HL7® FHIR® DevDays

JUNE | 2023

Learn to FSH: a Friendly Introduction to FHIR Shorthand

Mark Kramer, MITRE Corporation

HL7 FHIR DevDays 2023 | Hybrid Edition, Amsterdam | June 6–9, 2023 | @HL7 | @FirelyTeam | #fhirdevdays | www.devdays.com

ORGANIZED BY firely | HL7 International

Welcome!

- Mark Kramer, Distinguished Chief Engineer at MITRE Corporation (USA)
  - Creating implementation guides since 2015 (QI-Core)
  - Created FHIR Shorthand w/ Chris Moesel (released 2020)

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Learning Objectives

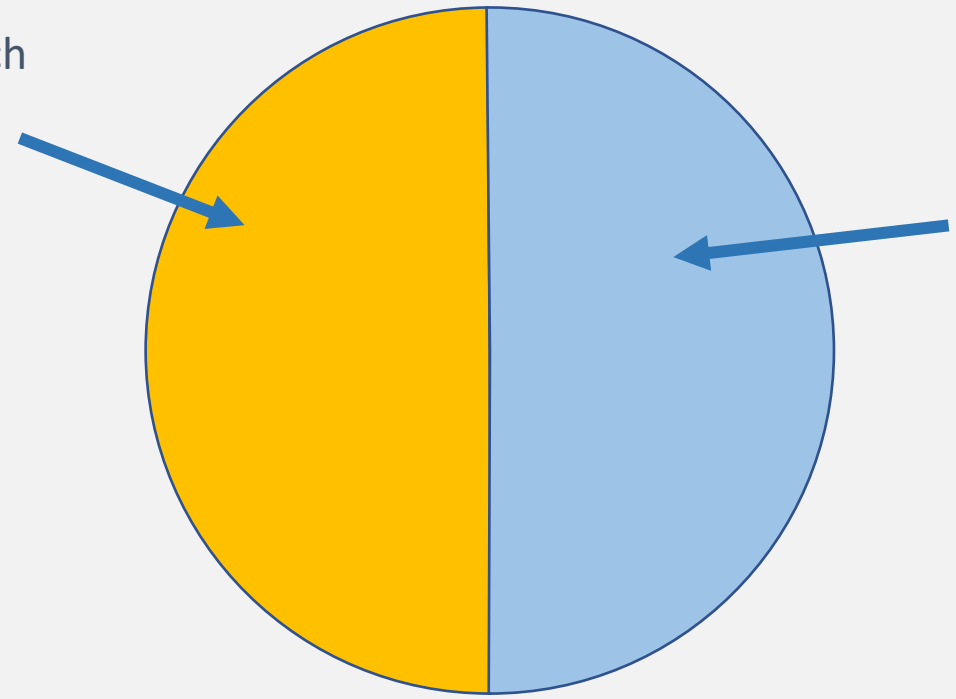
- Purpose of FHIR Shorthand
- Basics of the FHIR Shorthand Language
- How to create an IG from using Shorthand

- Want to learn more?
  - **Advanced FSH: What to do when you're hooked**
  - Friday at 2:30 pm with Chris Moesel

Why Profile FHIR?

Base FHIR:

- On-the-wire syntax
- API for read, write, search
- FHIR resources
- Basic data elements
- Extensibility mechanism



Implementation Guides (IGs) describe how to use FHIR for a particular purpose:

- Data structures
- Terminology and value sets
- Workflows
- API operations
- Conformance requirements

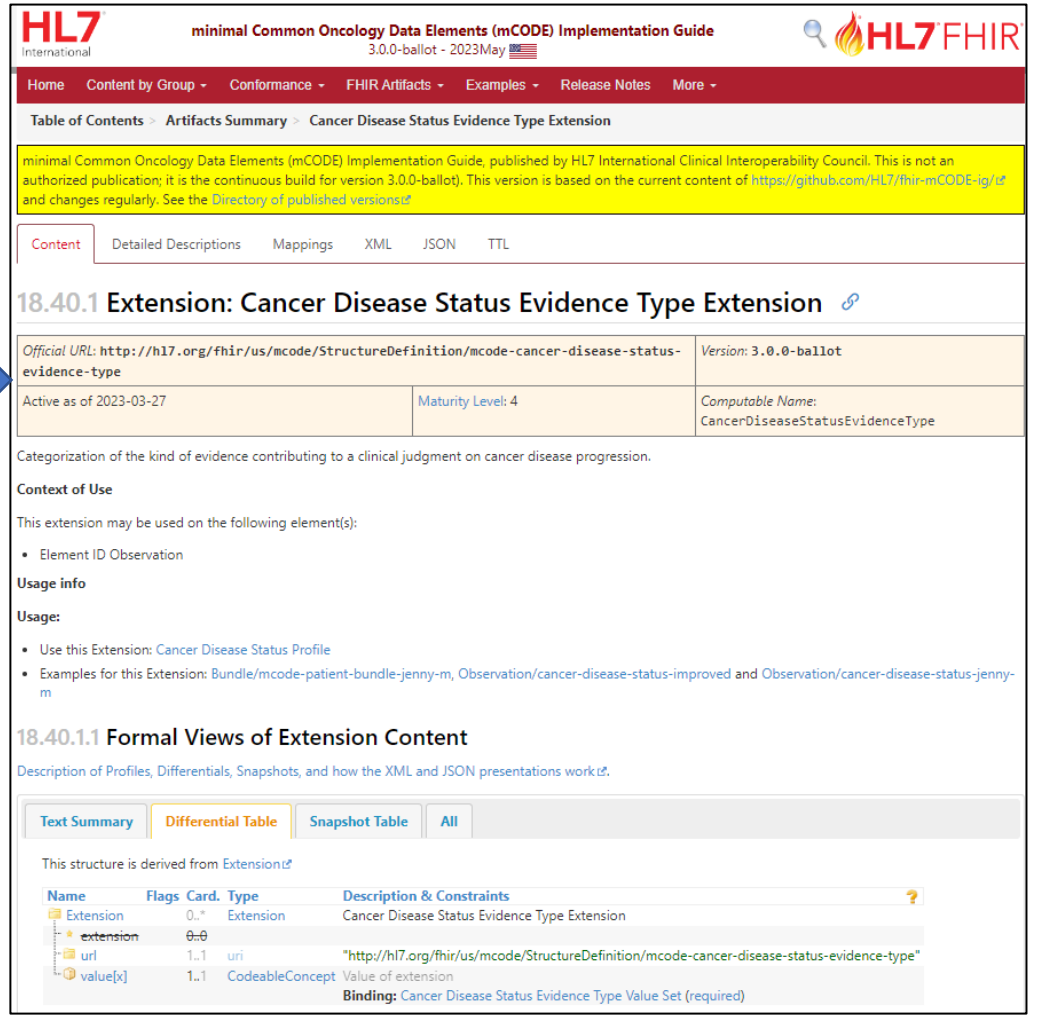
What is FHIR Shorthand (FSH)?

