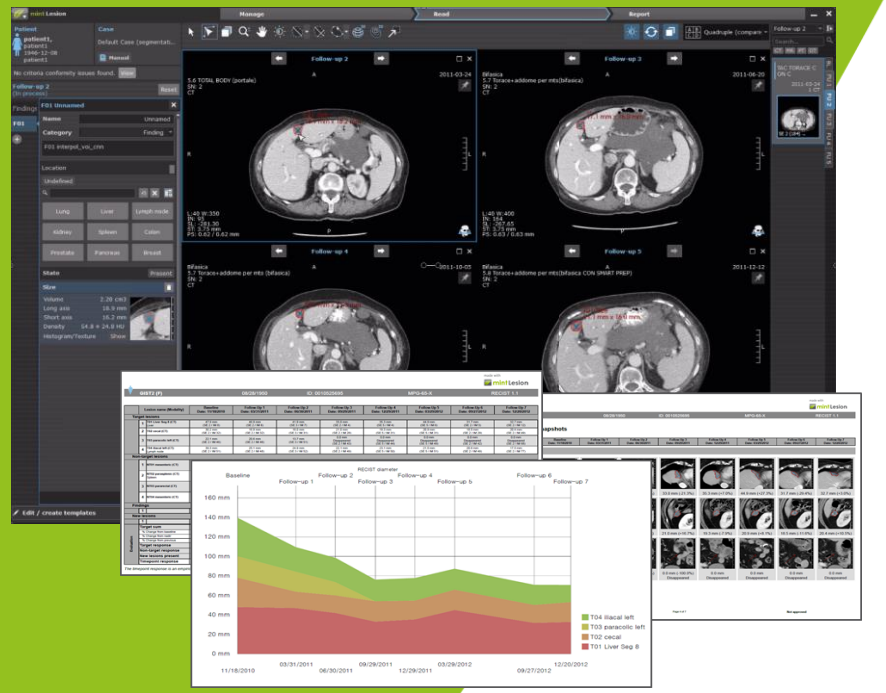
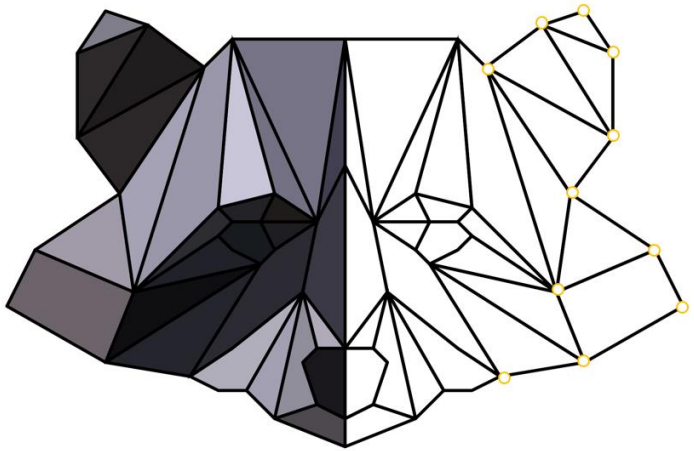
mint® medical

netzwerk universitäts medizin



Radiological **Coo**perative **N**etwork



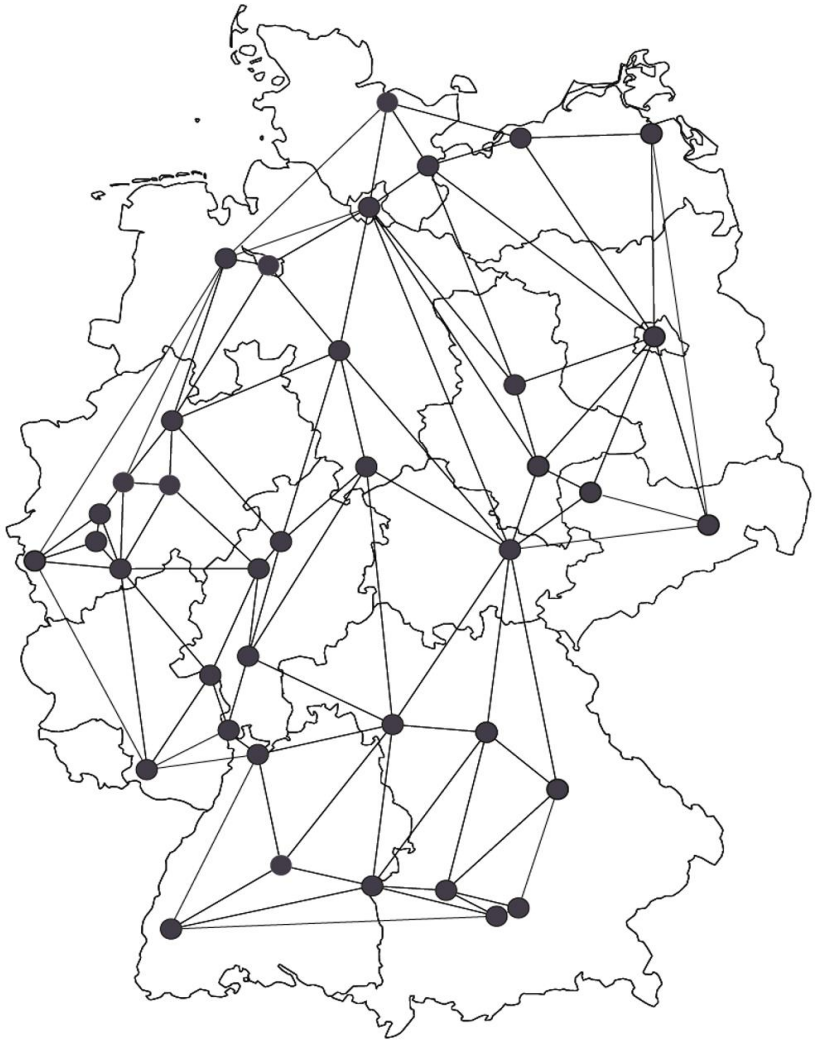
RACOON

SMART

Agenda

COVID-19 Reporting in the National Radiology Research Network

- What is the RACOON platform
- The need of harmonized data models
  - Common pitfalls in modelling
  - MII FHIR profiles and the GOLD project
- The need of easy integration into the platform



RACOON infrastructure

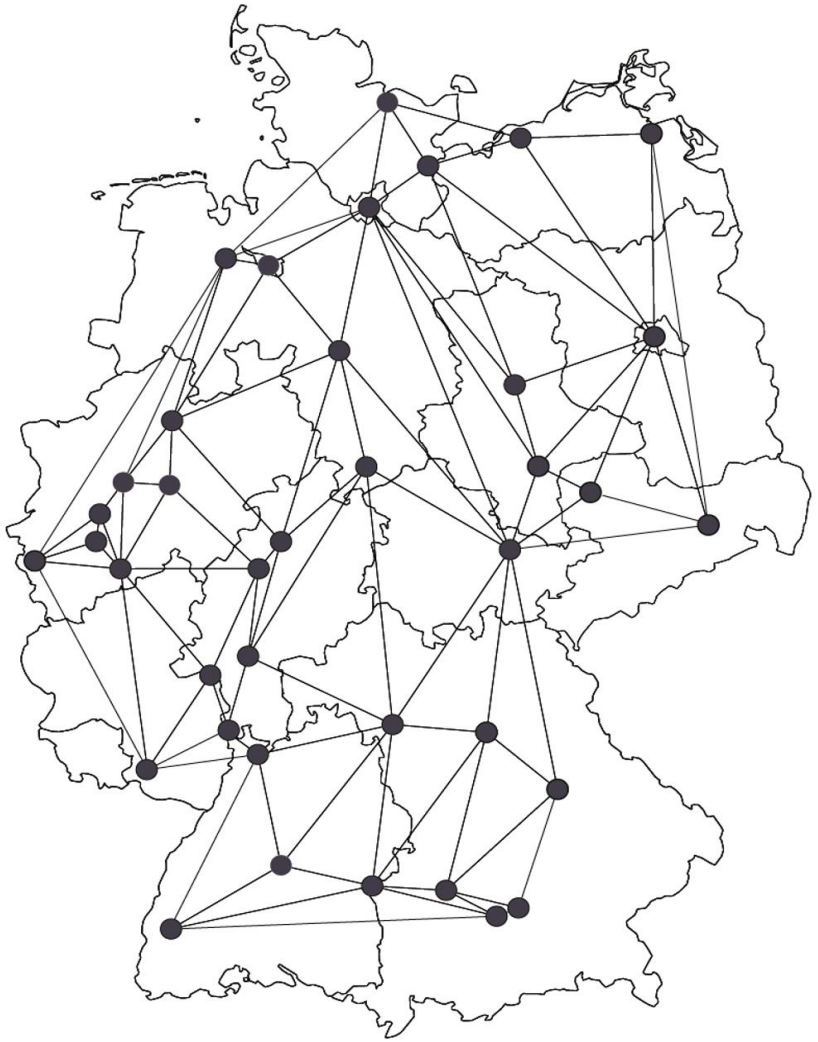
Merging structured data creates knowledge!

