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

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# Howdy!

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- Principal Health Technology Engineer @ MITRE
  - Co-creator of FHIR Shorthand with Mark Kramer
  - Development lead for FSH Tools (SUSHI, GoFSH, etc.)
  - Technical lead for AHRQ's CDS Connect project



This is me doing virtual conferences



A US non-profit operating federally-funded research and development centers, working in the public interest. We bring a conflict-free perspective and a whole of government vantage point to bring innovative ideas into existence.

## Exercise: Create a Patient Profile

In this exercise, you'll use FHIR Shorthand to:

- Create a simple profile on Patient
- Constrain cardinality of elements
- Mark elements as must support
- Create and apply a simple extension
- Create and bind a value set
- Create an example for your profile



Treadmill by CharmaineZoe: <https://www.flickr.com/photos/charmainezoe/24127924526>

Cartoon Fish by FreeSVG.org: <https://freesvg.org/cartoon-fish-1576077127>

**You will do all of this from the comfort of your own couch browser!**



## For the FSH Online Experience (*no installation needed*)

Start Here: <https://bit.ly/dev22-fsh1>

## For the SUSHI Experience (*requires installation*)

### 1. Run: `sushi --init`

```
> sushi --init

This interactive tool will use your answers to create a
working SUSHI project configured with your project's
basic information.

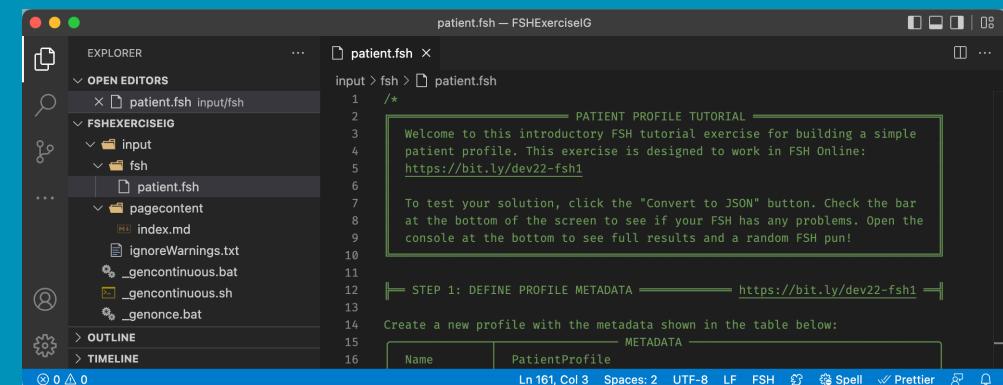
Name (Default: ExampleIG): FSHExerciseIG
Id (Default: fhir.example): fhir.fsh.exercise
Canonical (Default: http://example.org): http://example.org/fsh/exercise
Status (Default: draft): draft
Version (Default: 0.1.0): 0.1.0
Publisher Name (Default: Example Publisher): Just Me
Publisher Url (Default: http://example.org/example-publisher): http://example.org/just-me
Initialize SUSHI project in /Users/cmoesel/dev/fsh/FSHExerciseIG? [y/n]: y
```

### 2. Load **FSHExerciseIG** in VS Code

### 3. Browse to: <https://bit.ly/dev22-fsh1>

### 4. Copy FSH on left-hand side

### 5. Paste into **input/fsh/patient.fsh**



```
patient.fsh — FSHExerciseIG
patient.fsh x
input > fsh > patient.fsh
1 /* PATIENT PROFILE TUTORIAL
2 Welcome to this introductory FSH tutorial exercise for building a simple
3 patient profile. This exercise is designed to work in FSH Online:
4 https://bit.ly/dev22-fsh1
5
6 To test your solution, click the "Convert to JSON" button. Check the bar
7 at the bottom of the screen to see if your FSH has any problems. Open the
8 console at the bottom to see full results and a random FSH pun!
9
10
11
12 STEP 1: DEFINE PROFILE METADATA https://bit.ly/dev22-fsh1
13 Create a new profile with the metadata shown in the table below:
14
15
16
```

# FSH Online: FSHing with the ‘Net

- 1. Browse Examples**
- 2. FSH to FHIR (SUSHI)**
- 3. Share FSH**
- 4. Download FSH**
- 5. Clear FSH**
- 6. View Log**
- 7. View Errors**



The screenshot shows the FSH Online interface with two main panes. The left pane displays FSH code, and the right pane displays the generated FHIR JSON. Numbered circles (1-14) point to specific UI elements:

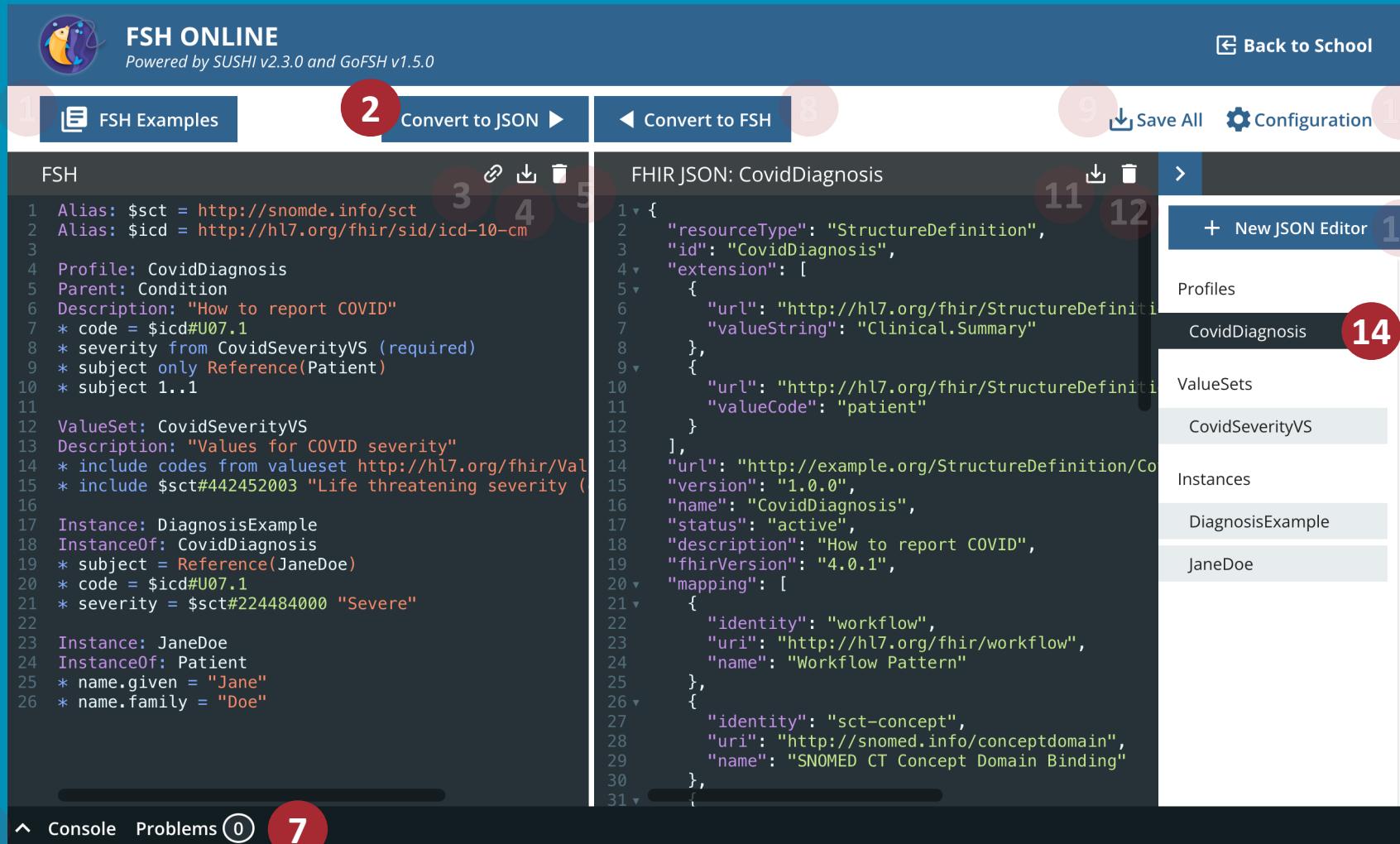
- 1**: FSH Examples button
- 2**: Convert to JSON button
- 3**: Copy icon
- 4**: Paste icon
- 5**: Delete icon
- 6**: Console link
- 7**: Problems link (0)
- 8**: Convert to FSH button
- 9**: Save All button
- 10**: Configuration button
- 11**: Copy icon
- 12**: Paste icon
- 13**: New JSON Editor button
- 14**: Context menu with options: Profiles, CovidDiagnosis, ValueSets, CovidSeverityVS, Instances, DiagnosisExample, JaneDoe.

- 8. FHIR to FSH (GoFHS)**
- 9. Save FSH and JSON**
- 10. Configure Settings**
- 11. Download JSON**
- 12. Clear JSON**
- 13. New JSON**
- 14. View JSON**

<https://fshschool.org/FSHOnline/>

# FSH Online: Features You'll Use Today

1. **Browse Examples**
2. **FSH to FHIR (SUSHI)**
3. **Share FSH**
4. **Download FSH**
5. **Clear FSH**
6. **View Log**
7. **View Errors**



The screenshot shows the FSH Online interface with two main panes. The left pane displays FHIR Structured Query Language (FSH) code, and the right pane displays the generated FHIR JSON. Numbered callouts point to specific features:

- 1.** Back to School button
- 2.** Convert to JSON button
- 3.** Copy icon
- 4.** Paste icon
- 5.** Delete icon
- 6.** Console link
- 7.** Problems link (0 errors)
- 8.** Convert to FSH button
- 9.** Save All button
- 10.** Configuration button
- 11.** Up arrow
- 12.** Down arrow
- 13.** New JSON Editor button
- 14.** Context menu with options: Profiles (CovidDiagnosis), ValueSets (CovidSeverityVS), Instances, DiagnosisExample, and JaneDoe.

