Building Interoperable Clinical Pathways through Standards and Modeling: Update from Academic and Professional Education (APE) Group

OMG BPM+ Health Meeting, March 24, 2021

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Angela Reilly,
Ann Nguyen, MS TM, PMP & LSSB
Disclosure

This material was presented at the following conferences:


Outline and Speakers

1. About BPM+ Health & Academic & Professional Education (APE) Group, *Lee Wise*
2. Standardizing Clinical Pathways and Data Templates, *Nicole Miller*
3. Standardized APE Educational Projects Demonstrations:
   
   **Pilot Projects:**
   - Patient Registration, *Anna Orlova*
   - Child Sex Trafficking, *Alison Lieb*
   - Dental Referral, *Angela Reilly*

   **Future Projects**
   - Inpatient Falls Prevention, *Ann Nguyen*
   - Revenue Integrity, *Lee Wise*

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4. Collaboration with BPM+ Health & APE, Lee Wise
About BPM+ Health & Academic & Professional Education (APE) Group

Lee Wise
Clinch Valley Medical Center
Co-chair, BPM+ Health APE Group
BPM+ HEALTH

Putting into place industry approaches and tools based on open standards, centered on a collaborative community of practice, can help our ecosystem communicate needs and knowledge in a common way, making it easier for healthcare providers to adopt and apply best practices.
The Problem

- Healthcare guidelines & best practices for clinical pathways are not supported consistently by the electronic health record (EHR)
- Every healthcare organization implements clinical pathways in EHR in a proprietary fashion
- Adoption of standards-based practices for clinical documentation including clinical pathways representation is difficult and inconsistent

The Solution:

**Business Process Management (BPM) +Health** offers a standards-based approach of modeling clinical pathways and data templates using
- modeling language standards for workflow
- information content standards for data templates, e.g. HL7 Fast Healthcare Interoperability Resources (FHIR)
What is BPM+ Health:

- A member-driven community of practice
- A place to collaborate to advance the “state of electronic practice” with clinicians and vendors
- Open environment in which anyone may engage
- Standards-based
- Tools based
- A collection of passionate, engaged, people advancing the next generation of health care and Health Information Technology (HIT)
What is MDMI - Model Driven Message Interoperability
ACADEMIC & PROFESSIONAL EDUCATION WORKING GROUP

JOIN THIS GROUP
SIGN ME UP

CO-CHAIRS
Dr. Anna Griswold, Tufts University
Lee Wise, MS, RHIA CHCO

BPM+ HEALTH WORKING GROUPS
- Authoring Working Group
- Implementer Working Group
- Methodology Working Group
- Institutional Adoption Working Group
- Academic and Professional Education Working Group

ACADEMIC & PROFESSIONAL EDUCATION WORKING GROUP
Healthcare organizations' Clinical Documentation Improvement (CDI) professionals, organizations' informatics and analytics staff, academicians, vendors' business analysts, and standards developers join the Academic and Professional Education Working Group.

This group will:
- Assess best practices for academic, professional development, and vocational education in standards-based health information technology (HIT) including the use of BPM+ standards
- Develop curriculum and content for educational modules on computable clinical pathways development and adoption
- Develop tutorials and materials for educational webinars, presentations, and online training
- "Train the trainers" to use and deliver these materials in academic courses, vocational training, and conferences

With the goal of building a workforce to participate in:
- Developing standards-based computable pathways at healthcare organizations
- Building standards for computable clinical pathways at SDOs
- Implementing standardized, computable clinical pathways in HIT products

WORK PRODUCTS
- Strategy and charter document for the Academic & Professional Education Working Group
- Student Capstone Project with Duke University School of Nursing - Identification and Care Coordination of Child Sex Trafficking Victims in the Emergency Department - Using BPM+ to Translate Knowledge into Clinical Decision Support (poster)
- Presentation at AHIMA 2020 conference - Teaching CDI Through Interoperable Clinical Pathways Standards and Modeling Tools

RESOURCES
Visit the Academic & Professional Education Working Group’s collaboration site.

https://www.bpm-plus.org/working-groups/academic-professional-education.htm
Goal: Build a proficient health workforce to
• Develop standards-based computable pathways (workflow & dataflow) at healthcare, public health and research organizations
• Implement standardized, computable clinical pathways in HIT products

https://www.bpm-plus.org/working-groups/academic-professional-education.htm
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Standardizing Clinical Pathways and Data Templates

Nicole Miller
Miller And Miller Associates USA, LLC
Member, BPM+ Health APE Group
BPM+ Health for Data, Information & Knowledge Sharing in Healthcare

CONTENT: Knowledge → Information → Data → Information → Knowledge

Clinical Guidelines
Best Practices
Clinical Pathways
Data Templates
Data Sets & Value Sets
Coded Data

<table>
<thead>
<tr>
<th>CONTENT: Knowledge -&gt; Information -&gt; Data -&gt; Information -&gt; Knowledge</th>
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**BPM+ Health for Data, Information & Knowledge Sharing in Healthcare**

**Table: Care Delivery**

<table>
<thead>
<tr>
<th>Care Delivery</th>
<th>Clinical Documentation Improvement (CDI)</th>
<th>Coding</th>
</tr>
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<tbody>
<tr>
<td>Healthcare Knowledge</td>
<td>Clinical Pathways Documents</td>
<td>Data Analytics</td>
</tr>
<tr>
<td></td>
<td>Case Definition Templates</td>
<td>Quality Data</td>
</tr>
</tbody>
</table>

**References:**
BPM+ Health for Data, Information & Knowledge Sharing in Healthcare

Professional Associations:
- AAP
- ADA
- AMA
- AHA
- ANA

Health Organization Knowledge Artifacts

Guideline Manager

Data Analytics

Practice Manager

Data Sources

Integrating the Healthcare Enterprise (IHE). Patient Care Coordination Technical Framework.
www.ihe.net
BPM+ Health for Data, Information & Knowledge Sharing in Healthcare

Professional Associations:
1 - Clinical Guidelines
Best Practices
Publications

Health Organization Knowledge Artifacts
1 - Clinical Guidelines

Guideline Manager

Clinical Pathways, Standard Operational Procedures (SOP)

