Lantana
CONSULTING GROUP

Dual FHIR/CDA Implementation Guide Development

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Speaker Information

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- Co-Chair FHIR Infrastructure Working Group
- Member of CDA Management Group, SDWG, and Attachments workgroups
- Former Co-Chair Structured Documents Working Group
- Co-Editor, CDA Consolidation (C-CDA) and many other Implementation Guides
- Lead: C-CDA on FHIR project
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Lantana Consulting Group

Mission:

- Improve healthcare through health information technology (IT)
- Lead the industry through our consulting and volunteer practice

Services:

- Software, standards development, and implementation
- Terminology, data governance, and education
- Health IT planning, design, and purchasing

Agenda

Overview & Background

- CDA and FHIR Standards
- Use Cases
- Challenges

Concurrent CDA & FHIR IG Development

- Inputs
- Development
- Mapping and Transforms
- Validation
- Outputs
- Challenges

Summary & Discussion

Problem Statement

- New implementers prefer FHIR over CDA
  - CDA has a steeper learning curve than FHIR
  - CDA has no API; limited to a static document format
- Significant existing investment in CDA throughout healthcare IT
- How can we preserve existing investments while levering the advantages of FHIR and reducing the burden for new implementers?

Dual FHIR/CDA Implementation Guides with bi-directional transforms

- Support a transitional roadmap for those with CDA in production
- Support an integrated architecture for exchange, supporting both CDA and FHIR

Clinical Document Architecture (CDA)

Clinical Documents

- **Defined**: authenticated part of clinical record, less like EDI and more like a contract
- **Human readability**: required
- **Machine readable** (coded data): option, defined by templates, per use case

"Architecture": constrain for specific use cases

- Continuity of Care
- Discharge Summary, H&P, etc.
- Healthcare Associated Infections
- Quality Reporting…

Idiosyncratic to conform to V3 methodology

- **Ideal**: data imported into, exported out of documents seamlessly through V3 API
- **Reality**: V3 messaging impractical

Some things work well, some not so well

- **Good**: human readability, single stylesheet rendering, consistent metadata
- **Not so well**: template definition complex, narrative/coded data management difficult
- **No** comparable messaging/API

F – Fast (to design & to implement)

Relative – No technology can make integration as fast as we'd like

H – Health

That's why we're here

I – Interoperable

Ditto

R – Resources

Building blocks

The FHIR Manifesto

1. Focus on Implementers
2. Target support for common scenarios
3. Leverage cross-industry web technologies
4. Support human readability as base level of interoperability
5. Make content freely available
6. Support multiple paradigms & architectures
7. Demonstrate best practice governance

Implementation Guides (IGs)

FHIR and CDA specifications are generic and have international scope.

- The specifications define capabilities and create an ecosystem.
- IGs constrain and customize the base specs for data exchange and to solve problems.

Examples:

- National standards
- Vendor consortiums
- Clinical societies

Implementation is always local.

Use Cases for Dual FHIR/CDA IGs

- Balance current vs. future exchange needs
- Allow implementers to leverage existing CDA investments
- Allow new implementers to start using FHIR (streamlined syntax, APIs, etc.)

Challenges

Different levels of abstraction

- FHIR is more concrete than CDA (e.g., representation for allergies)
- A single FHIR resource often maps to multiple CDA templates and entry relationships