COVID-19 Reporting in the National Radiology Research Network

netzwerk universitäts medizin

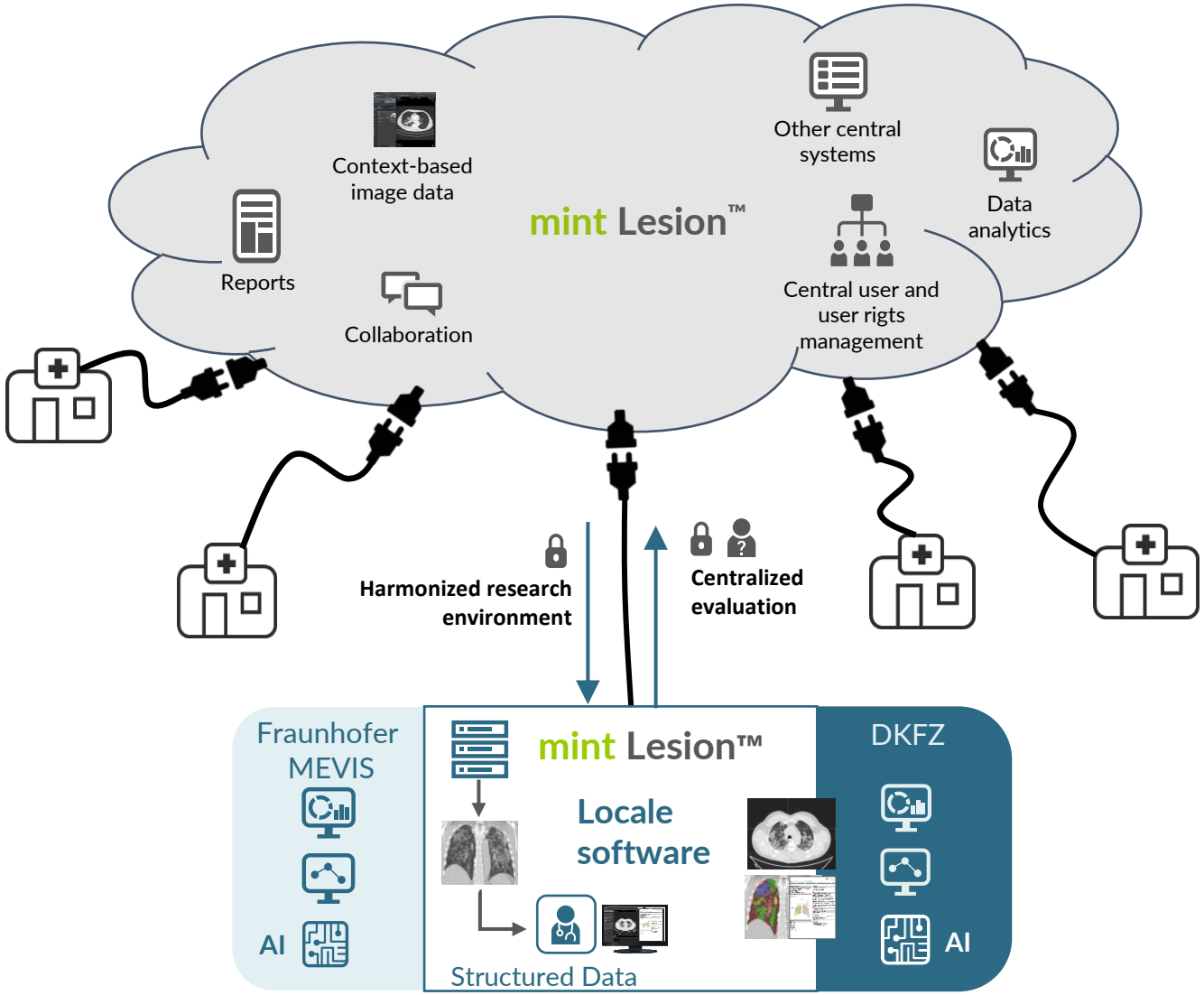
RACOON platform for the COVID-19 imaging research of all universities

- Imaging component of NUM concept
- Platform used by all 36 German university centers
- Nationwide infrastructure for consistent structured assessment of COVID-19 cases
- Structured reporting of a total of 14,000 lung patients
- Platform for imaging in future epidemics/pandemics with high scaling potential
- Expandable to other diseases



RACOON Infrastructure

Standardized IT-Infrastructure for all centers



RACOON Nodes (De-centralized)

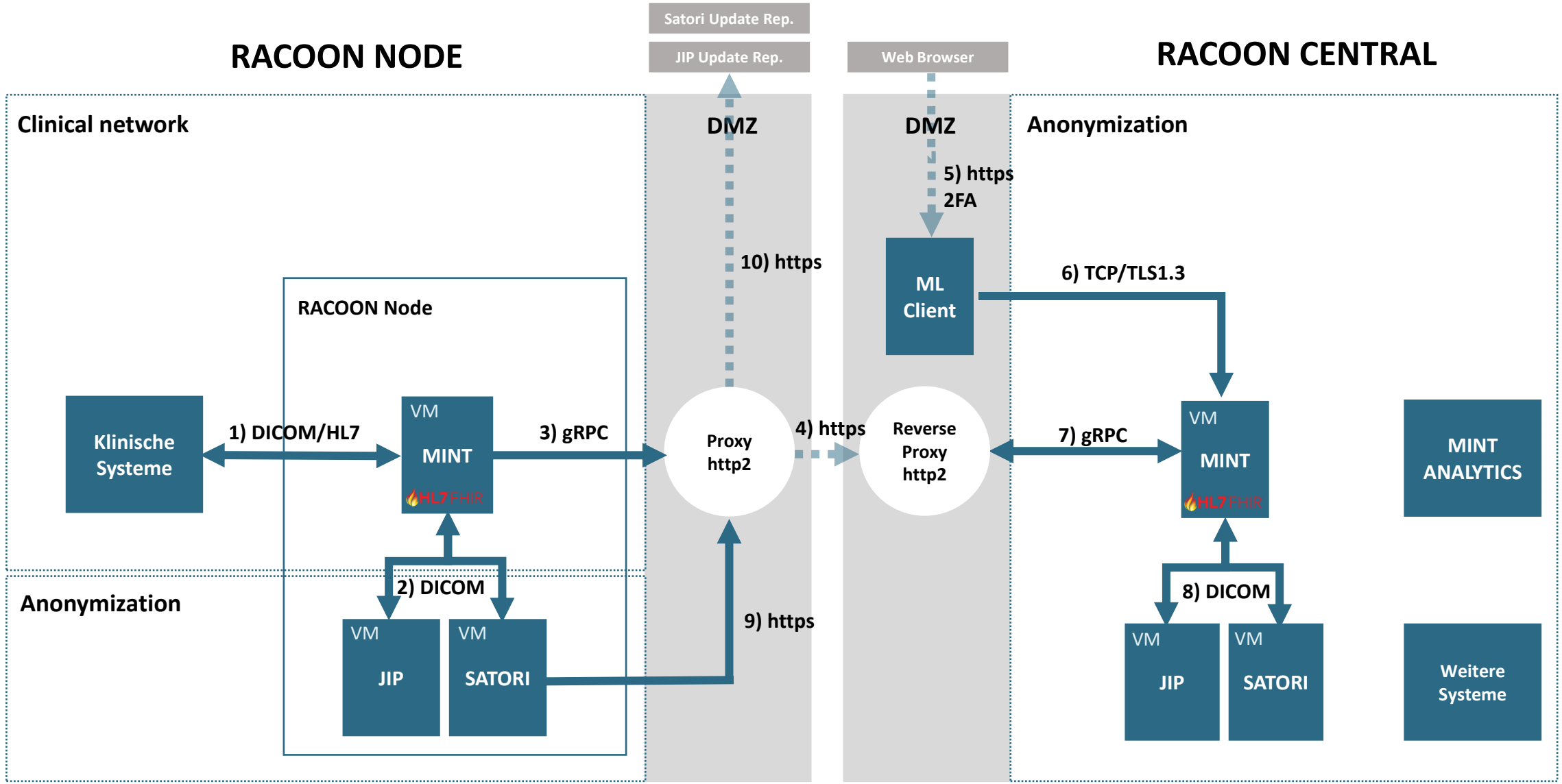
- Powerful GPU system for AI research
- Mint, JIP, Satori virtualized on a physical server
- Basic software and components available
- De-identification and secure data upload guaranteed

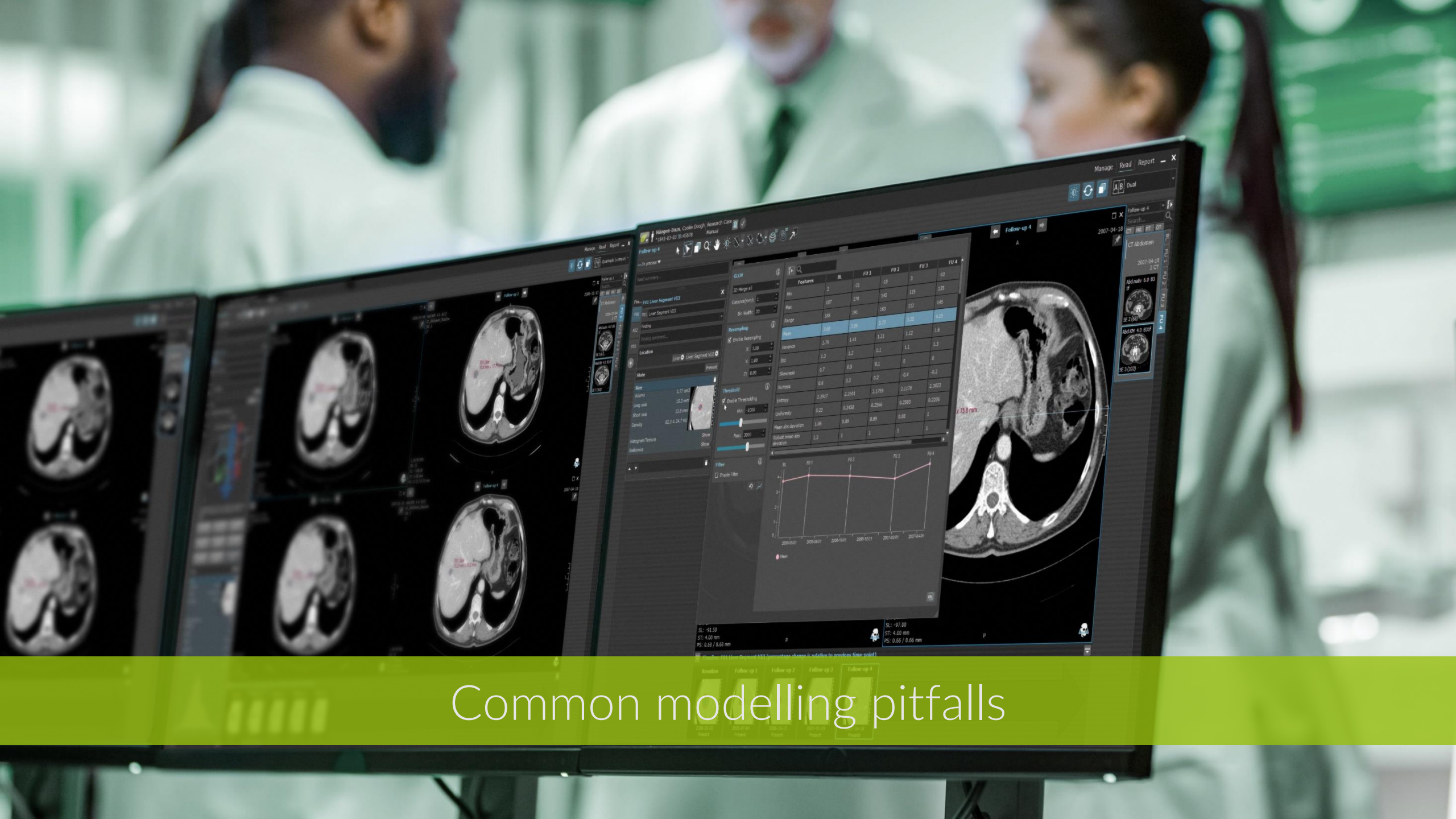
RACOON Central (Cloud)

- Cross-site collaboration & evaluations
- Real-time overview of project progress
- Training & Validation of the AI models
- Various other use cases (teleconsultation, etc.)

