HL7 FHIR DevDays 2018

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Searching in FHIR resources

Alexander Zautke

Amsterdam, 14-16 November | @HL7 @FirelyTeam | #fhirdevdays18 | www.fhirdevdays.com

Overview – Searching in FHIR resources

UNDERSTANDING THE FHIR SEARCH FRAMEWORK

ADVANCED SEARCH CONCEPTS

TIPS & TRICKS

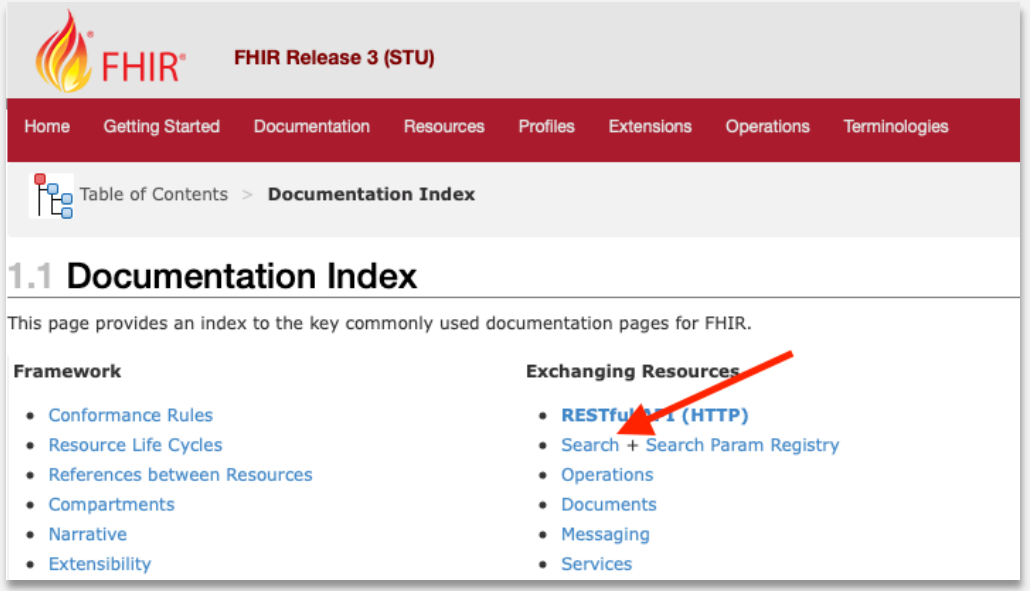
PRACTICAL EXAMPLES

Who am I?

- Name: Alexander Zautke
- Company: Firely, Amsterdam
- Background:
  - Software Engineer (Vonk FHIR Server)
  - Winning Student Team FHIR DevDays 2017
  - Master Thesis at Firely
- Contact:
  - alexander@fire.ly

Understanding the FHIR Search Framework

- FHIR without search capabilities would not be complete…
- API description: searching for resources based on their content and references
- Major extension of the FHIR CRUD interactions



Use Cases – FHIR Search Framework

- Searching is a requirement for various use cases!
- FHIR without search capabilities would significantly increase the complexity for clients

"Search for all patients who were prescribed some medication to treat a specific condition"

Use Cases – FHIR Search Framework

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"Give me a list of all patients that had an allergic reaction within the last two days"

Use Cases – FHIR Search Framework

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"Give me a list of all patients that had an allergic reaction within the last two days"