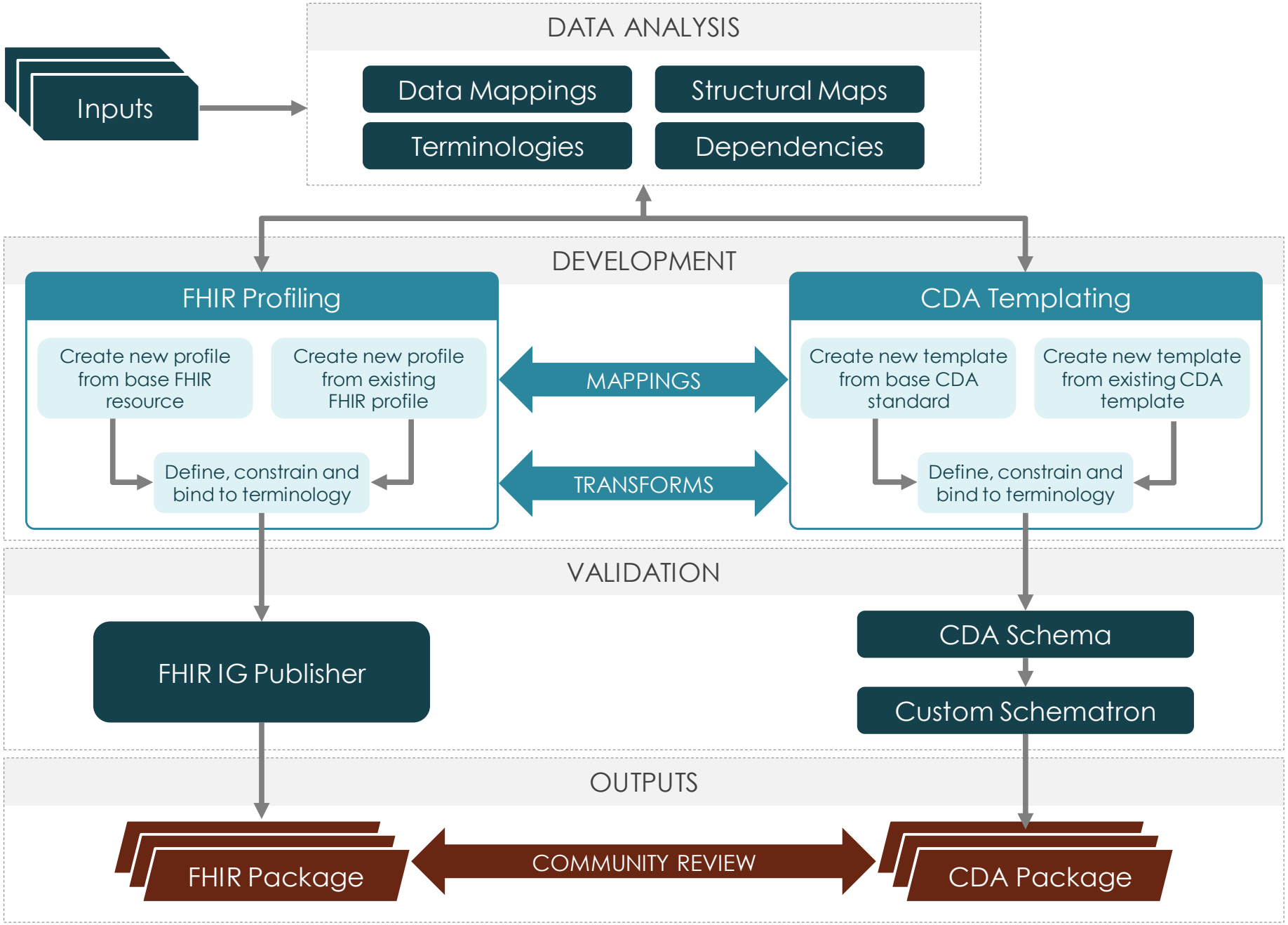
Datatypes

- FHIR uses common datatypes (e.g., W3C) with wide support in programming languages
- CDA datatypes often require custom parsing, which causes difficulty during transformation

Nesting vs. Referencing

- CDA documents are highly nested and have limited support for referencing, thus duplicate information is often copied in multiple places
- FHIR resources are created once then referenced everywhere

