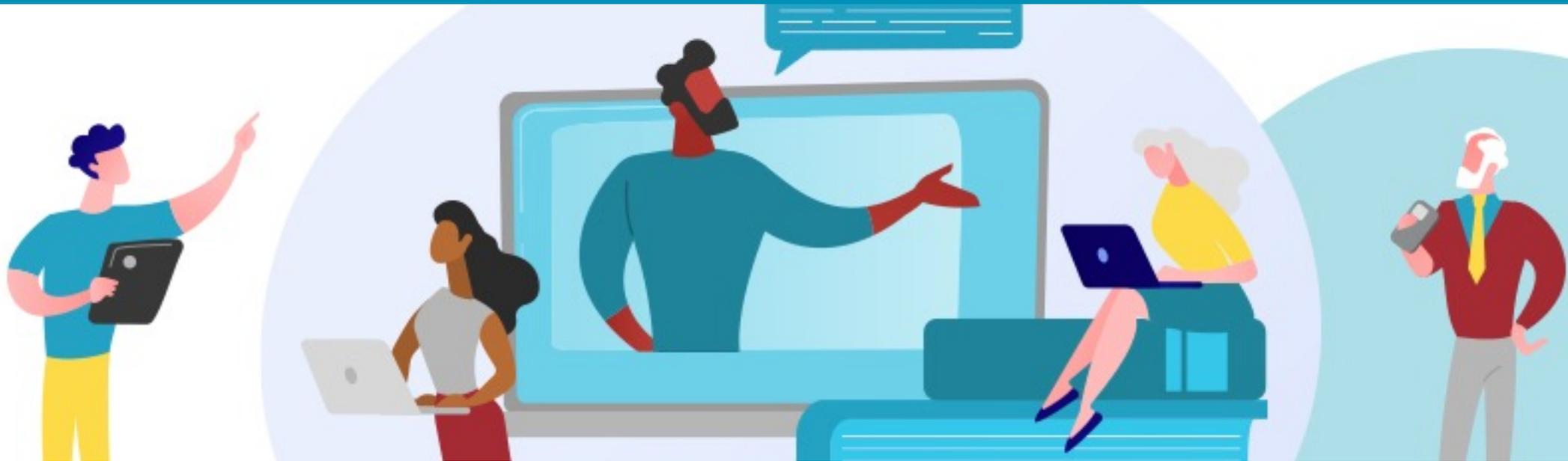


Let's Build: Create an Implementation Guide with FHIR Shorthand

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MITRE

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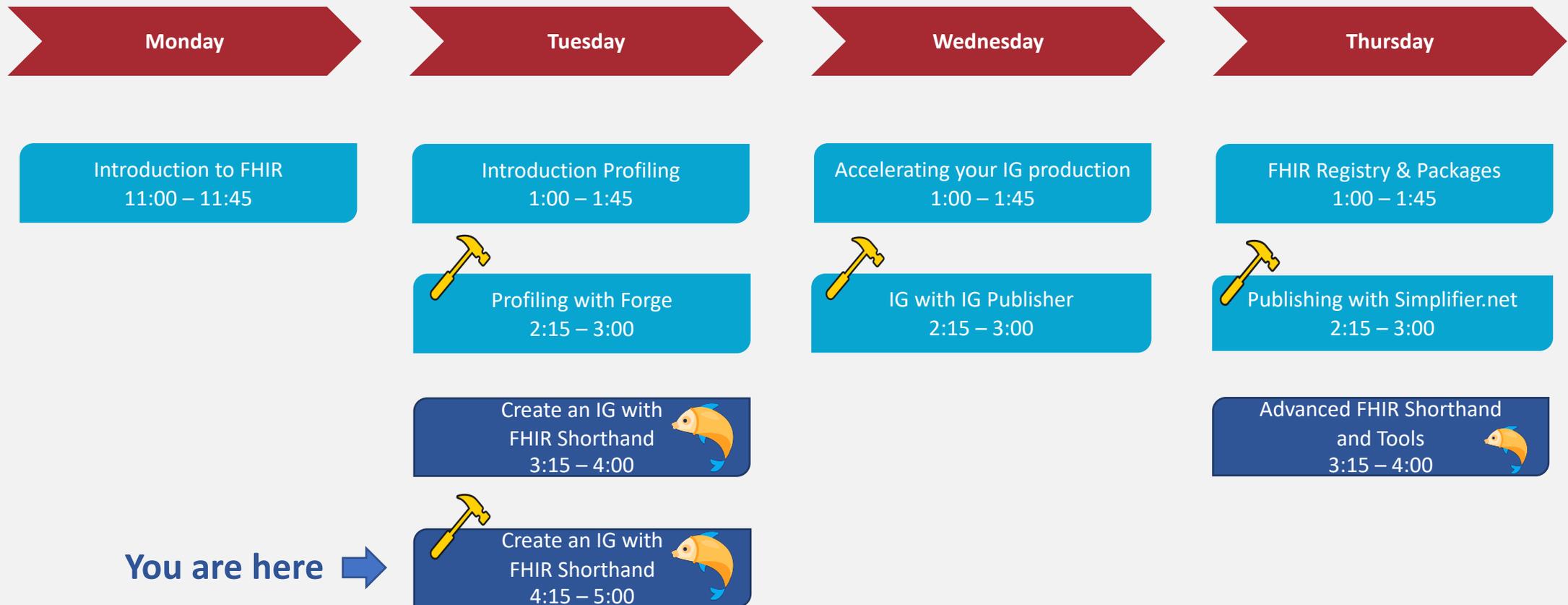
mCODE™