Practice Manager

Data Sources

3 - Data Capture Templates

Data Analytics

5 - Quality Measures
Public Health Reports
New Knowledge

6 - Updated Clinical Guidelines

Decision Support Algorithms

Integrating the Healthcare Enterprise (IHE). Patient Care Coordination Technical Framework.
www.ihe.net
# BPM+ Health APE Methodology

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▪ Information Content Standards, eg: HL7 FHIR resources for data sets  
▪ Information Exchange Standards, eg: HL7 version 2.x  
▪ Identifier Standards, eg: NPI  
▪ Privacy and Security Standards, eg: consent, ATNA  
▪ Functional Standards, eg: Use Cases  
▪ Business Standards: guidelines, best practices publications |
| 4  | Test and Evaluate IT Solution                | Specify IT solution success metrics and evaluation plan |
| 5  | Document Requirements                        | Specify Requirements (items 1-4) in the Requirement Analysis Document |

HL7 – Health Level Seven; FHIR – Fast Healthcare Interoperability Resources; ICD – International Classification of Diseases; SNOMED – Systematized Nomenclature of Medicine; LOINC – Logical Observations of Identifiers, Names and Codes; NPI – National Provider Identifier; ATNA – Audit Trial and Node Authentication
Business Case – Use Case Hierarchy

- Business case: problem
- Use cases: solution

Realization scenarios:
- Realization Scenario 1
- Realization Scenario 2
- Realization Scenario 3

Technical use cases:
- Option 1.1
- Option 1.2
- Option 1.3
- Option 1.4
- Option 2.1
- Option 2.2
- Option 2.3
- Option 3.1
- Option 3.2
- Option 3.3
- Option 4.1
- Option 4.2
- Option 4.3
- Option 5.1
- Option 6.1
- Option 6.2
- Option 7.1
- Option 7.2
- Option 7.3
- Option 7.4
- Option 7.5

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### Use Case: Communicable Disease Management, Outpatient Flow

**EHR**—Electronic Health Record, **LIMS**—Laboratory Information Management System, **HIE**—Health Information Exchange, **PHIS**—Public Health Information System

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<tr>
<th>User case name</th>
<th>Communicable disease management, outpatient flow</th>
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<td>Business actors:</td>
<td>Patient, physician, nurse, laboratory, public health (PH) agency</td>
</tr>
<tr>
<td>Technical actors:</td>
<td>EHR system, LIMS, HIE, PHIS</td>
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**Flow of events:**

1. Patient comes to physician with symptoms of a disease.
2. Physician provides clinical examination and assesses medical history. If patient’s symptoms require PH reporting without waiting for lab results, sends a report to PH agency.
3. Physician orders laboratory test. Nurse takes specimen and sends it to laboratory.
4. Laboratory performs ordered test on received specimens.
5. Laboratory sends results to physician and PH agency.
6. Physician re-examines clinical findings/diagnostic results and laboratory results; sends report to a PH agency.
7. Electronic confirmation of the report receipt is sent from PH to provider directly or via HIE.
8. PH agency links lab report and case report for a patient in PHIS.

**Data categories and dataflow:**

1. Demographics
2. Med. summary and PH case report, suspected case
3. Consent, in needed; test order
4. Test order
5. Test result, PH lab report
6. Lab report, PH case report, confirmed case
7. Notification of report availability and acknowledgement of receipt
8. Updated PH record

**Pre-condition**

EHR system, LIMS

**Post-condition**

PHIS

**Preferred timing**

Daily updates
# Use Case: Communicable Disease Management, Outpatient Flow

**EHR**—Electronic Health Record, **LIMS**—Laboratory Information Management System, **HIE**—Health Information Exchange, **PHIS**—Public Health Information System

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## Flow of events:

1. Patient comes to physician with symptoms of a disease.
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4. **Clinical Pathways: Workflow & Data Flow**
5. Physician re-examines clinical findings/diagnostic results and laboratory results; sends report to a PH agency.
6. Electronic confirmation of the report receipt is sent from PH to provider directly or via HIE.
7. PH agency links lab report and case report for a patient in PHIS.
8. PH agency links lab report and case report for a patient in PHIS.

**Data categories and dataflow**

1. Demographics
2. Med. summary and PH case report, suspected case
3. Consent: in needed
4. Data by Event
5. Test result, PH lab report
6. Lab report, PH case report, confirmed case
7. Notification of report availability and acknowledgement of receipt
8. Updated PH record

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<td>PHIS</td>
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<td>Daily updates</td>
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Data Templates

HL7 Fast Healthcare Interoperability Resources (FHIR) Resource List:
https://www.hl7.org/fhir/resourcelist.html
Data Templates

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## 8.1.2 Resource Content

<table>
<thead>
<tr>
<th>Name</th>
<th>Flags</th>
<th>Cardinality</th>
<th>Type</th>
<th>Description &amp; Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td></td>
<td></td>
<td>DomainResource</td>
<td>Information about an individual or animal receiving health care services</td>
</tr>
<tr>
<td>identifier</td>
<td>Σ</td>
<td>0..*</td>
<td>Identifier</td>
<td>An identifier for this patient</td>
</tr>
<tr>
<td>active</td>
<td>?!</td>
<td>0..1</td>
<td>boolean</td>
<td>Whether this patient's record is in active use</td>
</tr>
<tr>
<td>name</td>
<td>Σ</td>
<td>0..*</td>
<td>HumanName</td>
<td>A name associated with the patient</td>
</tr>
<tr>
<td>telecom</td>
<td>Σ</td>
<td>0..*</td>
<td>ContactPoint</td>
<td>A contact detail for the individual</td>
</tr>
<tr>
<td>gender</td>
<td>Σ</td>
<td>0..1</td>
<td>code</td>
<td>male</td>
</tr>
<tr>
<td>birthDate</td>
<td>Σ</td>
<td>0..1</td>
<td>date</td>
<td>AdministrativeGender (required)</td>
</tr>
<tr>
<td>deceased[x]</td>
<td>?!</td>
<td>0..1</td>
<td>boolean</td>
<td>Indicates if the individual is deceased or not</td>
</tr>
<tr>
<td>deceasedBoolean</td>
<td></td>
<td></td>
<td>boolean</td>
<td></td>
</tr>
<tr>
<td>deceasedDateTime</td>
<td></td>
<td></td>
<td>dateTime</td>
<td></td>
</tr>
<tr>
<td>address</td>
<td>Σ</td>
<td>0..*</td>
<td>Address</td>
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<tr>
<td>maritalStatus</td>
<td></td>
<td>0..1</td>
<td>CodeableConcept</td>
<td>Marital status of a patient</td>
</tr>
<tr>
<td>multipleBirth[x]</td>
<td></td>
<td>0..1</td>
<td>boolean</td>
<td>Whether patient is part of a multiple birth</td>
</tr>
</tbody>
</table>