Concurrent CDA & FHIR IG Development



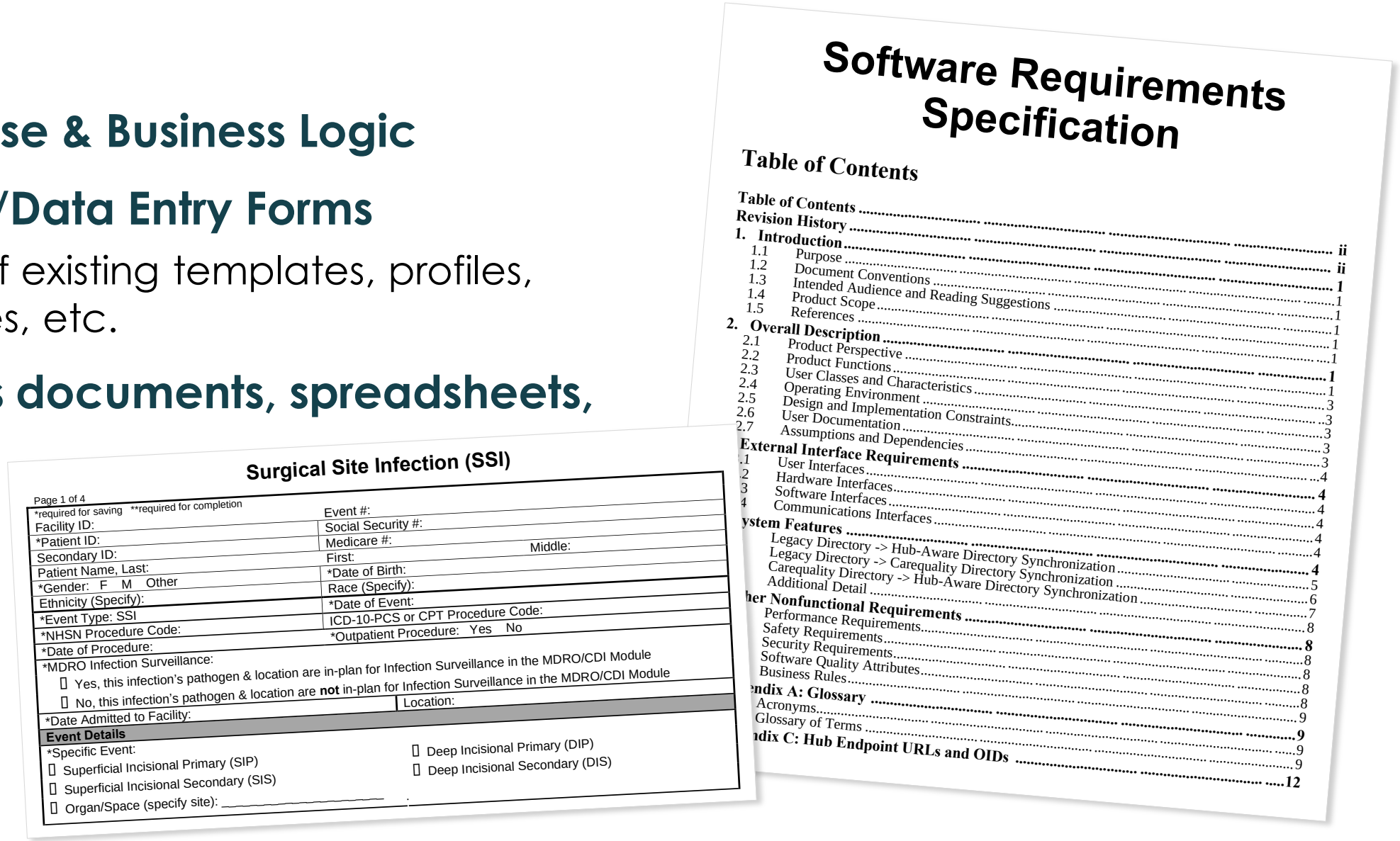
Inputs

Client Use Case & Business Logic

Sample Data/Data Entry Forms

- Client use of existing templates, profiles, vocabularies, etc.

