Introduction to FHIR Shorthand

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OpenID Connect

SYNTHEA

INFERNO

mCODE™
Standard Health Record for Oncology

hData

CDS Connect

Crucible

Lantern

Clinical Quality Language

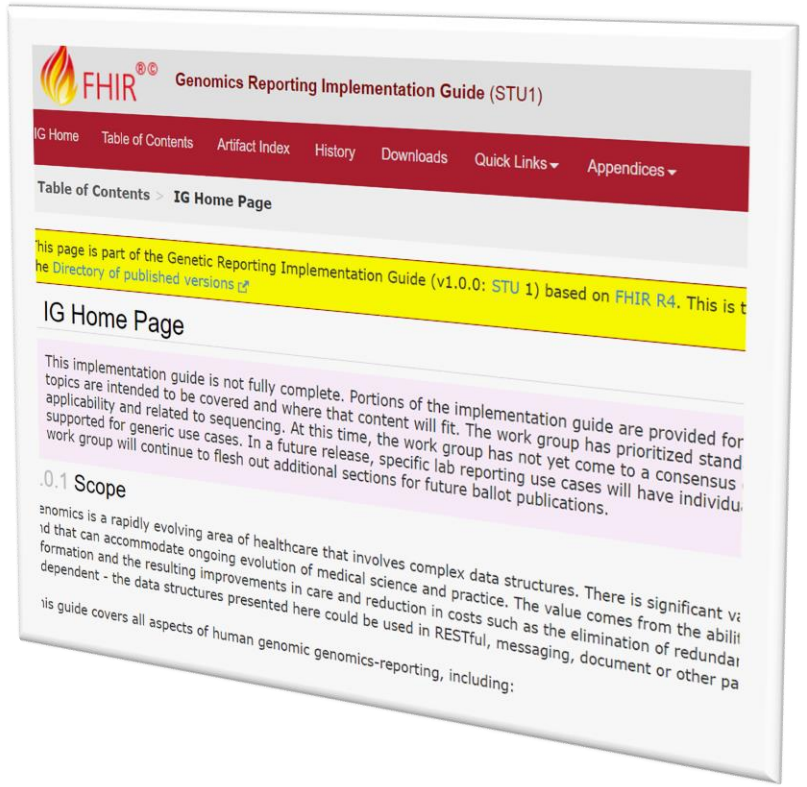
COVID-19 | Healthcare Coalition

PACIO

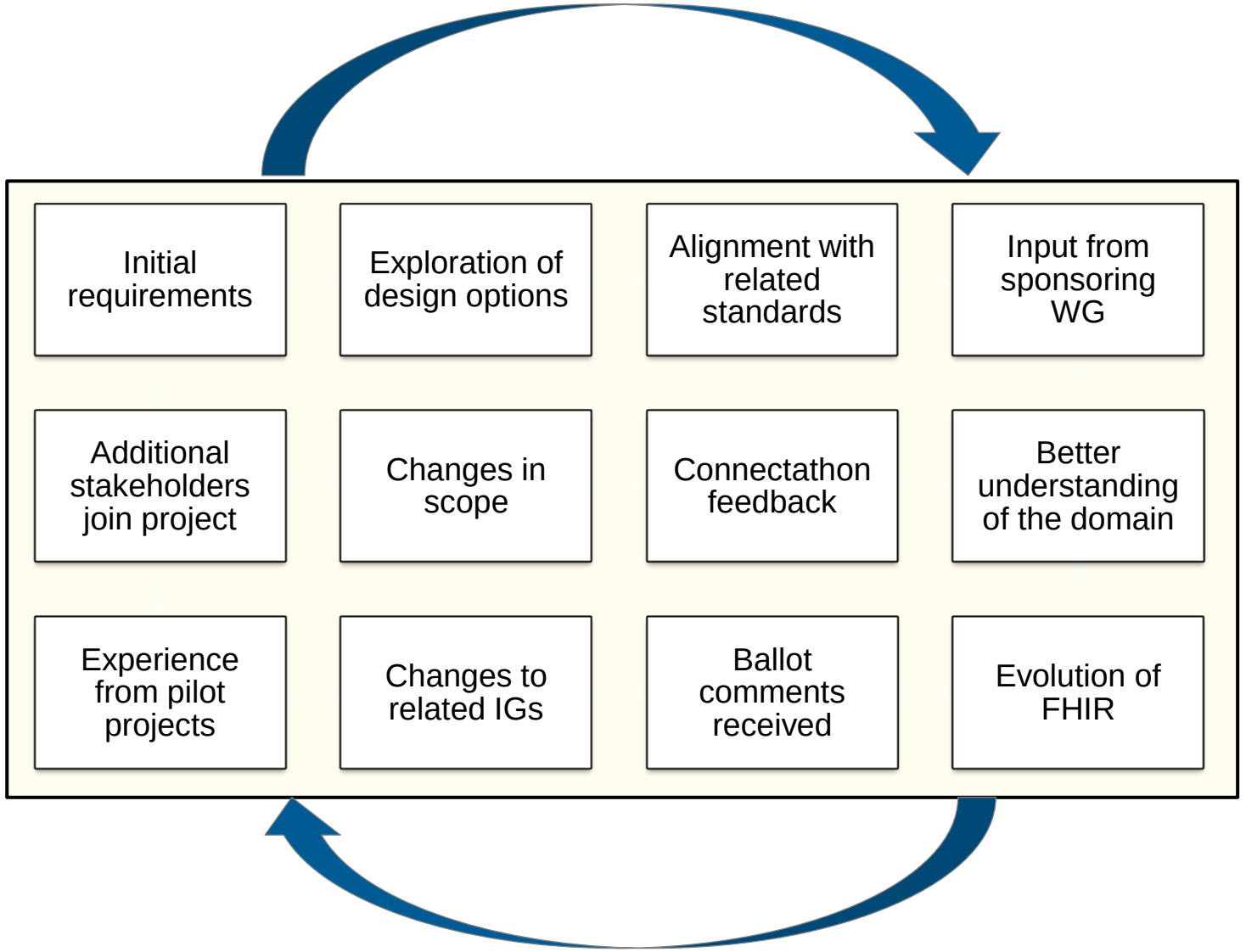
Poplin

FHIR Implementation Guides

- **An implementation guide (IG) is a set of documentation and artifacts about how FHIR is used to solve a particular problem**
- **An IG contains:**
  - Narrative Content
  - Definitions
  - Examples
- **Definitional resources include:**
  - StructureDefinition, ImplementationGuide, CapabilityStatement, OperationDefinition, SearchParameter, ValueSet, CodeSystem, PlanDefinition, Questionnaire, ActivityDefinition, & more



FHIR Shorthand Accelerates the IG Authoring Process



⇨ **Many iterations**

⇨ **Need for agility**

What is FHIR Shorthand?

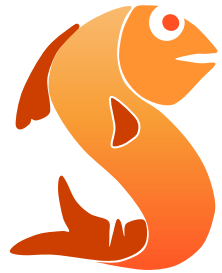
- **A domain-specific language (DSL) designed for profiling and IG creation**
  - Formal grammar (ANTLR4)
  - Reference implementation compiler (SUSHI)
- **Concise, understandable, and aligned to user intentions**
  - FSH representation is more understandable than a StructureDefinition (by far)
  - Concise way to store and exchange profiles (10s of lines versus 1000s lines)
- **Ideal for collaborative development under source code control**
  - Meaningful version-to-version differentials
  - Support for merging and conflict resolution
  - Refactoring through global search/replace operations
- **FHIR Shorthand Language Specification is HL7 Standard for Trial Use (STU)**
- **Open source and free to use**

Who is the target user for FSH?

- **Self-guided**
  - FSH is not point and click
- **Programming mindset**
  - Source code, compiling, inputs, outputs, etc.
  - File management, source code control
- **Familiar with FHIR**
  - Resources, profiles, extensions
  - StructureDefinitions (a little)
  - IG Publisher (a bit or a lot)

Why All the Fish Puns?

