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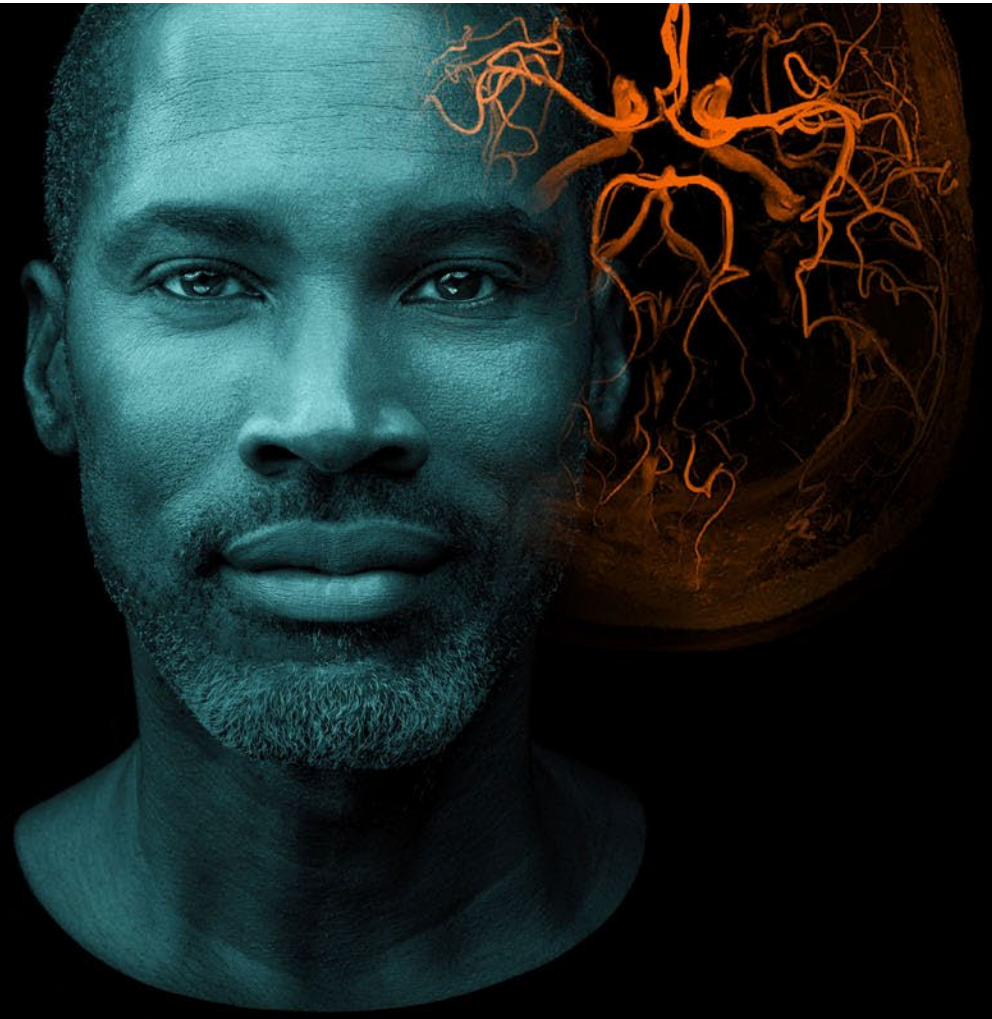
Interoperability in healthcare: why we should speak common language