Build your own "Select WHAT where FILTERS" -> Match resources

Solution: GET [base]/<resourceType>/?<parameter>&…

Understanding the FHIR Search Framework

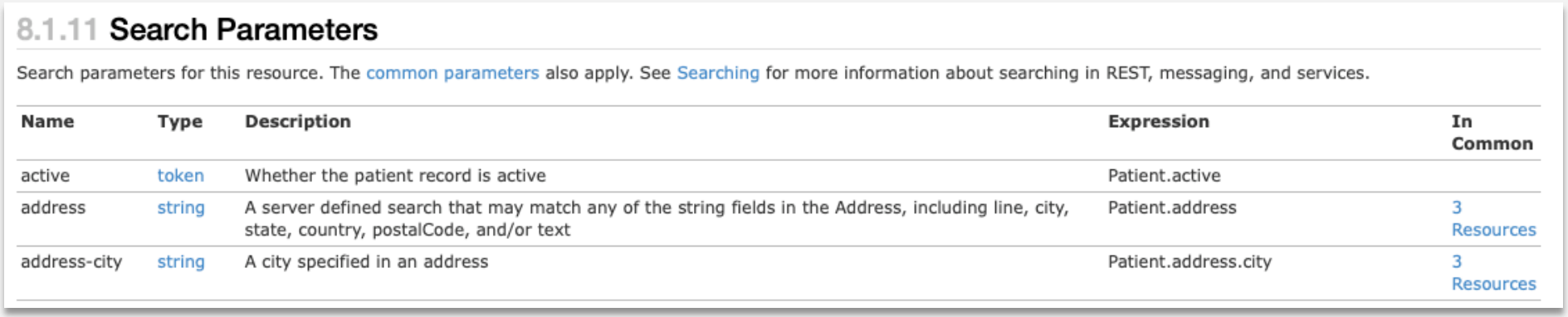
- Search parameters are defined for all resource types
- Not every resource element can be searched
  - Performance (indexing) vs. Convenience

8.1.11 Search Parameters

Search parameters for this resource. The common parameters also apply. See Searching for more information about searching in REST, messaging, and services.

Name	Type	Description	Expression	In Common
active	token	Whether the patient record is active	Patient.active	