Clinical
Quality
Language



Track overview: Let's Build a FHIR specification

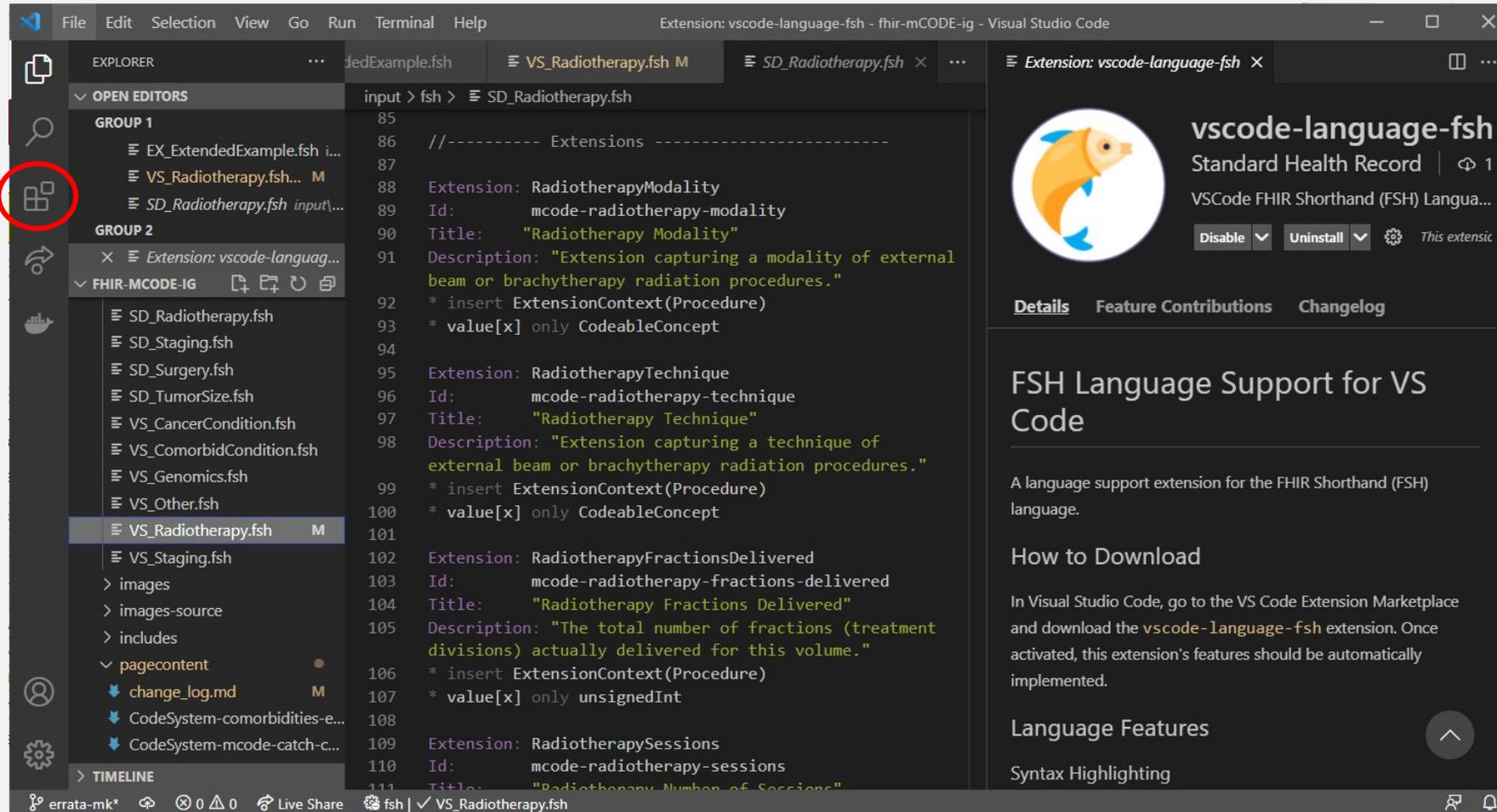


Prepare for Let's Build

1. Install **Node.js LTS** edition from <https://nodejs.org/>
2. Install **SUSHI** and **GoFSH**
 - Open a terminal and run: `npm install -g fsh-sushi`
 - Open a terminal and run: `npm install -g gofsh`
3. Install **VS Code** (if text editor is needed)
 - <https://code.visualstudio.com/download>
 - Install the VS Code extension for FSH: `vscode:extension/kmahalingam.vscode-language-fsh`