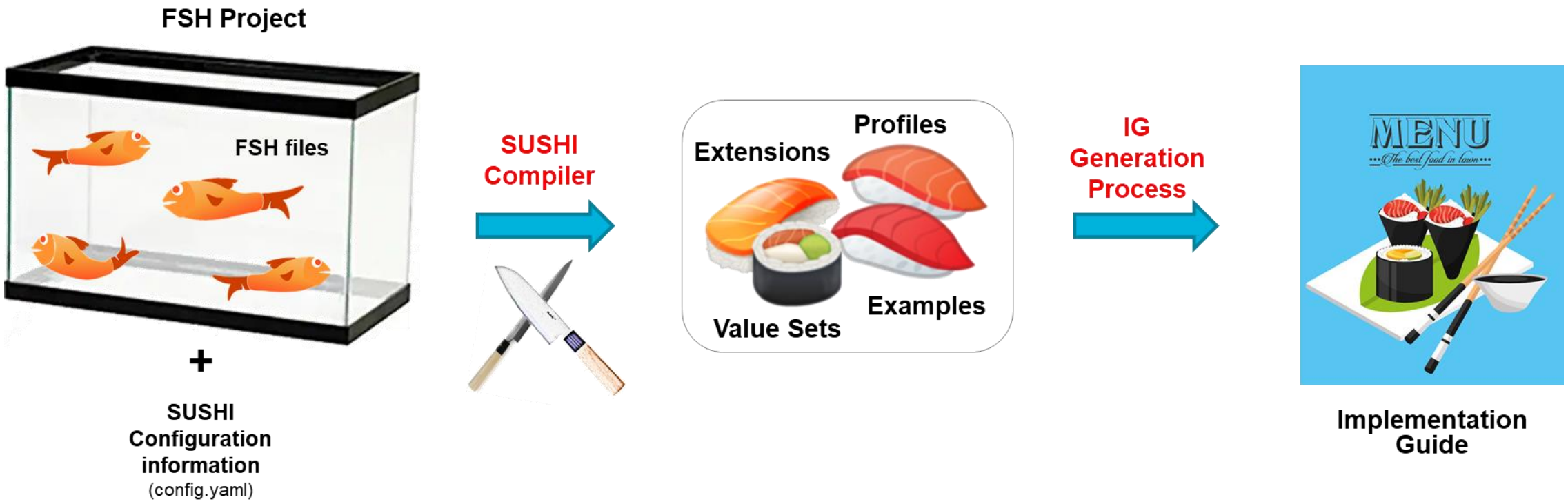
FHIR® Shorthand™ → .fsh file type



"Shorty"

SUSHI Compiler : “SUSHI Unshortens Short Hand Inputs”

Overall Workflow with FSH, SUSHI, IG Publisher



Credits: Sushi clipart from Google and WhatsApp rendering of Unicode 6.0 sushi emoji, Sushi menu from PNGWave, Non-Commercial Use, no attribution required (https://www.pngwave.com/png-clip-art-oxoer)

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Who is using FHIR Shorthand?

- **As of June 2020, ~40 Implementation Guide projects were using FSH**
  - At least 6 balloted IGs
  - DaVinci Project IGs
  - COVID-19 IGs
    - Logica COVID-19 FHIR Profile Library IG
    - SANER (Situational Awareness for Novel Epidemic Response)
  - Affiliate IGs (UK, Belgium, Canada)

- **Active community on Zulip (# shorthand stream)**
  - 10's of messages daily
  - https://chat.fhir.org/#narrow/stream/215610-shorthand

FHIR Shorthand Resources

- **FSH Language Specification:**
  - http://build.fhir.org/ig/HL7/fhir-shorthand/ -- Current version
  - http://hl7.org/fhir/uv/shorthand -- STU 1 version (coming soon!)

- **School of FSH:**
  - https://fshschool.org/docs/sushi/ -- SUSHI Documentation
  - https://fshschool.org/docs/tutorials/ -- Hands-on tutorials
  - https://fshschool.org/docs/downloads/ -- Download presentations (including this one)
  - https://fshschool.org/FSHOnline/ -- Interactive FSH playground (beta)

HL7 International

FHIR Shorthand
1.0.0 - CI Build

HL7 FHIR

Home | Table of Contents | Overview | Language Reference | SUSHI | Downloads

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FHIR Shorthand, published by HL7 International - FHIR Infrastructure Group. This is not an authorized publication; it is the continuous build for version 1.0.0). This version is based on the current content of https://github.com/HL7/fhir-shorthand/ and changes regularly. See the Directory of published versions

3 Language Reference

This chapter contains the formal specification of the FHIR Shorthand (FSH) language. It is intended as a reference, not a tutorial.

In this specification, the key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in RFC2119.

3.1 About the Specification

The FSH specification uses syntax expressions to illustrate the FSH language. While FSH has a formal grammar (see Appendix), most readers will find the syntax expressions more instructive.

Syntax expressions uses the following conventions:

Style	Explanation	Example
`Code`	Code fragments, such as FSH keywords, FSH statements, and FSH syntax expressions	`* status = #open`
`{curly braces}`	An item to be substituted in a syntax expression	`{display string}`
`<datatype>`	An element or path to an element with the given data type, to be substituted in the syntax expression	`<CodeableConcept>`
italics	An optional item in a syntax expression	*`"{string}"`*
ellipsis (...)	Indicates a pattern that can be repeated	`{flag1} {flag2} {flag3} ...`
bold	A directory path or file name	**example-1.fsh**
vertical bar	A choice of items or data types in the syntax	`name|id|url`

Examples:

- A FSH rule to assign the value of a Quantity:

```
* <Quantity> = {decimal or integer} '{UCUM unit}'
```

A FSH statement following this pattern would be written as:

http://hl7.org/fhir/uv/shorthand

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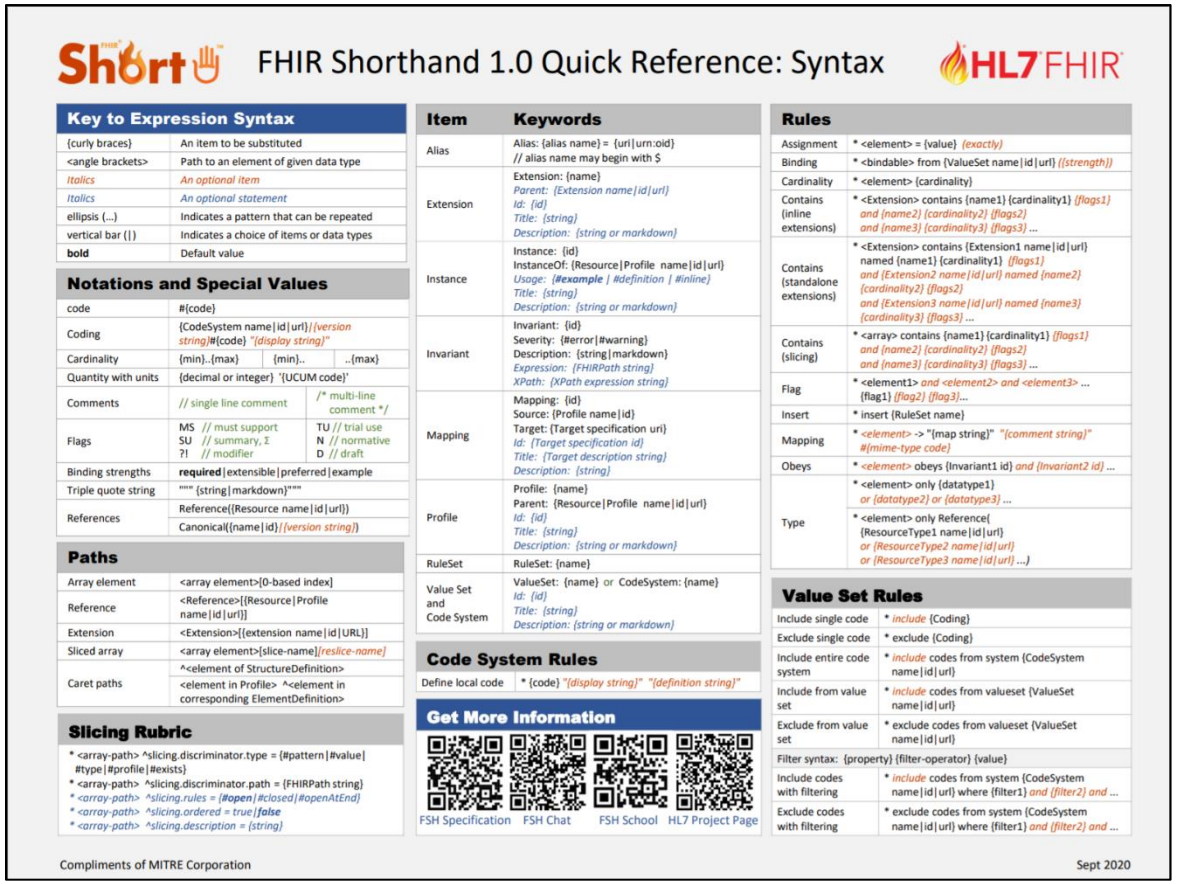
Quick Reference Card



Short FHIR Shorthand 1.0 Quick Reference: Syntax HL7 FHIR

Key to Expression Syntax

{curly braces}	An item to be substituted
<angle brackets>	Path to an element of given data type
Italics	*An optional item*
Italics	*An optional statement*
ellipsis (...)	Indicates a pattern that can be repeated
vertical bar (|)	Indicates a choice of items or data types
bold	Default value

Notations and Special Values

code	#{code}		
Coding	{CodeSystem name|id|url}*{version string}*#{code} *"{display string}"*		
Cardinality	{min}..{max}	{min}..	..{max}
Quantity with units	{decimal or integer} '{UCUM code}'		
Comments	// single line comment	/* multi-line comment */	
Flags	MS // must support SU // summary, Σ ?! // modifier	TU // trial use N // normative D // draft	
Binding strengths	**required**|extensible|preferred|example		
Triple quote string	""" {string|markdown}"""		
References	Reference({Resource name|id|url})		
	Canonical({name|id}*{version string}*)		