### Structure

- **Name**: HL7 FHIR Patient Resource
- **URL**: [https://www.hl7.org/fhir/resourcelist.html](https://www.hl7.org/fhir/resourcelist.html)
Information Systems Development Process: Requirement Elicitation = Informatics Approach

- Elicit Reqs
- Design
- Develop
- Test
- Implement
- Evaluate
- Deploy Operate
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Standardized APE Educational Projects: Demonstrations

Business Case: PATIENT REGISTRATION

Anna Orlova, Lee Wise, Nicole Miller
Tufts University School of Medicine, Clinch Valley Medical Center, Miller And Miller Associates USA, LLC

Modeler: Michael Cesino
Visible Systems Corporation
Patient Registration is the process of checking-in a person to initiate the episode of care that relies on:

1. A standardized approach for patient registration (workflow) across healthcare facilities
2. A set of standardized data elements in the patient registration process (data flow)

Patient Registration is conducted according with the organizational policies and best practices to ensure:
- Identity of the person receiving care
- Completeness of patient registration data
- Correctness of patient registration data
- Eligibility for healthcare services
- Timely payment for healthcare services

Use Case (IT Solution)
Ensure completeness and correctness of patient information in EHR and ancillary systems/applications involved.

# Use Case: Patient Registration

## Flow of Events

1. Patient presents to Registrar.
2. Registrar identifies patient, validates/registers visit in the EHR.
3. EHR creates audit record of the encounter.
4. Patient completes necessary forms (paper/electronic) including consent forms.
5. Registrar or insurance verifier/billing staff verifies insurance information and generate bill and process payment or makes payment arrangements.
6. EHR communicates with the financial system to obtain/update patient insurance/billing information.
7. Registrar scans signed paper documents and any paper orders carried in by patient into the registration document repository.
8. Registrar validates/updates patient information in EHR, prints ID bracelet and barcoded documents, and signs the record with e-signature.
9. EHR updates audit record of the encounter.
10. Patient is sent to clinician.

## Data Categories

- **1&2.** Patient, provider, facility, visit, demographics, reason for visit
- **3.** Audit/Provenance visit record
- **4.** Consents (treatment, info sharing), etc.
- **5&6.** Insurance information, bill/payment, Advanced Beneficiary Notice (ABN)
- **7.** Scanned documents
- **8 &10.** Updated visit information

## Business Actors

- Patient (or patient’s legal representative), registrar, insurance verifier, billing staff, payor, clinician

## Technical Actors

- EHR; financial system, eg, HOST; payor system; registration document repository, eg OnBase

## Actors

<table>
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<tr>
<th>Name</th>
<th>Flow of Events</th>
<th>Data Categories</th>
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<td><strong>Business Actors</strong></td>
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</tr>
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</table>

## Pre-Conditions:
- EHR

## Post-Conditions:
- Registration Document Repository

## Preferred Timing:
- Daily updates
## Use Case: Patient Registration

### Business Actors:
- Patient (or patient’s legal representative)
- Registrar
- Insurance verifier
- Billing staff
- Payor
- Clinician

### Technical Actors:
- EHR
- Financial system, e.g., HOST
- Payor system
- Registration document repository, e.g., OnBase

### Flow of Events

1. Patient presents to Registrar.
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### Clinical Pathways:
**Workflow & Data Flow**

### Data Categories

1&2. Patient, provider, facility, visit, demographics, reason for visit
3. Audit/Provenance visit record
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8 & 10. Updated visit information

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**Pre-Conditions:** EHR Registration Document Repository

**Post-Conditions:** Daily updates

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[Diagram: BPM Health]
Data Categories & FHIR Resources: Examples

Use Case: Patient Registration

Data Categories

1&2. Patient, visit, clinician, facility demographics; reason for visit; consent to treat & information sharing

3. Audit/Provenance visit record

4. Consents (treatment, info sharing), etc.

FHIR Resources

Patient: https://www.hl7.org/fhir/patient.html
Facility: https://www.hl7.org/fhir/organization.html
Encounter: https://www.hl7.org/fhir/encounter.html
Episode of care: https://www.hl7.org/fhir/episodeofcare.html
Care team: https://www.hl7.org/fhir/careteam.html#9.7
Task: https://www.hl7.org/fhir/task.html#Task
Provenance: https://www.hl7.org/fhir/provenance.html
Audit: https://www.hl7.org/fhir/auditevent.html
Consent: https://www.hl7.org/fhir/consent.html
Modeling Workflow and Dataflow: Content Management Tools
Using Content Management Tools: Components

Planning Statements for Clinical Pathways
(Business Processes/Workflow & Data Flow Requirements)
- Specify: WHY (Policies, Values, Goals, Success Criteria)
  - WHO (Actors/Participants)
  - WHAT (Business Processes as Pathways (Workflow/Dataflow))

Business Processes Models
- Specify: HOW (Clinical Pathways Models, Workflow/Data Flow)

Data Models Templates (Entities and Relationships)
- Derive: WHAT (Data Sets & Rules from Clinical Pathways)
Planning Statements for Clinical Pathways


Planning Statement Outline

1. **PATIENT REGISTRATION** *(Business Event)*
   Patient Registration Business Case defines work process (workflow) and data needs (dataflow) for registering a person for an episode of care in a healthcare organization.