(Optional) Visual Studio Code: Text Editor for .fsh Files

plug-in
for .fsh
files



Let's Build
using FSH



How to Produce an IG Using FHIR Shorthand

1

Install SUSHI

2

Create a new
project

3

Author your
FSH

4

Run SUSHI

5

Download or
Update IG
Publisher

6

Run IG
Publisher

1. Install SUSHI

To install SUSHI:

- First install **Node.js LTS** edition from <https://nodejs.org/>
- Open a terminal and run: `npm install -g fsh-sushi`

See <https://fshschool.org/docs/sushi/installation/> for additional details.

2. Initialize your IG Project

- Open command prompt
- Choose a parent directory
- Run `sushi -i`



```
MyIG
├── ig.ini
├── sushi-config.yaml
├── input
│   ├── fsh
│   │   └── patient.fsh
│   ├── ignoreWarnings.txt
│   └── pagecontent
│       └── index.md
├── _genonce.bat
├── _genonce.sh
├── _updatePublisher.bat
├── _updatePublisher.sh
└── .gitignore
```

If script downloads are blocked by firewall, download them from <https://github.com/HL7/ig-publisher-scripts>

3. Create your FSH Sources

- For expedience, copy from the FSH Online example
- Replace the contents of /input/fsh/patient.fsh (the file name does not matter)

<https://bit.ly/3yLJjxY> →

```

Profile: CovidDiagnosis
Parent: Condition
Description: "How to report COVID"
* code = $icd#U07.1
* severity from CovidSeverityVS (required)
* subject only Reference(Patient)
* extension contains ConditionCertainty named certainty 0..1 MS

Alias: $icd = http://hl7.org/fhir/sid/icd-10-cm

ValueSet: CovidSeverityVS
Description: "Values for COVID severity"
* include codes from valueset http://hl7.org/fhir/ValueSet/condition-severity
* include $sct#442452003 "Life threatening severity (qualifier value)"

Alias: $sct = http://snomed.info/sct

Instance: DiagnosisExample
InstanceOf: CovidDiagnosis
* subject.reference = "Patient/JaneDoe"
* code = $icd#U07.1
* severity = $sct#24484000 "Severe"

Instance: JaneDoe
InstanceOf: Patient
* name.family = "Doe"
* name.given = "Jane"

Extension: ConditionCertainty
Description: "The certainty of diagnosis"
* value[x] only CodeableConcept
* value[x] from ConditionCertaintyVS

ValueSet: ConditionCertaintyVS
Description: "Degree of confidence the condition is present"
* $sct#415684004 "Suspected (qualifier value)"
* $sct#410592001 "Probably present (qualifier value)"
* $sct#41060500 "Confirmed present (qualifier value)"
  
```

4. Run SUSHI

- Open command prompt
- Change to your IG directory
- Run **sushi**
- Fix any errors and re-run before the next step

```

info Converting FSH to FHIR resources...
info Converted 2 FHIR StructureDefinitions.
info Converted 2 FHIR ValueSets.
info Converted 2 FHIR instances.
info Exporting FHIR resources as JSON...
info Exported 6 FHIR resources as JSON.
info Assembling Implementation Guide sources...
info Generated ImplementationGuide-fhir.example.json
info Assembled Implementation Guide sources; ready for IG Publisher.
  
```

SUSHI RESULTS

Profiles	Extensions	ValueSets	CodeSystems	Instances
1	1	2	0	2

Well hooked and landed! 0 Errors 0 Warnings

5. Download or Update Publisher

- Open command window
- run `_updatePublisher` script
 - Wait for ~100 MB download

```

MyIG
├── ig.ini
├── sushi-config.yaml
├── input
├── input-cache
│   └── publisher.jar
├── _genonce.bat
├── _genonce.sh
├── _updatePublisher.bat
├── _updatePublisher.sh
└── package-list.json
  
```

If blocked by firewall, download directly from <https://github.com/HL7/fhir-ig-publisher/releases/latest/download/publisher.jar>

6. Run the IG Publisher

- In command window, run `_genonce`
- When run completes, open `/output/index.html`

2 Artifacts Summary

This page provides a list of the FHIR artifacts defined as part of this implementation guide.