- **A text language for defining FHIR artifacts**
- Profiles, extensions, instances, value sets, code systems, logical models, conformance resources & more
- Use any text editor
- SUSHI – the FSH compiler – creates JSON applying best practices
- Use GitHub for version control and collaboration
- Free, open source
- HL7® standard
- Built into HL7® FHIR® IG Publisher and Simplifier

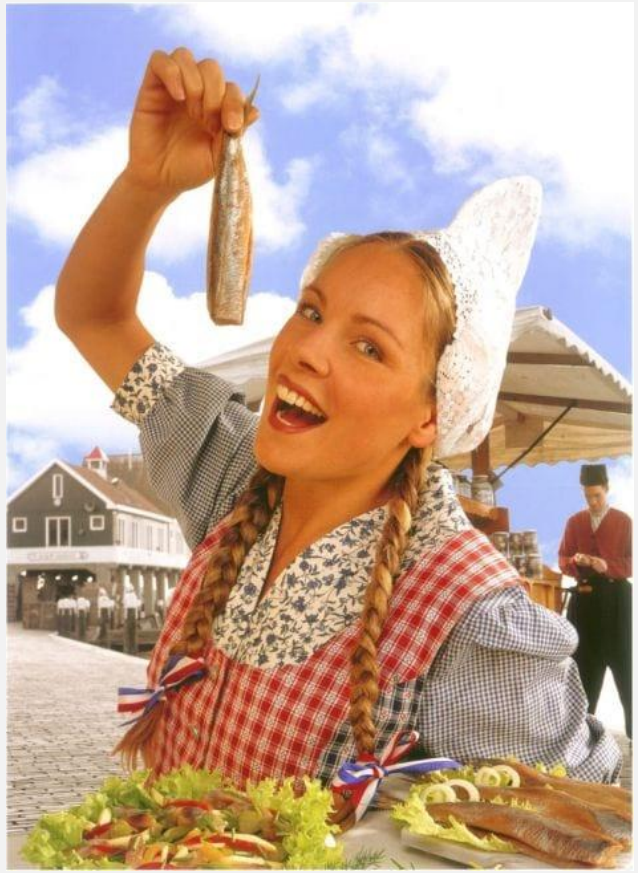
A few lines of FSH:

```
Extension: CancerDiseaseStatusEvidenceType
Id: mcode-cancer-disease-status-evidence-type
Title: "Cancer Disease Status Evidence Type Extension"
Description: "Categorization of the kind of evidence contributing to a clinical judgment
* insert ExtensionContext(Observation)
* ^extension[FMM].valueInteger = 4
* value[x] only CodeableConcept
* value[x] from CancerDiseaseStatusEvidenceTypeVS (required)
* value[x] 1..1
```

Become an artifact in an IG:



People are Consuming More FSH

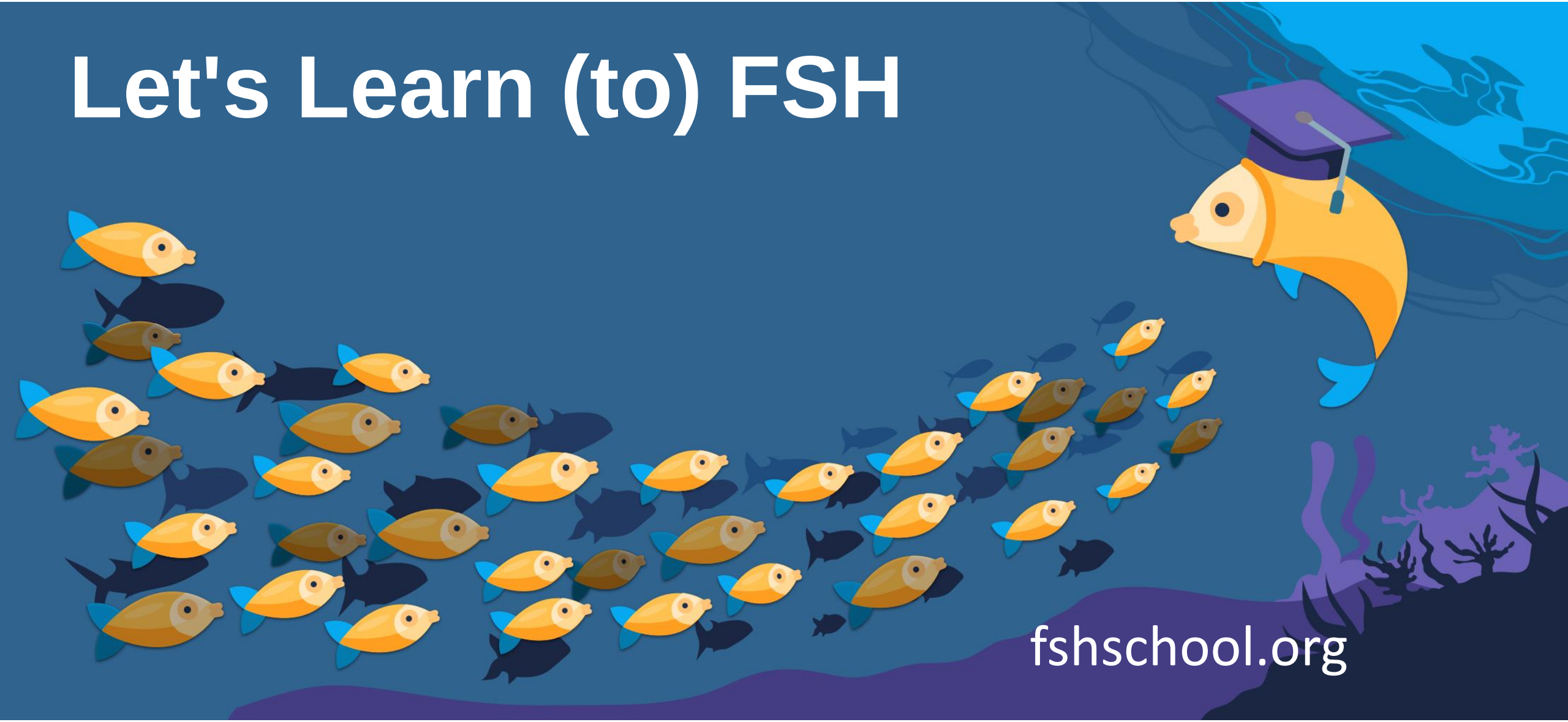


Source: Nederlands Visbureau

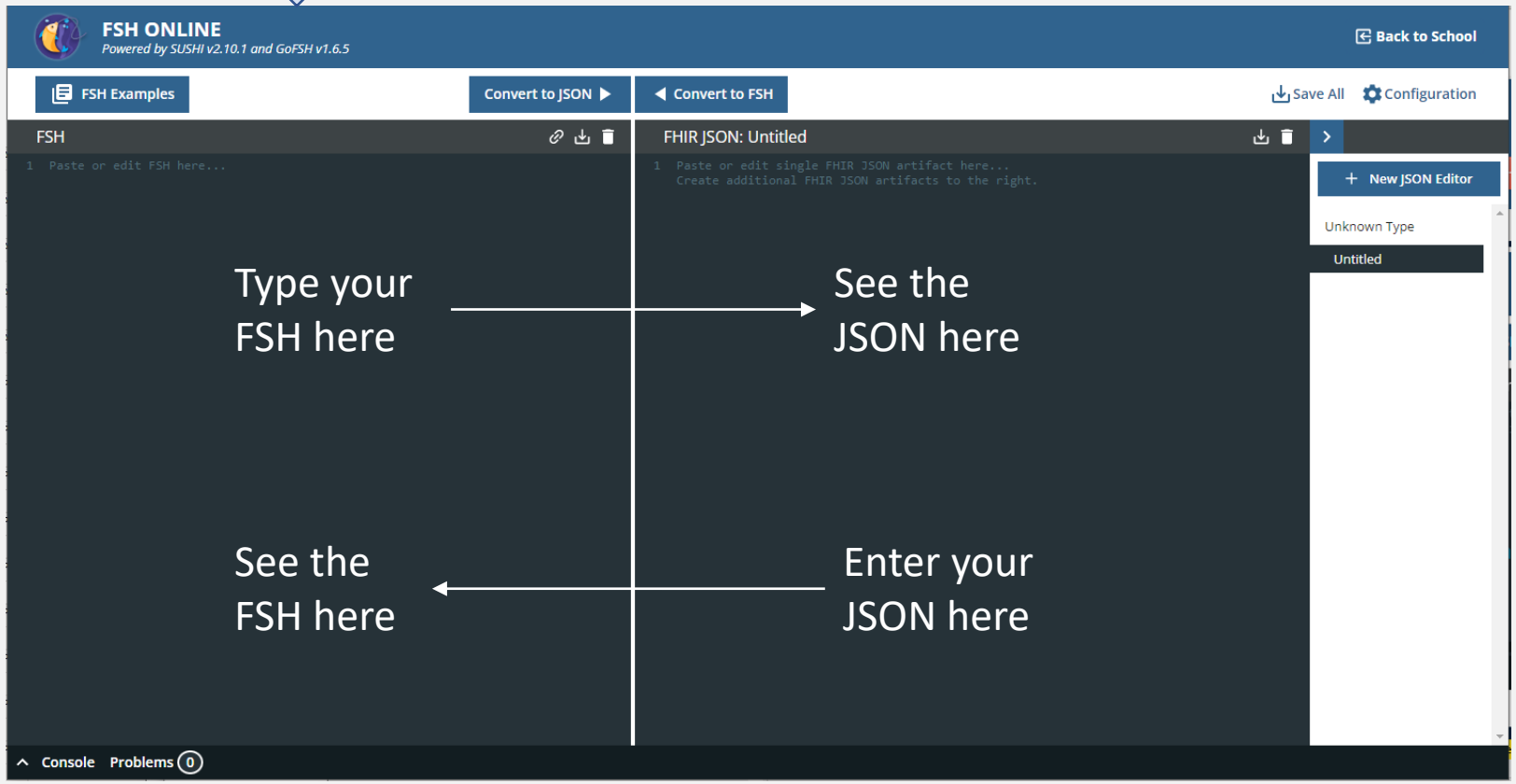
	Jan. 2021	Jan. 2022	June 2023
IG Projects[1]	40	177	400
Zulip Chat Subscribers[2]	169	308	525
SUSHI Downloads[3]	25K	82K	183K