1.1 **WHY-Patient Registration Overview** *(Business Event)*
   Patient Registration is the process of checking-in a person to initiate the episode of care that relies on (1) a standardized approach for patient registration (workflow) across various healthcare facilities and (2) standardized data elements in the patient registration process (dataflow).

1.2 **WHY-Patient Registration Policy** *(Policy)*
   Conduct patient registration across healthcare organization’s departments according with the organizational policies and best practices supported by the professional organization(s), e.g.

1.3 **WHY-Patient Registration Value Statement** *(Value Statement)*
   Proper registration of the patient in the healthcare facility is a basis for reliable patient matching.

1.4 **WHY-Patient Registration Goal** *(Goal)*
   Improve completeness and correctness of patient information in EHR and ancillary systems/applications involved

1.5 **WHY-Patient Registration Success Criteria** *(Critical Success Factor)*
   1. Ensure identity of the person receiving care
   2. Ensure completeness of patient registration data
   3. Ensure correctness of patient registration data
   4. Ensure eligibility for healthcare services
   5. Ensure timely payment for healthcare services

1.6 **WHO-Patient Registration Billing Staff** *(Business Actor)*
   A person responsible for: a-verification of patient insurance information, b-generation of invoice for a visit; and c- obtaining payment (AO developed definition; to be verified with LW)

1.7 **WHO-Patient Registration Payor** *(Business Actor)*
   Insurers, including health plans, self-insured employer plans, and third party administrators, providing healthcare benefits to enrolled members and reimbursing provider organizations.

1.8 **WHO-Patient Registration Insurance Verifier** *(Business Actor)*
   A person responsible for
Business Process Model & Records

BPM+ Workflow Model & Patient Registration Record

Discussion

Name: Patient Registration Record
Type: Data Object

Description: Dataset
Attributes:
- patient: Undefined NULL
- name: Undefined NULL
- telecom: Undefined NULL
- gender: Undefined NULL
- birthdate: Undefined NULL
- address: Undefined NULL
- photo: Undefined NULL
- patient: Undefined NULL
- active: Undefined NULL
- maritalStatus: Undefined NULL
- contact: Undefined NULL
- communication: Undefined NULL
- generalPractitioner: Undefined NULL

Notes:
Locations:
- Name: Patient Registration - Walk in
- Type: Diagram
- System Boundary
Record Content Model & FHIR Standards
Publishing

[Image of a software interface with options for publishing models, uploading projects, and other functionalities.]
Publishing
Standardized APE Educational Projects: Demonstrations

Business Case: CHILD SEX TRAFFICKING

Katherine Ariano, Alison Lieb, Ruben Medalla

Informatics Capstone Project,
Duke University School of Nursing (DUSON)

Mentors: Anna Orlova, Lee Wise, Rachel Richesson

Tufts University School of Medicine,
Clinch Valley Medical Center, DUSON

Modeler: Michael Cesino
Visible Systems Corporation
Human Trafficking (HT) cases in both adults and children can be identified by clinicians during patient healthcare encounters [1], such as:

- Emergency Department (ED) Visits
- Inpatient Admission
- Outpatient Visits
- Telehealth Visits

Once a victim is identified, the next steps include:

- Case investigation
- Case management and evaluation including reporting to public health and law authorities as per jurisdictional policies [2]
- Case mitigation through appropriate service coordination

Use Case (IT Solution)

Automatic case detection in Electronic Health Records (EHR) system based on

- specified triggers: visit, age, chief complaint
- patient screening via a survey tool [3]

2. Florida: General Statutes (GS) § 39.201; Hawaii Revised Statutes (HRS) § 350-1, HRS § 577A; North Carolina: GS § 7B-301, GS § 90-21.5, GS § 14-318.6
### Identification of Child Sex Trafficking Victims in ED

#### Actors

**Business Actors**: Patient, Parent/Guardian/Companion, Registration Clerk, Clinicians, Social Worker/Case Manager, Interpreter Services, Primary Care Provider (PCP)

**Technical Actors**: EHR (NOTE: ADT and Registration Document Repository could be used for patient registration and legal health record), PCP EHR

#### Flow of Events

1. Patient with parent/guardian/companion presents to Emergency Department
2. Patient is registered by registrar and given armband information is entered in the EHR
3. Patient placed in Triage room. Clinician conducts triage, verifies/obtains patient’s information and enters information in EHR. NOTE: *in the case of Live-Threatening event, critical care is provided before triage & patient registration*
4. Patient is moved to treatment room, waiting room, or holding area, per facility protocol. Clinician is notified by EHR of patient location
5.1 If indication for CST based on clinician discretion in triage, EHR activates standing order for Greenbaum tool administration. 5.2 EHR generates alert to clinician to administer Greenbaum tool
6. Clinician administer the tool according with organizational policies and enters responses into EHR
7. Based on survey results: 7.1 If positive, EHR generates an alert to clinician for case investigation with social worker/case manager involvement. Clinician authorizes case investigation via signatures; 7.2 If negative, proceed with routine care
8. Clinician provides appropriate medical care as indicated based on patient’s chief complaint and enters information into EHR
9. EHR sends electronically visit summary/care plan to PCP to coordinate care

#### Data Categories

1 & 2. Patient, visit, clinician, facility demographics; reason for visit; consents to treat & information sharing
3. Chief complaint, weight, vital signs, medical/surgical history, allergies, current medications, acuity level; clinician discretion (of possible CST)
4. Room information, notification to clinician
5.1 Standing order for CST tool; 5.2 Alert to clinician with CST survey order
6. Patient, clinician demographics; Greenbaum tool survey data; for failure to screen, eg, refusal
7. Patient, clinician demographics; Greenbaum tool survey data. 7.1 Alert for case investigation and notification to social worker/case manager; 7.2 Notification to proceed with routine care
8. Encounter data, CPOE for labs and procedures, treatment documentation, lab and imaging results, ancillary entity demographics, care plan, medications, referrals, e-signatures
9. Visit summary, continuity of care document
# Identification of Child Sex Trafficking Victims in ED

## Actors

**Business Actors:** Patient, Parent/Guardian/Companion, Registration Clerk, Clinicians, Social Worker/Case Manager, Interpreter Services, Primary Care Provider (PCP)