Anton Kováč

Agenda

- Introduction
- FHIR Profiling
- HAPI FHIR – The open source FHIR API

Introduction

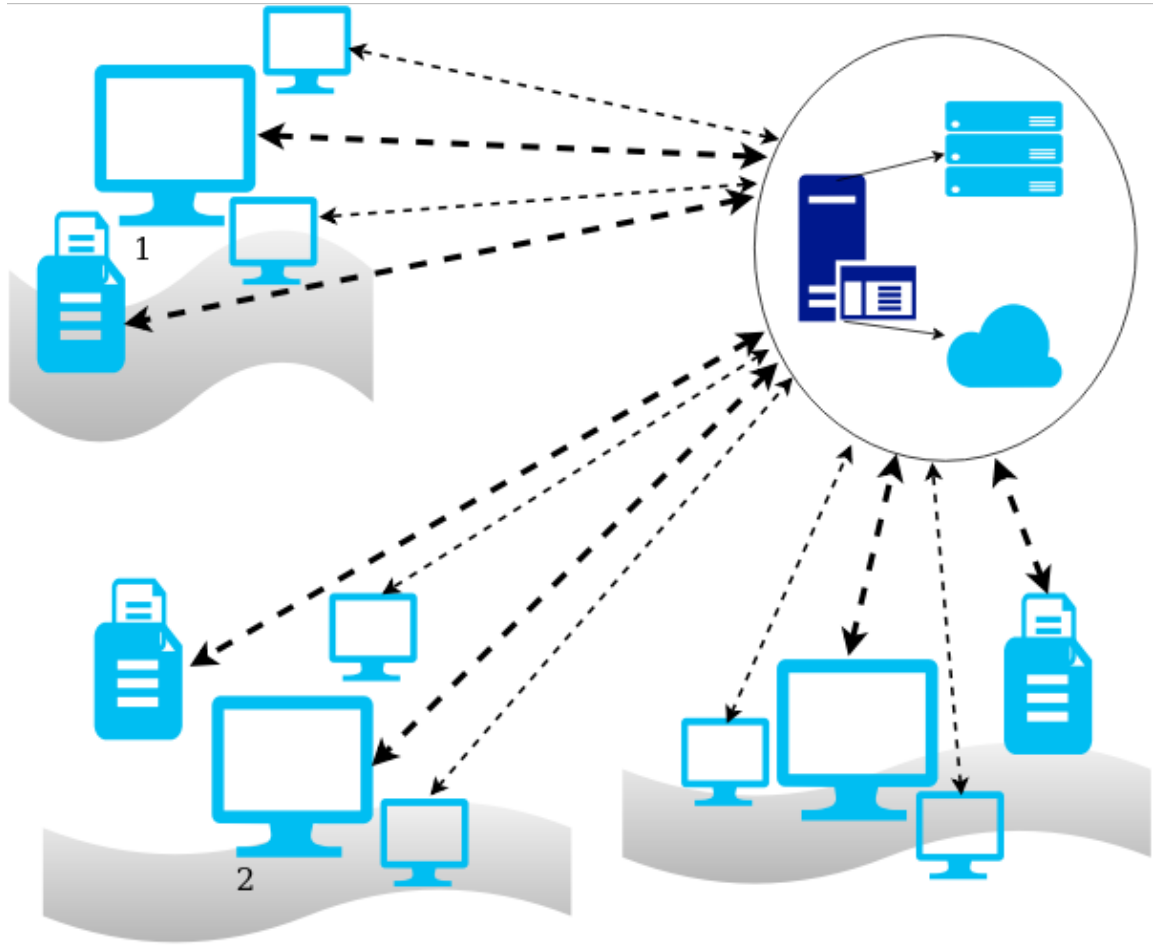
Interoperability

General

- **Different tech areas require specific criteria**

- **Telco**
  - CDR
- **Banking**
  - SDMX
  - SWIFT (BIC, IBAN, LEI)

- **Healthcare**
  - **Foundational**
  - **Structural**
  - **Semantic**
  - **Organizational**



CDR – Call Detail Record
SDMX – statistical data exchange model

Data in Healthcare (Overview)

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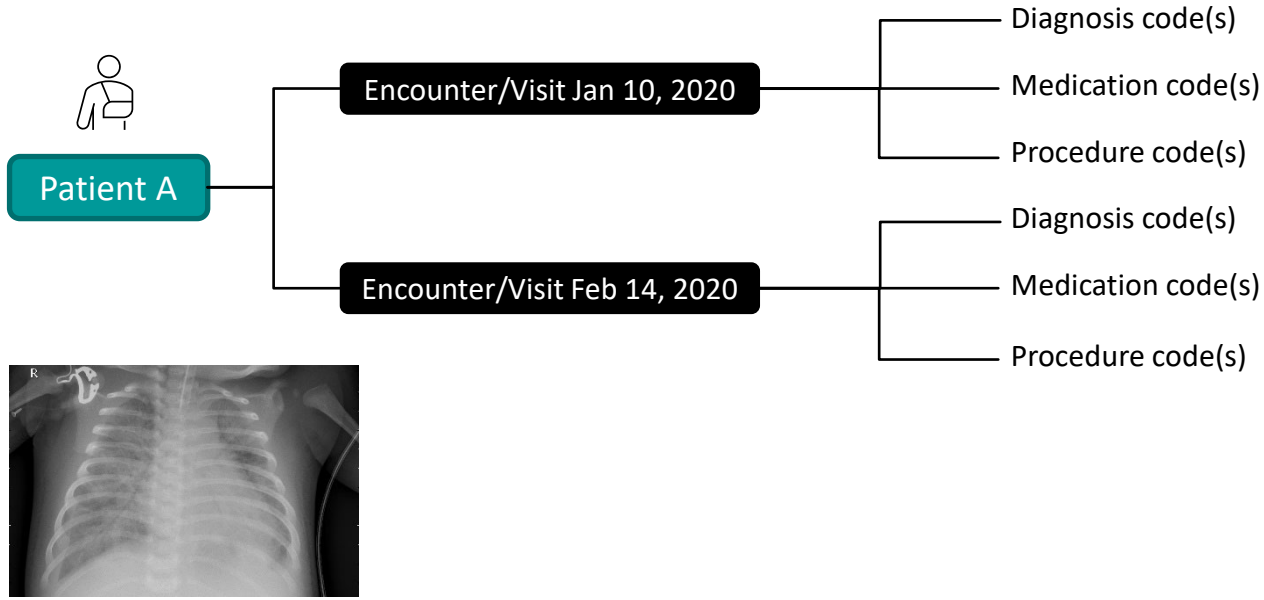
Key points