8. **FHIR to FSH (GoFSH)**
9. **Save FSH and JSON**
10. **Configure Settings**
11. **Download JSON**
12. **Clear JSON**
13. **New JSON**
14. **View JSON**

<https://fshschool.org/FSHOnline/>

<https://bit.ly/dev22-fsh1>

# Step 1: Define Profile Metadata

Create a new profile with the metadata shown in the table below.

Metadata	
Name	PatientProfile
Parent	Patient
Id	patient-profile
Title	A Patient Profile
Description	Defines constraints and extensions on the patient resource.

**Table of Contents > Artifacts Summary > A Patient Profile**

FSHExerciseIG - Local Development build (v0.1.0). See the [Directory of published versions](#)

[Content](#)   [Detailed Descriptions](#)   [Mappings](#)   [XML](#)   [JSON](#)   [TTL](#)

### 2.1.1 Resource Profile: A Patient Profile

Official URL: <a href="http://example.org/fsh/exercise/StructureDefinition/patient-profile">http://example.org/fsh/exercise/StructureDefinition/patient-profile</a>	Version: 0.1.0
Active as of 2022-04-25	Computable Name: PatientProfile
Defines constraints and extensions on the patient resource.	

Defining Profiles: <http://hl7.org/fhir/uv/shorthand/reference.html#define-profiles>

## Step 2: Cardinality Constraints

Constrain cardinality (allowed occurrences) for **name** and **gender**.

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

This structure is derived from [Patient](#) ↗

Name	Flags	Card.	Type	Description & Constraints
Patient		0..*	Patient	Information about an individual or animal receiving health care services
name		1..*	HumanName	A name associated with the patient
gender		1..1	code	male   female   other   unknown

Cardinality Rules: <http://hl7.org/fhir/uv/shorthand/reference.html#cardinality-rules>

<https://bit.ly/dev22-fsh3>

# Step 3: Must Support Flags

Add or modify your profile's rules to mark these elements as **Must Support**:

This structure is derived from [Patient](#)

Name	Flags	Card.	Type	Description & Constraints
Patient		0..*	Patient	Information about an individual or animal receiving health care services
name	S	1..*	HumanName	A name associated with the patient
family	S	0..1	string	Family name (often called 'Surname')
given	S	0..*		Mark each as Must Support ways 'first'). Includes middle names
gender	S	1..1	code	male   female   other   unknown
birthDate	S	0..1	date	The date of birth for the individual

Flag Rules: <http://hl7.org/fhir/uv/shorthand/reference.html#flag-rules>

Cardinality Rules: <http://hl7.org/fhir/uv/shorthand/reference.html#cardinality-rules>

# Step 4: Birth Sex Value Set

<https://bit.ly/dev22-fsh4>

Define a value set that will be used in a birth sex extension on PatientProfile.

Metadata		Code System	Code
Name	BirthSex	http://terminology.hl7.org/CodeSystem/v3-AdministrativeGender	M
		http://terminology.hl7.org/CodeSystem/v3-AdministrativeGender	F
		http://terminology.hl7.org/CodeSystem/v3-AdministrativeGender	UN
Id	birthsex	http://terminology.hl7.org/CodeSystem/v3-NullFlavor	UNK
Title	Birth Sex	<h3>2.3.1.1 Logical Definition (CLD)</h3> <p>This value set includes codes based on the following rules:</p> <ul style="list-style-type: none"> <li>Include all codes defined in <a href="http://terminology.hl7.org/CodeSystem/v3-AdministrativeGender">http://terminology.hl7.org/CodeSystem/v3-AdministrativeGender</a> ↗</li> <li>Include these codes as defined in <a href="http://terminology.hl7.org/CodeSystem/v3-NullFlavor">http://terminology.hl7.org/CodeSystem/v3-NullFlavor</a> ↗</li> </ul> <p><b>Code Display Definition</b></p> <p><b>UNK</b> Unknown **Description:**A proper value is applicable, but not known. ↗</p>	
Description	Codes for assigning sex at birth		

Defining Value Sets: <http://hl7.org/fhir/uv/shorthand/reference.html#define-value-sets>

Defining Aliases: <http://hl7.org/fhir/uv/shorthand/reference.html#define-aliases>

# Step 5: Birth Sex Extension

<https://bit.ly/dev22-fsh5>

Define a birth sex extension w/ a CodeableConcept value from BirthSex.