1. https://fshschool.org/fsh-finder/
2. https://chat.fhir.org/#streams/subscribed
3. https://npm-stat.com/charts.html?package=fsh-sushi&from=2020-02-01&to=2023-05-23

Let's Learn (to) FSH



https://fshschool.org



https://fshschool.org/FSHOnline

Example 1: Create a FHIR Profile (bit.ly/dd-fsh1)

```
// This is a comment

// (1) Declaration
Profile: MyPatientProfile

// (2) Keywords
Parent: Patient   // Must specify a parent resource or profile
Description: "Example Patient"

// (3) Rules
* name 1..2
* name.given and name.family MS
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
* deceased[x] only boolean
```

Part 1: Declaration

```
Profile: MyPatientProfile
```

```
// (1) Declaration
Profile: MyPatientProfile

// (2) Keywords
Parent: Patient   // Must specify a parent resource or profile
Description: "Example Patient"

// (3) Rules
* name 1..2
* name.given and name.family MS
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
* deceased[x] only boolean
```

- First line of any FSH definition
- Asserts what you want to create, and gives it a name or ID
- Common declarations:
  - Profile, Extension, Instance, ValueSet, Alias (for long URLs)
- Less common:
  - CodeSystem, RuleSet
  - Invariant, Mapping, Logical

Part 2: Keywords

```
Parent: Patient
Description: "Example Patient"
```

```
// (1) Declaration
Profile: MyPatientProfile

// (2) Keywords
Parent: Patient   // Must specify a parent resource or profile
Description: "Example Patient"

// (3) Rules
* name 1..2
* name.given and name.family MS
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
* deceased[x] only boolean
```

- Keywords further describe the thing you are creating
- Common keywords:
  - Id, Description, Title, Parent (for profiles), InstanceOf (for instances)
- Less Common:
  - Context, Expression, Severity, Source, Target, Usage, XPath

Part 3: Rules

```
* name 1..2
```

```
// (1) Declaration
Profile: MyPatientProfile

// (2) Keywords
Parent: Patient   // Must specify a parent resource or profile
Description: "Example Patient"

// (3) Rules
* name 1..2
* name.given and name.family MS
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
* deceased[x] only boolean
```

- “Cardinality rule”
- Used to set the min and max occurrence of an element
- Variations:

```
* name 1..  // change lower bound only
* name ..2  // change upper bound only
```

Part 3: More Rules

```
* name.given and name.family MS
```

```
// (1) Declaration
Profile: MyPatientProfile

// (2) Keywords
Parent: Patient   // Must specify a parent resource or profile
Description: "Example Patient"

// (3) Rules
* name 1..2
* name.given and name.family MS
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
* deceased[x] only boolean
```

- "Flag rule"
- Used to set *must support* and other information about an element
- Flags are MS, SU, ?!, TU, N, D

  (must support, summary, modifier, trial use, normative, draft)
- More examples:

```
* onsetDate MS SU
* identifier and identifier.system and identifier.value MS
* subject 1..1 MS  // combined cardinality and flag rule
```

Part 3: More Rules

```
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
```

- "Binding Rule"
- Used to associate a value set with a coded element with a given strength
  - Strengths are (example), (preferred), (extensible), and (required) *[default]*
- More examples:

```
* gender from http://hl7.org/fhir/ValueSet/administrative-gender(preferred)
* code from CancerConditionVS (extensible)
```

Part 3: More Rules

```
* deceased[x] only boolean
```

```
// (1) Declaration
Profile: MyPatientProfile

// (2) Keywords
Parent: Patient   // Must specify a parent resource or profile
Description: "Example Patient"

// (3) Rules
* name 1..2
* name.given and name.family MS
* maritalStatus from http://hl7.org/fhir/ValueSet/marital-status
* deceased[x] only boolean
```

- “Type rule”
- Used to restrict data types in a profile
- More examples:

```
* valueQuantity only SimpleQuantity
* onset[x] only dateTime
* onset[x] only dateTime or Period
* performer only Reference(Practitioner)
* performer only Reference(PrimaryCarePhysician or EmergencyRoomPhysician)
```

Example 2: Create a FHIR Instance (https://bit.ly/fsh-2)

```
// (1) Declaration
Instance: JaneDoe
// (2) Keywords
InstanceOf: Patient // could also be a profile
Description: "A sample patient instance“
// (3) Rules
* active = true
* name[0].given[0] = "Jane"
* name[0].family = "Doe"
* gender = #female
* birthDate = "1965-01-01"
* maritalStatus = http://terminology.hl7.org/CodeSystem/v3-MaritalStatus#L
"Legally Separated"
* generalPractitioner = Reference(DrSurtinLee)
```