2.0.1 Structures: Resource Profiles

These define constraints on FHIR resources

CovidDiagnosis	How to report COVID
--------------------------------	---------------------

2.0.2 Structures: Extensions

These define constraints on FHIR resources

ConditionCertainty	The certainty of condition
------------------------------------	----------------------------

2.0.3 Terminology: Value Sets

These define sets of codes used in the IG

ConditionCertaintyVS	Degree of certainty
CovidSeverityVS	Values of severity

2.0.4 Example: Example Instances

These are example instances of the resources defined in the IG

DiagnosisExample	
JaneDoe	

2.1.1 Resource Profile: CovidDiagnosis

Defining URL:	http://example.org/StructureDefinition/CovidDiagnosis
Version:	0.1.0
Name:	CovidDiagnosis
Status:	Active as of 2021-05-29T09:00:58-04:00
Definition:	How to report COVID
Source Resource:	XML / JSON / Turtle

The official URL for this profile is:

<http://example.org/StructureDefinition/CovidDiagnosis>

2.1.1.1 Formal Views of Profile Content

Description of Profiles, Differentials, Snapshots and how the different presentations work.

[Text Summary](#)
[Differential Table](#)
[Snapshot Table](#)
[Snapshot Table \(Must Support\)](#)
[All](#)

This structure is derived from [Condition](#)

Name	Flags	Card.	Type	Description & Constraints
Condition		0..*	Condition	Detailed information about conditions, problems or diagnoses
extension	★	0..*	Extension	Extension Slice: Unordered, Open by value:url
ConditionCertainty	Ⓢ	0..1	CodeableConcept	Extension URL: http://example.org/StructureDefinition/ConditionCertainty Binding: ConditionCertaintyVS (required)
severity		0..1	CodeableConcept	Subjective severity of condition Binding: CovidSeverityVS (required)
code		0..1	CodeableConcept	Identification of the condition, problem or diagnosis Required Pattern: At least the following
coding		1..*	Coding	Code defined by a terminology system Fixed Value: (complex)
system		1..1	uri	Identity of the terminology system Fixed Value: http://hl7.org/fhir/sid/icd-10-cm
code		1..1	code	Symbol in syntax defined by the system Fixed Value: U07.1
subject		1..1	Reference(Patient)	Who has the condition?

Documentation for this format

Improve your IG

- Add more FSH
 - One or more files
- Add Narrative Content
 - Edit /input/pagecontent/*.md
- Customize menus
 - sushi-config.yaml
 - <https://fshschool.org/docs/sushi/configuration/>
- Create a github repository and share your work

```

MyIG
├── ig.ini
├── sushi-config.yaml
├── fsh-generated
├── input
│   ├── fsh
│   │   └── patient.fsh
│   ├── ignoreWarnings.txt
│   ├── pagecontent
│   │   └── index.md
├── output
├── _genonce.bat
├── _genonce.sh
├── _updatePublisher.bat
├── _updatePublisher.sh
└── .gitignore
  