Metadata	
Name	BirthSexExtension
Id	Birthsex-extension
Title	Birth Sex Extension
Description	A code classifying the person's sex assigned at birth

This structure is derived from [Extension](#)

Name	Flags	Card.	Type	Description & Constraints
Extension		0..*	Extension	Birth Sex Extension
extension	★	0..0		
url		1..1	uri	" <a href="http://example.org/fsh/exercise/StructureDefinition/birthsex-extension">http://example.org/fsh/exercise/StructureDefinition/birthsex-extension</a> "
value[x]		0..1	CodeableConcept	Value of extension Binding: Birth Sex (required)

Only allow value type:  
**CodeableConcept**

Bind to **BirthSex** value set  
w/ strength: **required**

Defining Extensions: <http://hl7.org/fhir/uv/shorthand/reference.html#define-ext-extensions>

Type Rules: <http://hl7.org/fhir/uv/shorthand/reference.html#type-rules>

Binding Rules: <http://hl7.org/fhir/uv/shorthand/reference.html#binding-rules>

# Step 6: Add BirthSex Extension to Profile

Add the BirthSex extension to PatientProfile w/ local name **birthsex**.

This structure is derived from [Patient](#)

Name	Flags	Card.	Type	Description & Constraints
Patient		0..*	Patient	Information about an individual or animal receiving health care services
★ Slices for extension		0..*	Extension	Extension
● birthsex-extension	S	0..1	CodeableConcept	<b>Slice:</b> Unordered, Open by value:url <b>Birth Sex Extension</b> <b>URL:</b> <a href="http://example.org/fsh/exercise/StructureDefinition/birthsex-extension">http://example.org/fsh/exercise/StructureDefinition/birthsex-extension</a> <b>Binding:</b> Birth Sex (required)

**Mark as Must Support**

**Optional**

Contains Rules for Extensions: <http://hl7.org/fhir/uv/shorthand/reference.html#contains-rules-for-extensions>

# Step 7: Create Example Instance of Profile

<https://bit.ly/dev22-fsh7>

Create an example using this data:

Metadata	
<b>Id</b>	PatientExample
<b>Instance Of</b>	PatientProfile
<b>Title</b>	PatientProfile Example
<b>Description</b>	A simple example of PatientProfile

Patient Information	
<b>Name</b>	Sally Jones
<b>Born</b>	October 26, 1972
<b>Gender</b>	Female
<b>Birth Sex</b>	Female

## 2.4.9 : PatientProfile Example - JSON Representation

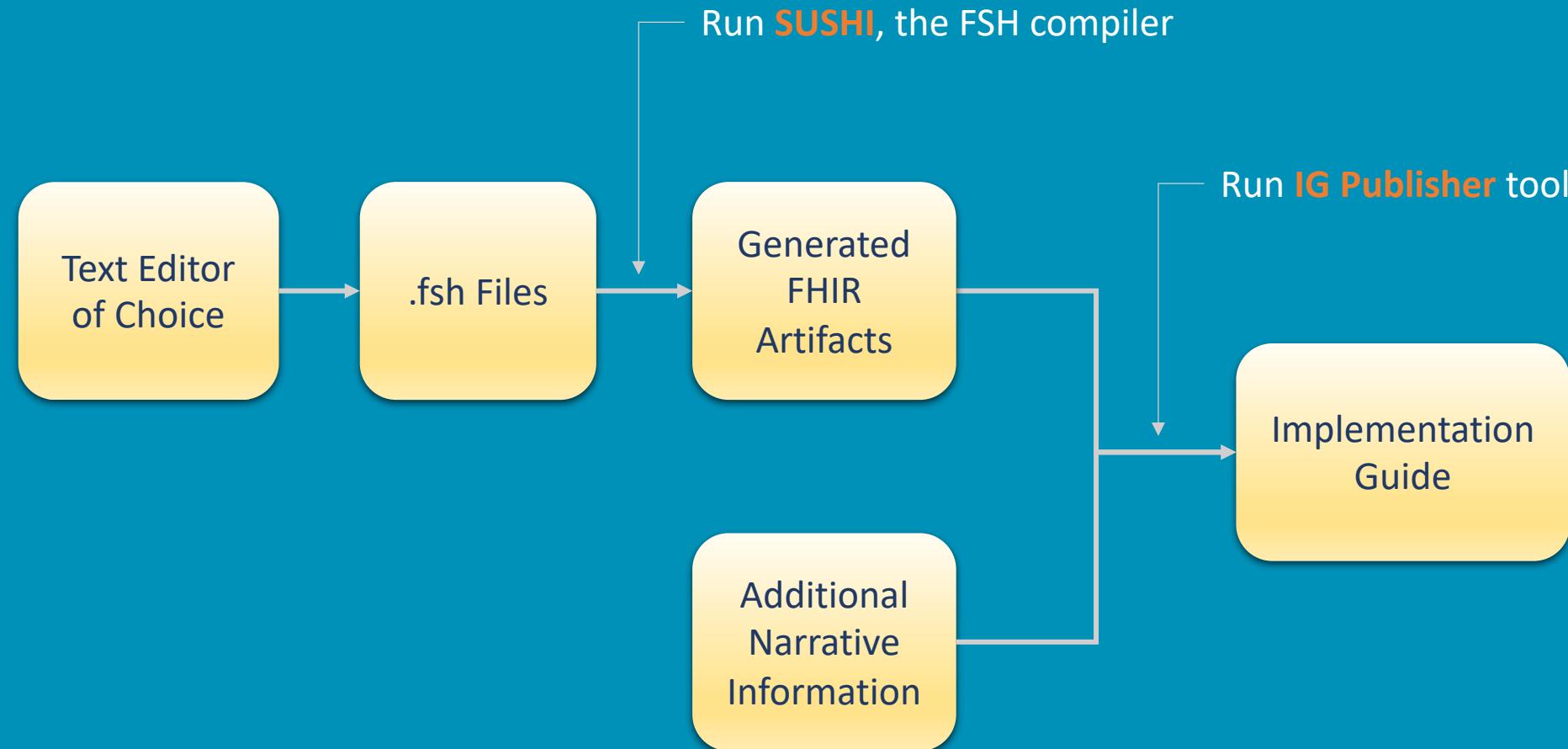
[Raw json](#) | [Download](#)

```
{
  "resourceType" : "Patient",
  "id" : "PatientExample",
  "meta" : {
    "profile" : [
      "http://example.org/fsh/exercise/StructureDefinition/patient-profile"
    ]
  },
  "text" : {
    "status" : "generated",
    "div" : "<div xmlns=\\"http://www.w3.org/1999/xhtml\\"><p><b>Sally Jones </b> female</p></div\\"
  },
  "name" : [
    {
      "family" : "Jones",
      "given" : [
        "Sally"
      ]
    }
  ],
  "gender" : "female",
  "birthDate" : "1972-10-26"
}
```