**Technical Actors:** EHR (NOTE: ADT and Registration Document Repository could be used for patient registration and legal health record), PCP EHR

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---

**Pre-Condition:** EHR

**Post-Condition:** Primary Care Providers EHR
# Data Categories & FHIR Resources: Examples

## Use Case: Identification of Child Sex Trafficking Victims in ED

### Data Categories

**1 & 2.** Patient, visit, clinician, facility demographics; reason for visit; consent to treat & information sharing

### FHIR Resources

<table>
<thead>
<tr>
<th>Data Category</th>
<th>Resource URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td><a href="https://www.hl7.org/fhir/patient.html">https://www.hl7.org/fhir/patient.html</a></td>
</tr>
<tr>
<td>Facility</td>
<td><a href="https://www.hl7.org/fhir/organization.html">https://www.hl7.org/fhir/organization.html</a></td>
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<tr>
<td>Encounter</td>
<td><a href="https://www.hl7.org/fhir/encounter.html">https://www.hl7.org/fhir/encounter.html</a></td>
</tr>
<tr>
<td>Episode of care</td>
<td><a href="https://www.hl7.org/fhir/episodeofcare.html">https://www.hl7.org/fhir/episodeofcare.html</a></td>
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<td>Care team</td>
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<td>Consent</td>
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<tr>
<td>Chief complaint</td>
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</tr>
<tr>
<td>Practitioner</td>
<td><a href="https://www.hl7.org/fhir/practitioner.html">https://www.hl7.org/fhir/practitioner.html</a></td>
</tr>
<tr>
<td>Practitioner role</td>
<td><a href="https://www.hl7.org/fhir/practitionerrole.html#PractitionerRole">https://www.hl7.org/fhir/practitionerrole.html#PractitionerRole</a></td>
</tr>
<tr>
<td>Age, weight, vital signs (Observation)</td>
<td><a href="https://www.hl7.org/fhir/observation.html">https://www.hl7.org/fhir/observation.html</a></td>
</tr>
<tr>
<td>Questionnaire response</td>
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<tr>
<td>Substance</td>
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</tr>
<tr>
<td>Allergy intolerance</td>
<td><a href="https://www.hl7.org/fhir/allergyintolerance.html#AllergyIntolerance_Adverse">https://www.hl7.org/fhir/allergyintolerance.html#AllergyIntolerance_Adverse</a></td>
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<td>Adverse events</td>
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</tr>
</tbody>
</table>

Workflow Models

### Animated Diagram

- **ED Tech**
  - Patient checks into ED

- **Triage RN**
  - RN enters patient information in the EHR
  - **High Risk CC?**
    - **YES**
      - **PT age 10-18 yrs**
    - **NO**

- **CDS ALERT Administer Greenstein Survey & consult SW/CM**

- **SW/CM**
  - Notify community & public agencies
  - **DUH**

- **ED Clinician/RN**
  - Provide appropriate medical care based on CC
  - Safe patient ADT planning

- **Conditions of safety and privacy must be met before survey administration**

---

### Business Process (Workflow) Model

- **Patient presents to Emergency Department**
  - Patient is registered and given emergent patient information is entered in ADT & EHR
  - Patient placed in Triage Room, circulates physician, obtains patient's diagnosis of extent of patients' illness
  - Patient moved to treatment room, waiting room, or holding area, circulates radiologist or extent of patients’ location

- **CDS alert, patient’s pharmacy and allergy information is transferred to computerized Greenstein Tool**
  - Clinician separates patient from surgery, physician, or computerized Greenstein Tool

- **To validate patient, inform patient name and demographics**
  - Provide appropriate medical care. Clinician enters information into EHR
  - EHR generates summary care plan, clinician provides it signature
  - Clinician sends care plan to PCP
  - Discharge from ED

- **Yes**
  - Safe patient ADT planning
  - Provide appropriate medical care. Clinician enters information into EHR
  - EHR generates summary care plan, clinician provides it signature
  - Clinician sends care plan to PCP
  - Discharge from ED
  - Yes
Planning Statements for Clinical Pathways
Modeling Clinical Pathways in BPM+
Patient Registration Record Content in CST Use Case
Connect to Situational Data Directly from Business Process
Standardized APE Educational Projects: Demonstrations

Business Case: DENTAL REFERRAL

Angela Reilly
Informatics Capstone Project, Tufts University School of Nursing
Mentors: Anna Orlova, Nicole Miller, Anthony Magni, Carla Evans
Tufts University School of Medicine, Miller and Miller Associated USA, LLC, American Association of Orthodontists & American Dental Association
Modeler: Michael Cesino
Visible Systems Corporation
Dental care is a dynamic and collaborative clinical process that connects general dentists, specialists, and patients. Patient data needs to be accurate and safely transferred for enhanced provider/patient experiences throughout the patient visit components as follows:

1) Pre-visit/Post-visit: Office Operation
2) General Dental Visit
3) Specialist Visit

**Problem 1:** Lack of consensus on what/how data is captured during the dental visit

**Problem 2:** Lack of consensus on what data is needed/shared for referral process

**Use Case (IT Solution)**

To support the referral process by sending/receiving accurate patient data from Provider A to Provider B across multiple information systems in order to increase continuity of care and safely expedite the orthodontic referral process.