Requirements documents, spreadsheets, etc.



Software Requirements Specification

Table of Contents

Surgical Site Infection (SSI)

Page 1 of 4

*required for saving **required for completion

Facility ID: | Event #:
*Patient ID: | Social Security #:
Secondary ID: | Medicare #:
Patient Name, Last: | First: | Middle:
*Gender: F M Other | *Date of Birth:
Ethnicity (Specify): | Race (Specify):
*Event Type: SSI | *Date of Event:
*NHSN Procedure Code: | ICD-10-PCS or CPT Procedure Code:
*Date of Procedure: | *Outpatient Procedure: Yes No

*MDRO Infection Surveillance:

☐ Yes, this infection's pathogen & location are in-plan for Infection Surveillance in the MDRO/CDI Module

☐ No, this infection's pathogen & location are **not** in-plan for Infection Surveillance in the MDRO/CDI Module

*Date Admitted to Facility: | Location:

Event Details

*Specific Event:

☐ Superficial Incisional Primary (SIP)
☐ Superficial Incisional Secondary (SIS)
☐ Organ/Space (specify site): _____
☐ Deep Incisional Primary (DIP)
☐ Deep Incisional Secondary (DIS)

DATA ANALYSIS

Data Mappings | Structural Maps | Terminologies | Dependencies

Data Analysis

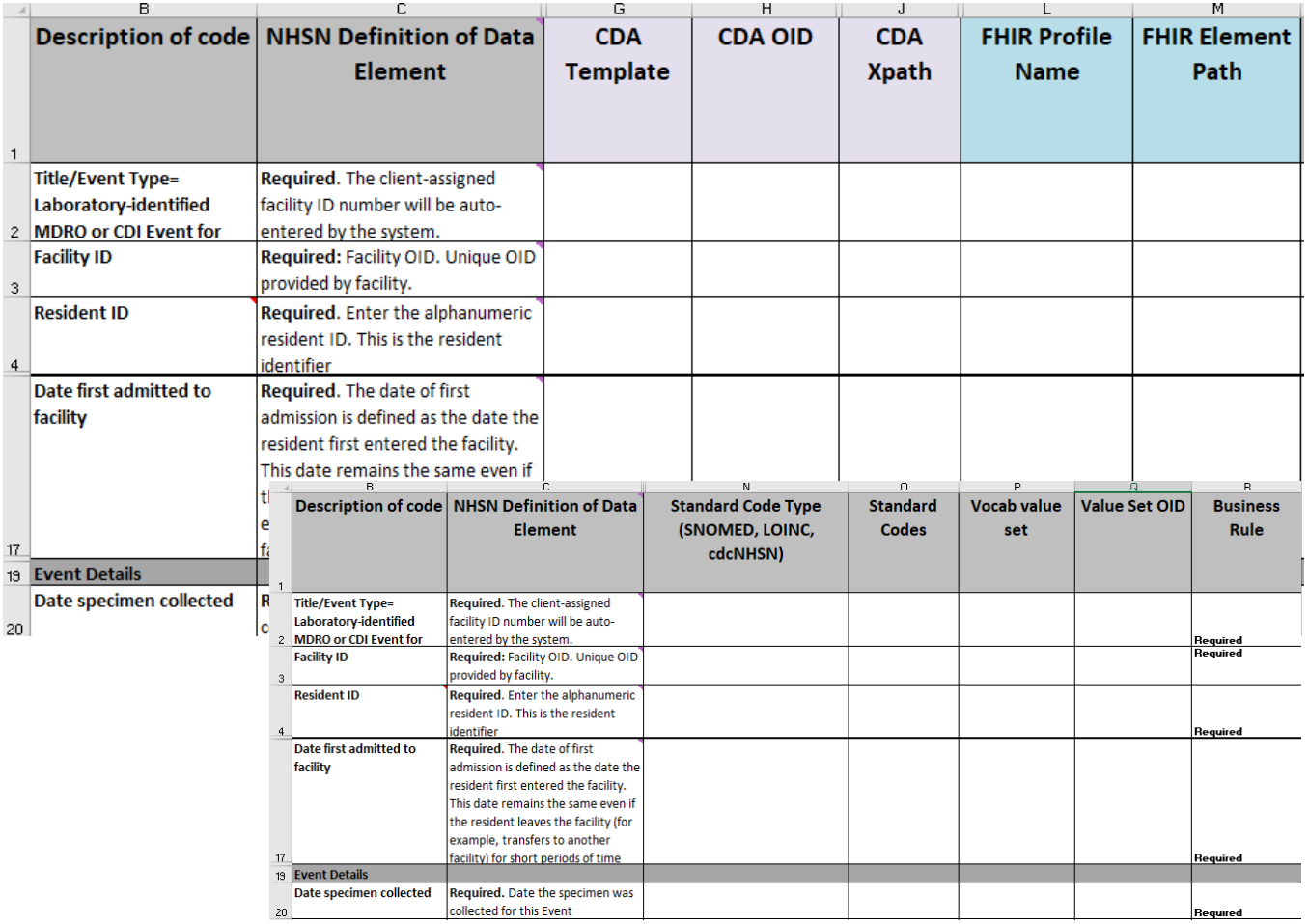
Work with the client to understand their business case