Defining Instances: <http://hl7.org/fhir/uv/shorthand/reference.html#defineinstances>  
 Extension Paths: <http://hl7.org/fhir/uv/shorthand/reference.html#extensionpaths>

**Solution: <https://bit.ly/dev22-fsh8>**

# IG Creation Process in FSH



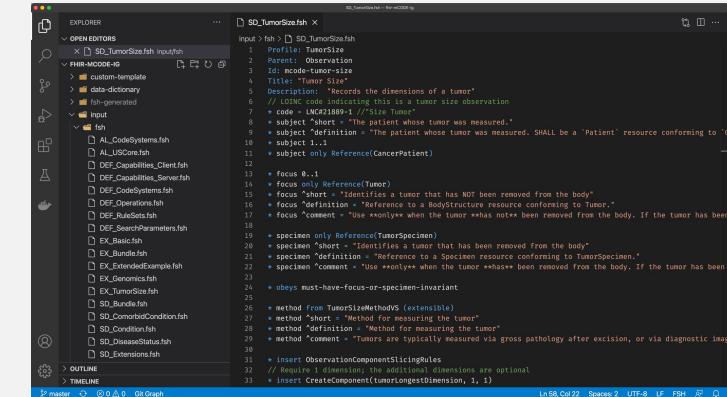
# FHIR Shorthand Tools



SUSHI



GoFSH

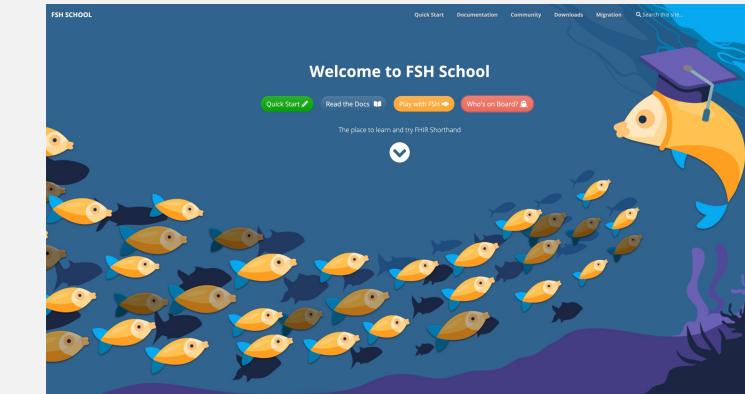


VS Code Extension

FSH Online

#	Implementation Guide	FSH Version	FSH: Profile	FSH: Instance	FSH: Extension	FSH: ValueSet	FSH: CodeSystem
1	Item-715-data	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
2	CH eTOC (RA)	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
3	Mobile access to Health Documents (MHD)	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
4	PACIO Advance Directive Interoperability Implementation Guide	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
5	r3iv-lam	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
6	Da Vinci Prior Authorization Support (PAS) FHIR IG	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
7	Patient Demographics Query for Mobile	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
8	SPI_Mapping FHIR Implementation Guide	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
9	CH RAD-Order (RA)	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0
10	HL7 FHIR Implementation Guide: Standard Health Record (SHR) Adverse Events Release 1 - DRAFT	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0	✓ 1.0

FSH Finder



FSH School

# SUSHI: SUSHI Unshortens Shorthand Inputs

To install SUSHI:

1. Install **Node.js LTS** edition from <https://nodejs.org/>
2. Open a terminal and run: **npm install -g fsh-sushi**
3. Test that it works by running: **sushi -v**

```
> sushi --version
SUSHI v2.5.0 (implements FHIR Shorthand specification v2.0.0)
```