Paths

Array element	<array element>[0-based index]
Reference	<Reference>[{Resource|Profile name|id|url}]
Extension	<Extension>[{extension name|id|URL}]
Sliced array	<array element>[slice-name]*{reslice-name}*
Caret paths	^<element of StructureDefinition> <element in Profile> ^<element in corresponding ElementDefinition>

Slicing Rubric

* <array-path> ^slicing.discriminator.type = {#pattern|#value|#type|#profile|#exists}
* <array-path> ^slicing.discriminator.path = {FHIRPath string}
* *<array-path> ^slicing.rules = {**#open**|#closed|#openAtEnd}*
* *<array-path> ^slicing.ordered = true|**false***
* *<array-path> ^slicing.description = {string}*

Item	Keywords
Alias	Alias: {alias name} = {uri|urn:oid} // alias name may begin with $
Extension	Extension: {name} *Parent: {Extension name|id|url}* *Id: {id}* *Title: {string}* *Description: {string or markdown}*
Instance	Instance: {id} InstanceOf: {Resource|Profile name|id|url} *Usage: {**#example** | #definition | #inline}* *Title: {string}* *Description: {string or markdown}*
Invariant	Invariant: {id} Severity: {#error|#warning} Description: {string|markdown} *Expression: {FHIRPath string}* *XPath: {XPath expression string}*
Mapping	Mapping: {id} Source: {Profile name|id} Target: {Target specification uri} *Id: {Target specification id}* *Title: {Target description string}* *Description: {string}*
Profile	Profile: {name} Parent: {Resource|Profile name|id|url} *Id: {id}* *Title: {string}* *Description: {string or markdown}*
RuleSet	RuleSet: {name}
Value Set and Code System	ValueSet: {name} or CodeSystem: {name} *Id: {id}* *Title: {string}* *Description: {string or markdown}*

Code System Rules

Define local code	* {code} *"{display string}"* *"{definition string}"*

Get More Information

FSH Specification FSH Chat FSH School HL7 Project Page

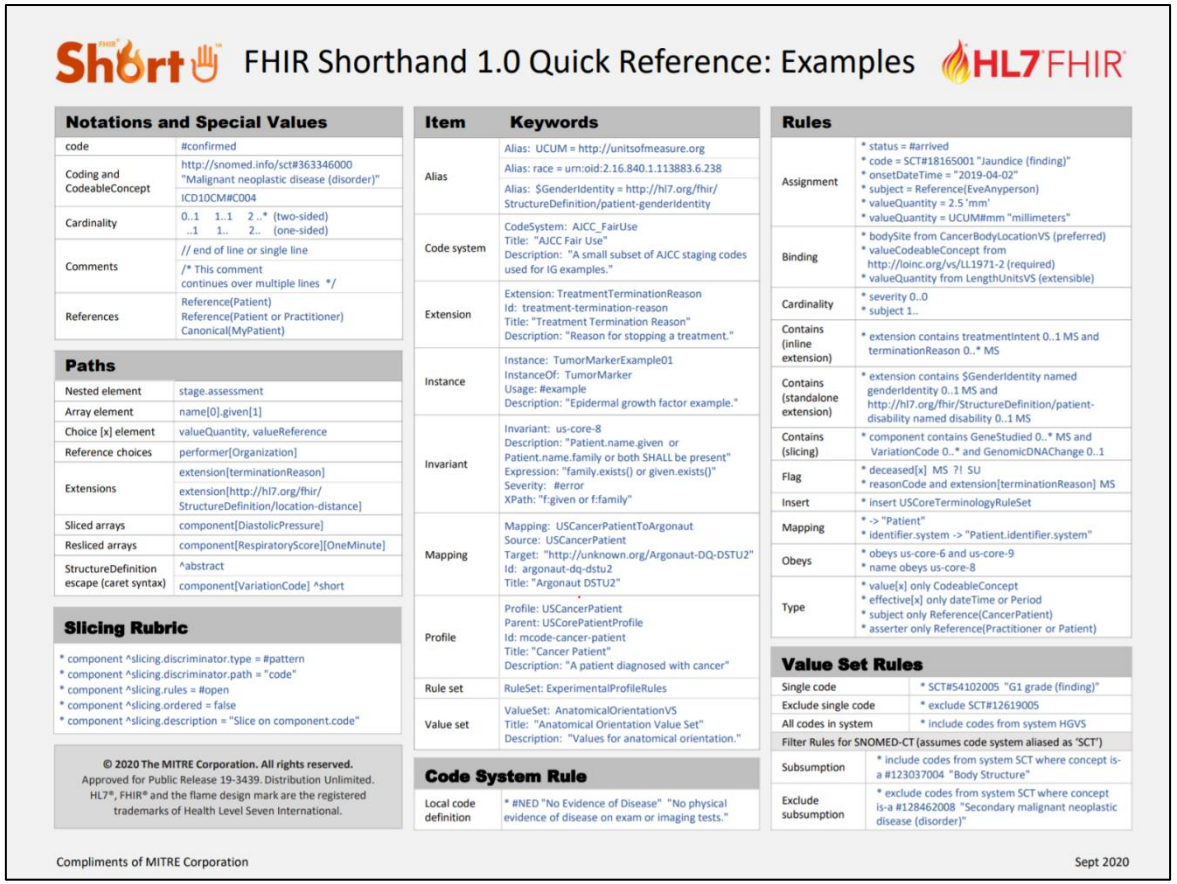
Rules	
Assignment	* <element> = {value} *(exactly)*
Binding	* <bindable> from {ValueSet name|id|url} *({strength})*
Cardinality	* <element> {cardinality}
Contains (inline extensions)	* <Extension> contains {name1}{cardinality1} *{flags1}* *and {name2}{cardinality2}{flags2}* *and {name3}{cardinality3}{flags3}* ...
Contains (standalone extensions)	* <Extension> contains {Extension1 name|id|url} named {name1}{cardinality1} *{flags1}* *and {Extension2 name|id|url} named {name2}{cardinality2}{flags2}* *and {Extension3 name|id|url} named {name3}{cardinality3}{flags3}* ...
Contains (slicing)	* <array> contains {name1}{cardinality1} *{flags1}* *and {name2}{cardinality2}{flags2}* *and {name3}{cardinality3}{flags3}* ...
Flag	* <element1> *and <element2> and <element3>* ... {flag1} *{flag2}{flag3}*...
Insert	* insert {RuleSet name}
Mapping	* *<element>* -> "{map string}" *"{comment string}"* *#{mime-type code}*
Obeys	* *<element>* obeys {Invariant1 id} *and {Invariant2 id}* ...
Type	* <element> only {datatype1} *or {datatype2} or {datatype3}* ... * <element> only Reference({ResourceType1 name|id|url} *or {ResourceType2 name|id|url}* *or {ResourceType3 name|id|url}* ...)

Value Set Rules

Include single code	* *include* {Coding}
Exclude single code	* exclude {Coding}
Include entire code system	* *include* codes from system {CodeSystem name|id|url}
Include from value set	* *include* codes from valueset {ValueSet name|id|url}
Exclude from value set	* exclude codes from valueset {ValueSet name|id|url}
Filter syntax: {property} {filter-operator} {value}	
Include codes with filtering	* *include* codes from system {CodeSystem name|id|url} where {filter1} *and {filter2} and* ...
Exclude codes with filtering	* exclude codes from system {CodeSystem name|id|url} where {filter1} *and {filter2} and* ...

Compliments of MITRE Corporation Sept 2020

Syntax



Short FHIR Shorthand 1.0 Quick Reference: Examples HL7 FHIR

Notations and Special Values

code	#confirmed
Coding and CodeableConcept	http://snomed.info/sct#363346000 "Malignant neoplastic disease (disorder)" ICD10CM#C004
Cardinality	0..1 1..1 2..* (two-sided) ..1 1.. 2.. (one-sided)
Comments	// end of line or single line /* This comment continues over multiple lines */
References	Reference(Patient) Reference(Patient or Practitioner) Canonical(MyPatient)

Paths

Nested element	stage.assessment
Array element	name[0].given[1]
Choice [x] element	valueQuantity, valueReference
Reference choices	performer[Organization]
Extensions	extension[terminationReason] extension[http://hl7.org/fhir/StructureDefinition/location-distance]
Sliced arrays	component[DiastolicPressure]
Resliced arrays	component[RespiratoryScore][OneMinute]
StructureDefinition escape (caret syntax)	^abstract component[VariationCode] ^short

Slicing Rubric

* component ^slicing.discriminator.type = #pattern
* component ^slicing.discriminator.path = "code"
* component ^slicing.rules = #open
* component ^slicing.ordered = false
* component ^slicing.description = "Slice on component.code"

Item	Keywords
Alias	Alias: UCUM = http://unitsofmeasure.org Alias: race = urn:oid:2.16.840.1.113883.6.238 Alias: $GenderIdentity = http://hl7.org/fhir/StructureDefinition/patient-genderIdentity
Code system	CodeSystem: AJCC_FairUse Title: "AJCC Fair Use" Description: "A small subset of AJCC staging codes used for IG examples."
Extension	Extension: TreatmentTerminationReason Id: treatment-termination-reason Title: "Treatment Termination Reason" Description: "Reason for stopping a treatment."
Instance	Instance: TumorMarkerExample01 InstanceOf: TumorMarker Usage: #example Description: "Epidermal growth factor example."
Invariant	Invariant: us-core-8 Description: "Patient.name.given or Patient.name.family or both SHALL be present" Expression: "family.exists() or given.exists()" Severity: #error XPath: "f:given or f:family"
Mapping	Mapping: USCancerPatientToArgonaut Source: USCancerPatient Target: "http://unknown.org/Argonaut-DQ-DSTU2" Id: argonaut-dq-dstu2 Title: "Argonaut DSTU2"
Profile	Profile: USCancerPatient Parent: USCorePatientProfile Id: mcode-cancer-patient Title: "Cancer Patient" Description: "A patient diagnosed with cancer"
Rule set	RuleSet: ExperimentalProfileRules
Value set	ValueSet: AnatomicalOrientationVS Title: "Anatomical Orientation Value Set" Description: "Values for anatomical orientation."