- **FHIR**
  - Fast Healthcare Interoperability Resources
    - Standard for exchanging healthcare information
    - JSON
- **EHR**
  - Electronic Health Records
    - Diagnosis, Procedure, Encounter, Medication
- **Imaging**
  - 2D – single angle
    - X-Ray
  - 3D – lots of angles (volume)
    - CT, MRI, Ultrasound
  - Data formats: DICOM, NIFTI
- **Wearable devices**
  - IOT



Further reading: FHIR
Image source: https://www.kaggle.com/datasets/paultimothymooney/chest-xray-pneumonia?resource=download (person1000_bacteria_2931)

Data in Healthcare (EHR)

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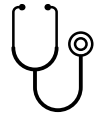
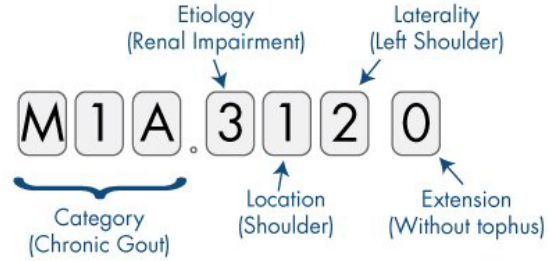
Diagnosis Codes
- ICD 10 - CM

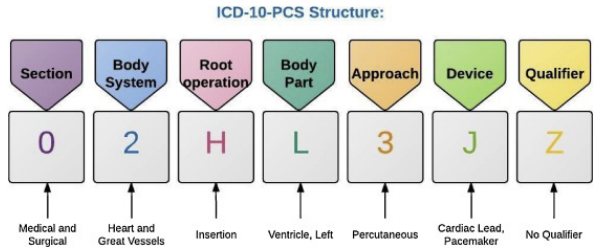


- ~ 70K codes
- Up to 7 Characters



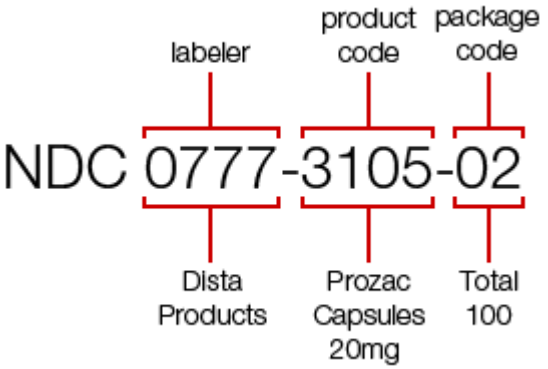
Procedures Codes
- ICD 10 – PCS
- CPT
- HCPCS

- ~ 72K codes
- Up 7 Characters



Medication Codes
- NDC
- RXNorm
- ATC

- 10-11 Digits



Grouping / Categorizing
- CSS

Source of images: google.com
Further reading: ICD10 -CM Coding Guidelines, Understanding CPT Codes, RXNorm Overview, SNOMED CT

FHIR Profiling

Intro

Def:

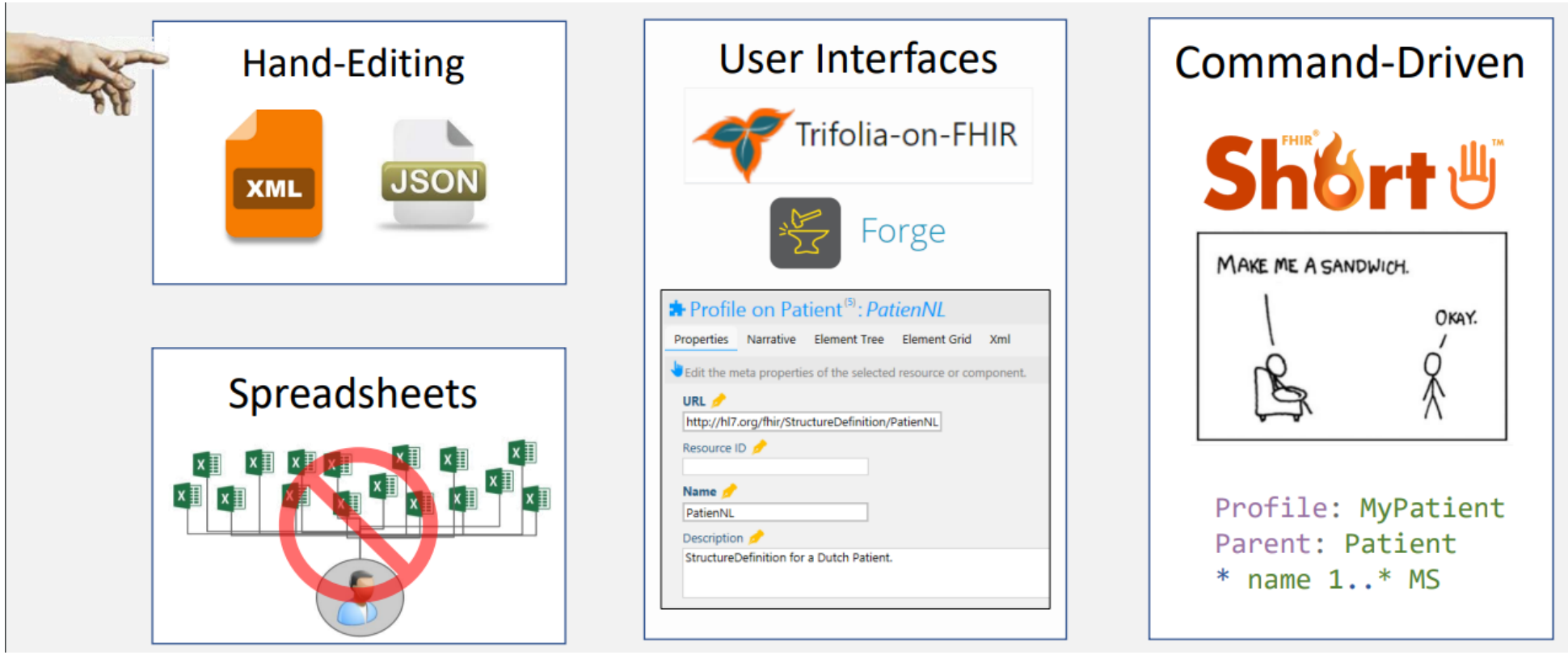
way to customize the FHIR (**Fast Healthcare Interoperability Resources**) standard to meet specific needs

1. **standard** - for exchanging healthcare information electronically
2. **customization** – more specific and useful resources that meet the needs of different healthcare systems and providers

Example:

A hospital could publish a profile for a patient resource that includes fields specific to their electronic health record system, which could be used by other healthcare providers who also use FHIR

Profiling Approaches



Source: https://www.devdays.com/wp-content/uploads/2021/12/DD21US_20210608_Mark_Kramer_Create_an_Implementation_Guide_with_FHIR_Shorthand_.pdf

FHIR SUSHI (Shorthand)

- A tool used to simplify the creation and management of FHIR resources and profiles

- It simplifies the process of creating and managing FHIR resources by using a concise and intuitive syntax, facilitating the development and adoption of FHIR profiles and extensions.

FHIR Profiling

Core terminology – Resource

A resource refers to a unit of healthcare information that is exchanged between systems using the FHIR standard. Examples of FHIR resources include Patient, Practitioner, Observation, and Medication. Each FHIR resource has a set of standardized elements (or properties) and a structure defined by the FHIR specification

Example resources:

- Patient
- Observation
- Encounter
- Procedure

Further reading:

- https://www.hl7.org/fhir/resourcelist.html

```
Profile: CodeconPatient
Parent: Patient
Id: shs-codecon-patient
Title: "SHS - Codecon -  Patient"
Description: "Basic descriptive information to iden
* ^name = "SHS_Codecon_Patient"
* ^meta.versionId = "1"
* ^status = #draft
* id 1..1 MS
* active 0..1 MS
* name
  * family 0..1 MS
  * given 0..* MS
  * prefix ..0
  * suffix ..0
* gender 1..1
* birthDate 1..1 MS
* birthDate only date
* deceased[x] 0..1 MS
* deceased[x] only boolean or dateTime
```

FHIR Profiling

Core terminology – Extension

An extension is a way to add additional information to a FHIR resource that is not already defined in the standard specification. It allows for customization and tailoring of FHIR resources to specific use cases. For example, an extension could be used to add a new field to the Patient resource that captures a patient's preferred language

```
// ------------------------------------------------------------------
/* Example for Extension */
// ------------------------------------------------------------------
Profile: ExampleObservationExtension
Parent: shs-codecon-observation
Id: example-observation-extension

* bodySite.extension contains
  Laterality
  named  myExtension 0..1

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

Further reading:

- https://www.hl7.org/fhir/extensibility.html

FHIR Profiling

Core terminology – Slicing

A slice is a way to define a subset of elements within a FHIR resource that meet specific criteria. It allows for the creation of specialized subsets of FHIR resources, based on specific needs. For example, a slice could be used to create a subset of the Observation resource that only includes elements related to blood pressure readings