# Use Case Name: Orthodontic Referral – *Under Public Review*

## Actors

**Business Actors:** Patient (Pt), General Dentist (GD), Orthodontist (OD), Office Staff (OS), Dental Assistant (DA)

**Technical Actors:** GD Electronic Heath Record (EHR)-1, OD EHR-2, Health Information Exchange (HIE)

## Workflow

<table>
<thead>
<tr>
<th>Flow of events</th>
<th>Entry conditions: General Dentist EHR-1</th>
<th>Exit conditions: Orthodontist EHR-2</th>
<th>Data categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient schedules visit with GD via phone/web-portal. OS enters data into EHR-1</td>
<td>General Dentist EHR-1</td>
<td>1-2. Pt, GD, visit, facility demogr-cs, reason for visit, consents</td>
<td>1-2. Pt, GD, visit, facility demogr-cs, reason for visit, consents</td>
</tr>
<tr>
<td>3. GD examines the patient. Dental Assistant enters data into EHR-1</td>
<td></td>
<td>4-5. Referral</td>
<td>4-5. Referral</td>
</tr>
<tr>
<td>4. GD refers patient to OD for treatment. Referral is created in EHR-1</td>
<td></td>
<td>6. Referral; visit confirmation</td>
<td>6. Referral; visit confirmation</td>
</tr>
<tr>
<td>5. GD EHR-1 sends referral data to OD EHR-2 directly or via HIE</td>
<td></td>
<td>7. Pt, OD, visit, facility demogr-s, reason for visit, consent</td>
<td>7. Pt, OD, visit, facility demogr-s, reason for visit, consent</td>
</tr>
<tr>
<td>6. OD reviews the referral data and confirms the visit</td>
<td></td>
<td>8. Medical history, procedure data</td>
<td>8. Medical history, procedure data</td>
</tr>
<tr>
<td>7. OD’s OS repeats steps 2-3 above for visit scheduling &amp; registration. Data are entered in EHR-2</td>
<td></td>
<td>9-10. OD treatment data</td>
<td>9-10. OD treatment data</td>
</tr>
<tr>
<td>8. OD examines the patient, performs the procedure; DA enters data in EHR-2</td>
<td></td>
<td>11. Care Plan</td>
<td>11. Care Plan</td>
</tr>
<tr>
<td>9. EHR-2 sends to EHR-1 orthodontist visit data directly or via HIE.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. GD reviews treatment data and uploads data into EHR-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. EHR-1 generates the Care Plan for follow-up</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Quality

Data verification and updates upon availability
**Use Case Name:** Orthodontic Referral – *Under Public Review*

| Actors | Business Actors: Patient (Pt), General Dentist (GD), Orthodontist (OD), Office Staff (OS), Dental Assistant (DA)  
Technical Actors: GD Electronic Health Record (EHR)-1, OD EHR-2, Health Information Exchange (HIE) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow of events</td>
<td>Workflow</td>
</tr>
</tbody>
</table>
| | 1. Patient schedules visit with GD via phone/web-portal. OS enters data into EHR-1.  
2. Patient comes to GD. OS register patient and enter/update patient data in EHR-1.  
3. GD examines the patient. Dental Assistant enters data into EHR-1.  
4. GD refers patient to OD for treatment. Referral is created in EHR-1.  
5. GD EHR-1 sends referral data to OD EHR-2 directly or via HIE.  
6. OD reviews the referral.  
7. OD's OS repeats steps 2-3 above for visit scheduling & registration. Data are entered in EHR-2.  
8. OD examines the patient, performs the procedure; DA enters data in EHR-2.  
9. EHR-2 sends to EHR-1 orthodontist visit data directly or via HIE.  
10. GD reviews treatment data and uploads data into EHR-1.  
11. EHR-1 generates the Care Plan for follow-up. | 1-2. Pt, GD, visit, facility demogr-cs, reason for visit, consents  
3. Med. history, chief complaint  
4. Referral  
7. Pt, OD, visit, facility demogr-s, reason for visit, consent  
8. Medical history, procedure data  
9-10. OD treatment data  
11. Care Plan |

**Clinical Pathways:** Workflow & Data Flow

**Entry conditions:** General Dentist EHR-1

**Exit conditions:** Orthodontist EHR-2

**Quality:** Data verification and updates upon availability
Data Categories & FHIR Resources: Examples

Use Case: Dental Referral

- Patient: https://www.hl7.org/fhir/patient.html
- Facility: https://www.hl7.org/fhir/organization.html
- Encounter: https://www.hl7.org/fhir/encounter.html
- Episode of care: https://www.hl7.org/fhir/episodeofcare.html
- Care team: https://www.hl7.org/fhir/careteam.html#9.7
- Task: https://www.hl7.org/fhir/task.html#Task
- Consent: https://www.hl7.org/fhir/consent.html
- Chief complaint: https://www.hl7.org/fhir/condition.html
- Practitioner: https://www.hl7.org/fhir/practitioner.html
- Practitioner role: https://www.hl7.org/fhir/practitionerrole.html#PractitionerRole
- Allergy intolerance: https://www.hl7.org/fhir/allergyintolerance.html#AllergyIntolerance
- FamilyMemberHistory: https://www.hl7.org/fhir/familymemberhistory.html
- ServiceRequest: https://www.hl7.org/fhir/servicerequest.html

Data Categories

1-2. Pt, GD, visit, facility demographics, reason for visit, consents

3. Med. history, chief complaint

4-5. Referral
Patient

1. Patient schedules visit via portal/online

2. OS member inputs data into EHR-1

Office Staff Member

3. GD performs exam

4. DA-1 enters exam data into EHR-1

General Dentist

5. GD refers patient to orthodontist for treatment.

6. Referral created in EHR-1

7. OD confirms referral and enters exam data into EHR-2

Dental Assistant

8. DA-2 enters exam data into EHR-2

Orthodontist

9. EHR-2 sends data to EHR-1 directly

10. GD reviews OD data entry

11. EHR-1 generates Care Plan follow-up

Start

Finish
Standardized APE Educational Projects: Demonstrations

Business Case: INPATIENT FALL PREVENTION

Ann Nguyen, Henrik Berdel, Andrew Bernard, Kenneth Powel

University of Kentucky Healthcare
Inpatient Falls Prevention is the standard process of prevention trauma patient from falls

(1) a standardized approach for residents to educate patients and patient family on their fall prevention during an encounter (workflow) across Trauma surgery facilities and

(2) a set of standardized data elements on prediction of patient who is at risk of fall (data flow) and educational materials for the patients and caregivers

Predicted patient falls and education of patient on fall prevention is conducted according with the organizational policies and best practices to ensure

- Completeness of patient medical record data
- Correctness of patient medical record data
- Identity of the patient receiving falls prevention education
- Timely list of patients who are at risk of falls
- Timely education of patient/caregivers on fall risk and prevention