Code System Rule

Local code definition	* #NED "No Evidence of Disease" "No physical evidence of disease on exam or imaging tests."

Rules	
Assignment	* status = #arrived * code = SCT#18165001 "Jaundice (finding)" * onsetDateTime = "2019-04-02" * subject = Reference(EveAnyperson) * valueQuantity = 2.5 'mm' * valueQuantity = UCUM#mm "millimeters"
Binding	* bodySite from CancerBodyLocationVS (preferred) * valueCodeableConcept from http://loinc.org/vs/LL1971-2 (required) * valueQuantity from LengthUnitsVS (extensible)
Cardinality	* severity 0..0 * subject 1..
Contains (inline extension)	* extension contains treatmentIntent 0..1 MS and terminationReason 0..* MS
Contains (standalone extension)	* extension contains $GenderIdentity named genderIdentity 0..1 MS and http://hl7.org/fhir/StructureDefinition/patient-disability named disability 0..1 MS
Contains (slicing)	* component contains GeneStudied 0..* MS and VariationCode 0..* and GenomicDNAChange 0..1
Flag	* deceased[x] MS ?! SU * reasonCode and extension[terminationReason] MS
Insert	* insert USCoreTerminologyRuleSet
Mapping	* -> "Patient" * identifier.system -> "Patient.identifier.system"
Obeys	* obeys us-core-6 and us-core-9 * name obeys us-core-8
Type	* value[x] only CodeableConcept * effective[x] only dateTime or Period * subject only Reference(CancerPatient) * asserter only Reference(Practitioner or Patient)

Value Set Rules

Single code	* SCT#54102005 "G1 grade (finding)"
Exclude single code	* exclude SCT#12619005
All codes in system	* include codes from system HGVS
Filter Rules for SNOMED-CT (assumes code system aliased as 'SCT')	
Subsumption	* include codes from system SCT where concept is-a #123037004 "Body Structure"
Exclude subsumption	* exclude codes from system SCT where concept is-a #128462008 "Secondary malignant neoplastic disease (disorder)"

Compliments of MITRE Corporation Sept 2020

Examples

http://build.fhir.org/ig/HL7/fhir-shorthand/FSHQuickReference.pdf

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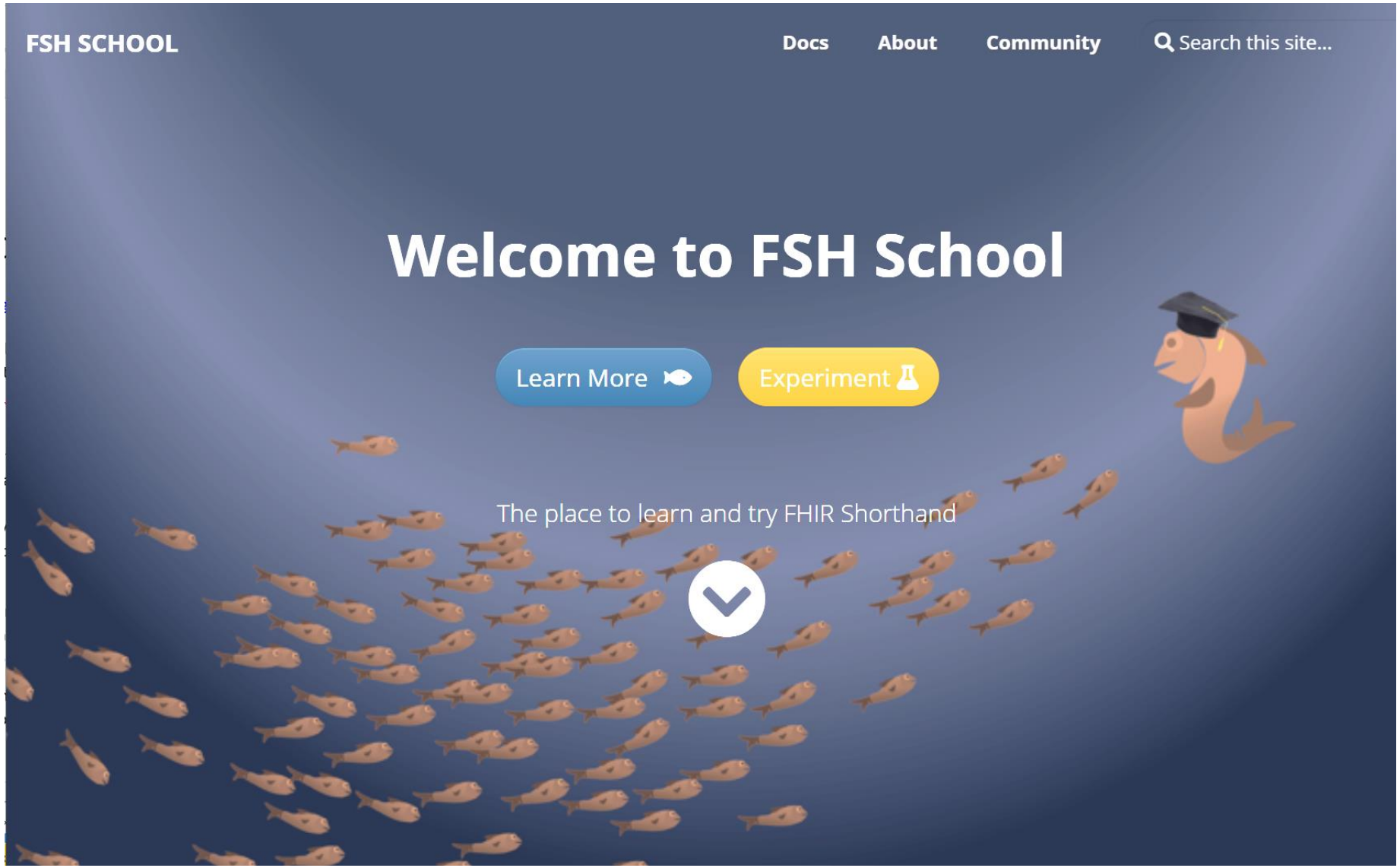


This is where the SUSHI documentation now lives (https://fshschool.org/docs/sushi/)

Search this site...

Docs
Getting Started
SUSHI
Installation
Project Structure
Configuration
Running SUSHI
Tutorials

Docs / SUSHI

SUSHI

This section contains documentation for SUSHI (**S**USHI **U**nshortens **S**hort**H**and **I**nputs), a reference implementation FSH compiler.