RACOON Infrastructure

Defined interfaces and data flows

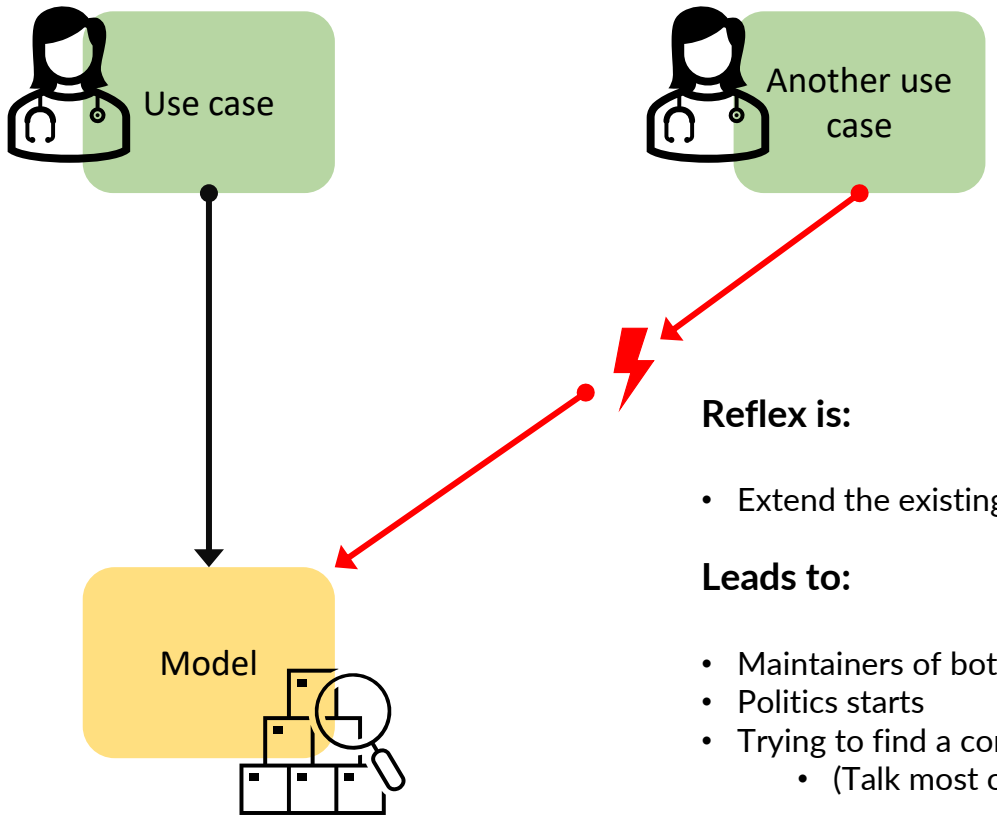




Common modelling pitfalls

General issues with information models (in Germany)

My experience - “Let’s start with this use case”



Reflex is:

- Extend the existing model so that it also fits the new use case as well

Leads to:

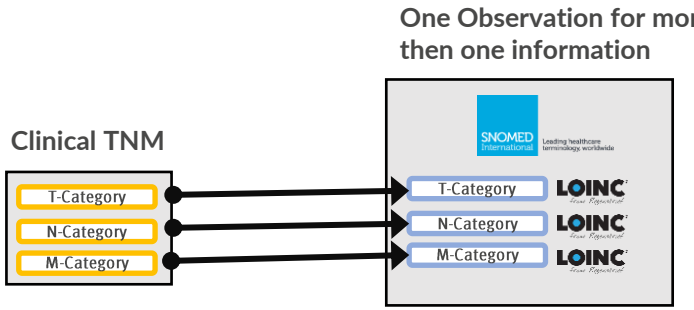
- Maintainers of both use cases need to communicate
- Politics starts
- Trying to find a consent
    - (Talk most of the time about GDPR)

Results in:

- Much time spent
- Having a consent which might work for the new use case but it is not ideal and has workarounds

The TNM FHIR Observation resource

Many-to-one



Implication for the export implementation

- Application needs a concept on how to group certain information
- Missing implementations (e.g. factories) will lead to faulty implementations of profiles

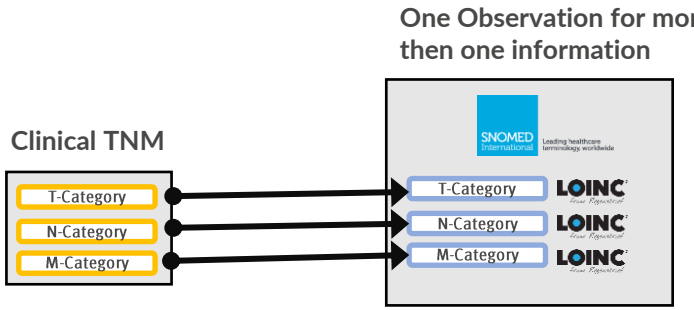
Export Pseudocode

```
FhirBundle FHIRExport::CreateBundle( ItemList items )
{
    var tnmObservationGroup = TnmObservationGroup()
    var fhirBundle = FhirBundle()
    forall item in items
    {
      if ( tnmObservationGroup.canHandle(item) )
      {
        tnmObservationGroup.addAsComponent(item)
      }
      else
      {
        fhirExport.add( item.getObservationRepresentation() )
      }
    }

    fhirExport.add( tnmObservationGroup.getObservationRepresentation() )

    return fhirBundle;
}
```

```
TnmObservationGroup::addAsComponent( Item item )
{
  if ( canHandle(item) == false )
  {
    return
  }

  componentList.add( item.getComponentRepresentation() )
}

FhirObservation TnmObservationGroup::getObservationRepresentation()
{
  var observation = FhirObservation()

  // dependent on type of the component?
  observation.setCode(SnomedCodeSystem, "260879005")

  observation.addComponents(componentList)

  return observation
}
```

The TNM FHIR Observation resource

Many-to-one



Implications for the import implementation

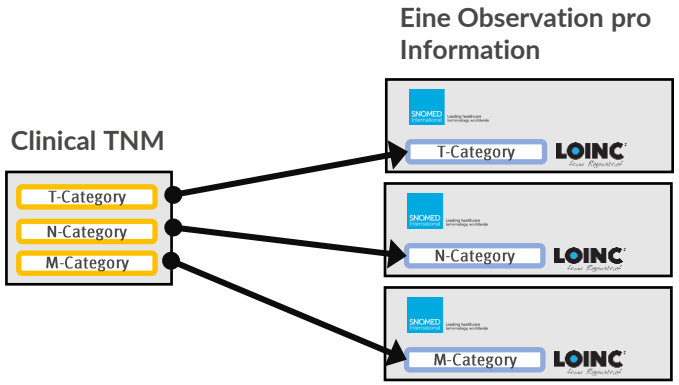
- Implementation also needs a concept for grouped information
- Such a resource cannot be consumed without special handling on import side
- Missing implementation may lead to incomplete data
- Complex documentation of such profiles is likely to be interpreted different in different applications

Import Pseudocode

```
ItemList FhirImport::ReadFromBundle( FhirBundle fhirBundle )
{
    var itemList = ItemList()
    var tnmObservationGroup = TnmObservationGroup()
    forall observation in fhirBundle
    {
        if ( itemList.canHandle(observation) == false )
        {
            continue;
        }

        if ( tnmObservationGroup.canHandle(observation) )
        {
            itemList.add( tnmObservationGroup.extractItems(observation) )
        }
        else
        {
            itemList.add( observation )
        }
    }
}
```

The TNM FHIR Observation resource

One-to-one



Implications for the import and export implementation

- An application can handle each information in the same way.
- Less interpretation of the documentation as there are most likely only valid codes are presented