Use Case (IT Solution)
Ensure completeness and correctness of patient’s falls information in EHR and Tableau
<table>
<thead>
<tr>
<th>Name</th>
<th>Inpatient Falls Prevention – Under Public Review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actors</strong></td>
<td><strong>Data Categories</strong></td>
</tr>
<tr>
<td>Business Actors: Patient, Caregiver, Provider, Nurse</td>
<td>1. Patient, clinician, facility, visit demographics; chief complaint; reason for visit; consents; triage</td>
</tr>
<tr>
<td>Technical Actors: EHR, Tableau</td>
<td>2. Diagnosis types: Septic, Narcan (over-narcotized), intoxicated, Fall risk assessment score (Fall Score issue type), Traumatic brain injury, Delirium, Orthostatic hypotension, anemia/hypovolemia, long bone fractures (femur), GAIT</td>
</tr>
<tr>
<td><strong>Flow of Events</strong></td>
<td>3. Total Fall Risk Scores: Fallen in the past 6 mos (5 points); Age: &lt; 60 (0 pts), 60 – 69 (1pt), &gt;70 (2pt); Mental Status: confuse (1pt); Elimination: frequent toileting (2 pts); Urgency (2 pts); Mobility: New issue (2 pts); Requires assistance (walker, etc.) (2 pts); Meds: Narcotics (1pt), Sedatives (1pt), Diuretics (5 pts), Laxatives (1pt), Hypnotics (1pt), Insulin/Oral hypoglycemic (1 pt); Nurses’ observation (Low Risk 0-10 High Risk); High Fall Risk: score &gt;=13</td>
</tr>
<tr>
<td>1. Provider sees patient in Trauma</td>
<td>4. Daily Fall Risk email alert: Visit ID, Patient Name, Age, hospital department, patient bed, Fall Score issue type (see #2)</td>
</tr>
<tr>
<td>2. Provider examines patient, enters data to EHR and orders Fall Assessment</td>
<td>5. Daily Fall Risk email alert, education materials, education session record</td>
</tr>
<tr>
<td>3. Nurse uses the Baptist Health High-Risk Falls Assessment form to assess patient’s fall risk and enters data to EHR</td>
<td></td>
</tr>
<tr>
<td>4. Tableau performs daily query of EHR based on condition criteria (fall risk score, age, issue type) &amp; sends daily Fall Risk email alert to attending Providers</td>
<td></td>
</tr>
<tr>
<td>5. Providers receive daily Fall Risk email alert; educates patient/caregiver about fall risks and prevention; education is available in EHR</td>
<td></td>
</tr>
</tbody>
</table>

Pre-Conditions: EHR System
Post-Conditions: Education is documented in EHR
Preferred Timing: Daily
<table>
<thead>
<tr>
<th><strong>Name</strong></th>
<th><strong>Inpatient Falls Prevention – Under Public Review</strong></th>
</tr>
</thead>
</table>
| **Actors** | **Business Actors:** Patient, Caregiver, Provider, Nurse  
              **Technical Actors:** EHR, Tableau |
| **Flow of Events** |  
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2. Provider examines patient, enters data to EHR and orders Fall Assessment  
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4. Tableau performs daily query of EHR based on condition criteria (fall risk score, age, issue type) & sends daily Fall Risk email alert to attending Providers  
5. Providers receive daily Fall Risk email alert; educates patient/caregiver about fall risks and prevention; education is available in EHR  

**Clinical Pathways:** Workflow & Data Flow  

**Data Categories**  
1. Patient, clinician, facility, visit demographics; chief complaint; reason for visit; consents; triage  
2. Diagnosis types: Septic, Narcan (over-narcotized), intoxicated, Fall risk assessment score (Fall Score issue type), Traumatic brain injury, Delirium, Orthostatic hypotension, anemia/hypovolemia, long bone fractures (femur), GAIT  
3. Total Fall Risk Scores: Fallen in the past 6 mos (5 points); Age: < 60 (0 pts), 60 – 69 (1pt), >70 (2pt); Mental Status: Confuse (1pt); Elimination: Frequent toileting (2 pts); Urgency (2pts); Mobility: New issue (2 pts); Requires assistance (walker, etc.) (2pts); Meds: Narcotics (1pt), Sedatives (1pt), Diuretics (5pts), Laxatives (1pt), Hypnotics (1pt), Insulin/Oral hypoglycemic (1 pt); Nurses’ observation (Low Risk 0-10 High Risk); High Fall Risk: score >=13  

**Data by Event**  
4. Daily Fall Risk email alert: Visit ID, Patient Name, Age, hospital department, patient bed, Fall Score issue type (see #2)  
5. Daily Fall Risk email alert, education materials, education session record  

**Pre-Conditions:** EHR System  
**Post-Conditions:** Education is documented in EHR  
**Preferred Timing:** Daily
## Data Categories & FHIR Resources: Examples

### Use Case: Inpatient Falls Prevention – *Under Public Review*

#### Data Categories

1. Patient, clinician, facility, visit demographics; chief complaint; reason for visit; consents; triage

#### FHIR Resources

<table>
<thead>
<tr>
<th>Category</th>
<th>Resource Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td><a href="https://www.hl7.org/fhir/patient.html">https://www.hl7.org/fhir/patient.html</a></td>
</tr>
<tr>
<td>Facility</td>
<td><a href="https://www.hl7.org/fhir/organization.html">https://www.hl7.org/fhir/organization.html</a></td>
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<td>Encounter</td>
<td><a href="https://www.hl7.org/fhir/encounter.html">https://www.hl7.org/fhir/encounter.html</a></td>
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</tr>
<tr>
<td>Practitioner</td>
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<td>Practitioner role</td>
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<tr>
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</tr>
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<td>Task</td>
<td><a href="https://www.hl7.org/fhir/task.html">https://www.hl7.org/fhir/task.html</a></td>
</tr>
<tr>
<td>Consent</td>
<td><a href="https://www.hl7.org/fhir/consent.html">https://www.hl7.org/fhir/consent.html</a></td>
</tr>
<tr>
<td>Age, weight, vital signs</td>
<td><a href="https://www.hl7.org/fhir/observation.html">https://www.hl7.org/fhir/observation.html</a></td>
</tr>
</tbody>
</table>

BPM Model: INPATIENT FALLS PREVENTION

Under Development
Standardized APE Educational Projects: Demonstrations

Business Case: REVENUE INTEGRITY

Lee Wise, Anna Orlova, Nicole Miller

Clinch Valley Medical Center,
Tufts University School of Medicine,
Miller And Miller Associates USA, LLC
Revenue Integrity is the process of preventing recurring issues that cause compliance risks, and/or revenue loss utilizing

1. a standardized approach for effective processes
2. a set of standardized data elements for internal controls across the continuum of patient care.