```

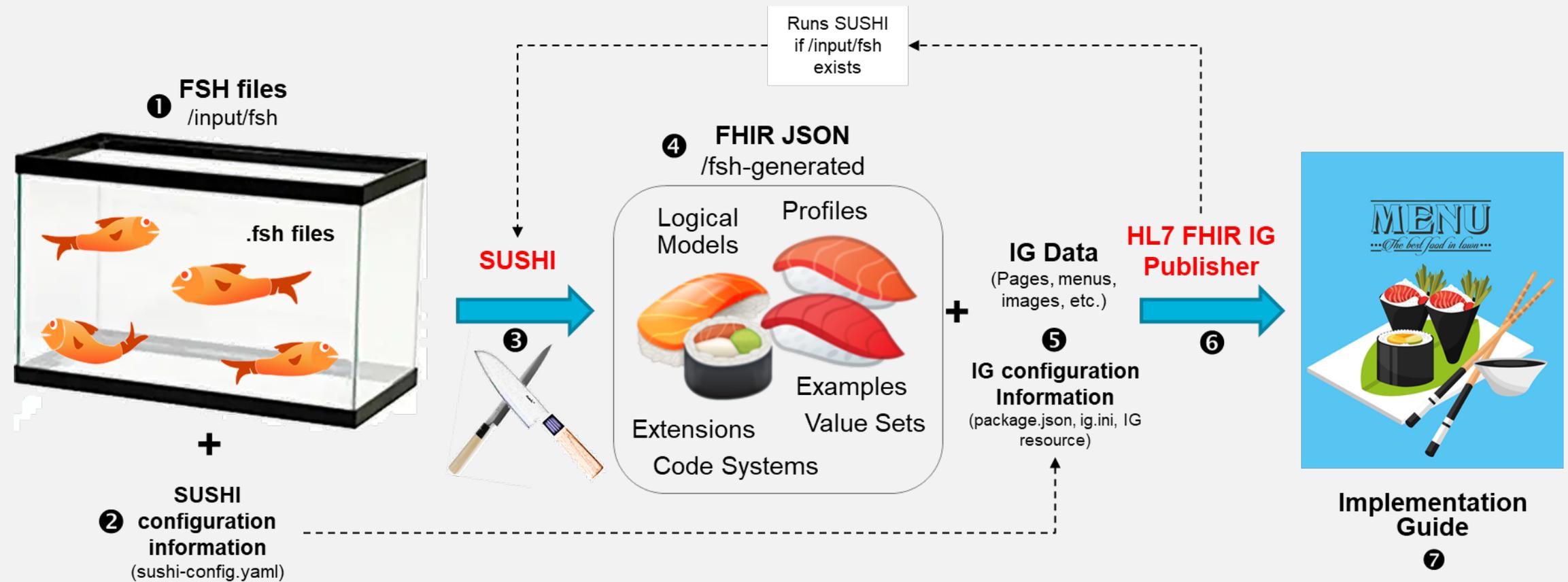
Configuration File: sushi-config.yaml

Include in top level project directory:

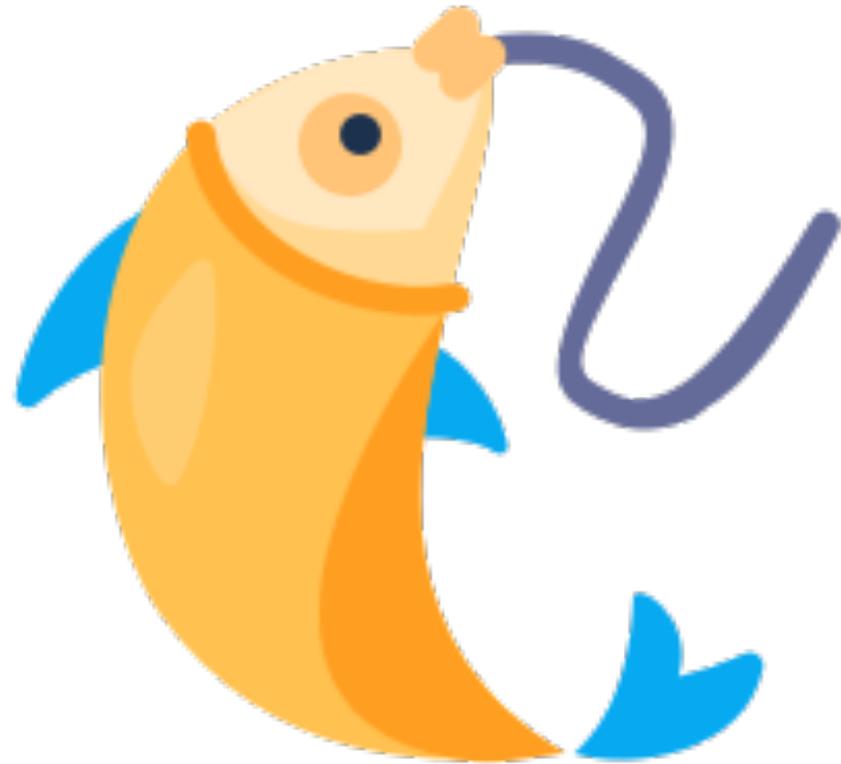
```
id: fhir.example
canonical: http://hl7.org/fhir/example
name: ExampleIG
title: "Example IG Version 0.1.0"
description: "An example IG that demonstrates FSH grammar"
status: draft
license: CC0-1.0
version: 0.1.0
fhirVersion: 4.0.1
copyrightYear: 2020+
releaseLabel: ci-build
dependencies:
  hl7.fhir.us.core: 3.1.0
```

See <https://fshschool.org/docs/sushi/configuration/>

Overview: Creating an IG with FSH



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.pngwaves.com/png-clip-art-oxper/>)



Convert an
Existing IG to
FSH using
GoFSH

General Tips:

- Conversion to FSH works best on a clean IG (few errors on QA report)
 - Use the JSON IG package downloaded from the published IG
 - Use the artifacts in the **/output** folder after running the IG Publisher
 - Use the sources in Github
- GoFSH and SUSHI will often find latent problems
- GoFSH may not be 100% perfect in all cases (but it is getting there)