Installation

Project Structure

Configuration

Running SUSHI

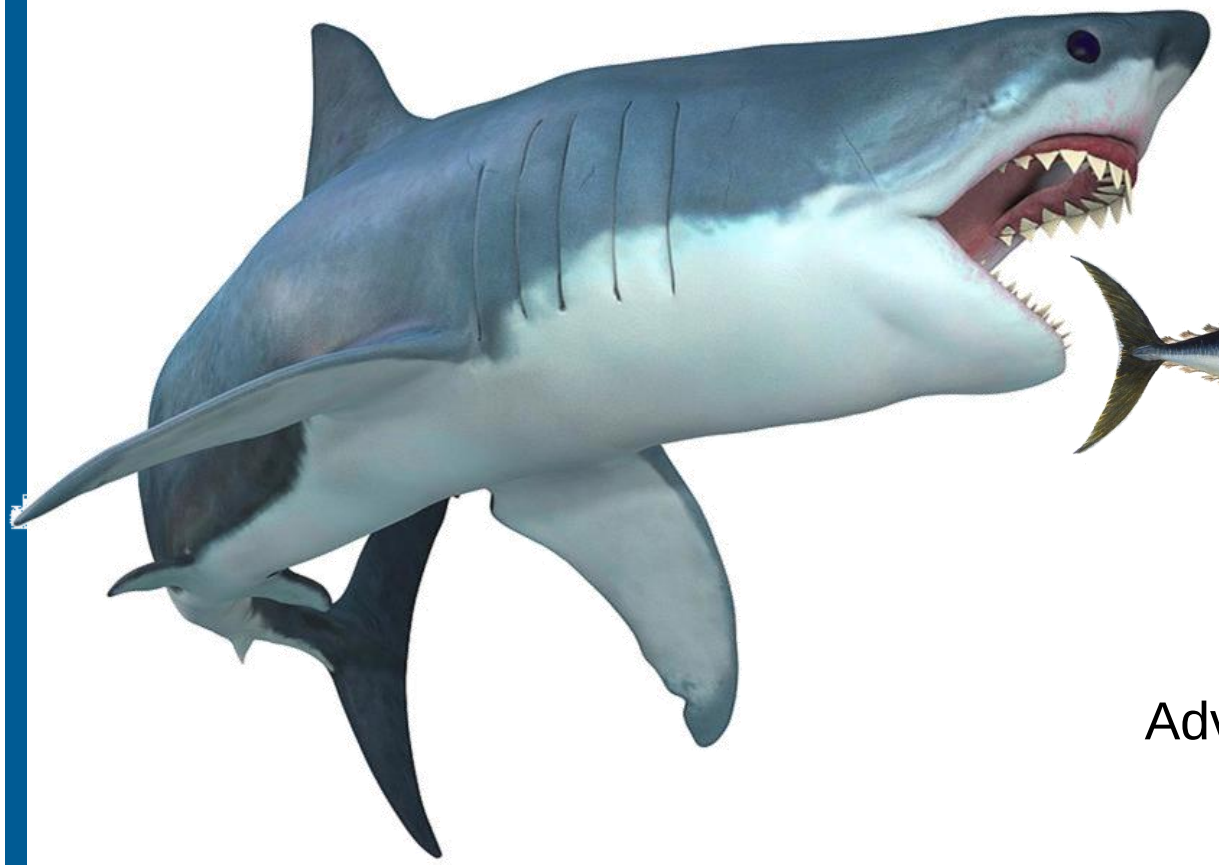
Last modified July 28, 2020: Moving to docsy (#1) (af50e9c)

Current Status

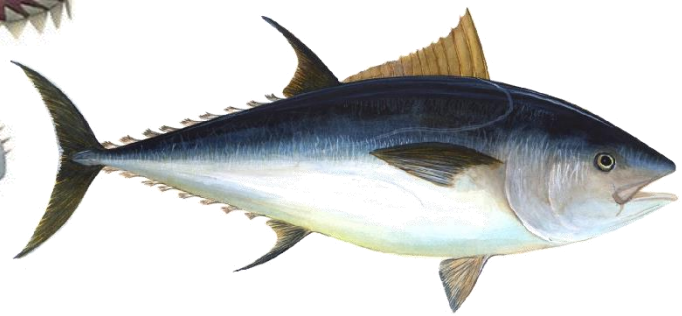
- **FSH just turned one year old**
- **FSH STU 1 has just been published**
  - http://hl7.org/fhir/uv/shorthand
- **There are significant new features planned**
  - Covered in "Wicked Shorthand"

(This is a FSH cake)

FHIR Shorthand Training Overview



Wicked Shorthand
"Shark"



Advanced Shorthand
"Tuna"

Basic Shorthand
"Mackerel"

Intro Shorthand
"Krill"

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New FSHing Equipment (Beta)

- GoFSH -- turn existing IGs into Shorthand
- FSH School -- a site for learning and experimentation
- FSH Online -- interactive FHIR Shorthand
- FSHing Trip -- roundtripping from StructureDefinition to FSH and back

Tutorial: Beginning FHIR Shorthand

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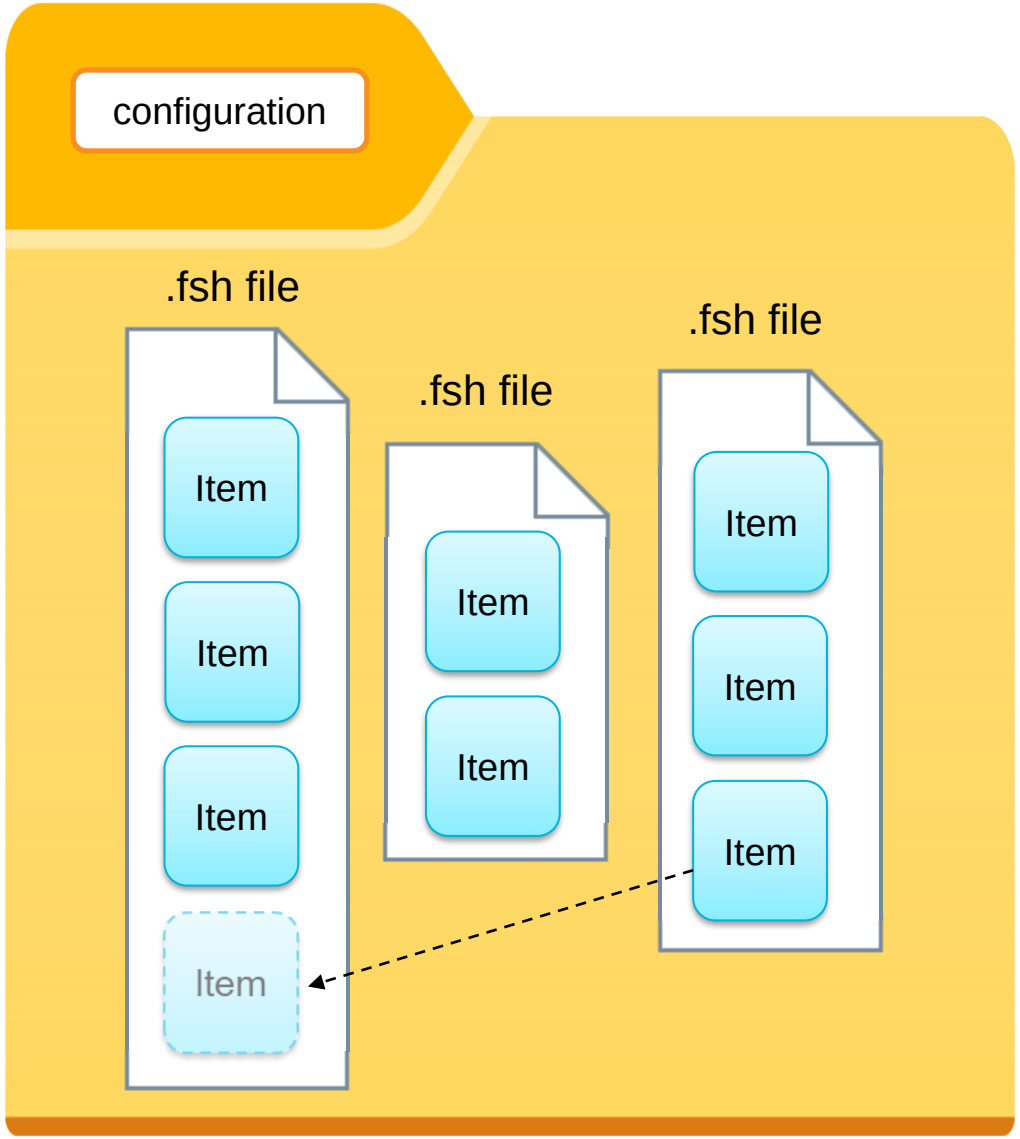
Principal Software Systems Engineer
MITRE Corporation

September, 2020

Mackerel Topics

- Projects
- Items
- Language Elements
- Walk-Through Example

FSH Projects (aka "FSH Tank")



- One FSH Project ↔ One IG
- Items can appear in any order within **.fsh** files
- Items can be moved around within a file or to other **.fsh** files in the same project without affecting the interpretation of the content

Configuration File (SUSHI-Specific)

```yaml
id: fhir.us.example
canonical: http://hl7.org/fhir/us/example
name: ExampleIG
title: "HL7 FHIR Implementation Guide: Example IG Release 1 - US Realm | STU1"
description: An example IG that exercises many of the fields in a SUSHI configuration
status: draft
license: CC0-1.0
version: 0.1.0
fhirVersion: 4.0.1
copyrightYear: 2020+
releaseLabel: ci-build
publisher:
  name: HL7 International - US Realm Steering Committee
  url: http://www.hl7.org/Special/committees/usrealm/index.cfm
  email: usrsc@lists.HL7.org
dependencies:
  hl7.fhir.us.core: 3.1.0
template: hl7.fhir.template#0.0.5
```

This is typical -- but there are optional parameters to control SUSHI execution and IG creation:

- Menu configuration
- Non-default page layout
- Version history
- FSHOnly flag

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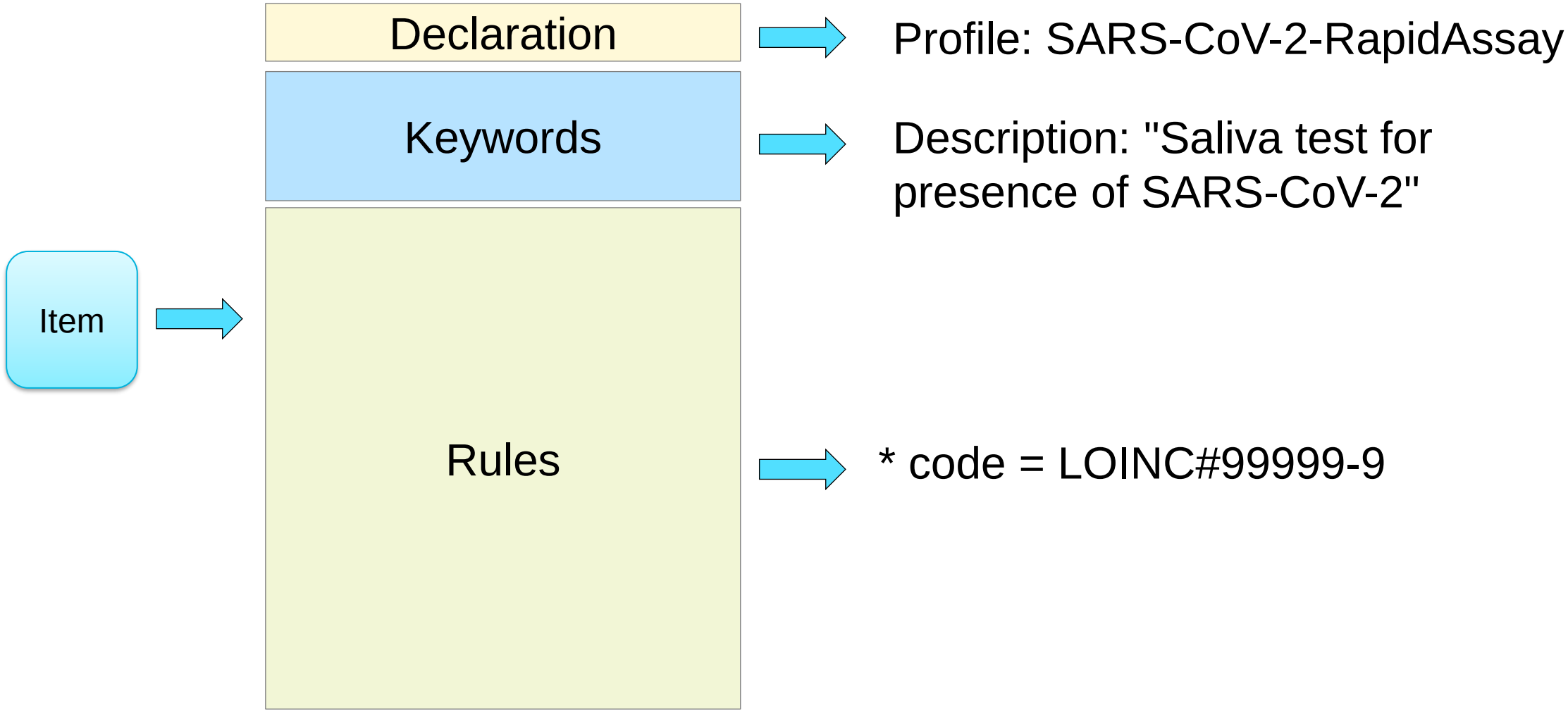
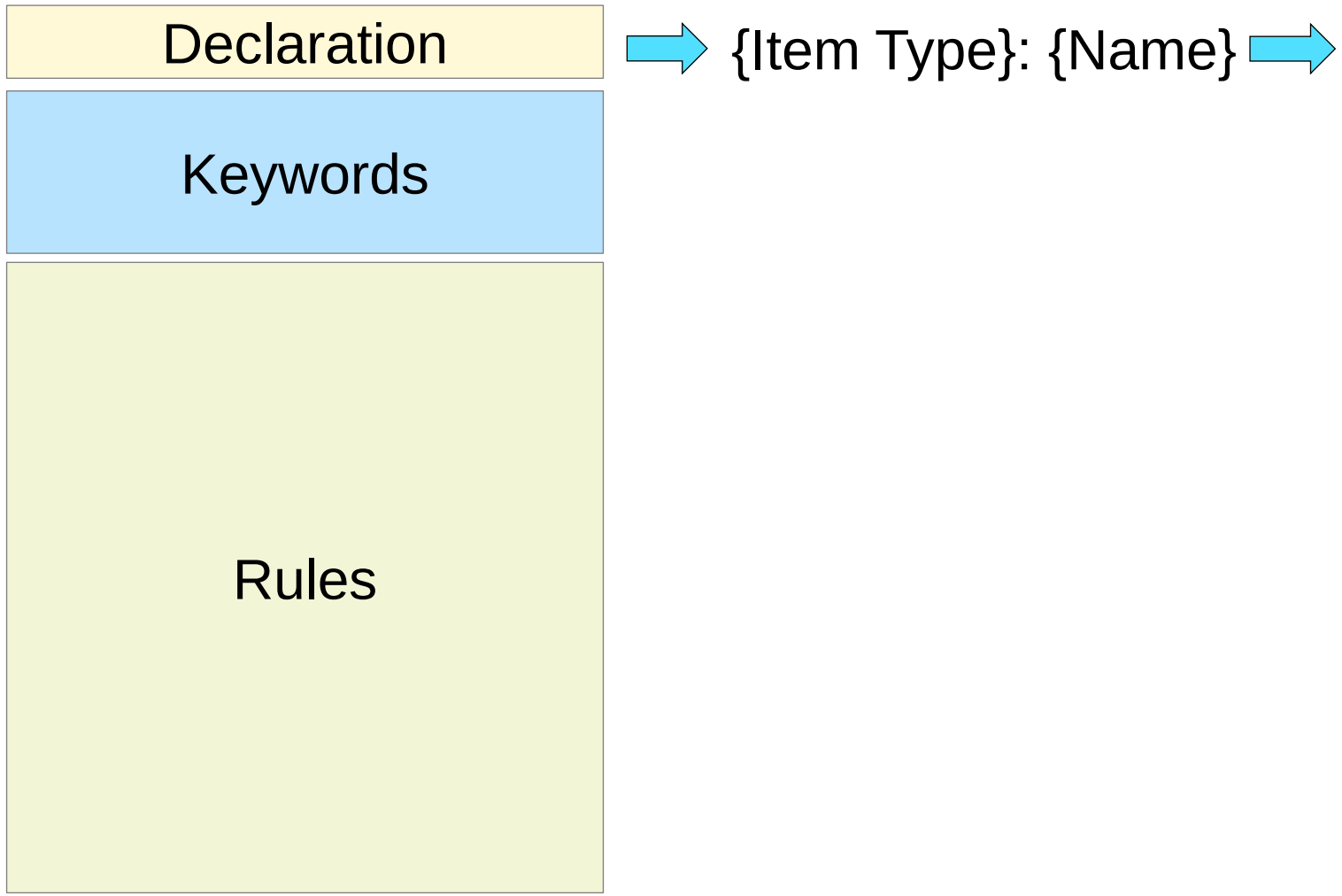
Anatomy of a FSH Item