```
Profile: CodeconProstateSpecificAntigenPSA
Parent: shs-codecon-lab-values-general
Id: shs-codecon-prostate-specific-antigen-psa
Title: "SHS - Codecon - Prostate specific antigen (PSA)"
Description: "A protein made by the prostate gland and found in the blood
* insert Codecon_ValueQuantity
* ^name = "SHS_Codecon_ProstateSspecificAntigen_PSA"
* ^status = #draft
* code.coding ^slicing.discriminator.type = #value
* code.coding ^slicing.discriminator.path = "commonCode"
* code.coding ^slicing.rules = #open
* code.coding.userSelected ..0
* code.coding.version ..0
* code.coding contains commonCode 1..1
* code.coding[commonCode] ^binding.strength = #required
* code.coding[commonCode] ^binding.description = "only those codes can be
* code.coding[commonCode] from VsProstatespecificantigenPSA (required)
* valueQuantity.code = #ng/mL (exactly)
* valueQuantity.system = "http://unitsofmeasure.org" (exactly)
* valueQuantity.unit = "ng/mL" (exactly)
```

Further reading:

- https://build.fhir.org/profiling.html#slicing

FHIR Profiling

Core terminology – Value Set

A ValueSet is a collection of codes that represent a specific concept or idea in healthcare. It is used to define the allowable values for a particular FHIR resource element. For example, a ValueSet could be used to define the list of allowable values for a patient's gender, such as male, or female

```
ValueSet: VsProstatespecificantigenPSA
Id: VsProstatespecificantigenPSA
Title: "ValueSet for: Prostate specific antigen (PSA)(Observation.code)"
Description: "Codes associated with domain information element Prostate s
* ^version = "1.0.0"
* ^status = #active
* ^date = "2018-04-07T06:53:01+10:00"
* $loinc#2857-1 "Prostate specific Ag [Mass/volume] in Serum or Plasma"
* SNOMED_CT#102687007 "Prostate specific antigen (substance)"
```

Further reading:

- https://www.hl7.org/fhir/valueset.html

FHIR Profiling

Core terminology – Code System