address	string	A server defined search that may match any of the string fields in the Address, including line, city, state, country, postalCode, and/or text	Patient.address	3 Resources
address-city	string	A city specified in an address	Patient.address.city	3 Resources

Understanding the FHIR Search Framework



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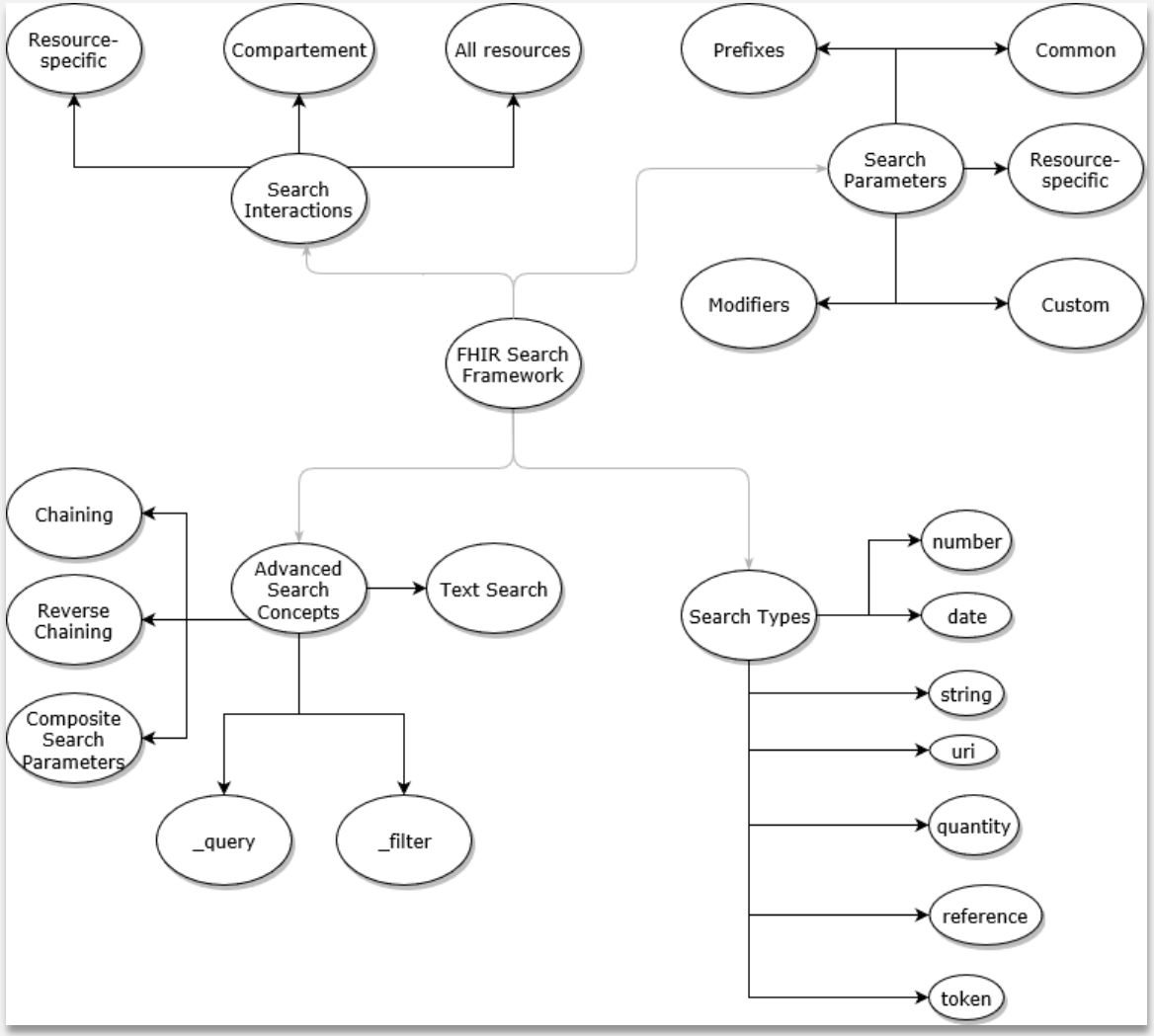
- Structure of a search parameter
  - Name
  - Type
  - Description
  - Expression
- Search output is always a bundle of type “searchset”
- Important: Only logical AND combinations are possible!