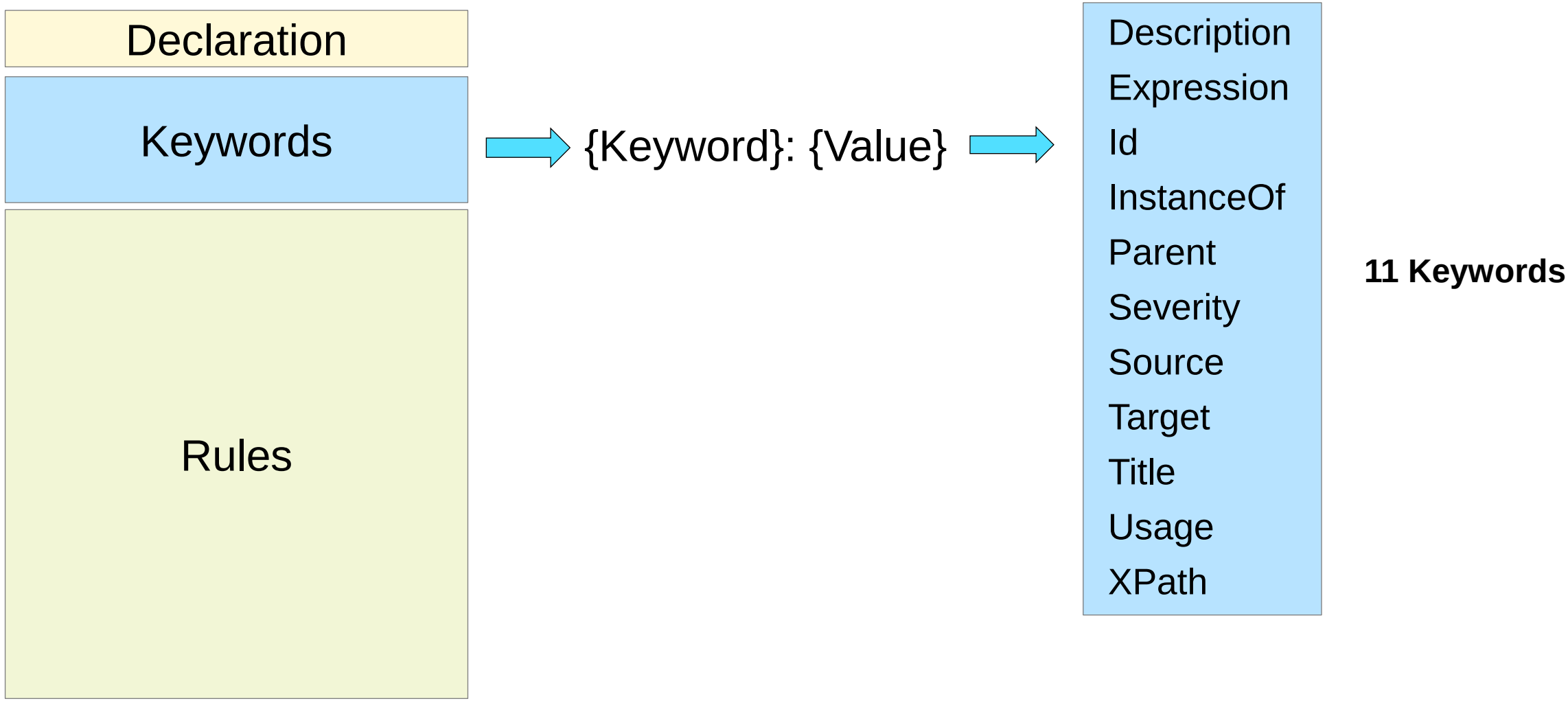


Anatomy of a FSH Item

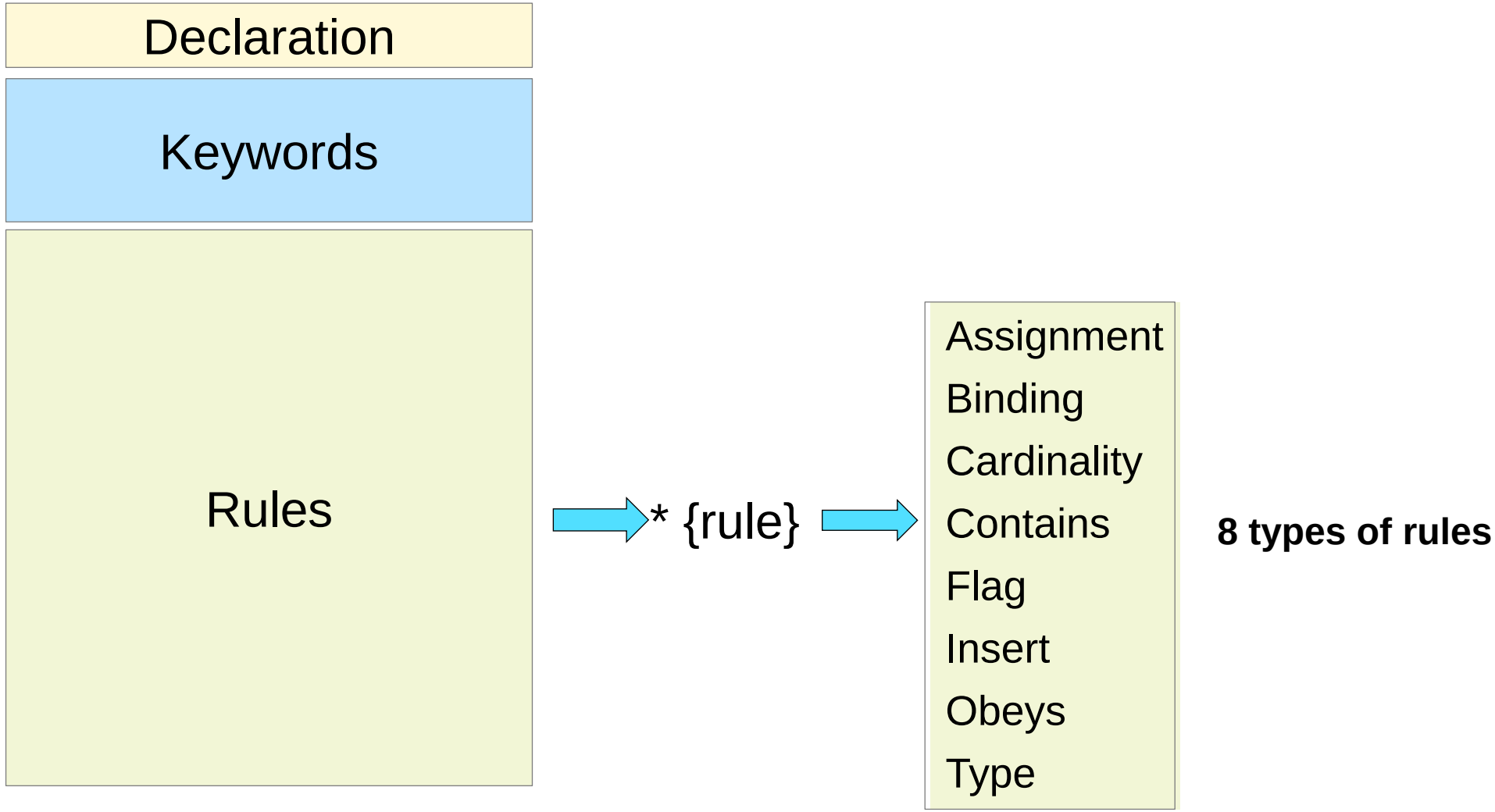


9 types of items

Anatomy of a FSH Item



Anatomy of a FSH Item



Which keywords go with which items?

http://build.fhir.org/ig/HL7/fhir-shorthand/reference.html#defining-items

Declaration \ Keyword	Id	Description	Title	Parent	InstanceOf	Usage	Source	Target	Severity	XPath	Expression
Alias											
Code System	S	S	S								
Extension	S	S	S	O							
Instance	x	S	S		R	O					
Invariant	x	R							R	O	O
Mapping	x	S	S				R	R			
Profile	S	S	S	R							
Rule Set											
Value Set	S	S	S								

KEY: R = REQUIRED, S = suggested (SHOULD be used), O = OPTIONAL, blank = disallowed, x = Id is required but specified in the declaration statement

Language Elements

- Primitives are the same as FHIR
- Names follow FHIR naming guidance
- References appear as `Reference(foo)`
- Repeated whitespace is ignored
- Rules start with *
- // for single line comment
- /* multiple
  line
  comment */

Alias Statements

- **You can alias any url, urn, or oid**
- **Only for readability -- does not affect functionality**
- **Typically, alias statements appear at the top of a file**
- **Aliases are global within a project**
- **Alias names can begin with $ (assists with error checking)**

```
Alias: SCT = http://snomed.info/sct

Alias: $LNC = http://loinc.org

Alias: RACE = urn:oid:2.16.840.1.113883.6.238

Alias: USCorePatient = http://hl7.org/fhir/us/core/StructureDefinition/us-core-patient
```

Coded Data Types: The # Sign

{CodeSystem URL or alias}#{code} *"{display string}"*

Examples:

Name	Flags	Card.	Type
Coding	Σ N		Element
system	Σ	0..1	uri
version	Σ	0..1	string
code	Σ	0..1	code
display	Σ	0..1	string
userSelected	Σ	0..1	boolean

```
#active // code data type

ICD10CM#C004  // Coding, no display

SCT#363346000 "Malignant neoplastic disease (disorder)"

http://snomed.info/sct#363346000 "Malignant neoplastic disease
(disorder)"
```

MITRE

Paths: Referring to Elements

- **Top-level element:**

  `severity`

  `bodySite`

  `abatement[x]`

  `abatementAge`

- **Nested path:**

  `bodySite.text`

  `dosage.doseAndRate.doseQuantity.value`

- **Array path (zero-based)**

  `bodySite.coding[0]`

  `contact[1].telecom[0]`

  `name[0].given[1]`

Paths for Choices and Slices

- **Choices**

generalPractitioner	Reference(Organization | Practitioner | PractitionerRole)

```
generalPractitioner[Organization]
generalPractitioner[PractitionerRole]
```

- **Extensions and Sliced Arrays**
  - Use the URL, slice or extension name in brackets:

```
extension[race]
extension[http://hl7.org/fhir/us/core/StructureDefinition/us-core-race]
component[SystolicBP]
component[DiastolicBP]
```