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

# Initialize a SUSHI Project

1. Open a terminal
2. Navigate to a parent directory
3. Run: **sushi --init**

```
> sushi --init

This interactive tool will use your answers to create a
working SUSHI project configured with your project's
basic information.

Name (Default: ExampleIG): FSHEExerciseIG
Id (Default: fhir.example): fhir.fsh.exercise
Canonical (Default: http://example.org): http://example.org/fsh/exercise
Status (Default: draft): draft
Version (Default: 0.1.0): 0.1.0
Publisher Name (Default: Example Publisher): Just Me
Publisher Url (Default: http://example.org/example-publisher): http://example.org/just-me
Initialize SUSHI project in /Users/cmoesel/dev/fsh/FSHEExerciseIG? [y/n]: y
```



FSHEExerciseIG

- \_genonce.bat
- \_genonce.sh
- \_updatePublisher.bat
- \_updatePublisher.sh
- ig.ini
- input
  - fsh
    - patient.fsh
  - ignoreWarnings.txt
- pagecontent
  - index.md

**sushi-config.yaml**

*NOTE: If script downloads are blocked by a firewall, either*

- *set an “https\_proxy” environment variable to your proxyHost:proxyPort, or*
- *download scripts directly from <https://github.com/HL7/ig-publisher-scripts>*

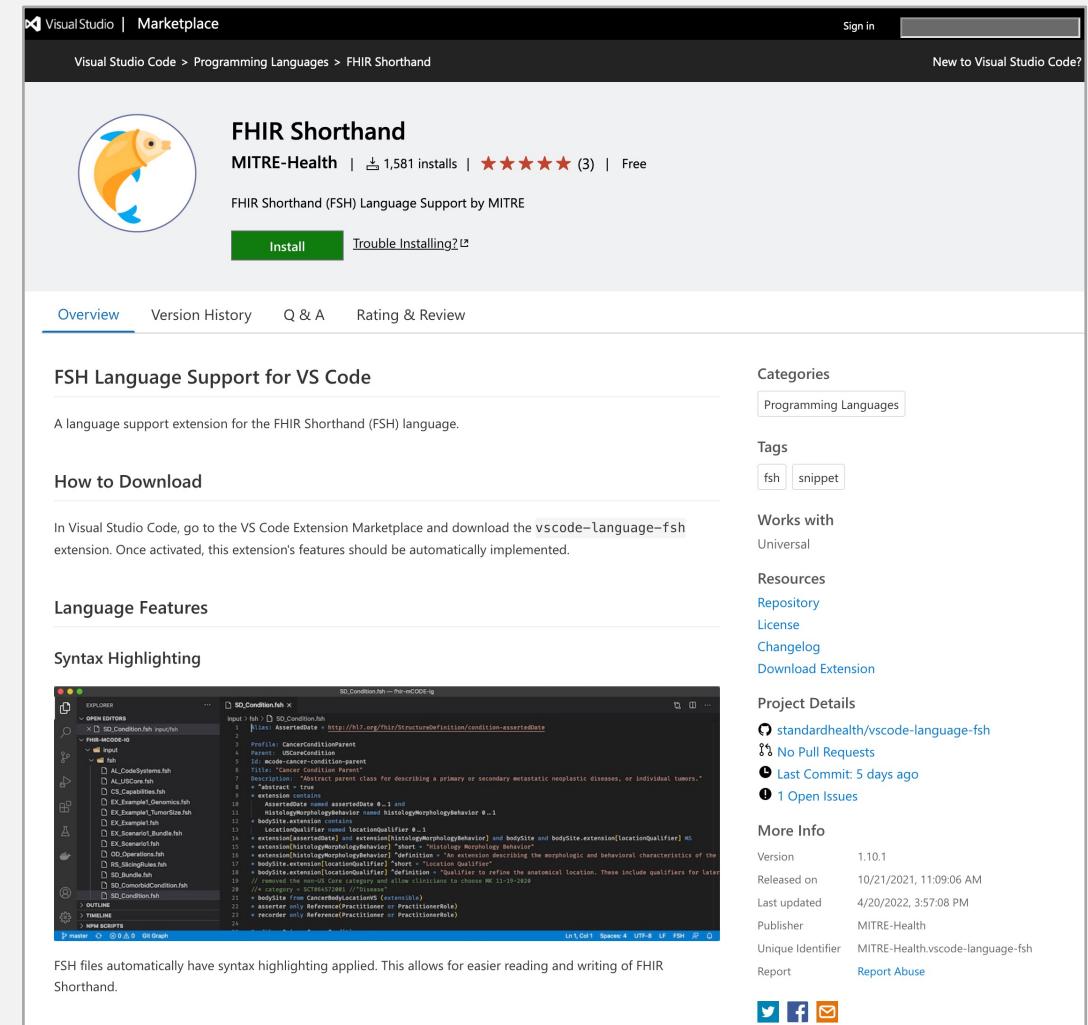
# Use Visual Studio Code to Author SUSHI Projects