Make it a bit more readable...

```
Alias:  $marital = http://terminology.hl7.org/CodeSystem/v3-MaritalStatus

Instance: JaneDoe
InstanceOf: Patient
Description: "A sample patient instance"
* active = true
* name[0]
  * given[0] = "Jane"
  * family = "Doe"
* gender = #female
* birthDate = "1965-01-01"
* maritalStatus = $marital#L "Legally Separated"
* generalPractitioner = Reference(DrSurtinLee)
```

Indent 2 spaces for nesting

Use alias for brevity

Right-Hand Sides in Assignment Rules:

- Reference to another instance defined in FSH:

```
Reference(DrSurtinLee)
```

- Codes are indicated with # symbol:

```
#female
```

- Codings use the format CodeSystem#Code "display text"

```
http://terminology.hl7.org/CodeSystem/v3-MaritalStatus#L "Legally Separated"
$marital#L "Legally Separated"
```

- Array elements indicated with square brackets, starting at 0:

```
* name[0].given[0] = "Jane"
* name[0].family = "Doe"
```

Example 3: Define a Value Set (bit.ly/fsh-4)

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

ValueSet: ProcedureIntentVS
Id: procedure-intent-vs
Title: "Procedure Intent Value Set"
Description: "The purpose of a procedure."
* ^copyright = "SNOMED CT is copyright © 2002+ IHTSDO"
* SCT#373808002 "Curative - procedure intent"
* SCT#363676003 "Palliative - procedure intent"
* SCT#399707004 "Supportive - procedure intent"
```

Things to note:

- Declaration and Keywords:
  - ValueSet
  - Id, Title, Description
- Use carat (^) character to directly access attributes in StructureDefinition, CodeSystem, or ValueSet:

```
* ^copyright = "SNOMED CT is copyright © 2002+ IHTSDO"
```

Create an Implementation Guide

- Have the HL7 IG Publisher installed
- Install SUSHI
- In command window, run: **sushi --init**
- Create FSH files in /input/fsh
- We suggest using Visual Studio Code with FSH extension for editing

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

Test Your FSH

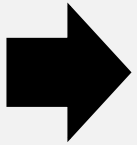
- In MyIG directory, run: **sushi .**

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



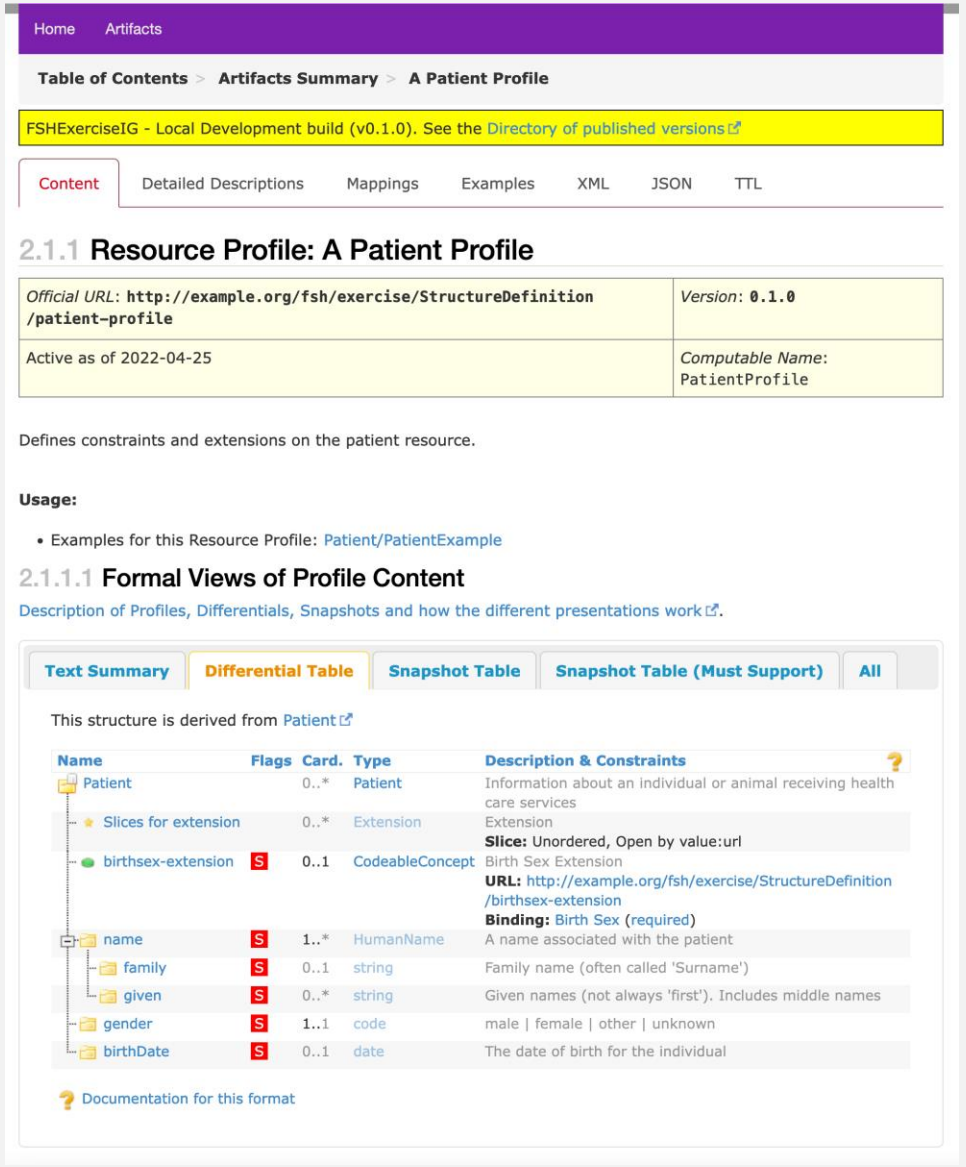
```
MyIG
├─ _genonce.bat
├─ _genonce.sh
├─ _updatePublisher.bat
├─ _updatePublisher.sh
├─ fsh-generated
│  ├─ includes
│  │  └─ menu.xml
│  └─ resources
│     ├─ ImplementationGuide-fhir.fsh.exercise.json
│     ├─ Patient-PatientExample.json
│     ├─ StructureDefinition-birthsex-extension.json
│    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