Overview
FHIR Search Framework

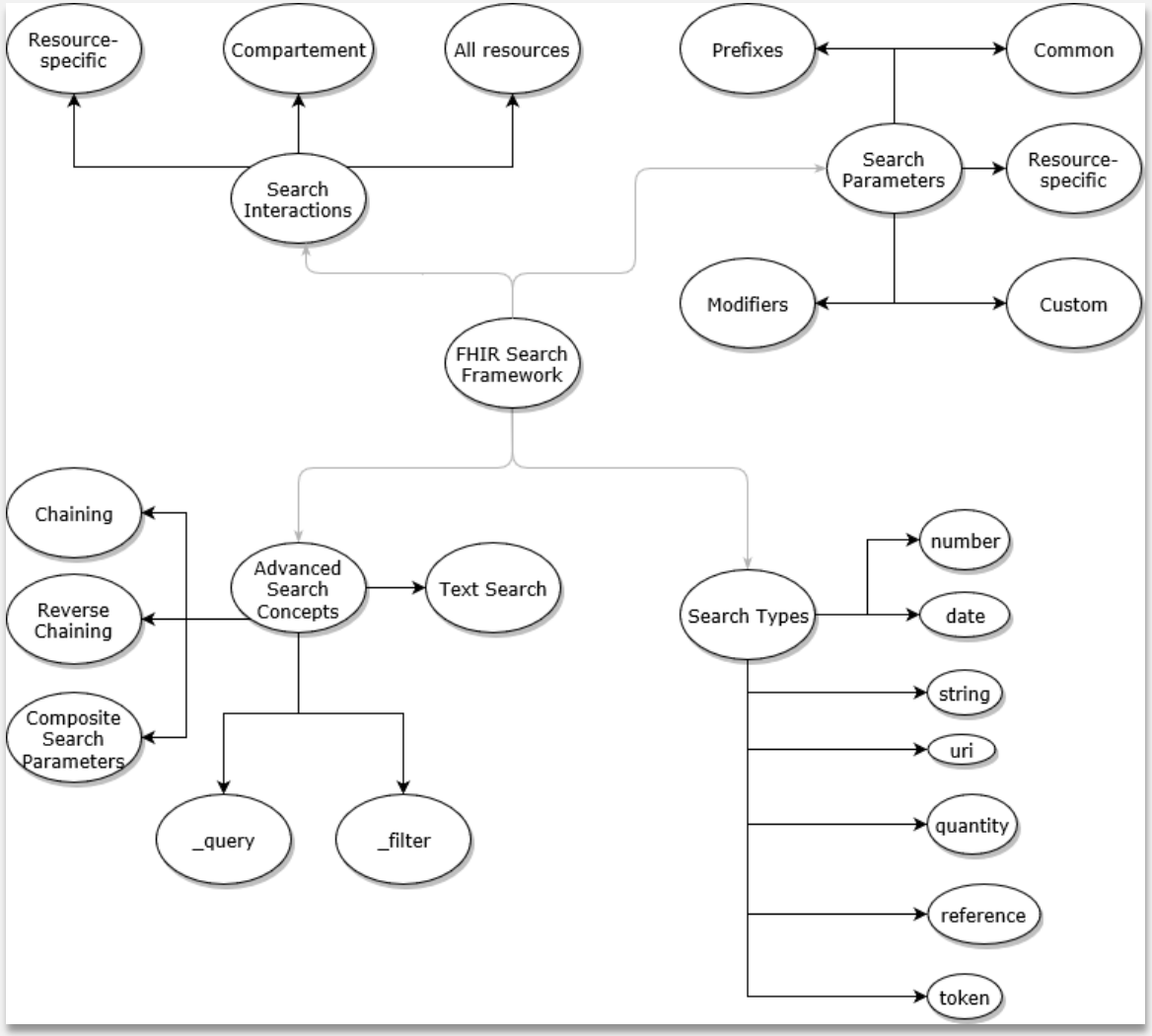
- FHIR Search Framework can be clustered:
  - Search interactions
  - Search parameters
  - Search Types
  - Advances Search Concepts

- Search Framework is optional to implement for FHIR servers



Overview
FHIR Search Framework

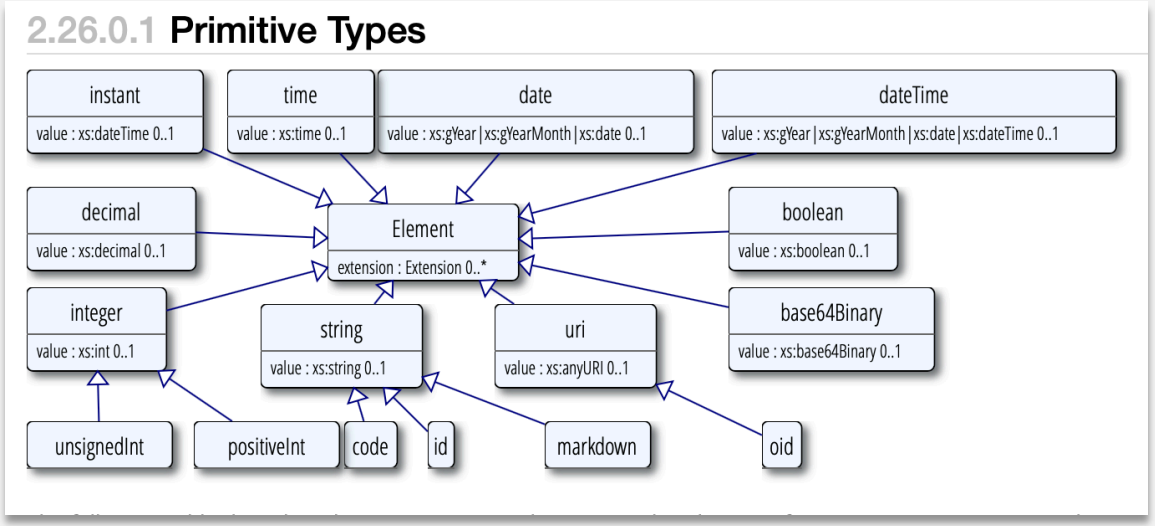
- Scaling from simple search request up to complex query like functionalities