Organize client requirements per data element

- Data labels/descriptions
- Cardinalities
- Required terminologies

Identify incomplete and ambiguous requirements

Identify dependencies



	B	C	G	H	J	L	M
1	**Description of code**	**NHSN Definition of Data Element**	**CDA Template**	**CDA OID**	**CDA Xpath**	**FHIR Profile Name**	**FHIR Element Path**
2	**Title/Event Type= Laboratory-identified MDRO or CDI Event for**	**Required.** The client-assigned facility ID number will be auto-entered by the system.					
3	**Facility ID**	**Required:** Facility OID. Unique OID provided by facility.					
4	**Resident ID**	**Required.** Enter the alphanumeric resident ID. This is the resident identifier					
17	**Date first admitted to facility**	**Required.** The date of first admission is defined as the date the resident first entered the facility. This date remains the same even if					
19	**Event Details**						
20	**Date specimen collected**	**R**					

	B	C	N	O	P	Q	R
1	**Description of code**	**NHSN Definition of Data Element**	**Standard Code Type (SNOMED, LOINC, cdcNHSN)**	**Standard Codes**	**Vocab value set**	**Value Set OID**	**Business Rule**
2	**Title/Event Type= Laboratory-identified MDRO or CDI Event for**	**Required.** The client-assigned facility ID number will be auto-entered by the system.					**Required**
3	**Facility ID**	**Required:** Facility OID. Unique OID provided by facility.					**Required**
4	**Resident ID**	**Required.** Enter the alphanumeric resident ID. This is the resident identifier					**Required**
17	**Date first admitted to facility**	**Required.** The date of first admission is defined as the date the resident first entered the facility. This date remains the same even if the resident leaves the facility (for example, transfers to another facility) for short periods of time					**Required**
19	**Event Details**						
20	**Date specimen collected**	**Required.** Date the specimen was collected for this Event					**Required**

FHIR <-> CDA Mappings

Refine high level analysis to detailed mappings

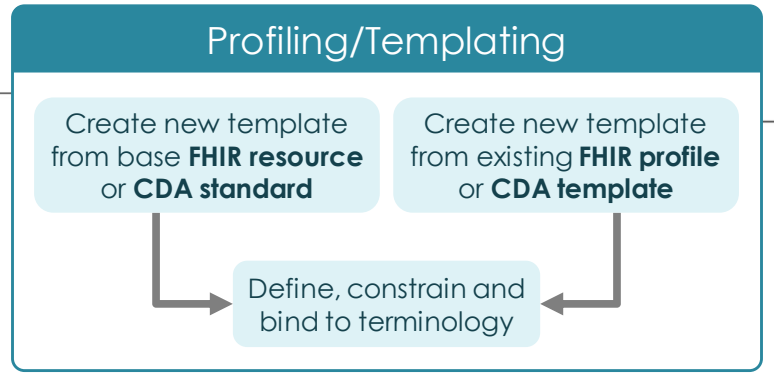
Capture sufficient detail to build profiles and write transforms