Run the IG Publisher

1. Edit the narrative content /input/pagecontent/
2. Run:

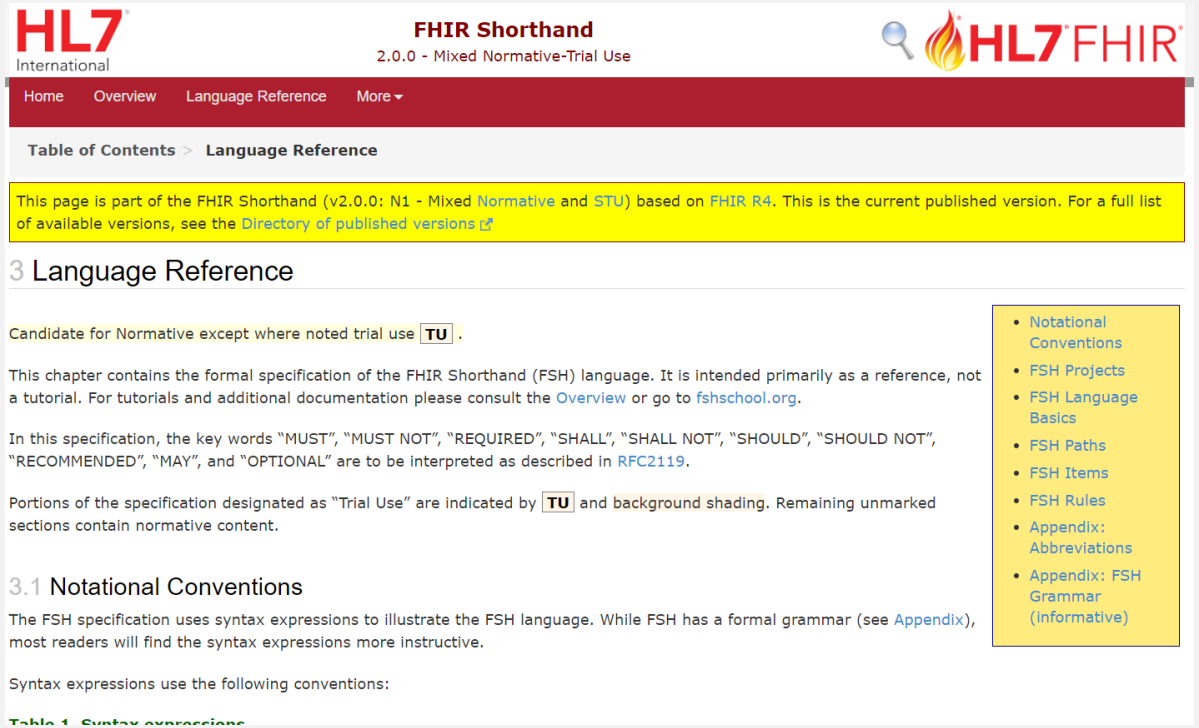
   _genonce.bat (Win)

   ./_genonce.sh (Mac)
3. Open **output/index.html**



The Full FSH Language Reference

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



HL7 International

FHIR Shorthand

2.0.0 - Mixed Normative-Trial Use

HL7 FHIR

Home | Overview | Language Reference | More

Table of Contents > Language Reference

This page is part of the FHIR Shorthand (v2.0.0: N1 - Mixed Normative and STU) based on FHIR R4. This is the current published version. For a full list of available versions, see the Directory of published versions

3 Language Reference

Candidate for Normative except where noted trial use **TU** .

This chapter contains the formal specification of the FHIR Shorthand (FSH) language. It is intended primarily as a reference, not a tutorial. For tutorials and additional documentation please consult the Overview or go to fshschool.org.

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.

Portions of the specification designated as "Trial Use" are indicated by **TU** and background shading. Remaining unmarked sections contain normative content.