Export Pseudocode

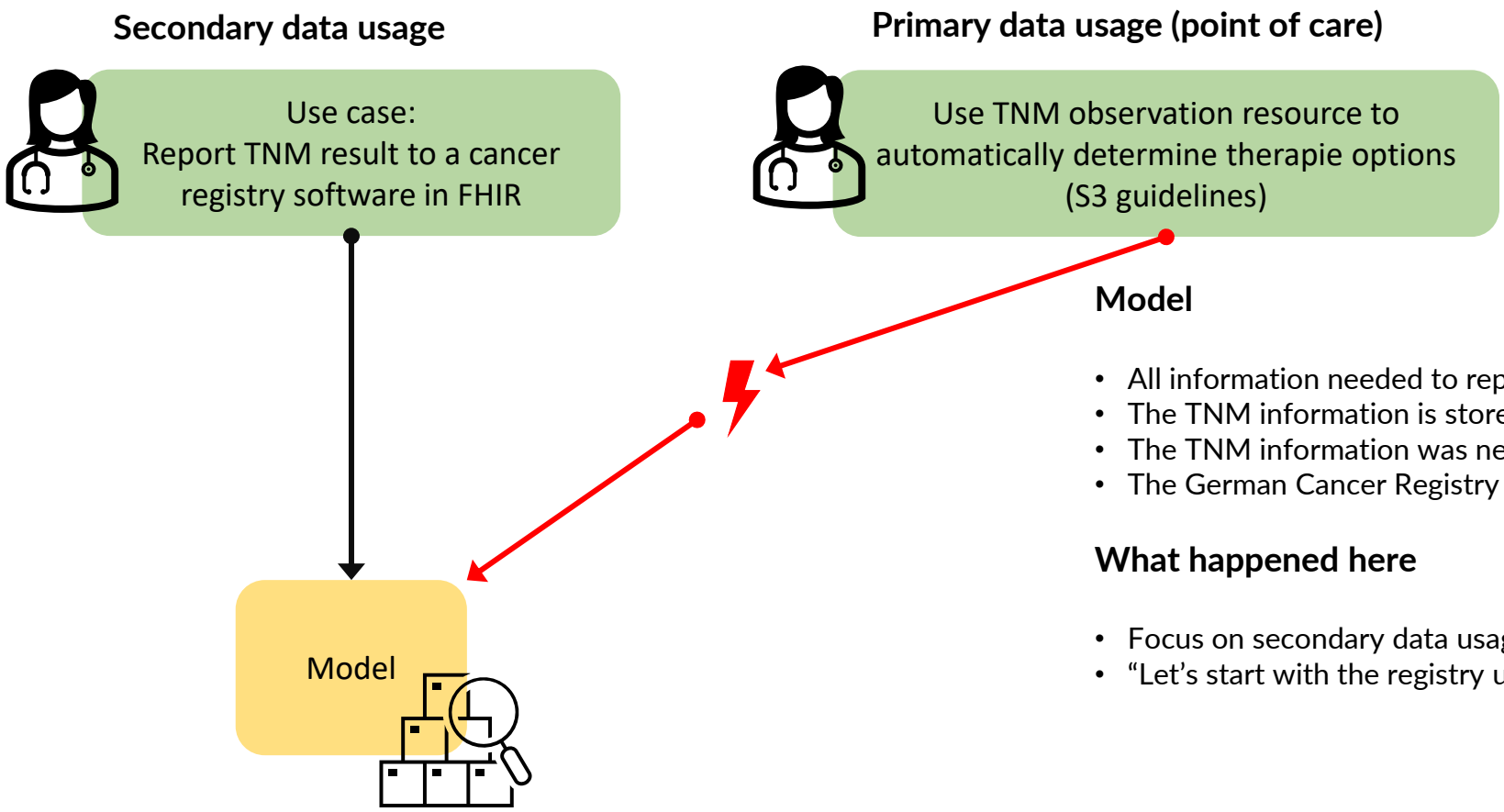
```
FhirBundle FHIRExport::CreateBundle( ItemList items )
{
    var fhirBundle = FhirBundle()
    forall item in items
    {
        fhirExport.add( item.getObservationRepresentation() )
    }

    return fhirBundle;
}
```

Import Pseudocode

```
ItemList FhirImport::ReadFromBundle( FhirBundle fhirBundle )
{
    var itemList = ItemList()
    forall observation in fhirBundle
    {
        if ( itemList.canHandle(observation) == false )
        {
            continue;
        }

        itemList.add( observation )
    }

    return itemList
}
```

General issues with models (in Germany)

My experience – Concrete example in FHIR



Model

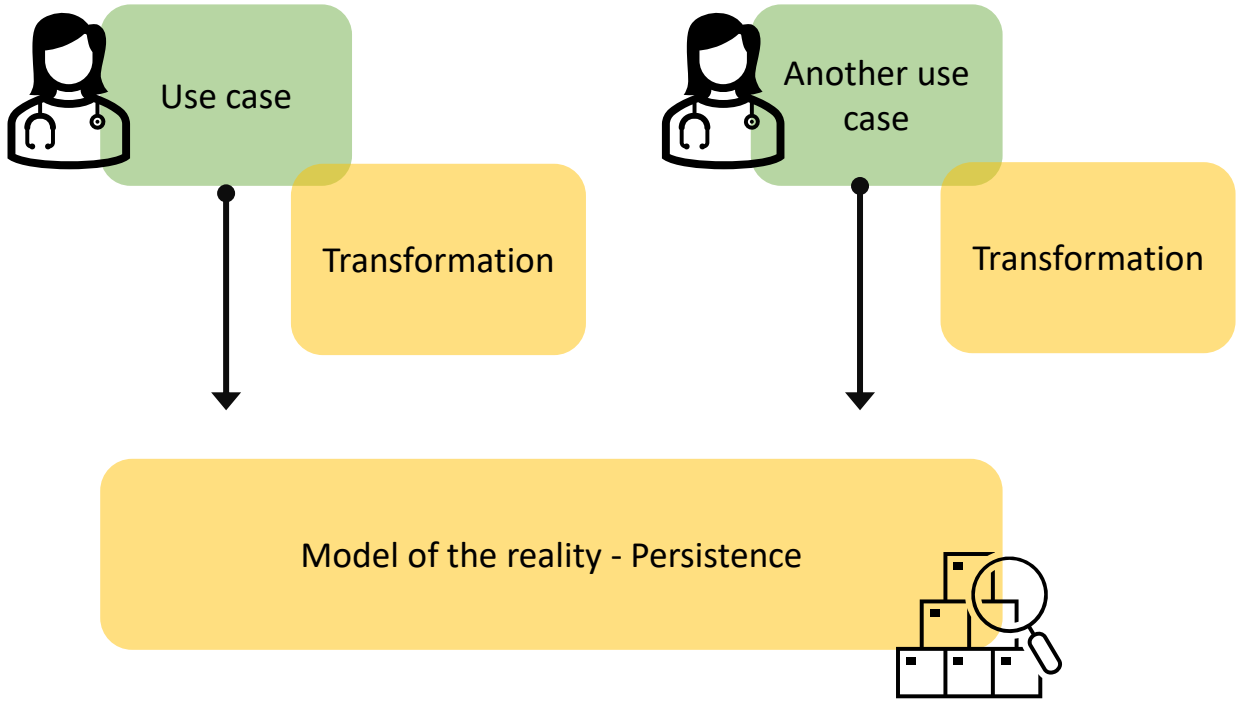
- All information needed to report to the registry
- The TNM information is stored in one observation
- The TNM information was never recorded in a diagnostic report that way!
- The German Cancer Registry has a XML model so the FHIR resource is never used

What happened here

- Focus on secondary data usage
- “Let’s start with the registry use case”

Conclusion for the RACOON modells

"Let's start with all use cases"



Model (a part of) the reality

- Be specific
- Record always context and time
- Hierarchies should not modify semantic meaning!
- Address each bit of information
    - Code questions and answers

Have a clear understanding how to extend the model

- Try to know what possible future extensions are
- Give good examples on how to extend the model

Domain experts should not deal with FHIR

- They need to be trained to lookup codes (SNOMED LOINC ...)
- They should have proper tools to model things in a correct way

What is Vision Zero GOLD?

GOLD in Vision Zero

"Themenfelder" – Digitalization is one of the Vision Zero topics

vision zero

Gemeinsam gegen Krebs

7 / DIGITALISIERUNG

Alle Patienten haben das Recht auf ihre Daten! Es muss sichergestellt werden, dass Hausärzte, Fachärzte und Kliniken die vollständigen patientenbezogenen Daten in strukturierter Form zeitnah und automatisch in eine digitale Patientenakte einpflegen, damit die medizinische Versorgung optimiert werden kann. Gleichzeitig sollten die anonymisierten Daten in wissenschaftlichen Auswertungen dazu beitragen, dass künftige Krebspatienten besser versorgt werden.

VORSITZENDER

PROF. DR. CHRISTOF VON KALLE

Berlin Institute of Health, BIH-Chair für Klinisch-Translationale Wissenschaften, Direktor des Klinischen Studienzentrums

How the actual work is done

Git Hub –> Simplifier.net

https://github.com/vision-zero-oncology/GOLD

https://vision-zero-oncology.github.io/GOLD/

Andrea Essenwanger

Gruppe: wissenschaftliche Einrichtung und Patientenorganisation

Expertise für: Syntaktische und semantische Interoperabilität; Zertifikate: SNOMED CT Foundation, HL7 FHIR proficient

Arbeitgeber: Berlin Institute of Health in der Charité

Bestätigende Organisation: Berlin Institute of Health in der Charité

Julian Saß

Gruppe: wissenschaftliche Einrichtung und Patientenorganisation

Expertise für: syntaktische Standards (HL7 FHIR), semantische Standards (SNOMED, LOINC)

Arbeitgeber: Berlin Institute of Health at Charité (BIH)

Bestätigende Organisation: Berlin Institute of Health at Charité (BIH)

Where we started and how the discussion shifted

“Maximal Tabelle” to the GOLD FHIR model

All fields needs to be included

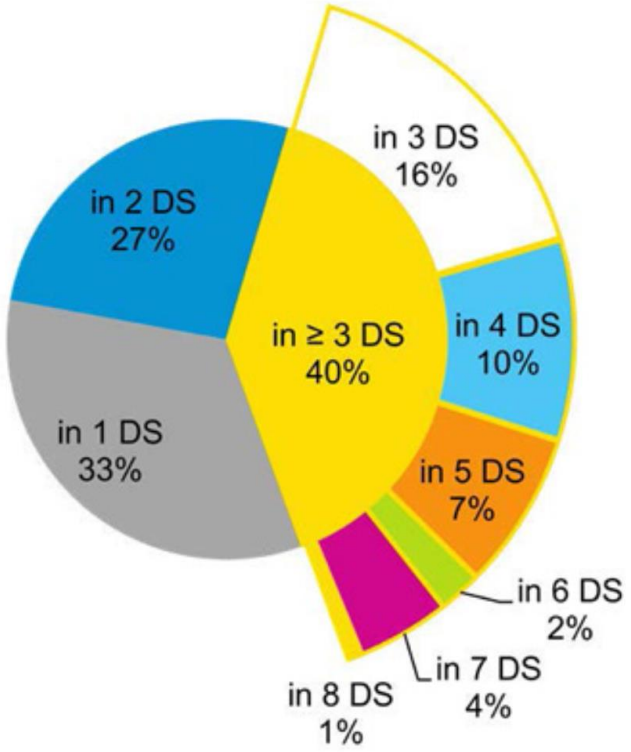
- Collect from different projects all data and try to find common fields
  - mCode
  - ADT GEKID “Basisdatensatz”
  - MII KDS Basis
  - ROCHE
  - …
- Do not reinvent the wheel.