A code system is a standardized set of codes that are used to represent specific healthcare concepts. Code systems are typically managed by a centralized authority, such as the World Health Organization (WHO), and provide a standardized vocabulary for healthcare information exchange. Examples of code systems include SNOMED CT, LOINC, and ICD-10.

Further reading:

- https://www.hl7.org/fhir/codesystem.html

Image source: link

FHIR Profiling

Useful tips

- **Leverage on existing artifacts (Implementation Guide)**

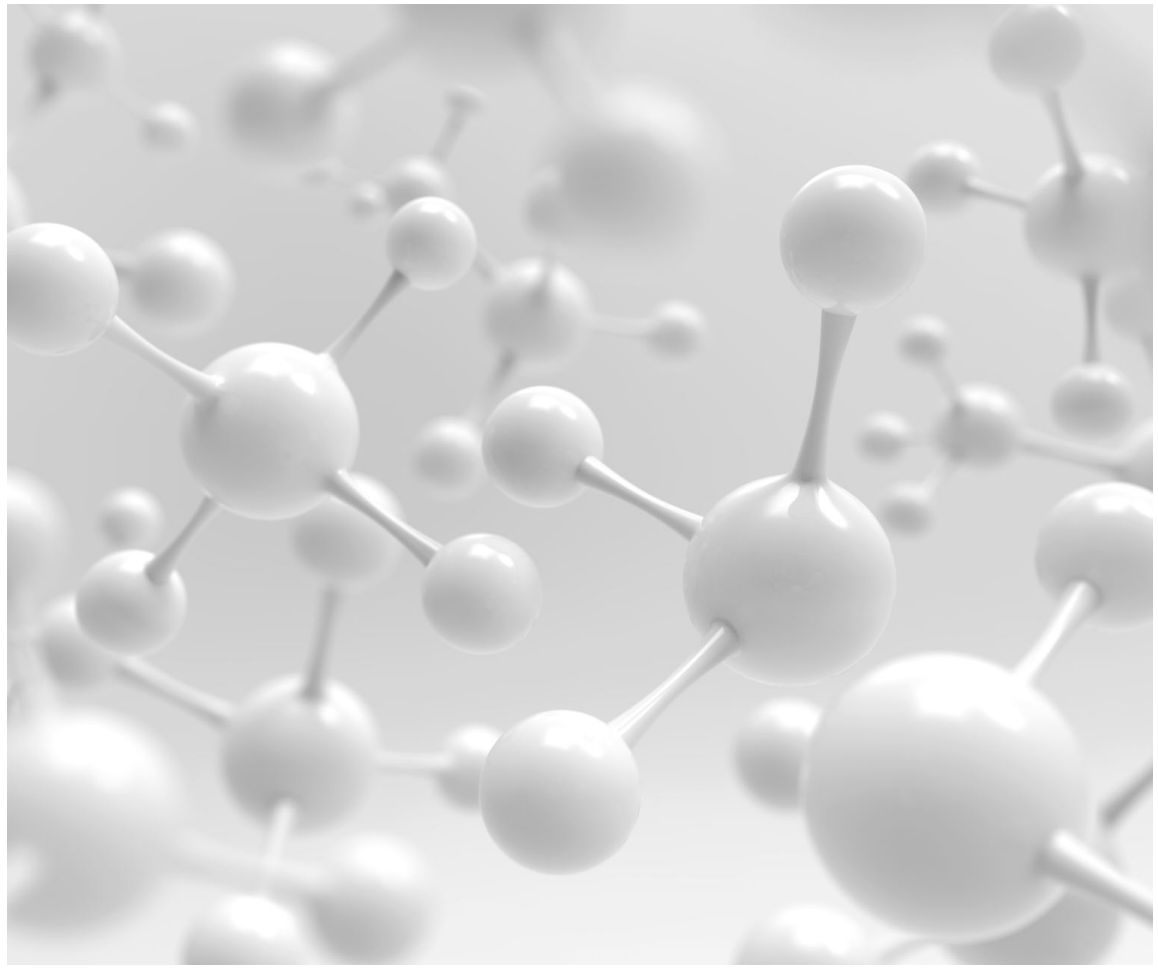
```
dependencies:
  fhir.dicom:
    url: http://fhir.org/packages/fhir.dicom/ImplementationGuide/fhir.dicom
    version: 2022.4.20221006
```

- **Always check if the extension you need already exists**

- **Are you using external ontology? (Value Set, Code System)**
- **Do you need to define new/private and project specific codes?**
- **It is a good practice to include Instances (examples)**

Tips and Useful Links

- Language Reference: http://hl7.org/fhir/uv/shorthand/
- Quick Sheet: http://hl7.org/fhir/uv/shorthand/FSHQuickReference.pdf
- FSH Online: https://fshschool.org/FSHOnline/#/
- FSH School: https://fshschool.org/
- Zulip #shorthand: https://chat.fhir.org/#narrow/stream/215610-shorthand
- FHIR Registry for DICOM: http://fhir.org/packages/fhir.dicom/
- NodeJS LTS: https://nodejs.org/en/
- VS Code extension: https://marketplace.visualstudio.com/items?itemName=kmahalingam.vscode-language-fsh
- Customizing templates: http://build.fhir.org/ig/FHIR/ig-guidance/template.html



Install pre-requisites

FHIR Shorthand

https://fshschool.org/docs/sushi/tutorial/

FHIR Profiling

Install pre-requisites (1/2)

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Please, be aware that some installation logs may differ from the screenshots

Install node.js LTS edition

- Download link
- Open terminal and verify if the installation was successful