- Notational Conventions
- FSH Projects
- FSH Language Basics
- FSH Paths
- FSH Items
- FSH Rules
- Appendix: Abbreviations
- Appendix: FSH Grammar (informative)

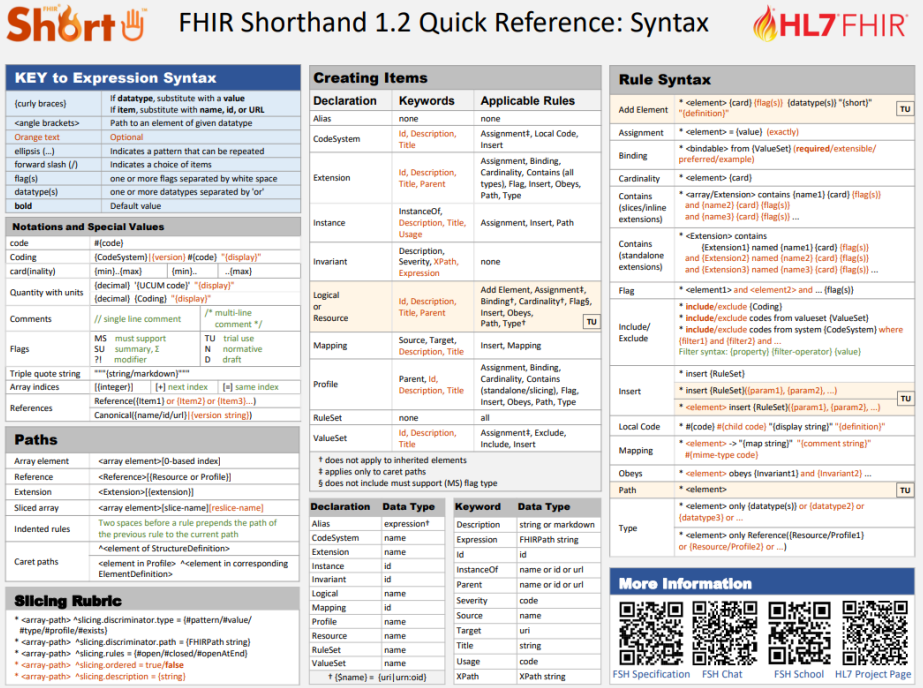
3.1 Notational Conventions

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 use the following conventions:

Table 1: Syntax expressions

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



Short — FHIR Shorthand 1.2 Quick Reference: Syntax — HL7 FHIR

KEY to Expression Syntax

(curly braces)	If **datatype**, substitute with a **value** If **item**, substitute with **name, id, or URL**
<angle brackets>	Path to an element of given datatype
Orange text	Optional
ellipsis (...)	Indicates a pattern that can be repeated
forward slash (/)	Indicates a choice of items
flag(s)	one or more flags separated by white space
datatype(s)	one or more datatypes separated by 'or'
bold	Default value

Notations and Special Values

code	#{code}		
Coding	{CodeSystem}|{version} #{code} "{display}"		
card(inality)	{min}..{max}	{min}..	..{max}
Quantity with units	{decimal} '{UCUM code}' "{display}" {decimal} {Coding} "{display}"		
Comments	// single line comment	/* multi-line comment */	
Flags	MS must support SU summary, Σ ?! modifier	TU trial use N normative D draft	
Triple quote string	"""{string/markdown}"""		
Array indices	[{integer}]	[+] next index	[=] same index
References	Reference({Item1} or {Item2} or {Item3}...) Canonical({name/id/url}|{version string})		

Paths

Array element	<array element>[0-based index]
Reference	<Reference>[{Resource or Profile}]
Extension	<Extension>[{extension}]
Sliced array	<array element>[slice-name]{reslice-name}
Indented rules	Two spaces before a rule prepends the path of the previous rule to the current path
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}

Creating Items

Declaration	Keywords	Applicable Rules
Alias	none	none
CodeSystem	Id, Description, Title	Assignment‡, Local Code, Insert
Extension	Id, Description, Title, Parent	Assignment, Binding, Cardinality, Contains (all types), Flag, Insert, Obeys, Path, Type
Instance	InstanceOf, Description, Title, Usage	Assignment, Insert, Path
Invariant	Description, Severity, XPath, Expression	none
Logical or Resource	Id, Description, Title, Parent	Add Element, Assignment‡, Binding†, Cardinality†, Flag§, Insert, Obeys, Path, Type† TU
Mapping	Source, Target, Description, Title	Insert, Mapping
Profile	Parent, Id, Description, Title	Assignment, Binding, Cardinality, Contains (standalone/slicing), Flag, Insert, Obeys, Path, Type
RuleSet	none	all
ValueSet	Id, Description, Title	Assignment‡, Exclude, Include, Insert

† does not apply to inherited elements
‡ applies only to caret paths
§ does not include must support (MS) flag type

Declaration	Data Type
Alias	expression†
CodeSystem	name
Extension	name
Instance	id
Invariant	id
Logical	name
Mapping	id
Profile	name
Resource	name
RuleSet	name
ValueSet	name

† {Sname} = {uri|urn:oid}

Keyword	Data Type
Description	string or markdown
Expression	FHIRPath string
Id	id
InstanceOf	name or id or url
Parent	name or id or url
Severity	code
Source	name
Target	uri
Title	string
Usage	code
XPath	XPath string

Rule Syntax

Add Element	* <element> (card) (flag(s)) (datatype(s)) "{short}" "{definition}" TU
Assignment	* <element> = (value) (exactly)
Binding	* <bindable> from (ValueSet) (required/extensible/preferred/example)
Cardinality	* <element> (card)
Contains (slices/inline extensions)	* <array/Extension> contains {name1} (card) (flag(s)) and {name2} (card) (flag(s)) and {name3} (card) (flag(s)) ...
Contains (standalone extensions)	* <Extension> contains {Extension1} named {name1} (card) (flag(s)) and {Extension2} named {name2} (card) (flag(s)) and {Extension3} named {name3} (card) (flag(s)) ...
Flag	* <element1> and <element2> and ... (flag(s))
Include/ Exclude	* include/exclude {Coding} * include/exclude codes from valueset {ValueSet} * include/exclude codes from system {CodeSystem} where {filter1} and {filter2} and ... Filter syntax: {property} {filter-operator} {value}
Insert	* insert {RuleSet} * insert {RuleSet}({param1}, {param2}, ...) TU * <element> insert {RuleSet}({param1}, {param2}, ...)
Local Code	* #{code} #{child code} "{display string}" "{definition}"
Mapping	* <element> -> "{map string}" "{comment string}" #{mime-type code}
Obeys	* <element> obeys {invariant1} and {invariant2} ...
Path	* <element> TU
Type	* <element> only {datatype(s)} or {datatype2} or {datatype3} or ... * <element> only Reference({Resource/Profile1} or {Resource/Profile2} or ...)