Different views and use cases

- Pharma and clinical trials
- Cancer registry
- Routine data?

Wrong abstraction layers

- Implementation of Use Cases
- Not addressed use cases lead to
  - Workarounds
  - Information deficits
  - Special treatment in code



Where we started and how the discussion shifted

“Maximal Tabelle” is the wrong approach

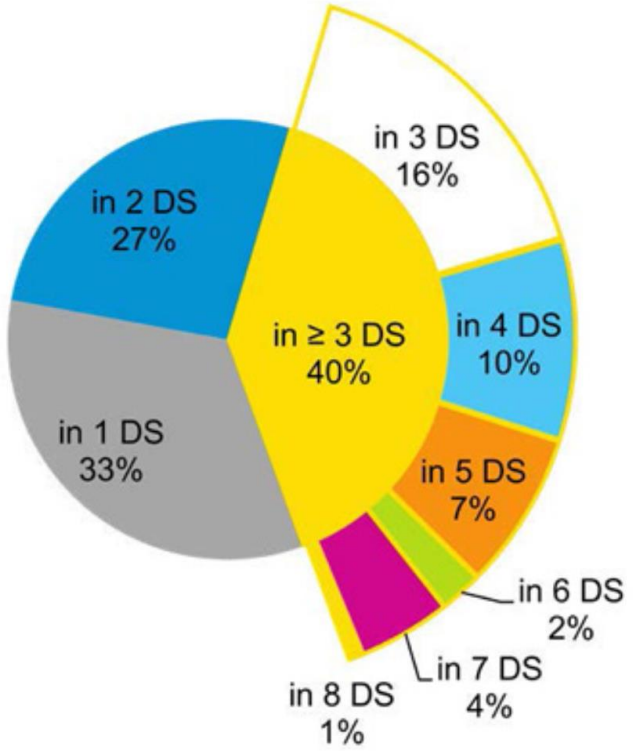
Not all fields needs to be included right from the beginning

- Implementation is now value based

Focus on primary usage of the information

- Primary = point of care
- Secondary = registry / research

Also cover clinical workflows as we actually want to save patients lifes



Where we started and how the discussion shifted

Apply development good practices

Do not reinvent the wheel

- Use FHIR framework with as less extensions as possible
- Use existing resources and relations wherever possible
- Search for existing (working) FHIR profiles and link them
    - MIOs
    - MII
    - mCode

Address the customer (=physicians)

- Get them into the loop
- Always have clinical workflows in mind
- We address primary use cases first
    - We try to find the low hanging fruits instead of enabling registry or research use cases
    - Not everything needs to be structured from the beginning

Address the customer (=developers)

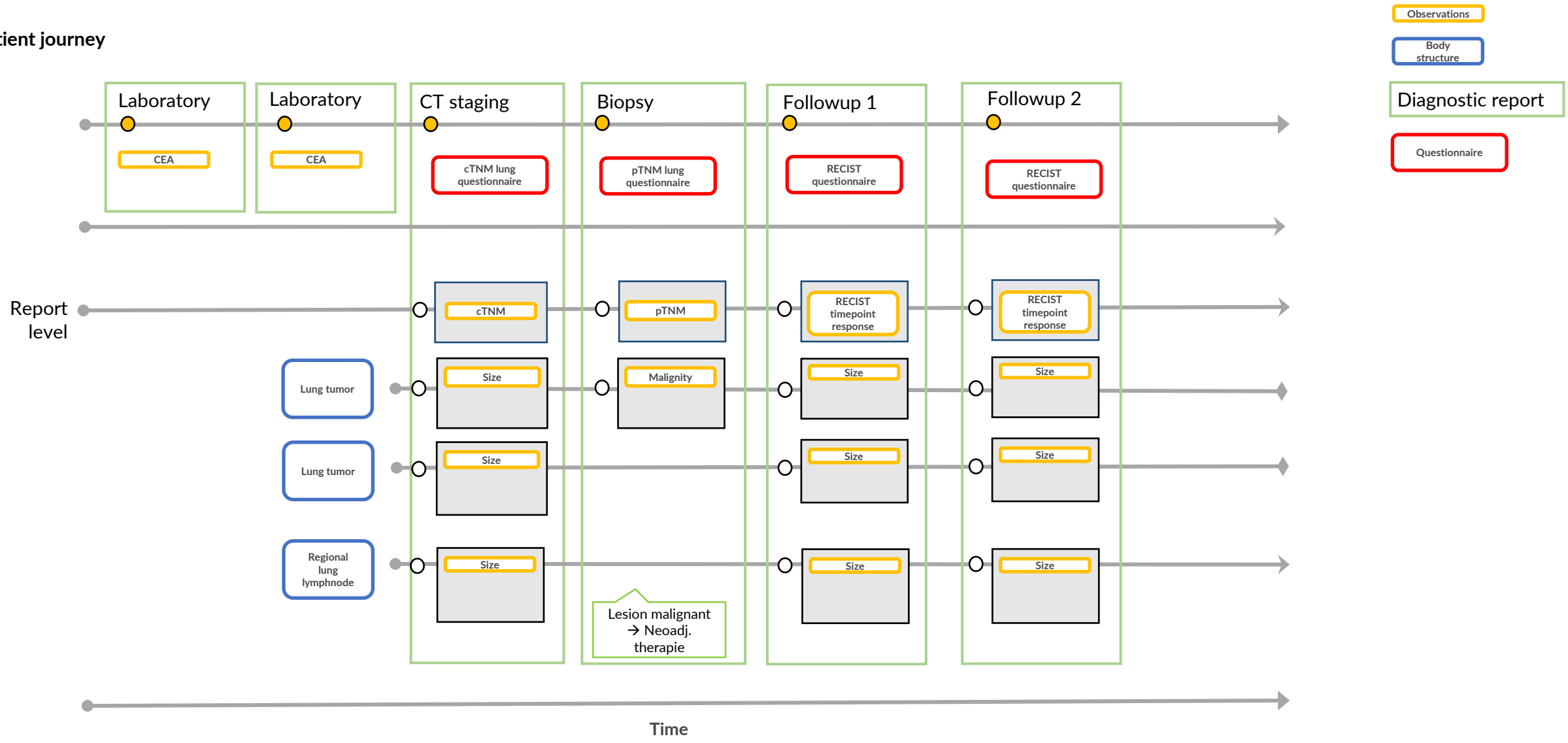
- Make a low-threshold offering to start:
    - Contributing to the GOLD profiles
    - To use GOLD in their own applications

What is the GOLD model?

Interoperability Requirements

Lung cancer Patient Journey

Patient journey



FHIR SDC and interoperability

Two types of interoperability

Display of (same) data in different applications

Use scenarios

- Bring information from A to B
- Improves quality of data acquisition

Implications

- Not queryable
- Easy to consume and implement
- Semantic is not needed as it is just about formatting and display information