	A	D	E	F	G	H
1	Data Elements	Cardinality	FHIR Mapping	CDA Mapping in Sample	FHIR to CDA	CDA to FHIR
84	RxNumber	1..*	MedicationDispense.identifier	substanceAdministration.id	X	X
85	Fill Date	1..*	MedicationDispense.whenHandedOver	substanceAdministration.entryRelationship.supply.effectiveTime	X	X
	RX Norm code	1..1	MedicationDispense.medicationCodeableConcept.coding[1]	substanceAdministration.entryRelationship.supply.product.manufacturedProduct.manufacturedMaterial.code		X
		0..1	MedicationDispense.medicationCodeableConcept.coding[2]	substanceAdministration.entryRelationship.supply.product.manufacturedProduct.manufacturedMaterial.code.translation	X	X
				substanceAdministration.entryRelationship.supply.product.manufacturedProduct.manufacturedMaterial.code.originalText	X	X
					X	X

	A	I	J	K
1	Data Elements	Value Sets	Value Set OID	Description
90	QuantityUnit	This doseQuantity SHOULD contain zero or one [0..1] @unit, which SHALL be selected from ValueSet UnitsOfMeasureCaseSensitive urn:oid:2.16.840.1.113883.1.11.12839 DYNAMIC	2.16.840.1.113883.1.11.12839	
91	Days Supply	NA	NA	
92	Prescription Status	There is a required Value Set in C-CDA for the Prescription Status that should be used. SHALL be selected from ValueSet ActStatus urn:oid:2.16.840.1.113883.1.11.159331 DYNAMIC	HL7 MedicationPrescriptionStatus	active, on hold, completed, entered in error, stopped, superceded
93	Pharmacy Name	N/A	N/A	Pharmacy store name
94	Pharmacy Number	N/A	N/A	store number for multi-pharmacy ownership
95	Pharmacy Number Code			Pharmacy NPI number

Mapping Example

Data Element	Cardinality
Owning organization/facility	1..1
Organization name	1..1
Address	1..*
Telecom	1..*
NPI of organization/facility	0..1