```
PS D:\> node --version
v16.13.0
PS D:\> npm --version
8.8.0
```

Install SUSHI

- **Open terminal and run**
  - npm install –g fsh-sushi
  - Verify the installation typing (sushi –v)

```
PS D:\> npm install -g fsh-sushi

changed 108 packages, and audited 116 packages in 2m

found 0 vulnerabilities
PS D:\> sushi -v
SUSHI v2.9.0 (implements FHIR Shorthand specification v2.0.0)
```

FHIR Profiling

Install pre-requisites (2/2)

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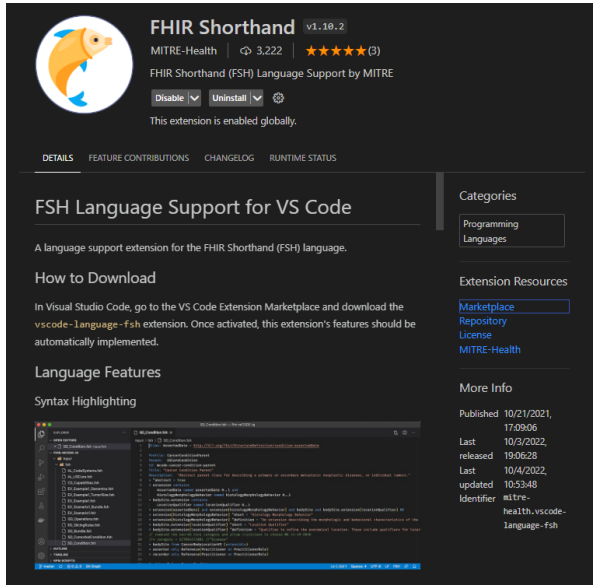
Please, be aware that some installation logs may differ from the screenshots

Visual Studio Code

- Download link

FHIR Shorthand extension for Visual Studio Code

- Download link

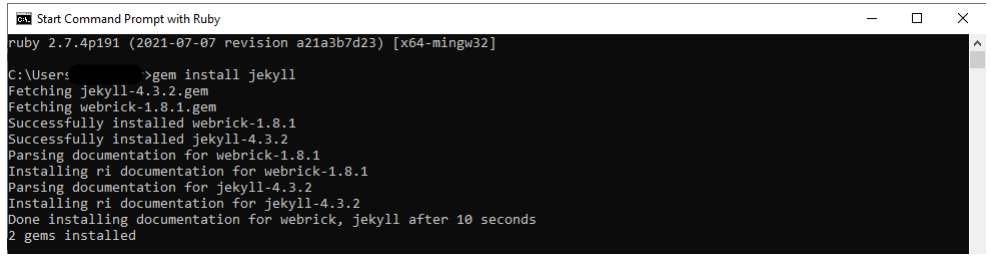


Ruby & Devkit

- Download link
- Note: we are using version 2.7.4 but the newer version should work properly

Jekyll gem

- Download link
- Note: use Ruby command prompt for install Jekyll Gem



HAPI FHIR – The open source FHIR API

HAPI Tutorial

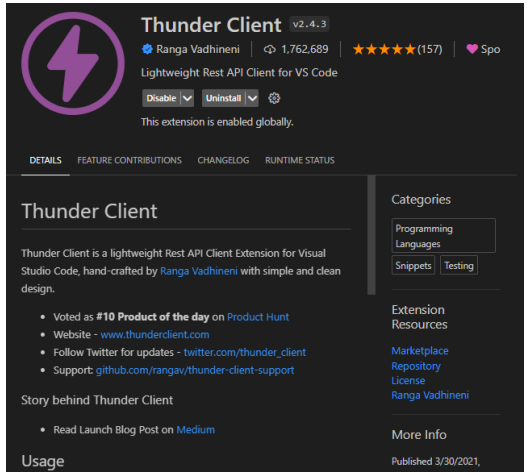
Install pre-requisites (1/4)

Please, be aware that some installation logs may differ from the screenshots

Install tool using REST API

- **Postman**
  - Download Link

- **Thunder Client (VS Code Extension)**
  - Link to extension



Python

- Download Link
- We recommend to use some module/package for management virtual environments (e.g. virtualenv)
- If you are using Anaconda distribution you can proceed with it using the requirements.txt file
- Create new virtual environment using the packages provided
  - *python –m venv .venv*
    .\env\Scripts\Activate.ps1[1]
    python -m pip install -r requirements.txt

HAPI Tutorial

Install pre-requisites (2/4)

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Please, be aware that some installation logs may differ from the screenshots

Install Docker

- Docker is mandatory for the purposes of the workshop
- We recommend to use Docker-Desktop for the purposes of this workshop (on Windows or on Linux). However, if - for whatever reason - you are not able to use Docker-Desktop, you may be fine with the usage of Docker on Linux (or WSL).
  - Please, follow the instructions for installation on Windows without Docker-Desktop