Usage of data in different applications

Use scenarios

- Use information from A in B

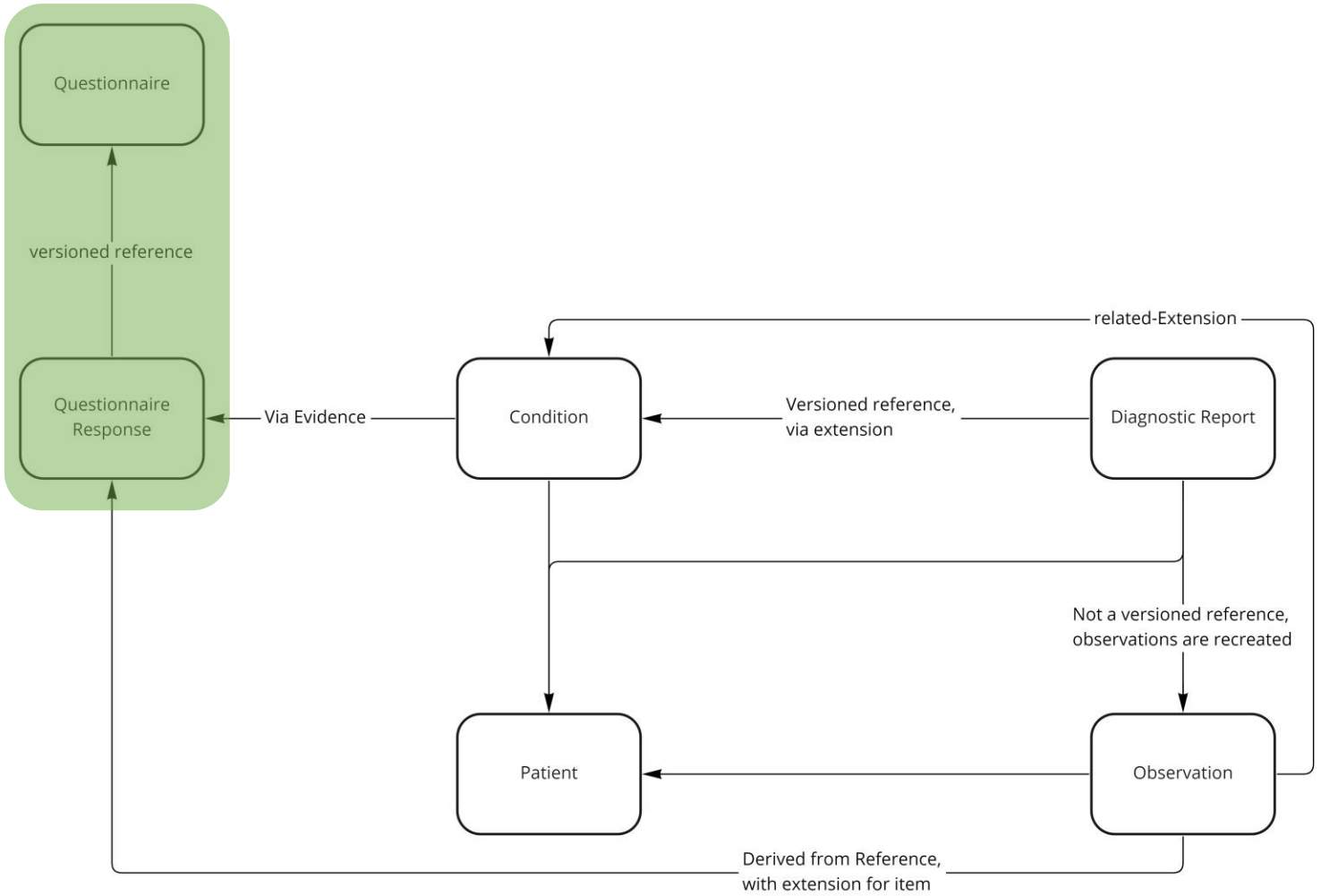
Implications

- Semantic coding is crucial to guarantee clinical usage
- Queryable

FHIR SDC

When to use what / Interoperability perspective

Questionnaires



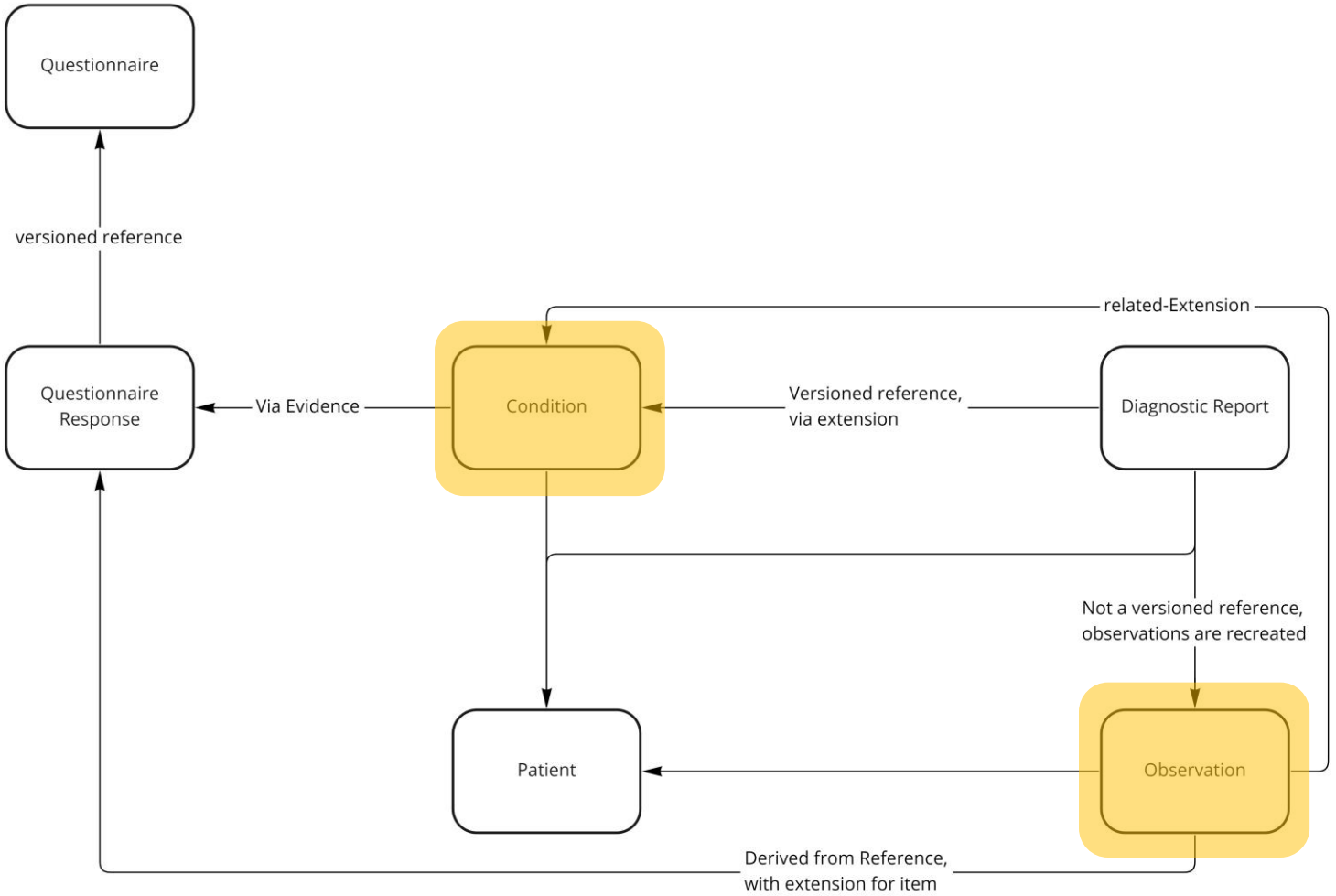
Questionnaire / QuestionnaireResponse

- Used when receiver needs to render the same content in the same way as the sender.
- E.g.
  - PROMs

Questionnaires and Observations

When to use what / Interoperability perspective

Observations / Conditions



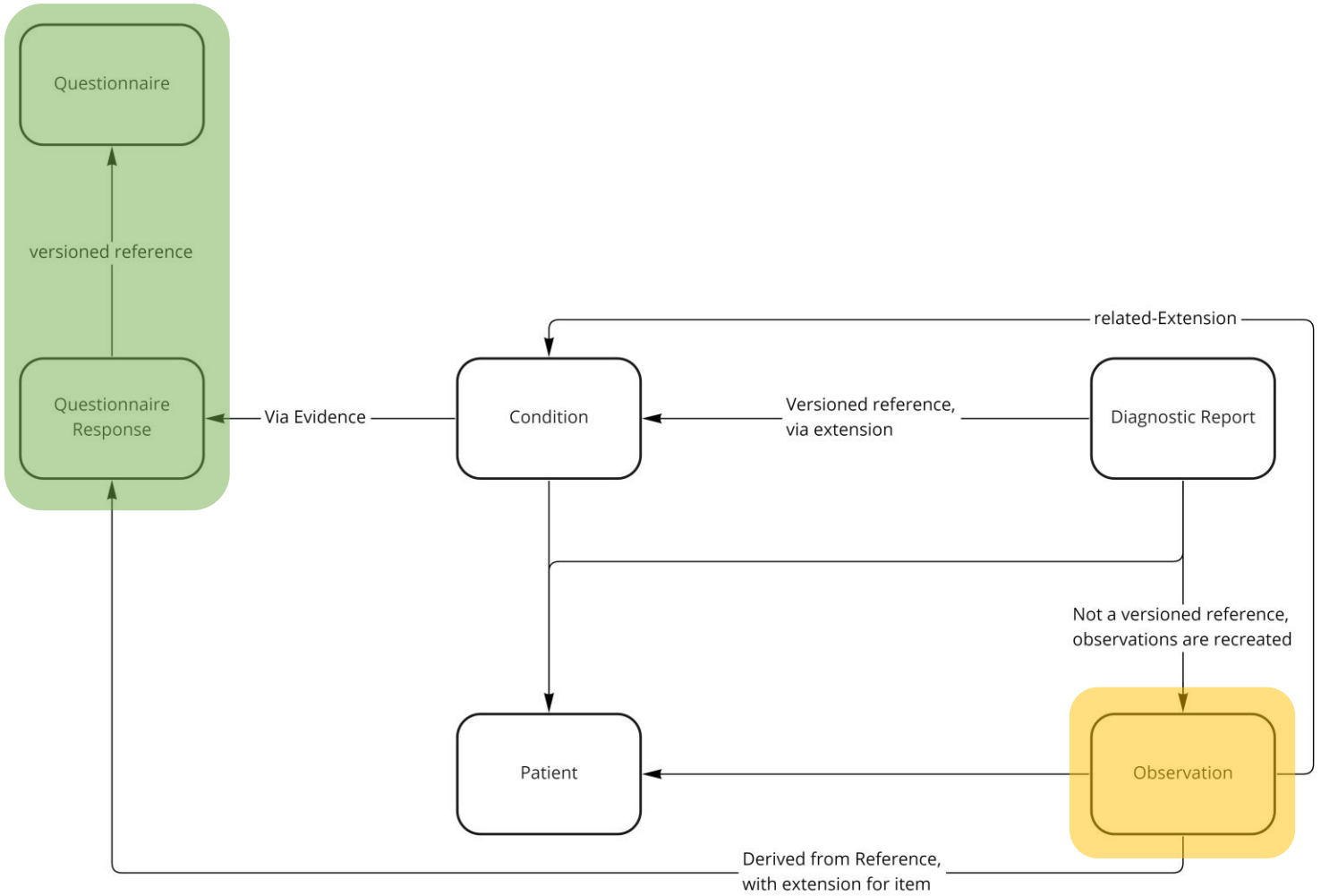
Observation / Condition

- Used when a receiver needs to know specific information.
- E.g.
  - PSA value -> Calculate with segmentation the PSA density
  - TNM in tumor boards
  - Graphs of laboratory results
  - Use diagnosis as context to improve usability

Questionnaires and Observations

Interoperability building blocks

FHIR Resource relations (high level)



Questionnaire

- A representation of a structured reporting template
- (Nested) question and answer data model
- Rendering and UI representation is controlled via extensions