## To install VS Code and the FSH extension:

1. **VS Code:** <https://code.visualstudio.com/download>
2. **FSH Extension:**
  - Open a .fsh file and follow prompts, or
  - Search “FHIR Shorthand” in Marketplace, or
  - Go to: <https://bit.ly/394hokj>

## WHY?

- Syntax highlighting
- Path completion
- Snippets
- Go to definition
- Open FHIR documentation
- SUSHI build task



# Configure Your Project: sushi-config.yaml

The screenshot shows a code editor interface with a dark theme. On the left is the Explorer sidebar, which lists several files and folders under the 'FSHExerciseIG' project, including 'input', 'fsh' (with 'patient.fsh'), and 'pagecontent' (with 'index.md'). The 'sushi-config.yaml' file is selected in the Explorer and is also the active editor tab at the top.

The main editor area displays the YAML configuration for the implementation guide:

```
1  # Commonly Used ImplementationGuide Properties
2  # The properties below are used to create the ImplementationGuide resource. The most commonly
3  # used properties are included. For a list of all supported properties and their functions,
4  # see: https://fshschool.org/docs/sushi/configuration/.
5 #
6 id: fhir.fsh.exercise
7 canonical: http://example.org/fsh/exercise
8 name: FSHExerciseIG
9 # title: Example Title
10 # description: Example Implementation Guide for getting started with SUSHI
11 status: draft # draft | active | retired | unknown
12 version: 0.1.0
13 fhirVersion: 4.0.1 # https://www.hl7.org/fhir/valueset-FHIR-version.html
14 copyrightYear: 2022+
15 releaseLabel: ci-build # ci-build | draft | qa-preview | ballot | trial-use | release | update | normat
16 # license: CC0-1.0 # https://www.hl7.org/fhir/valueset-spdx-license.html
17 # jurisdiction: urn:iso:std:iso:3166#US "United States of America" # https://www.hl7.org/fhir/valueset-jurisdiction-US.html
18 publisher:
19   name: Just Me
20   url: http://example.org/just-me
21   # email: test@example.org
```

At the bottom of the editor, status bars indicate 'Ln 53, Col 27', 'Spaces: 2', 'UTF-8', 'LF', 'YAML', 'No JSON Schema', and icons for copy/paste, find/replace, and other file operations.

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

# Build Your IG Source with SUSHI

1. Open a terminal
2. Navigate to your project
3. Run: **sushi .**

```
> sushi .
info  Running SUSHI v2.4.0 (implements FHIR Shorthand specification v2.0.0)
info  Arguments:
info    /Users/cmoesel/dev/fsh/FSHExerciseIG
info  No output path specified. Output to .
```

**SUSHI RESULTS**

Profiles	Extensions	Logicals	Resources
1	1	0	0

ValueSets	CodeSystems	Instances
1	0	1

It doesn't get any betta than this!    0 Errors    0 Warnings



```

FSHExerciseIG
├── _genonce.bat
├── _genonce.sh
├── updatePublisher.bat
└── updatePublisher.sh
├── fsh-generated
│   ├── includes
│   │   └── menu.xml
│   └── resources
│       ├── ImplementationGuide-fhir.fsh.exercise.json
│       ├── Patient-PatientExample.json
│       ├── StructureDefinition-birthsex-extension.json
│       ├── StructureDefinition-patient-profile.json
│       └── ValueSet-birthsex.json
└── ig.ini
└── input
    ├── fsh
    │   └── patient.fsh
    └── ignoreWarnings.txt
    └── pagecontent
        └── index.md
└── sushi-config.yaml

```

# Build Your IG with the IG Publisher

## 1. Install Java SDK:

<https://adoptopenjdk.net/>

## 2. Install Jekyll:

<https://jekyllrb.com/docs/installation/>

## 3. Open a terminal

## 4. Navigate to your project

## 5. Download the latest IG Publisher

- `_updatePublisher.bat` (Win)
- `./_updatePublisher.sh` (Mac)

## 6. Run the IG Publisher

- `_genonce.bat` (Win)
- `./_genonce.sh` (Mac)

## 7. Open `output/index.html`

## 8. Open `output/qa.html`

Home Artifacts

Table of Contents > Artifacts Summary > A Patient Profile

FSHExerciseIG - Local Development build (v0.1.0). See the [Directory of published versions](#)

**Content** Detailed Descriptions Mappings Examples XML JSON TTL

### 2.1.1 Resource Profile: A Patient Profile

Official URL: <a href="http://example.org/fsh/exercise/StructureDefinition/patient-profile">http://example.org/fsh/exercise/StructureDefinition/patient-profile</a>	Version: 0.1.0
Active as of 2022-04-25	Computable Name: PatientProfile

Defines constraints and extensions on the patient resource.