Search template/profile repositories

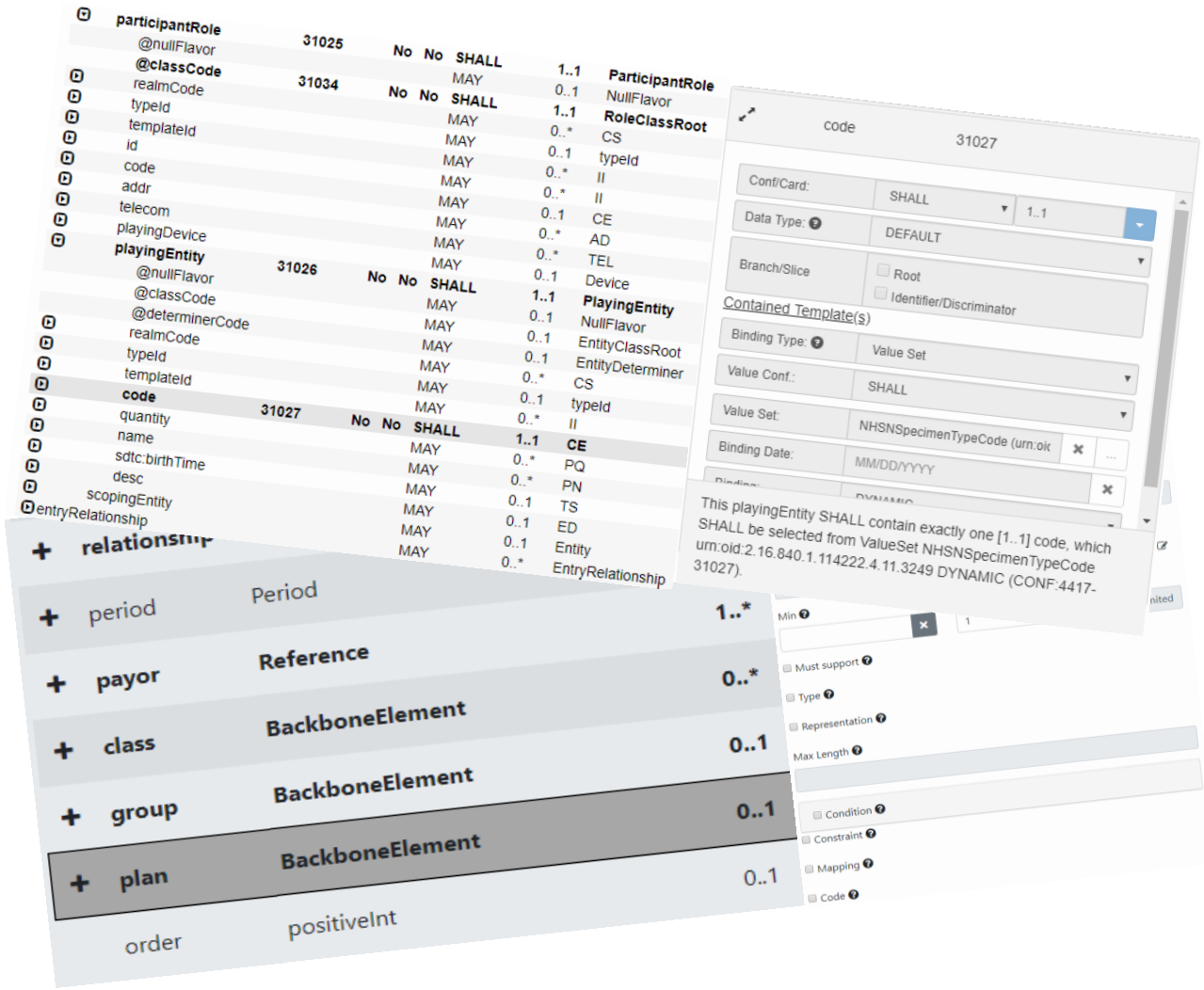
- Published through standards publishing bodies
- Tooling (Trifolia, Trifolia on FHIR, etc.)

Create new template/profile

- Based on base CDA/FHIR specification
- Based on existing template/profile

Update definitions and constraints

Bind to Terminology



Development Tooling

Trifolia on FHIR

- End to end implementation guide creation tool
- Includes profiling and terminology support
- Web based
- Open source
- Integrated with the FHIR IG Publisher

Forge

- Full featured profile editor
- Windows Desktop tool

Simplifier

- Web based implementation guide creation/assembly tool
- Upload profiles with Forge

FHIR <-> CDA Transforms

Develop transforms:

- Between CDA and FHIR
- Between FHIR versions (i.e., STU3 <-> R4) if needed

Create sample files:

- Create valid CDA and FHIR examples
- Cover as many profiles/templates as possible (including dependencies)
- Will serve as inputs for testing transforms
- Include as examples in the IG

Test transforms:

- Against sample files
- At a Connectathon
- During pilots
- In production
- Transform development and testing iteratively feeds back to mapping stage

```
<xsl:template
    match="
        cda:organizer[cda:templateId[
        @root = '2.16.840.1.113883.10.20.22.4.1'
        or @root = '2.16.840.1.113883.10.20.22.4.26'
        or @root = '2.16.840.1.113883.10.20.22.4.66']
        ]">
    <xsl:variable name="category">
        <xsl:choose>
            <xsl:when test="cda:templateId[@root = '2.16.840.1.113883.10.20.22.4.1']"
                >laboratory</xsl:when>
            <xsl:when test="cda:templateId[@root = '2.16.840.1.113883.10.20.22.4.26']"
                >vital-signs</xsl:when>
            <xsl:when test="cda:templateId[@root = '2.16.840.1.113883.10.20.22.4.66']"
                >activity</xsl:when>
        </xsl:choose>
    </xsl:variable>
    <Observation>
        <xsl:call-template name="add-meta"/>
        <xsl:apply-templates select="cda:id"/>
        <status value="final"/>
        <category>
            <coding>
                <system value="http://hl7.org/fhir/observation-category"/>
                <code value="{$category}"/>
            </coding>
        </category>
        <xsl:apply-templates select="cda:code">
            <xsl:with-param name="elementName">code</xsl:with-param>
        </xsl:apply-templates>
        <xsl:call-template name="subject-reference"/>
        <xsl:if test="cda:effectiveTime/@value">
            <effectiveDateTime>
                <xsl:attribute name="value">
```

Transformation Execution

Multiple possible technologies for creating FHIR < - > CDA transforms

- XSLT
- FHIR Mapping Language (FML)
- Custom code (Java, .Net, etc.)

XSLT is common but requires XML

- CDA is only available in XML, so not an issue for CDA to FHIR
- FHIR is available in XML or JSON
- Converting FHIR JSON to CDA requires JSON to XML conversion at some point

FML support is built into FHIR tooling, but few programmers are proficient

Validation

Templates AND profiles will be validated against:

- Asserted base standard
- Asserted templates/profiles
- Asserted additional:
  - Constraints
  - Extensions

Outputs

CDA Package:

- Volume 1: Introduction, CDA background, use case(s), context, actors
- Volume 2: Templates and Supporting Materials (tooling generated)
  - Template definitions, constraints, table view with hyperlinks to related templates, pros view with hyperlinks to related templates
  - Sample XML snippets
  - ValueSet tables show sample of codes/definitions/codeSystems and hyperlinks to source of truth
- Full sample XML document(s)
- CDA schema
- Custom Schematron file to validate asserted constraints (tooling generated)
- CDA <-> FHIR Transforms

Outputs

FHIR Package:

- Valid FHIR Implementation Guide successfully published through the FHIR IG publisher (tooling generated)
  - Home Page with background, description, use cases, and actors
  - Profiles, Instances, other example resources (XML and JSON)
  - Terminologies page with hyperlinks to Value Sets and Code Systems
- CDA <-> FHIR Transforms

Summary

- Dual FHIR/CDA IGs paired with bi-directional transforms preserves CDA investment for existing implementers while reducing costs for new implementers
- There are significant challenges developing dual IGs and transforms, including different levels of abstraction, datatype mismatches, and the different design approaches of the standards (referencing vs. nesting)
- None of these challenges are show-stoppers, especially if you scope your IGs and transforms to well understood use cases

Lantana Academy: January 21-23

- Hands-on FHIR training for architects, engineers, developers, analysts, domain experts
- Learn and apply practical skills
- See https://www.lantanagroup.com/lantana-academy-2020/

Day	Topic
January 21	Introduction to HL7 FHIR
	The FHIR Specification
	FHIR IGs
	Profiling FHIR
January 22	Building IGs using Trifolia (Part 1)
January 23	Building IGs using Trifolia (Part 2)
	Closing

Trifolia Workbench and Trifolia-on-FHIR are open-source template and IG creation tools developed by Lantana Consulting Group. For more information, visit https://www.lantanagroup.com/resources/free-tools/

Questions?