QuestionnaireResponse

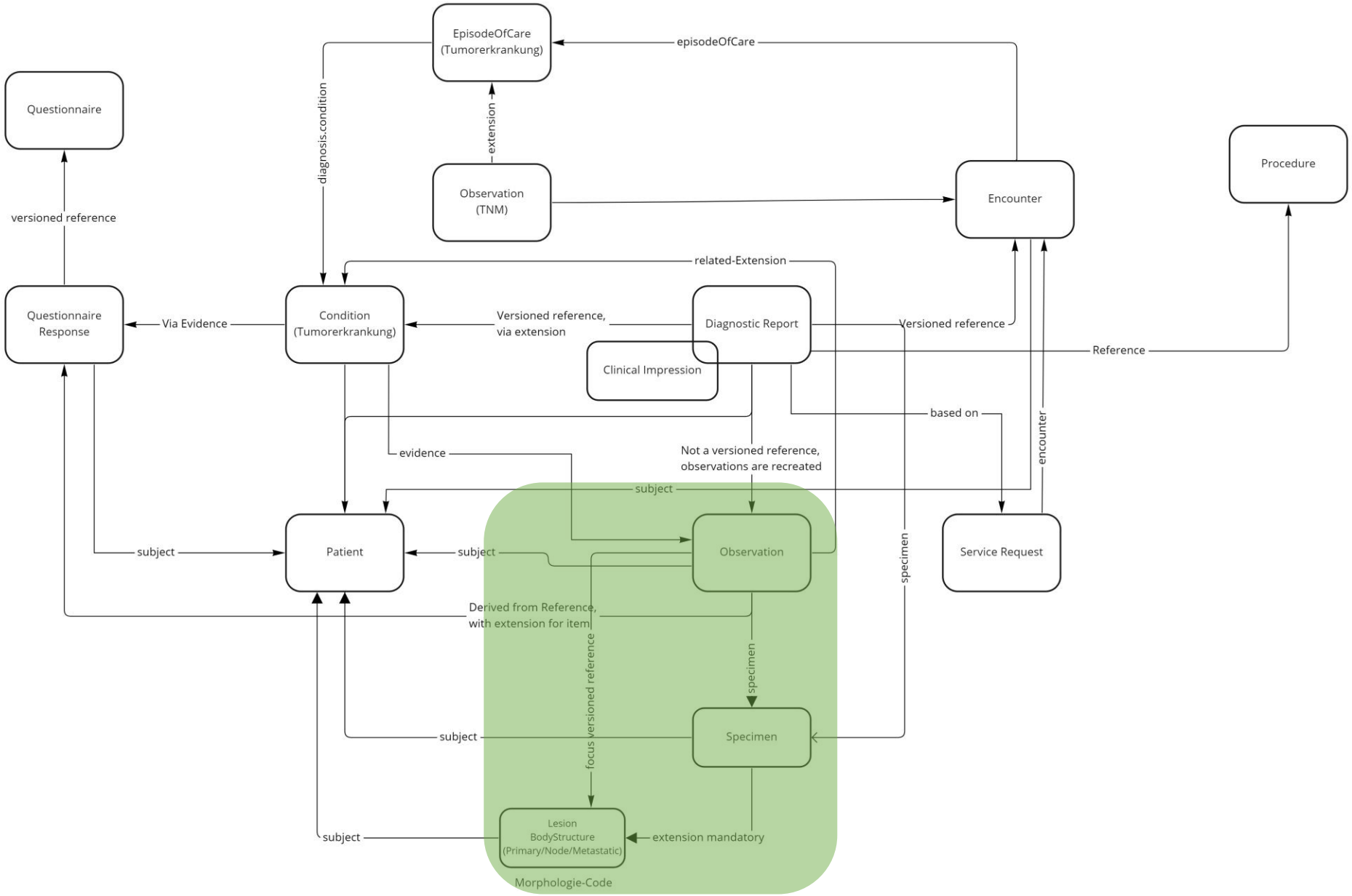
- Instance of a questionnaire
- Relation to patient
- Evidence of a Condition resource (e.g. Diagnosis)

Observation

- Ideally represents one piece of information
- Observations are indexed and therefore searchable
- Necessity for semantic interoperability

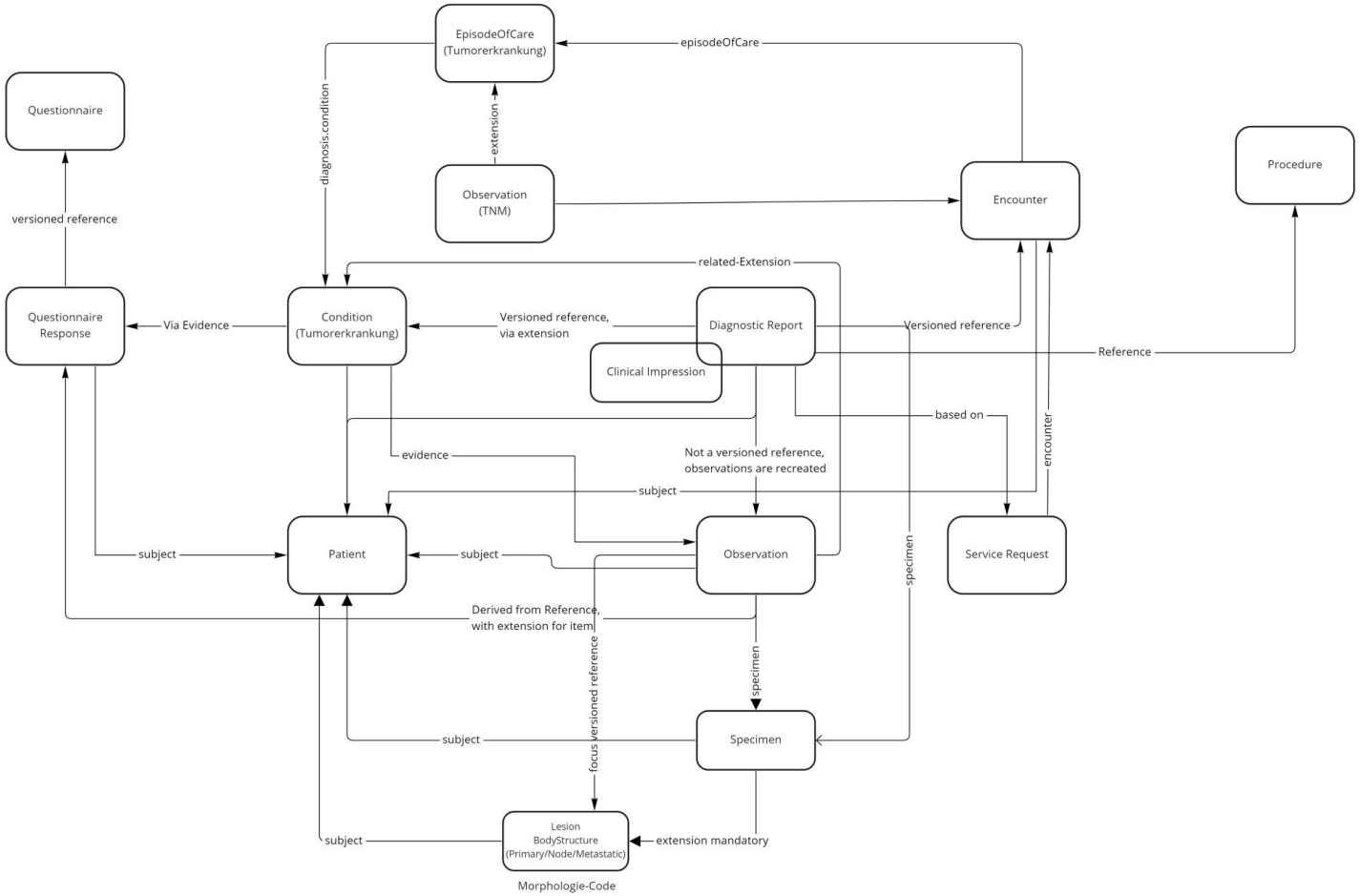
FHIR GOLD Model overview

Mulitplicity



GOLD where are we heading to

Sustainability



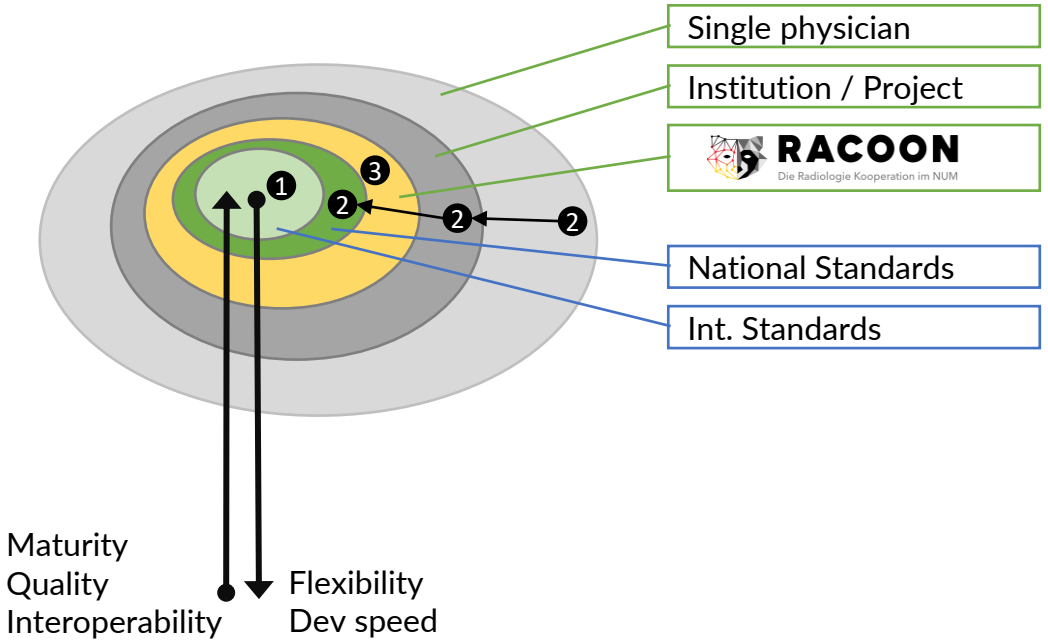
Generalized information model

- We allow tracing of a single tumor (body structure):
  - Radiological
  - Pathological and molecular genetic
  - Surgical
- Recording of
  - Medication
  - Diagnosis (over time / relations like result of medication)
- As less extensions to the standard FHIR model as possible

