justification:* Provides a standardized way to record and exchange information about patient allergies.
- **Locations (e.g., Facility Type):**
  - **Healthcare Facility Taxonomy:** A standardized classification of healthcare facility types.
    - *Justification:* Useful for categorizing origin and destination facilities.
- **Administrative Codes (e.g., Urgency, Priority, Status):**
  - **FHIR CodeSystems:** FHIR defines various CodeSystems for administrative concepts like `ServiceRequest.priority`, `ServiceRequest.status`, `Appointment.status`.

- *Justification:* Using FHIR's own CodeSystems ensures consistency and interoperability within the FHIR framework.

### Mapping and Application:

- For each coded data element identified in Part 1, we will explicitly map it to the most appropriate terminology and code system.
- When creating FHIR resource instances (as described in Part 2), the `coding` element within various attributes (e.g., `Condition.code`, `Observation.code`, `ServiceRequest.reasonCode`) will be populated with codes from the selected terminologies, including the `system` URI and the `code` value.
- We will prioritize widely adopted and international standards like SNOMED CT and LOINC to maximize interoperability.

## -----Part 4: Define Which Architectural Components Your Project Will Require

**Objective:** Outline the key architectural components needed to implement the integrated transport services solution

The solution will require a set of interconnected architectural components to handle data exchange, processing, and service coordination:

- **FHIR Server:**
  - *Role:* The central data repository for all FHIR resources (Patient, ServiceRequest, Appointment, Location, etc.). It will handle storing, retrieving, and managing FHIR data.
  - *Requirements:* Must support the relevant FHIR resources and profiles, provide a secure API for data access, and potentially support FHIR subscriptions for real-time updates.
- **Data Integration Layer/ETL:**
  - *Role:* Responsible for extracting data from various source systems (EHRs, ADT systems, scheduling systems), transforming it into FHIR format, and loading it into the FHIR server. Also handles mapping medical terminologies.
  - *Requirements:* Needs connectors to different source systems, data transformation capabilities (including terminology mapping), error handling, and monitoring.
- **Transport Request Management System:**

- *Role:* A dedicated application or module to manage the lifecycle of transport requests. This includes creating, updating, cancelling, and tracking requests. It will interact with the FHIR server to retrieve and store request data.
- *Requirements:* User interface for healthcare providers to submit and manage requests, business logic for validating requests, integration with the FHIR server.
- **Transport Provider Gateway/API:**
  - *Role:* An interface for external transport service providers to receive transport requests, update status (e.g., dispatched, en route, completed), and provide estimated times of arrival (ETAs).
  - *Requirements:* Secure API for external access, ability to receive and send FHIR ServiceRequest and Appointment resources (or mapped equivalents), mechanisms for status updates and ETA communication.
- **Scheduling and Dispatching Engine:**
  - *Role:* A component that assists in scheduling and dispatching transport requests to available transport providers based on factors like urgency, location, patient needs, and provider availability.
  - *Requirements:* Algorithms for optimization, real-time visibility of provider availability and location (if possible), integration with the Transport Provider Gateway.
- **Monitoring and Alerting System:**
  - *Role:* Provides real-time monitoring of transport request status, identifies potential delays or issues, and generates alerts to relevant stakeholders (healthcare providers, patients, transport providers).
  - *Requirements:* Dashboards for visualization, configurable alert rules, notification mechanisms (email, SMS, in-app).
- **Security and Access Control:**
  - *Role:* Ensures the confidentiality, integrity, and availability of patient data. Manages user authentication, authorization, and data encryption.
  - *Requirements:* Compliance with healthcare regulations (e.g., HIPAA), robust authentication and authorization mechanisms (e.g., OAuth, SMART on FHIR), audit trails.
- **User Interfaces:**
  - *Role:* Provides interfaces for different users:
    - **Healthcare Provider Interface:** To submit, view, and manage transport requests.
    - **Transport Provider Interface:** To receive, accept, update, and complete transport assignments.
    - **Patient Interface (Optional):** To view their scheduled transport, receive notifications, and potentially provide consent.
  - *Requirements:* User-friendly design, mobile compatibility, role-based access to information.



**Architectural Style:** A micro services-based architecture could be suitable, with each component (FHIR server, Data Integration, Request Management, etc.) implemented as a separate service to promote scalability and maintainability

## -----Part 5: Define Which Kind of Team Will You Need to Implement

**Objective:** Identify the key roles and expertise required to implement and maintain the integrated transport services solution.

A multidisciplinary team with a range of skills will be essential for successful implementation:

- **Project Manager:**
  - *Role:* Oversees the entire project, manages timelines, resources, and budget, and facilitates communication between team members and stakeholders.
  - *Skills:* Strong organizational, leadership, and communication skills, experience in healthcare IT projects.
- **Healthcare Domain Experts:**
  - *Role:* Provides expertise on clinical workflows, patient needs, medical terminologies, and regulatory requirements related to patient transport and referrals.
  - *Skills:* Clinical background (e.g., nurse, physician, medical administrator), in-depth understanding of healthcare processes.
- **FHIR Experts:**
  - *Role:* Specializes in the FHIR standard, including resource modeling, profile creation, API usage, and interoperability best practices.
  - *Skills:* Deep knowledge of FHIR specifications, experience in implementing FHIR-based solutions.
- **Software Developers:**
  - *Role:* Designs, builds, and tests the various architectural components, including the FHIR server