Convert an Existing IG using GoFSH

1

Install GoFSH

2

Create a local
copy of the
IG

3

Run GoFSH
and correct
any problems

4

Run SUSHI
and correct
any problems

5

Replace IG
sources with
FSH files

6

Run IG
Publisher

1. Install GoFSH

- Open a terminal window and run: `npm install -g gofsh`

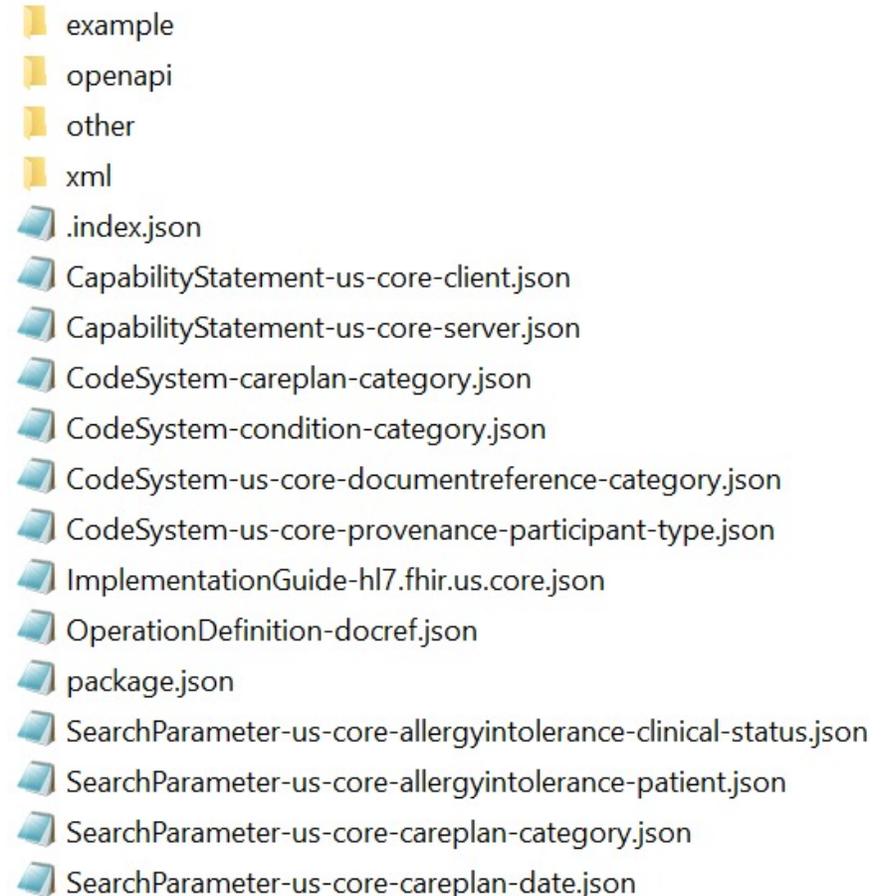
(If you haven't, first install **Node.js LTS** edition from <https://nodejs.org/>)

2. Create a Local Copy of the IG

- Let's convert the US Core IG
- Download the US Core version in 3.2 Package:

<http://hl7.org/fhir/us/core/2021Jan/downloads.html>

- Unzip to a new directory



3. Run GoFSH and Correct Any Errors

- Review optional arguments: **gofish -h**
- Run (for example): **gofsh -s file-per-definition**
- A **/gofsh** directory will be created:
 - **/input** contains all generated definitions and examples
 - **sushi-config.yaml** -- needed for running sushi

3. Run GoFSH and Correct Any Errors

error Encountered profile with a duplicate name, **USCoreRespiratoryRateProfile**, which GoFSH cannot make unique. Fix the source file to resolve this error or update the resulting FSH definition.

```
Profile: USCoreRespiratoryRateProfile
Parent: USCoreVitalSignsProfile
Id: us-core-bmi
Title: "US Core BMI Profile"
```

fix
→

```
Profile: USCoreBMIProfile
Parent: USCoreVitalSignsProfile
Id: us-core-bmi
Title: "US Core BMI Profile"
```

Typical Generated FSH File

USCore Condition in FSH

```
1 Profile: USCoreCondition
2 Parent: Condition
3 Id: us-core-condition
4 Title: "US Core Condition Profile"
5 Description: "Defines constraints and extensions on the Condition resource for the minimal set of data to query and retrieve
concerns information."
6 * ^version = "3.2.0"
7 * ^status = #active
8 * ^experimental = false
9 * ^date = "2020-06-27"
10 * ^publisher = "HL7 International - US Realm Steering Committee"
11 * ^contact.name = "HL7 International - US Realm Steering Committee"
12 * ^contact.telecom.system = #url
13 * ^contact.telecom.value = "http://www.hl7.org/Special/committees/usrealm/index.cfm"
14 * ^jurisdiction = urn:iso:std:iso:3166#US
15 * ^copyright = "Used by permission of HL7 International, all rights reserved Creative Commons License"
16 * obeys us-core-1
17 * . ^definition = "The US Core Condition Profile is based upon the core FHIR Condition Resource and created to meet the 2015
Data Set 'Problems' and 'Health Concerns' requirements."
18 * . ^constraint[8].extension.url = "http://hl7.org/fhir/StructureDefinition/elementdefinition-bestpractice"
19 * . ^constraint[=].extension.valueBoolean = true
20 * . ^mustSupport = false
21 * clinicalStatus 0..1 MS
22 * clinicalStatus only CodeableConcept
23 * clinicalStatus from ConditionClinicalStatusCodes (required)
24 * verificationStatus 0..1 MS
25 * verificationStatus only CodeableConcept
26 * verificationStatus from ConditionVerificationStatus (required)
27 * category 1..* MS
28 * category only CodeableConcept
29 * category from $us-core-condition-category (extensible)
30 * category ^short = "problem-list-item | encounter-diagnosis | health-concern"
31 * category ^condition = "us-core-1"
32 * code 1..1 MS
33 * code only CodeableConcept
34 * code from USCoreConditionCode (required)
35 * code ^binding.description = "Valueset to describe the actual problem experienced by the patient"
36 * subject 1..1 MS
37 * subject only Reference(USCorePatientProfile)
```