**Usage:**

- Examples for this Resource Profile: [Patient/PatientExample](#)

#### 2.1.1.1 Formal Views of Profile Content

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

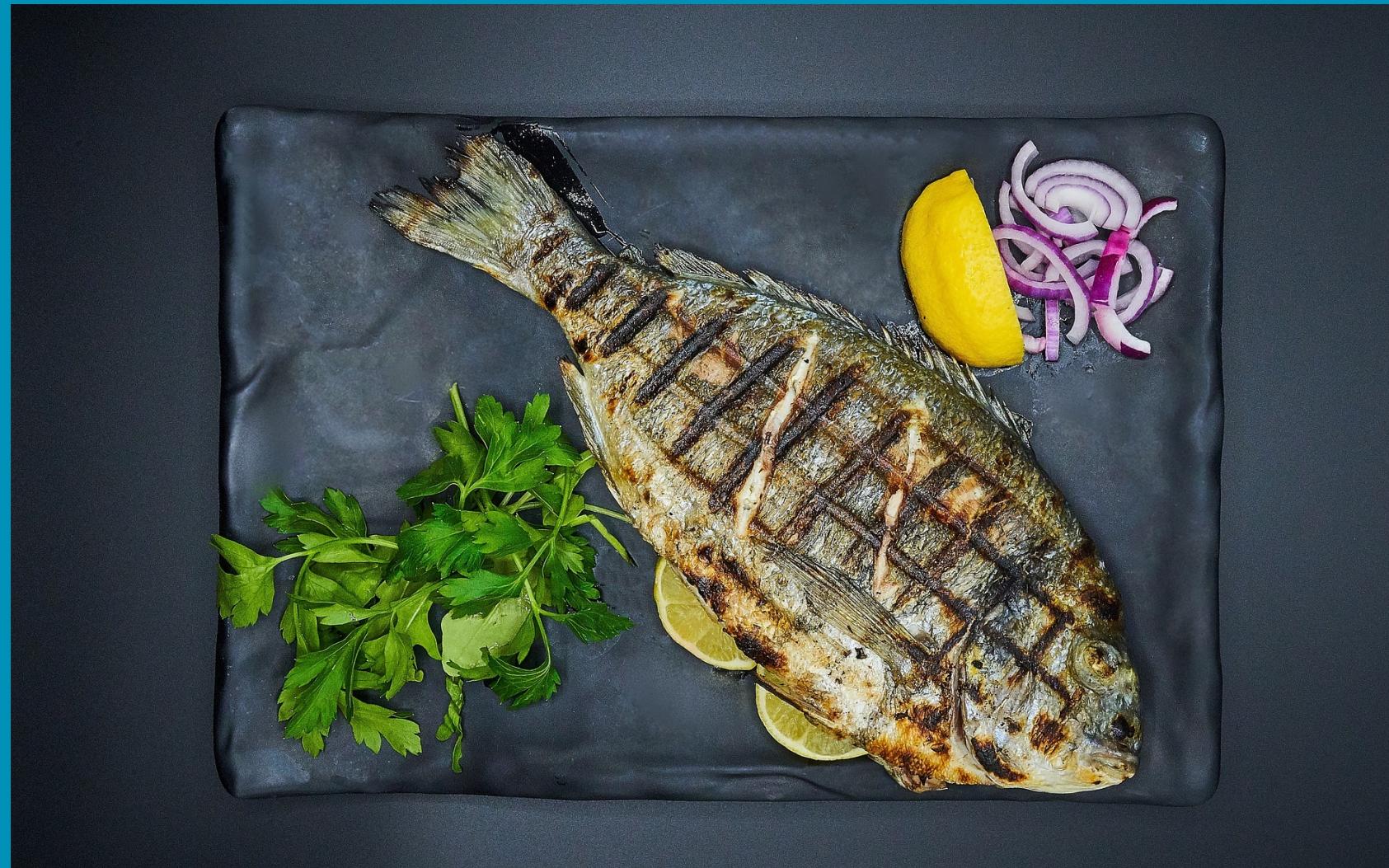
**Text Summary Differential Table Snapshot Table Snapshot Table (Must Support) All**

This structure is derived from [Patient](#)

Name	Flags	Card.	Type	Description & Constraints
Patient		0..*	Patient	Information about an individual or animal receiving health care services Extension <b>Slice:</b> Unordered, Open by value:url
★ Slices for extension		0..*	Extension	Birth Sex Extension <b>URL:</b> <a href="http://example.org/fsh/exercise/StructureDefinition/birthsex-extension">http://example.org/fsh/exercise/StructureDefinition/birthsex-extension</a> <b>Binding:</b> Birth Sex (required)
birthsex-extension	S	0..1	CodeableConcept	A name associated with the patient
name	S	1..*	HumanName	Family name (often called 'Surname')
family	S	0..1	string	Given names (not always 'first'). Includes middle names
given	S	0..*	string	male   female   other   unknown
gender	S	1..1	code	The date of birth for the individual
birthDate	S	0..1	date	

[Documentation for this format](#)

# Finis



# Q&A



This is me after finishing my DevDays session

## Contact

- Whova App – Speaker's Gallery (*DevDays only*)
- Email: [cmoesel@mitre.org](mailto:cmoesel@mitre.org)
- <https://chat.fhir.org>

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