Resource-specific search requests

- Target only a single resource
- AND-combination of any search parameter defined for this resource
- The use of types simplify the implementation of search / complexity of requests
  - e.g., token is an abstraction for Coding, CodableConcept, code, identifier

- Searching on multiple values is allowed
  - GET [base]/[resource]?[SearchParam]=<value>,<value2>
  - GET [base]/Patient?name=Peter,Vera



Search request - All resources

- Search parameters that all resources have in common can be used to execute a search against all resources
- [base]/?< parameter>
- _id, _lastUpdated, _profile, ….

- Useful examples:
  - GET [base]/?_profile:below= http://hl7.org/fhir/StructureDefinition/
  - GET [base]/?_text=Text included in the resource narrative

Search request - Compartment

- Resources that share a common outgoing reference are grouped in compartments
- For example: all resources that are linked to a specific Patient resource

- Complete list is defined by HL7
- Custom compartments are not allowed

- GET [base]/[compartement]/[id]/[ResourceWithOutgoingReference]?[SearchParam]=<value>&...
- GET [base]/[compartement]/[id]/*

Search request - Compartment

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- For example: all resources that are linked to a Patient resource

- Complete list is defined by HL7
- Custom compartments are not allowed

- GET [base]/Patient/example/Observation?status=final

FHIR Search Framework - Modifiers

- Change how the supplied search value is interpreted by a FHIR server
- There are many options for combinations, not entirely clear which options are being widely used / supported

Search Parameter Type	Modifier
All search types	:missing
references	:[type]
uri	:below, :above
string	:contains, :text, :exact
token	:text, :not, :above, :below, :in, :not-in
quantity	n/a
number	”
date	”

FHIR Search Framework - Modifiers

- GET [base]/ Observation?code:text=Body temperature
- [base]/StructureDefinition?url:below=http://hl7.org/ fhir/
- GET [base]/Observation?code:not=http://loinc.org|3141 -9
- GET [base]/MedicationStatement?taken:missing=false

FHIR Search Framework - Prefixes

- Change the relational operator for a specific search value
- =, !=, >, <, >=, <=
- startAfter, endsBefore
- ≈

Search Parameter Type	Prefixes
All search types	n/a
references	"
uri	"
string	"
token	"
quantity	eq, ne, gt, lt, ge, le, ap
number	"
date	eq, ne, gt, lt, ge, le, sa, eb, ap

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UNDERSTANDING THE FHIR SEARCH API