More Path Examples

- **Combining nested paths with array elements:**

  `bodySite.coding[0].display`

  `contact[1].telecom[0].rank`

- **Path into a slice of Observation.component:**

  `component[SystolicBP].valueQuantity.value`

- **Path into a complex extension:**

  `extension[race].extension[ombCategory].valueCoding.system`

- **Illegal path crossing resource boundary from Patient to Organization:**

  `generalPractitioner[Organization].name`

Line-by-Line Walkthrough

Define "Cancer Diseases Status" Profile

- **Profile of Observation resource**
- **LOINC Code 88040-1 "Response to cancer treatment"**
- **Coded values: Stable, Progressing, Responding**
- **Type of evidence (coded extension):**
  - Imaging, Histopathology, Reported Symptoms, Physical Exam, Lab Data
- **Applies only to Cancer Patients**
- **Performed only by Practitioner**
- **Cannot have a body site, device, component, or member observations**
- **Server must support**

Walkthrough: Defining a Profile in FSH

Declaration

Keywords

Rules

```
4   Profile:  CancerDiseaseStatus
```

```
5   Parent:   Observation
6   Id:       mcode-cancer-disease-status
7   Title:    "Cancer Disease Status"
8   Description: "A clinician's qualitative judgment on the current trend of the cancer, e.g., whether
it is stable, worsening (progressing), or improving (responding)."
```

```
9   * ^status = #draft
10  * extension contains EvidenceType named evidenceType 0..*
11  * extension[evidenceType].valueCodeableConcept from CancerDiseaseStatusEvidenceTypeVS (required)
12  * status and code and subject and effective[x] and valueCodeableConcept MS
13  * bodySite 0..0
14  * specimen 0..0
15  * device 0..0
16  * referenceRange 0..0
17  * hasMember 0..0
18  * component 0..0
19  * interpretation 0..1
20  * subject 1..1
21  * basedOn only Reference(ServiceRequest or MedicationRequest)
22  * partOf only Reference(MedicationAdministration or MedicationStatement or Procedure)
23  * code = LNC#88040-1
24  * subject only Reference(CancerPatient)
25  * focus only Reference(CancerConditionParent)
26  * performer only Reference(http://hl7.org/fhir/us/core/StructureDefinition/us-core-practitioner)
27  * effective[x] only dateTime or Period
28  * value[x] only CodeableConcept
29  * valueCodeableConcept from ConditionStatusTrendVS (required)
```

http://build.fhir.org/ig/HL7/fhir-shorthand/overview.html#fsh-line-by-line-walkthrough

Walkthrough: Declaration and Keywords

```
4   Profile:  CancerDiseaseStatus

5   Parent:   Observation
6   Id:       mcode-cancer-disease-status
7   Title:    "Cancer Disease Status"
8   Description: "A clinician's qualitative judgment on the current trend of the cancer, e.g., whether
it is stable, worsening (progressing), or improving (responding)."
```

- **Parent could be a:**
  - Resource (e.g., Patient, Observation)
  - Profile defined in the current project
  - Profile in another IG d (e.g., http://hl7.org/fhir/us/core/StructureDefinition/us-core-patient)
- **ID is used in the canonical URL for the item**
- **Title and description appear in the IG**

Walkthrough: Flag Rules

```
12  * status and code and subject and effective[x] and valueCodeableConcept MS
```

Flags can be set separately or several in one rule (as shown above)

- **MS = Must Support**
- **Other flags include SU (Summary), ?! (Modifier), N (Normative), TU (Trial Use), D (Draft).**

Walkthrough: Cardinality Rules

```
13  * bodySite 0..0
14  * specimen 0..0
15  * device 0..0
16  * referenceRange 0..0
17  * hasMember 0..0
18  * component 0..0
19  * interpretation 0..1
20  * subject 1..1
```

- **One line per cardinality**
- **Can combine cardinality and flag(s):**

```
* interpretation 0..1 MS SU
```

- **Can specify one-sided cardinality:**

```
* category 1..
* basedOn ..1
```

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Walkthrough: Type Rules ("only")

Restrict choice using "only". Separate with "or" for remaining choices:

```
21  * basedOn only Reference(ServiceRequest or MedicationRequest)
22  * partOf only Reference(MedicationAdministration or MedicationStatement or Procedure)
```

Restrict choices to profiles of the original types (e.g., Patient → CancerPatient):

```
24  * subject only Reference(CancerPatient)
25  * focus only Reference(CancerConditionParent)
26  * performer only Reference(http://hl7.org/fhir/us/core/StructureDefinition/us-core-practitioner)
```

The "only" keyword with datatype choices [x]:

```
27  * effective[x] only dateTime or Period
28  * value[x] only CodeableConcept
```

Walkthrough: Assignment Rules ("=")

Equals sign (=) is used to set most type of values (strings, quantities, dates and times, booleans, codings, etc.):

```
23  * code = LNC#88040-1
```

Other examples:

- Assignment of a code data type:

```
* status = #arrived
```

- Recommended style for assignment of a LOINC code in an **instance** of an Observation:

```
* code = LNC#69548-6 "Genetic variant assessment"
```

- Recommended style for assignment of a LOINC code in an Observation **profile**:

```
* code = LNC#69548-6  // Genetic variant assessment (display text in comment only!)
```

- Assignment of a boolean:

```
* active = true
```

- Assignment of a date:

```
* onsetDateTime = "2019-04-02"
```

- Assignment of a quantity with single quotes indicating UCUM units:

```
* valueQuantity = 36.5 'C'
```

- Assignment of a reference type to another resource:

```
* subject = Reference(EveAnyperson)
```

Walkthrough: Binding Rules ("from")

"from" is used to indicate a coded value must come from a value set. The modifiers are the same as FHIR (required, extensible, preferred, example):

```
29  * valueCodeableConcept from ConditionStatusTrendVS (required)
```

Other examples:

- Bind to an externally-defined value set using its canonical URL:

```
* telecom.system from http://hl7.org/fhir/ValueSet/contact-point-system (required)
```

- Bind to an externally-defined value set with required binding by default:

```
* gender from http://hl7.org/fhir/ValueSet/administrative-gender
```

- Bind to a value set using an alias name:

```
* address.state from USPSTwoLetterAlphabeticCodes (extensible)
```

Value Sets

Defining Value Sets in FSH

An extensional value set contains an explicit list of codes

The extensional form is very simple: * {coding}

```
Alias: SCT = http://snomed.info/sct
```

```
ValueSet:   ConditionStatusTrendVS
Id: mcode-condition-status-trend-vs
Title: "Condition Status Trend Value Set"
Description:  "How patient's given disease, condition, or ability is trending."
* SCT#260415000 "Not detected (qualifier)"
* SCT#268910001 "Patient condition improved (finding)"
* SCT#359746009 "Patient's condition stable (finding)"
* SCT#271299001 "Patient's condition worsened (finding)"
* SCT#709137006 "Patient condition undetermined (finding)"
```

Value Set Rules

- **Rule to include/exclude a single code:**
  * SCT#54102005 "G1 grade (finding)"
  * exclude SCT#54102005 "G1 grade (finding)"

- **Rule to include/exclude an entire value set:**
  * codes from valueset http://hl7.org/fhir/ValueSet/bodysite-laterality
  * exclude codes from valueset http://hl7.org/fhir/ValueSet/bodysite-laterality

- **Rule to include/exclude an entire code system:**
  * codes from system http://hl7.org/fhir/ndfrt
  * exclude codes from system http://hl7.org/fhir/ndfrt

Value Set Filtering Rules

- **Rules can contain filter expressions that modify the codes to be included/excluded**
- **Syntax of filters depends on the particular vocabulary**
  - **e.g., ICD-10 filters are not the same as SNOMED-CT filters**

Here are examples for SNOMED-CT (aliased to SCT):

```
* codes from system SCT where concept is-a #367651003 "Malignant neoplasm of primary, secondary, or uncertain origin (morphologic abnormality)"
* codes from system SCT where concept is-a #399919001 "Carcinoma in situ - category (morphologic abnormality)"
* codes from system SCT where concept is-a #399983006 "In situ adenomatous neoplasm - category (morphologic abnormality)"
* exclude codes from system SCT where concept is-a #128640002 "Glandular intraepithelial neoplasia, grade III (morphologic abnormality)"
* exclude codes from system SCT where concept is-a #450890000 "Glandular intraepithelial neoplasia, low grade (morphologic abnormality)"
* exclude codes from system SCT where concept is-a #703548001 "Endometrioid intraepithelial neoplasia (morphologic abnormality)"
```

Preview: Additional Tutorials

- **Advanced FHIR Shorthand (Tuna)**

```
9   * ^status = #draft
10  * extension contains EvidenceType named evidenceType 0..*
11  * extension[evidenceType].valueCodeableConcept from CancerDiseaseStatusEvidenceTypeVS (required)
```

  - Extensions, slicing, caret rules, instances, rule sets

- **FSHing Equipment**
  - **GoFSH** -- turn existing IGs into Shorthand
  - **FSH School** -- a site for learning and experimentation
  - **FSH Online** -- interactive FHIR Shorthand
  - **FSHing Trip** -- roundtripping from StructureDefinition to FSH and back

- **Wicked FHIR Shorthand (Shark)**
  - Planned Future Features, including Macros, Soft Array Indexing, Context Paths, and Logical Models