Proposal: Models from an organizational view

Agile Data Governance in practice

Governance model



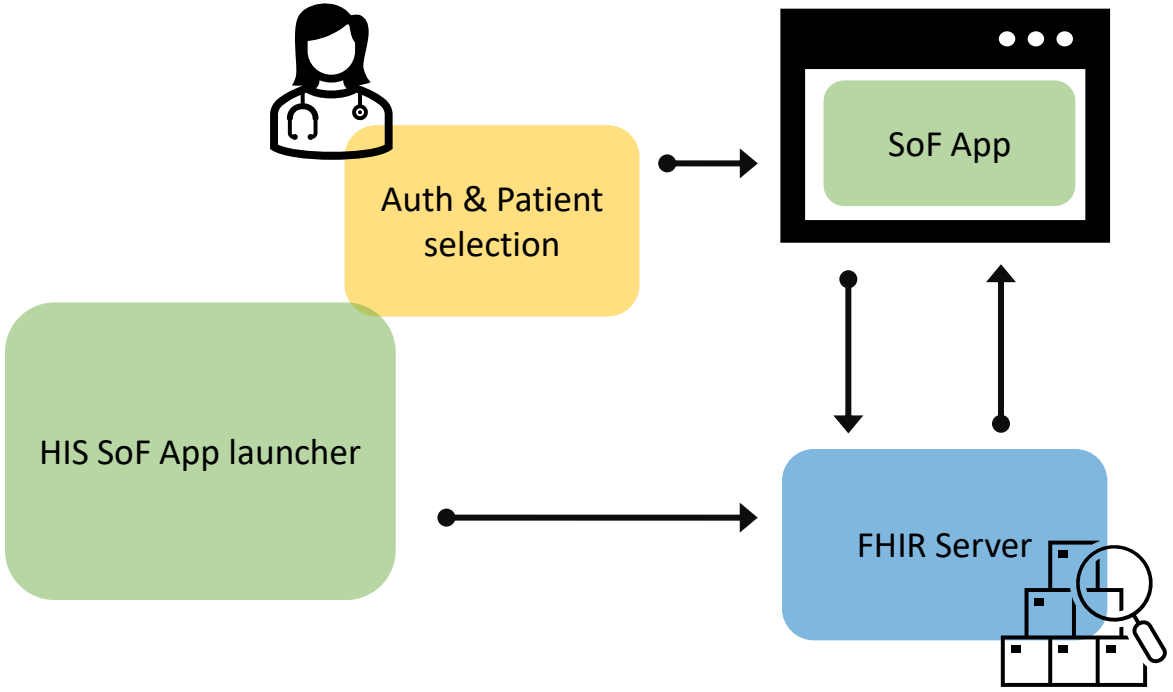
Start with

- Low-threshold offering. Start with what you already have.
- Extend the model with additional information without reinventing the wheel
- Add additional data points at any time. Gain general interoperability later.
- Interoperability might increase just by the usage of more and more stakeholders


Integration SMART on FHIR

SMART on FHIR

Solve integration of applications



Why

- Small niche solutions cannot be deployed cost effective
- Large systems needs tight integrations into existing systems
- Introduce a new system in an existing environment is challenging
    - Allocation of resources
    - Project risks
    - Solve the same problems for each new integration
        - Authentication
        - Authorization
        - Deployment in data centers
    - Complexity of the entire system landscape increases
    - Takes often several months

How

- Implement a standard which addresses the repetitive task of system integrations
- Grant tailored access to data dependent on the application
    - Consider GDPR compliance from the beginning on

https://simplifier.net/guide/isik-sicherheit/ImplementationGuide-markdown-SmartAppLaunch?version=current

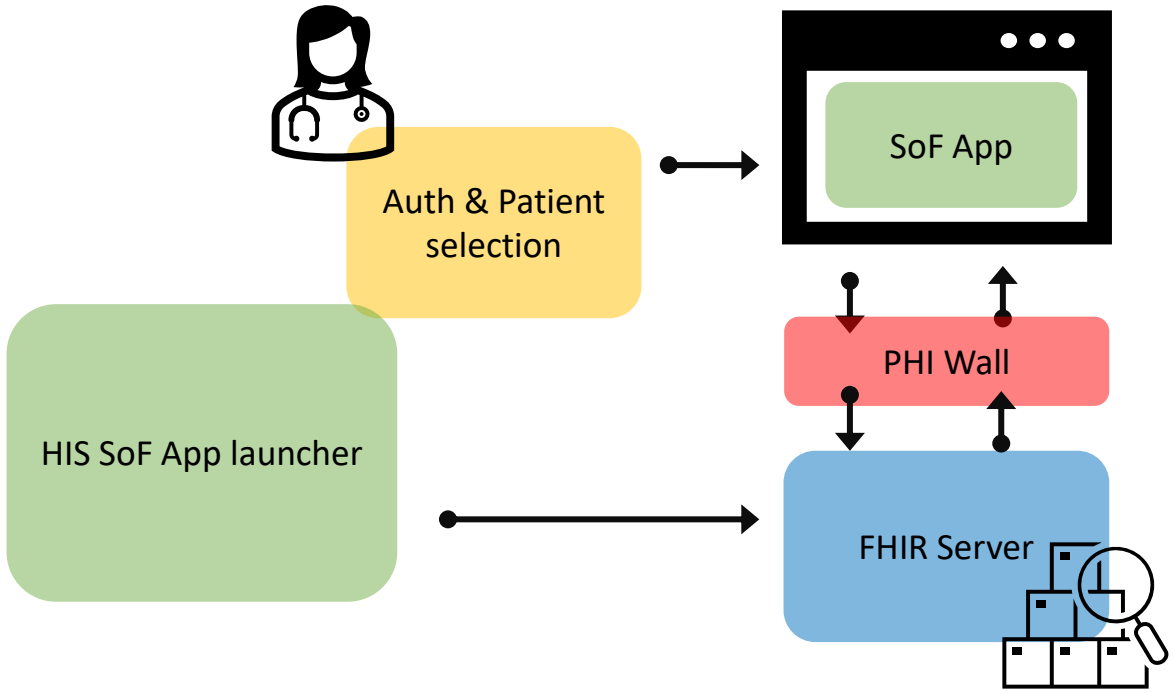
SMART on FHIR

Demo

https://apps.smarthealthit.org/app/bp-centiles

SMART on FHIR

Concept of a PHI wall



PHI wall

- Smart on FHIR app has even in different sessions a different patient
- On the fly per session / project pseudonymization
- Authorization flow for data access level
- Single source of truth

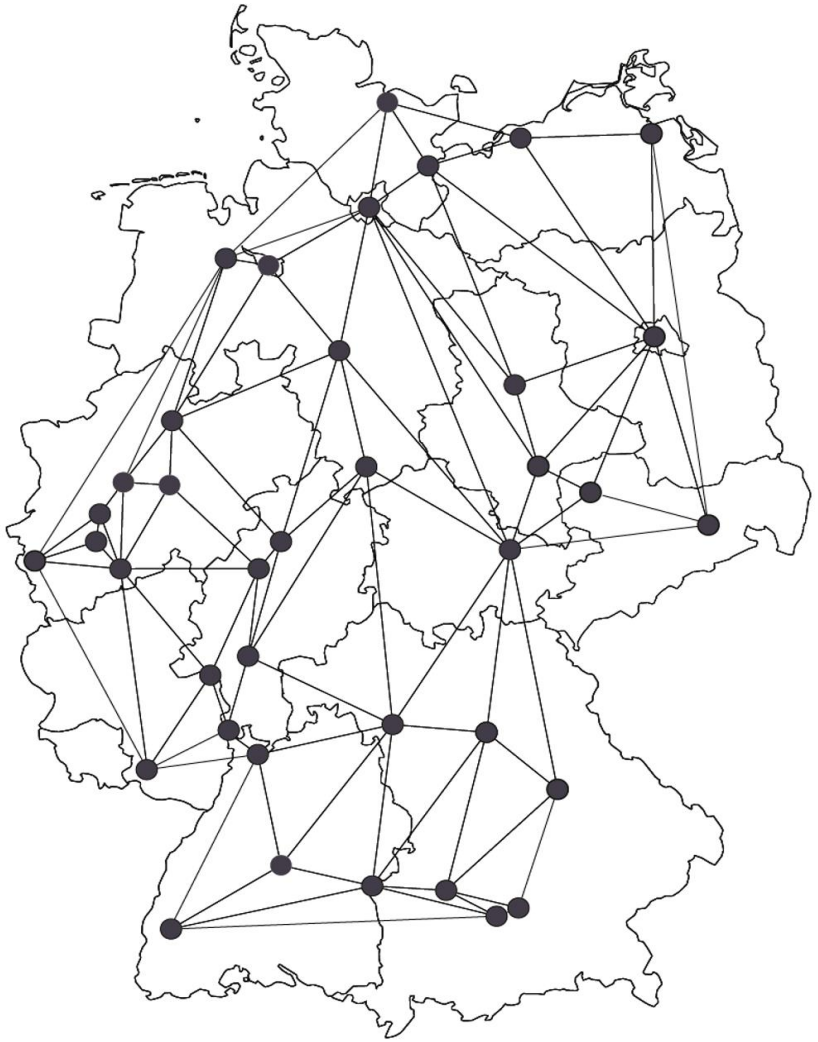
Allows

- App deployment in the cloud
- Plugin different Pseudonymization services
    - E.g. gPAS / Trust centers

Wrap up

Wrap up

- The RACOON platform aims to have a harmonized infrastructure to run radiological trials
- To gain most of the platform we need harmonized data models
- Smart on FHIR is an easy way to exend the platform in a sustainable way




Thank you