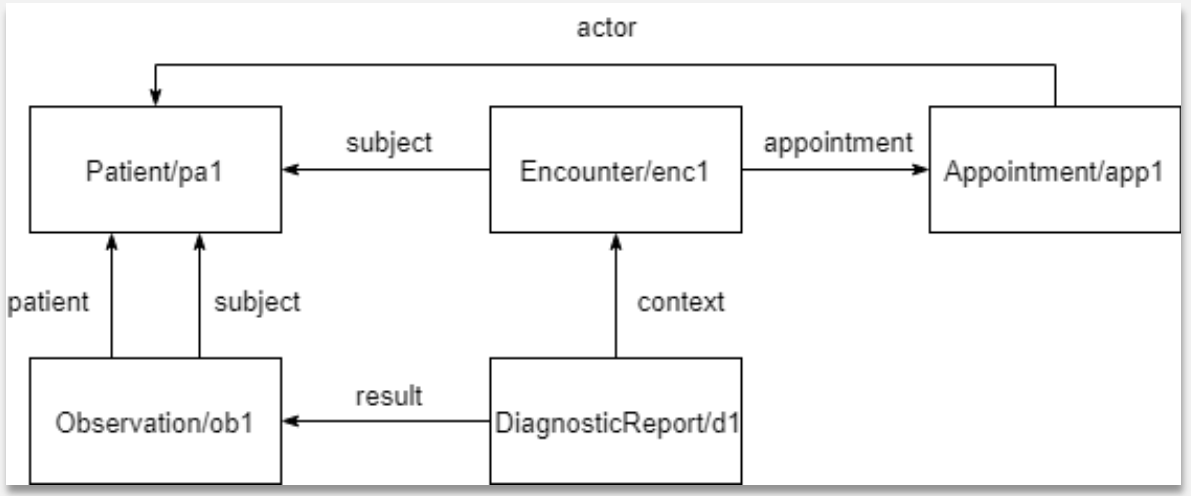
ADVANCED SEARCH CONCEPTS

TIPS & TRICKS

PRACTICAL EXAMPLES

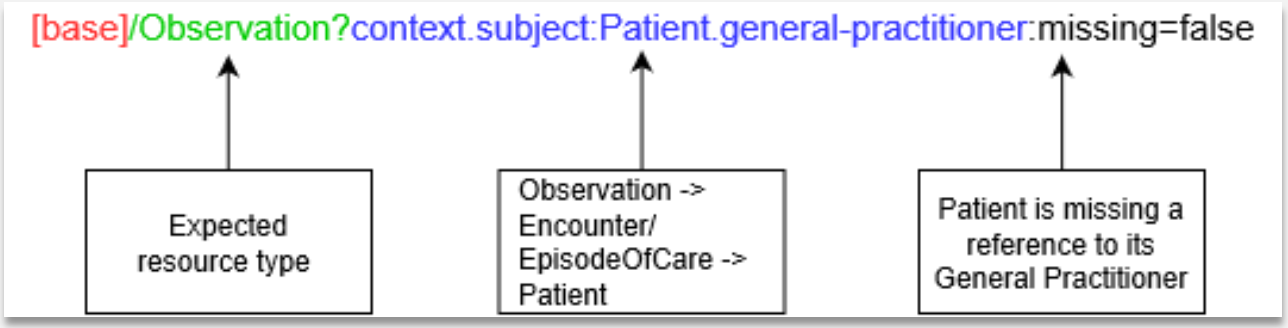
Advanced search concepts

- Chaining
- Reverse chaining
- :include, :revinclude
- _type
- Composite Search Parameter
- _filter



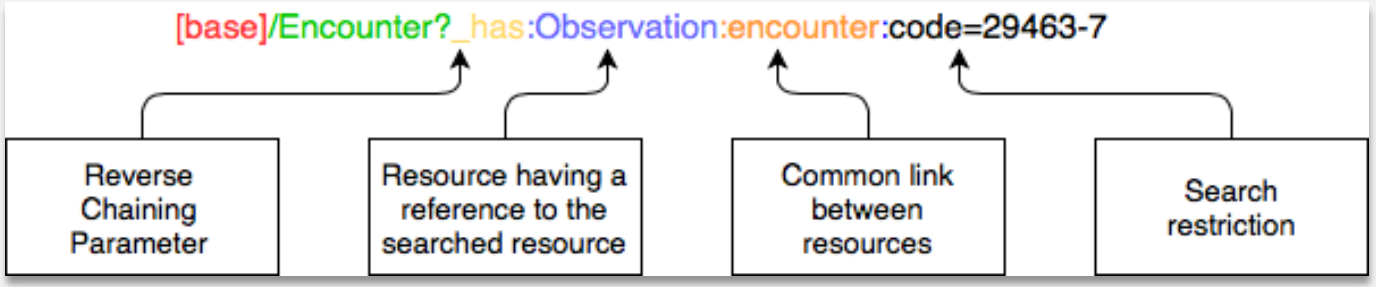
Advanced search concepts - Chaining

- “Join” resources by traversing resource references
- Only resource elements for which a reference search parameter exist can be chained
- Search is executed against the last resource type in a chain