Revenue Integrity is conducted according with the organizational policies and best practices to ensure

- Proper encounter documentation
- Encounters are scrubbed for information integrity
- Problem encounters are sent to be analyzed
- Denials are managed appropriately

Use Case (IT Solution)
Ensures proper and valid billing/payment for all procedures within the facility

<table>
<thead>
<tr>
<th>Name</th>
<th>Revenue Integrity, Acute Care, Inpatient – Under Development</th>
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<tbody>
<tr>
<td><strong>Actors</strong></td>
<td></td>
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<tr>
<td><strong>Business Actors:</strong></td>
<td>Revenue Integrity Analysts, Business Office, Coders, CDI, HIM, Clinicians, Payors</td>
</tr>
<tr>
<td><strong>Technical Actors:</strong></td>
<td>EHR; Legal Health Record (LHR); Registration Document Repository (OnBase) Coding system (3M); Data Scrubbers (eRequest, OPERA, T-System); Payor IS; Business Office IS (Host)</td>
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</tbody>
</table>
| **Flow of Events** | 1. Clinician has encounter with patient in acute care setting.  
2. Clinician documents visit information in the EHR.  
3. CDI reviews the record, queries clinicians for missing information, update the EHR  
4. EHR transfers information from Step 2 and 3 to Legal Health Record (LHR)  
5. HIM scans paper documents and adds them to LHR  
6. Coders review and code the encounter in EHR, queries clinicians to verify coding, finalize account, indicate to Business Office that account is ready for bill to be sent for payment, update the EHR and LHR (further details)  
7. Scrubber systems automatically verify information integrity overnight  
8. If correct, bill is sent for payment from EHR to Payor system  
9. If incorrect, Scrubber systems generate problem reports for Revenue Integrity Analyst to address  
10. Revenue Integrity Analyst address the problems in the reports (needs to be specified in further details), indicate to Business Office that bill is ready for payment or anticipated denial; bill is sent to the Payor system  
11. Payment received from the Payor. Business office apply payment, adjust the balance for insurance contract in HER and Business IS  
12. Payor send the denial letter. Repeat steps 10-11 3 time by appealing the denial. Business office writes the balance off in EHR and Business IS |
| **Data Categories** | 1. Patient, clinician, facility, visit demographics  
2,3,4. History & physical, discharge summary, progress notes, orders, operative reports, nursing notes, lab reports, imaging reports, consultations, medications, case mngt; CDI queries for missing information  
5. Paper documents  
6. Code (ICD, Snomed, Loinc, CPT, etc.); Coder queries to verify coding; notification to business office of final bill readiness  
7, 8, 9. Data Scrubbers Reports: 1-Charges Entered by Clinicians; 2-Missing Information and Internal Denial Report; 3-Observation Status Patient; Bill; Problem Reports  
10. Notification to business office of final bill readiness, or Anticipated denial  
11. Payment receipt  
12. Denial letter, appeal letter, data from steps 10-11 or balance write-off |

**Pre-Conditions:** EHR System  
**Post-Conditions:** EHR and Business IS  
**Preferred Timing:** Daily updates
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAP</td>
<td>American Academy of Pediatrics</td>
</tr>
<tr>
<td>ADA</td>
<td>American Dental Association</td>
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<tr>
<td>AHA</td>
<td>American Hospital Association</td>
</tr>
<tr>
<td>AMA</td>
<td>American Medical Association</td>
</tr>
<tr>
<td>ANA</td>
<td>American Nurses Association</td>
</tr>
<tr>
<td>ADT</td>
<td>Admission, Discharge, Transfer</td>
</tr>
<tr>
<td>CDI</td>
<td>Clinical Documentation Integrity</td>
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<tr>
<td>CPOE</td>
<td>Computerized Physician Order Entry</td>
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<tr>
<td>CST</td>
<td>Child Sex Trafficking</td>
</tr>
<tr>
<td>HIT</td>
<td>Health Information Technology</td>
</tr>
<tr>
<td>HIM</td>
<td>Health Information Management</td>
</tr>
<tr>
<td>ICD</td>
<td>International Classification of Diseases</td>
</tr>
<tr>
<td>MD</td>
<td>Medical Doctor</td>
</tr>
<tr>
<td>RN</td>
<td>Registered Nurse</td>
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<tr>
<td>PCP</td>
<td>Primary Care Provider</td>
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Outline and Speakers

1. About BPM+ Health & Academic & Professional Education (APE) Group, Lee Wise
2. Standardizing Clinical Pathways and Data Templates, Nicole Miller
3. Standardized APE Educational Projects Demonstrations:
   
   **Pilot Projects:**
   a. Patient Registration, Anna Orlova
   b. Child Sex Trafficking, Alison Lieb
   c. Dental Referral, Angela Reilly

   **Future Projects**
   a. Inpatient Falls Prevention, Ann Nguyen
   b. Revenue Integrity, Lee Wise

4. Collaboration with BPM+ Health & APE, Lee Wise
BPM+ APE Next Steps

• Refine APE process and resources via public review of APE artifacts by
  • BPM+ Health members
  • Members of professional associations and academia
  • Representatives from healthcare, public health and research organizations
  • Other health stakeholders

• Collaborate with BPM+ Health Groups to further align the needs and educational resources

• Collaborate with the BPM+ Health Tooling Group to deploy tooling into the APE educational process

• Disseminate APE approach and resources across health stakeholders to
  • recruit of new members & new projects and
  • enable BPM+ adoption
Contact Speakers

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Participate in BPM+ APE Group

Join APE (and other BPM+ groups):
https://www.bpm-plus.org/working-groups/sign-up-form.htm

APE Website:
https://www.bpm-plus.org/working-groups/academic-professional-education.htm