(Optional) Check Translation with FSHing Trip

- FSHing Trip is a round-trip analysis, JSON → FSH → JSON, to validate the correctness of the generated FSH
- Use the GoFSH **-f** option

FSHing Trip Comparison

Files changed (40) hide

ImplementationGuide-hl7.fhir.us.core.json → gofsh/ImplementationGuide-hl7.fhir.us.core.json	+0	-3770
StructureDefinition-head-occipital-frontal-circumference-percentile.json → gofsh/fsh-generated/resources/StructureDefinition-head-occipital-frontal-circumference-percentile.json	+16	-37
StructureDefinition-pediatric-bmi-for-age.json → gofsh/fsh-generated/resources/StructureDefinition-pediatric-bmi-for-age.json	+16	-37
StructureDefinition-pediatric-weight-for-height.json → gofsh/fsh-generated/resources/StructureDefinition-pediatric-weight-for-height.json	+16	-39
StructureDefinition-us-core-allergyintolerance.json → gofsh/fsh-generated/resources/StructureDefinition-us-core-allergyintolerance.json	+15	-15
StructureDefinition-us-core-birthsex.json → gofsh/fsh-generated/resources/StructureDefinition-us-core-birthsex.json	+31	-12
StructureDefinition-us-core-blood-pressure.json → gofsh/fsh-generated/resources/StructureDefinition-us-core-blood-pressure.json	+30	-78
StructureDefinition-us-core-bmi.json → gofsh/fsh-generated/resources/StructureDefinition-us-core-bmi.json	+16	-37
StructureDefinition-us-core-body-height.json → gofsh/fsh-generated/resources/StructureDefinition-us-core-body-height.json	+16	-37

FSHING Trip JSON Comparison

<pre>"differential": { "element": [{ "id": "Condition", "path": "Condition", "definition": "The US Core Condition Profile is based upon the core FHIR Condition Resource and crea "constraint": [{</pre>	<pre>86 "differential": { 87 "element": [88 { 89 "id": "Condition", 90 "path": "Condition", 91 "definition": "The US Core Condition Profile is based upon the core FHIR Condition Resourc 92 "constraint": [93 {</pre>
	<pre>94 + { 95 + "key": "us-core-1", 96 + "severity": "warning", 97 + "human": "A code in Condition.category SHOULD be from US Core Condition Category Codes 98 + "expression": "where(category.memberOf('http://hl7.org/fhir/us/core/ValueSet/us-core-c 99 + "xpath": "(no xpath equivalent)", 100 + "source": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-condition",</pre>
<pre> "extension": [{ "url": "http://hl7.org/fhir/StructureDefinition/elementdefinition-bestpractice", "valueBoolean": true }],</pre>	<pre>101 { 102 "url": "http://hl7.org/fhir/StructureDefinition/elementdefinition-bestpractice", 103 "valueBoolean": true 104 } 105 +]</pre>
<pre> "key": "us-core-1", "severity": "warning", "human": "A code in Condition.category SHOULD be from US Core Condition Category Codes value set "expression": "where(category.memberOf('http://hl7.org/fhir/us/core/ValueSet/us-core-condition-c "xpath": "(no xpath equivalent)" }</pre>	<pre>106 } 107], 108 "mustSupport": false, 109 "mapping": [</pre>
<pre>-103,15 +115,8 @@ }, {</pre>	<pre>115 }, 116 {</pre>
<pre> "id": "Condition.clinicalStatus", "path": "Condition.clinicalStatus", "min": 0, "max": "1", "type": [{ "code": "CodeableConcept"</pre>	<pre>117 "id": "Condition.clinicalStatus", 118 "path": "Condition.clinicalStatus",</pre>
<pre>], "mustSupport": true,</pre>	<pre>119 "mustSupport": true,</pre>