Advanced search concepts – Reverse Chaining

- Search for resources based on “incoming” references
- Check if a chain of references exist which ends at the enquired resource
- Search result set can be reduced through a search restriction for the target of the reverse chaining request



Advanced search concepts - :include, :revinclude

- Include related resources in the search bundle
- Advantage: saves round-trip time for multiple requests
- _revinclude useful as the inverse of a reverse chain request

- [base]/?<SearchCriteria>&_include=<ResourceType>:<reference>
- [base]/?<SearchCriteria>&_revinclude=<ResourceType>:<reference>
- [base]/MedicationRequest?_include=Medication:medication
- [base]/Patient?_revinclude=Provenance:target

Advanced search concepts - _type

- Reduce a search against multiple resources to certain types
- All types must share all used search parameters, otherwise HTTP 400 Status Code returned
- [base]/?_type=Condition,Observation,Encounter&patient.identifier=1234

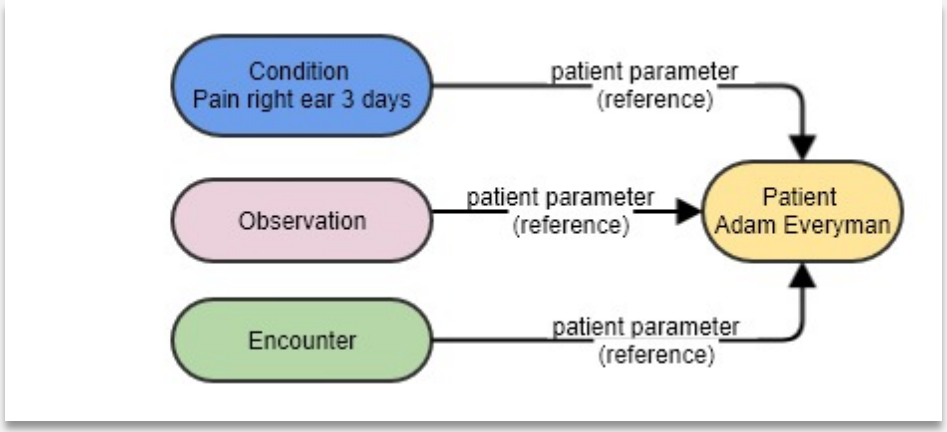


Image: CC-BY - Ringholm bv. Thank you ☺

Advanced search concepts – Composite Search Parameter

- Express combinations of related search parameters
- Build pairs of values by combining them with “$”
- Multiple values (choices) still allowed
- In some cases semantics differs from a search with both elements as single values

- [base]/Observation?component-code-value-quantity=http://loinc.org|29463 -7$gt80|kg
- [base]/Group?characteristic -value=gender$mixed,owner$peter

Advanced search concepts - _filter

- Alternative search syntax, formal grammar available
- filter> and <filter> | <filter> or <filter>
- not <filter>
- <paramPath> SP <compareOp> SP <compValue>

- [base]/ Observation?_filter=(patient re Patient/example) and (performer. name ne Todd)
- Unfortunately, not widely implemented

Operation
eq
ne
co
sw
ew
gt / lt
ge / le
pr
po
ss
sb
in
re

Limitations FHIR Search Framework

“Missing” features

- Using the search framework as an analytics tool (No support for aggregations)
- No support for sub-queries
- Limited support for recursion

Use CQL for more advanced queries!