HAPI Tutorial

Install pre-requisites (3/4)

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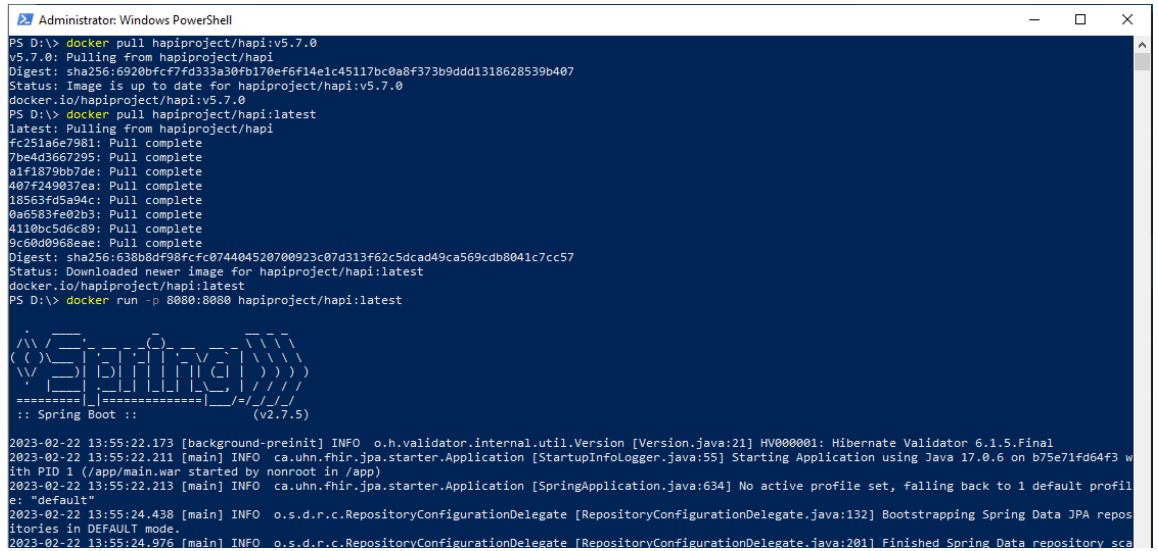
Please, be aware that some installation logs may differ from the screenshots

Pull hapiproject image and run FHIR test server

- You can follow instructions on the hapi-fhir-jpaserver page (running via Docker Hub) or on docker hub



HAPI Tutorial

Install pre-requisites (4/4)

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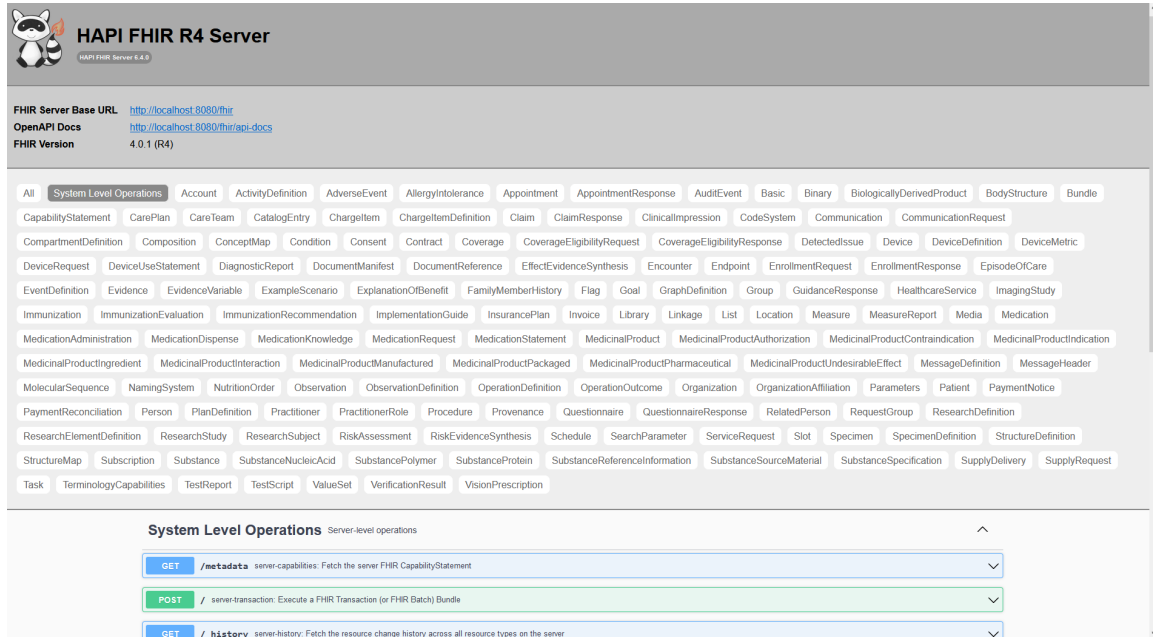
Please, be aware that some installation logs may differ from the screenshots

Test running hapi container

- If you proceeded with the default settings and followed the instructions you should now be able to see and play around with the hapi instance on your local machine
- Visit `*http://localhost:8080/fhir/swagger-ui/*` to play with the hapi in the Swagger UI environment
- The FHIR Base URL is: **http://localhost:8080/fhir**

http://localhost:8080/fhir/swagger-ui/



HAPI Tutorial

Useful tips

docker run -d --name hapi-fhir-workshop -p 8080:8080 -e hapi.fhir.enable_repository_validating_interceptor=true hapiproject/hapi:latest

- **FHIR docs using swagger-ui**
  - http://localhost:8080/fhir/swagger-ui/

Structure definitions

- https://hapifhir.io/hapi-fhir/docs/validation/instance_validator.html
- http://hl7.org/fhir/us/core/STU5.0.1/CapabilityStatement-us-core-client.html
- Enabling validation
  - https://groups.google.com/g/hapi-fhir/c/cs5oq2Coebk
  - https://github.com/hapifhir/hapi-fhir-jpaserver-starter/blob/eaffce0d42e5e783de02c597725bfd5b88bf385f/src/main/resources/application.yaml#L75

About us

- **5 mil patients**
  - daily use our products
- **70% clinical decisions**
  - is affected by our technologies
- **> 90% of the biggest healthcare provides**
  - cooperate with Siemens Healthineers
- **170 years**
  - of experience in medical technologies
- > 50K colleagues in ~ 70 countries

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Learn
Enjoy
Deliver

Development Center Slovensko

Thank you for your attention

Open discussion

Presenter

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