More Information

FSH Specification | FSH Chat | FSH School | HL7 Project Page

Compliments of The MITRE Corporation

Sep 2021

FSH Ecosystem

- FSH Language Specification -- complete syntax and examples
- SUSHI -- convert FSH into FHIR Artifacts
- Go FSH -- convert FHIR Artifacts into FSH
- FSH School -- a web site with documentation, tools, tutorials
- FSH Online -- interact with FHIR Shorthand
- Visual Studio Code extension -- Handy tools for VS Code editor

Summary: Why Choose FSH?

- Concise, readable, understandable
- Great set of free tools
- Fast, rapid changes via text operations
- Large & active user community
- Collaborative authoring and project management via source code control
- Balloted Normative+STU standard
- Error checking & application of best practices (SUSHI)
- Built into the HL7® FHIR® IG Publisher
- Use with Simplifier and other tools
- FSH-ify any existing IG (GoFSH)

What did you learn?

- Advantages of FHIR Shorthand
- Basic FSH:
  - Three parts of a FSH item (Declaration, Keywords, Rules)
  - Several types of rules
  - Creating profiles, instances, extensions, and value sets
  - Having fun with FSH Online

- Reminder: "Advanced FSH: What to do when you're hooked"
  - See you 2:30 Friday!

Contact

- During DevDays, you can find / reach me here:
  - Via Whova App – Speaker's Gallery
  - mkramer@mitre.org
  - Send me a message on chat.fhir.org

Q&A

ORGANIZED BY

Example 3: Define and Use an Extension (bit.ly/fsh-3)

```
Extension: Laterality
Description: "The left or right side of the body"
* value[x] only CodeableConcept
* value[x] from http://hl7.org/fhir/ValueSet/bodysite-laterality
```

Name	Flags	Card.	Type	Description & Constraints
Extension	I N		Element	Optional Extensions Element *+ Rule: Must have either extensions or value[x], not both* Elements defined in Ancestors: id, extension
url		1..1	uri	identifies the meaning of the extension
value[x]		0..1	*	Value of extension

URL set automatically by IG's canonical plus name of the extension

Add the Extension to a Profile

```
Profile:  LateralBodyStructure
Parent:  BodyStructure
Description: "Add Laterality extension to BodyStructure"
* extension contains Laterality named laterality 0..1
```

arbitrary local name

```
Extension: Laterality
Description: "The side of a body"
* value[x] only CodeableConcept
* value[x] from http://hl7.org/fhir/ValueSet/bodysite-laterality
```

Things to note:

- New rule type "contains"
  - Used to add extensions
  - Also used to slice arrays
- Refer to FSH-defined extension by the FSH name
  - Could use a standard FHIR extension or one defined in another IG by its canonical URL

Common Declarations and Keywords

Declaration	Data Type
`CodeSystem:`	name
`Extension:`	name
`Instance:`	id
`Profile:`	name
`ValueSet:`	name

Keyword	Applies to…	Purpose	Data Type
`Description:`	Most item types	Human-readable description	string or markdown
`Id:`	Most items, not instances	Item identifier	id
`InstanceOf:`	Instances	Instantiated profile or resource	name, id, or url
`Parent:`	Profiles (rarely extensions)	Base definition	name, id, or url
`Title:`	Most item types	Human-readable name	string

Basic FSH Rules

Type	Syntax	Examples

Assignment	`* <element> = {value}`	`* code = https://loinc.org#69548-6`
		`* status = #active`
		`* onsetDateTime = "2019-04-02"`

Binding	`* <bindable> from {ValueSet} ({strength})`	`* gender from http://hl7.org/fhir/ValueSet/administrative-gender`
		`* telecom.system from http://hl7.org/fhir/ValueSet/contact-point-system (required)`
		`* code from CancerConditionVS (extensible)`

Cardinality	`* <element> {min}..{max}` `// specify min, max, or both`	`* subject 1..1` `* category 1..  // only set lower bound`

Flag	`* <element(s)> {flag(s)}`	`* onsetDate MS`
		`* communication MS SU TU ?!`
		`* identifier and identifier.system and identifier.value and name and name.family MS`
		`* subject 1..1 MS  // combined cardinality and flag`

Type	`* <element> only {datatype(s)}`	`* valueQuantity only SimpleQuantity`
		`* onset[x] only dateTime`
		`* onset[x] only Period or Range`
		`* performer only Reference(Practitioner)`
		`* performer only Reference(PrimaryCarePhysician or EmergencyRoomPhysician) // profiles`

Intensional Value Set Definition

```
* include codes from system SCT where concept is-a #262202000  "Therapeutic intent"
```

The permitted intensional rules depends on the code system

See https://build.fhir.org/valueset.html#csnote