re-ordered statements

new statement

unnecessary statements



4. Run SUSHI and Correct Any Problems

- In terminal window, run **sushi**
- SUSHI will flag data type and other errors
- The file name and line number will be reported

```
error Cannot bind value set to xhtml; must be coded (code, Coding, CodeableConcept, Quantity, CodeableReference),
or the data types (string, uri).
File: C:\Users\mkramer\Documents\GitHub\us-core-3.2-package\gofsh\input\fsh\USCoreCarePlanProfile-Profile.fsh
Line: 22
```

```
22 *text.div from NarrativeStatus (required)
```

it is illegal to bind a value set to an xhtml element

element definition
invariants:

eld-11	Rule	(base)	Binding can only be present for coded elements, string, and uri
--------	------	--------	---

5. Move FSH files into IG

- Clone a copy of the US Core github sources
 - <https://github.com/HL7/US-Core.git>
 - Use git clone command or Github desktop
- Remove the current definition sources: **/input/examples** and **/input/resources**
- Copy your **/fsh** folder into the **/input** folder of the IG

6. Run the IG Publisher

- Get the publisher scripts and publisher.jar are present (using instructions on previous slide)
- Run **_genonce**
- When complete, open **/output/index.html**

Result:
US Core IG
produced from
FSH sources



HL7 International US Core Implementation Guide 3.2.0 - CI build

Home Guidance FHIR Artifacts Security Examples Downloads

Table of Contents > Artifacts Summary > US Core Condition Profile

US Core Implementation Guide - Local Development build (v3.2.0). See the [Directory of published versions](#)

Content Detailed Descriptions Examples XML JSON

18.86.1 Resource Profile: US Core Condition Profile

Defining URL:	http://hl7.org/fhir/us/core/StructureDefinition/us-core-condition
Version:	3.2.0
Name:	USCoreCondition

18.86.1.3 Formal Views of Profile Content

Description of Profiles, Differentials, Snapshots and how the different presentations work

Text Summary **Differential Table** Snapshot Table Snapshot Table (Must Support) All

This structure is derived from [Condition](#)

Name	Flags	Card.	Type	Description & Constraints
Condition	I	0..*	Condition	Detailed information about conditions, problems or diagnoses us-core-1: A code in Condition.category SHOULD be from US Core Condition Category Codes value set. Binding: ConditionClinicalStatusCodes (required)
clinicalStatus	S	0..1	CodeableConcept	active recurrence relapse inactive remission resolved Binding: ConditionClinicalStatusCodes (required)
verificationStatus	S	0..1	CodeableConcept	unconfirmed provisional differential confirmed refuted entered-in-error Binding: ConditionVerificationStatus (required)
category	S I	1..*	CodeableConcept	problem-list-item encounter-diagnosis health-concern Binding: US Core Condition Category Codes (extensible)
code	S	1..1	CodeableConcept	Identification of the condition, problem or diagnosis Binding: US Core Condition Code (required): Valueset to describe the actual problem experienced by the patient
subject	S	1..1	Reference(US Core Patient Profile)	Who has the condition?

? Documentation for this format

US Core 3.2.0

Text Summary **Differential Table** Snapshot Table

This structure is derived from [Condition](#)

Name	Flags	Card.	Type	Description
Condition	I	0..*	Condition	Detailed information about conditions, problems or diagnoses
clinicalStatus	S	0..1	CodeableConcept	active recurrence relapse inactive remission resolved
verificationStatus	S	0..1	CodeableConcept	unconfirmed provisional differential confirmed refuted entered-in-error
category	S I	1..*	CodeableConcept	problem-list-item encounter-diagnosis health-concern
code	S	1..1	CodeableConcept	Identification of the condition, problem or diagnosis
subject	S	1..1	Reference(US Core Patient Profile)	Who has the condition?



Bonus points: See any differences?

Advantages of FHIR Shorthand Profiling Language

- Concise, readable, understandable
- Rapid changes via text operations: copy, paste, search, and replace
- Perfect for source code control (branching, merging, diffs)
- Error checking and incorporation of best practices
- Complete: FSH does everything you can do by manually editing
 - Profiles, extensions, value sets, code systems, invariants, mappings
 - Resources and logical models (NEW!)
- HL7 Standard and integrated with HL7 FHIR IG Publisher

FSH Resources and Tools

- [FSH Language Specification](#) -- HL7 FHIR Standard
- [SUSHI](#) -- compile FSH into FHIR Artifacts
- [FSH School](#) -- web site with documentation, tools, examples
- [FSH Online](#) -- interactive FHIR Shorthand with examples
- [GoFSH](#) -- convert existing implementation guides into FSH (beta)
- [FSH Finder](#) -- web crawler to find FSH projects
- [VS Code extension](#) -- code highlighter for VS Code editor

Questions?



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