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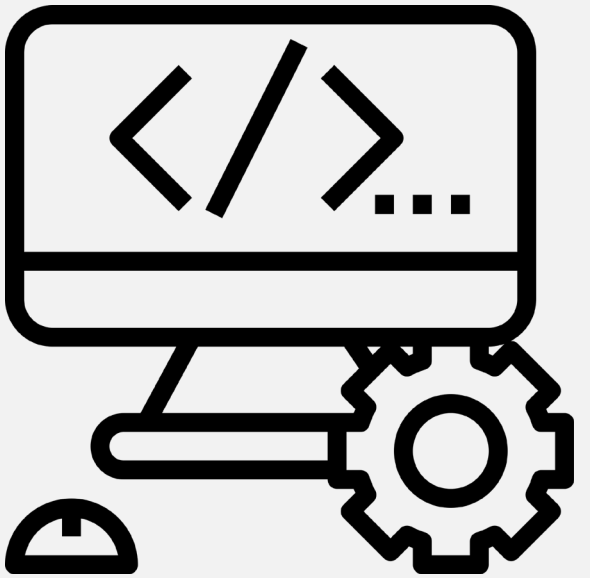
Tips & Tricks

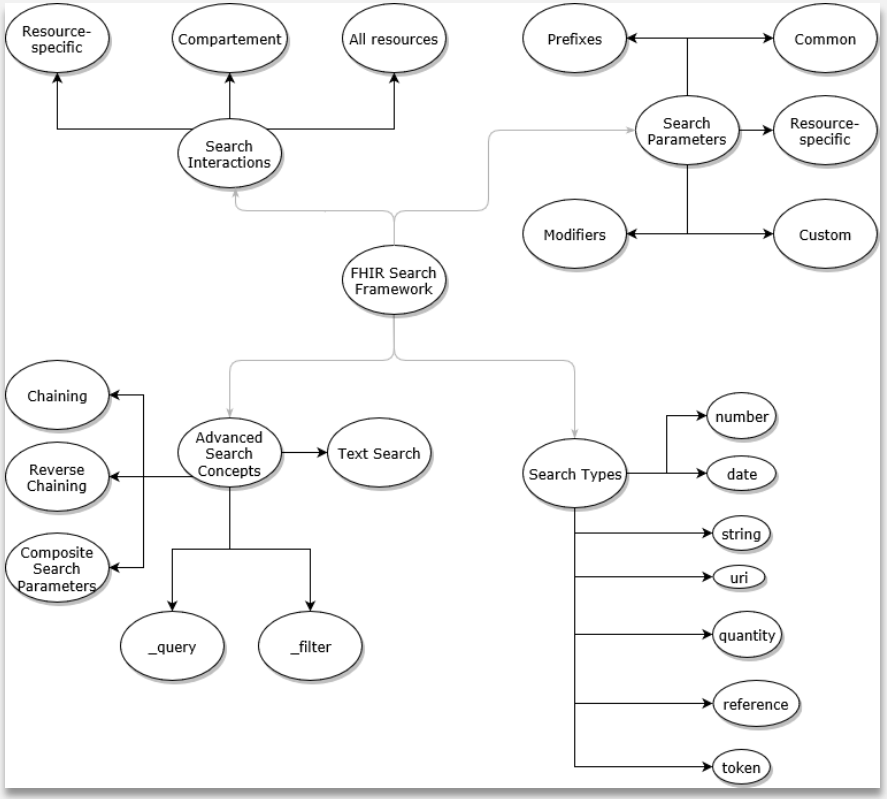
- **Related talks at DevDays 2018:**
  - GraphQL, FHIR and Javascript
  - R on FHIR
  - Scalable Data Science with FHIR
- **Interesting projects:**
  - Bunsen - FHIR Data with Apache Spark
  - SQL on FHIR Proposal
- **Literature:**
  - https://www.hl7.org/fhir/search.html
  - https://www.hl7.org/fhir/search_filter.html
  - https://simplifier.net/guide/profilingacademy/Advancedsearchparameters
  - https://doi.org/10.13140/RG.2.2.33753.57445

Tips & Tricks II

- Ask questions on chat.fhir.org
- Hands-on tutorial after a short break!
  - FHIR Search Framework exercises with solutions
  - In-depth discussion limitations FHIR Search Framework
  - More questions?



Summary – Searching in FHIR resources



Any questions?

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Exercises incl. solutions are uploaded to the DevDays website!

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