MODUL STANDARISASI DAN INTEROPERABILITAS

Modul 9

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MODUL FHIR

Fast Health Interoperable Resources (FHIR) Orientation / Specific objectives

Orientation / Specific objectives

- Introductions
- Plan for today and tomorrow
- Goals:
    - Learn how to use the FHIR RESTful API to read / write Patients & medical information
    - Know what the Argonaut specifiation does
    - Create a FHIR Community
    - Create a national Implementation Guide
    - Discuss the use of FHIR for national health record
- Today: Mainly Tutorial
- Tomorrow: Mainly Practical exercises
    - Using POSTMan (https://www.getpostman.com/)
    - Or your own software if you want

What is FHIR?

- Fast Health Interoperable Resources
- A Community
    - Meets under the umbrella of HL7 International
    - Dedicated to making it easier to exchange healthcare information
    - Uses web infrastructure to solve problems about healthcare
- A specification
    - Freely available on the web (http://hl7.org/fhir)
    - Describes how to exchange information about healthcare
    - Adds healthcare knowledge to web standard infrastructure

FHIR : The Web for Healthcare

- A standard for a RESTful API based access to healthcare records

        - Both read and write supported
    - Different servers all provide the same API
    - A client can use different servers without having to be rewritten
    - Connects API to wider context of health

Understanding HTTP

- The protocol underlying the web
- Client (e.g. Web Browser) opens a connection to the server
- Client sends a ‘request’ to the server asking for some content
- Server responds with an answer
- Client and Server disconnect

Client Request

- GET /resource HTTP/1.0
  Accept: text/html
  Accept-Language: en-ID

HTTP Method Codes

GET “/resource”

- Request for the server to return the content for “/document”
- The most common HTTP method

POST /handler
<content>

- Ask the server to do whatever it does with <content>
- Ue the method at /handler to do it
- E.g. when a user fills out a form on the browser

Server Response

- HTTP 200 OK
  Accept: text/html
  Accept-Language: vi-VI

- Content-Type: text/html
- Server: Apache 6.0
- <html>
- ….
- </html>

Understanding HTTP

- That's how the web works - built on top of the simple HTTP protocol
- Value comes from networks of content built on top of the 'resources'

Fetching a patient

- Start POSTMAN on your computer
- Choose GET
- Request URL = http://test.fhir.org/r3/Patient/Brian
- Add Header "Accept" = "application/fhir+xml"
- Hit "Send"

Patient Response

- 200 OK
- Headers:
    - Content-Type: application/fhir+xml
    - etc
- + a Patient resource in the body

Patient Response

- 200 OK
- Headers:
    - Content-Type: application/fhir+xml
    - etc
- + a Patient resource in the body

Patient Resource

<Patient xmlns="http://hl7.org/fhir">

<id value="vietnam"/>

- “Patient” - identifies the resource
- “Id” - the local identifier (identifier assigned by this server)

Patient Resource

<meta>

<versionId value="2"/>

<lastUpdated value="2017-10-22T15:18:17Z"/>

</meta>

- “Meta” - information about the resource (rather than about the patient)
- “versionId” - assigned by the server - changes if the content changes
- “lastUpdated” - assigned by the server - to show to the user

<text>

<status value="generated"/>

<!-- some xHTML -->

</text>

- Human readable display
- for if system doesn’t understand the content - it can still display the content to a user

<identifier>

<active/>

<name/>

<address/>

<telecom/>

<gender/>

<birthDate/>

- Data about the patient (as in the specification)
- See http://hl7.org/fhir/patient.html

Server Failure

HTTP/1.1 422 Unprocessable Entity

Content-Length: 161

Content-Type: application/json+fhir

Date: Mon, 18 Aug 2014 01:43:30 GMT


```
{
  "resourceType": "OperationOutcome",
  "text": {
    "status": "generated",
    "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\">MRN conflict
   - the MRN 123456 is already assigned to a different patient</div>"
  },
}
```


Finding the patient record

- Before you get Patient/vietnam - where did the ‘vietnam’ come from?
- You have to know that (by magic)
  - You already knew it in your database from past interactions
  - You looked it up
- Looking up a patient: searching

Finding a patient

- Go to POSTMAN
- Choose GET (as before)
- Request URL = http://test.fhir.org/r3/Patient?name=XXXX
- Add Header “Accept” = “application/fhir+xml” (if not already present)

- Hit “Send”

Patient Search Bundle

```
<Bundle xmlns="http://hl7.org/fhir">
  <id value="1fe46e90-79c9-411e-8e40-eec8425648"/>
  <meta>
    <lastUpdated value="2017-11-22T04:00:15Z"/>
  </meta>
  <type value="searchset"/>
  <total value="235"/>
```

- “Bundle” - a set of resources
- “Id” / “lastUpdated” - identifies the search
- “Type” - this is the result of a search

“Total” - the number of matching resources

```
  <link>
    <relation value="self"/>
    <url value="..."/>
  </link>
  <link>
    <relation value="last"/>
    <url value="..."/>
  </link>
```

- “link” - more information about the search
- “self” - what the server actually did for this search
- “First / last / prev / next” - paging through the result if there’s too many

```
  <entry>
    <fullUrl value="http://test.fhir.org/r3/Patient/vietnam"/>
    <resource>
      <Patient xmlns="http://hl7.org/fhir">
```

- “Entry” - one for each match in the search

Since we searched Patients, each entry will contain a Patient

Finding a particular patient

- Go to POSTMAN
- Choose GET (as before)
- Request URL = http://test.fhir.org/r3/Patient?identifier=123456
- Add Header “Accept” = “application/fhir+xml”
- Hit “Send”
- You’ll only get 0 or 1 patient back - if the server is enforcing identifiers are unique

Creating a patient

- Go to POSTMAN
- Choose POST this time
- Request URL = http://test.fhir.org/r3/Patient
- Add Header “Accept” = “application/fhir+xml”
- Copy patient from before into “body”
- Hit “Send”

Patient Response

- 201 Created
- Headers:
    - Location: http://test.fhir.org/r3/Patient/[new id]
    - Content-Type: application/fhir+xml
    - etc
- + The patient resource in the body
    - Usually what you just sent to the server

Other Operations

- PUT - update a patient resource
- DELETE - delete the patient resource

- Transaction
- Batch
- History
- Operations (later)

Security

- FHIR API doesn't say anything about security
- But you need security (nearly always)
- Add an authorization header:

  Authorization: Basic Z2c6cGFzc3dvcmQ=
- Authorization header can be set lots of ways.
- We recommend OAuth using Smart: http://hl7.org/fhir/smart-app-launch/
- Can test this using https://test.fhir.org/r3

Understanding Resources

Resources

Common characteristics of all FHIR resources:

- A URL that identifies it
- Common metadata
- A human-readable XHTML summary
- A set of defined common data elements
- An extensibility framework

Represented as either XML or JSON (or RDF)

JSON vs XML vs RDF

- Both JSON and XML represent exactly the same content
- Structure is the same, content can be interconverted
- XML and JSON have different tools, can be used differently
- JSON use more common than XML

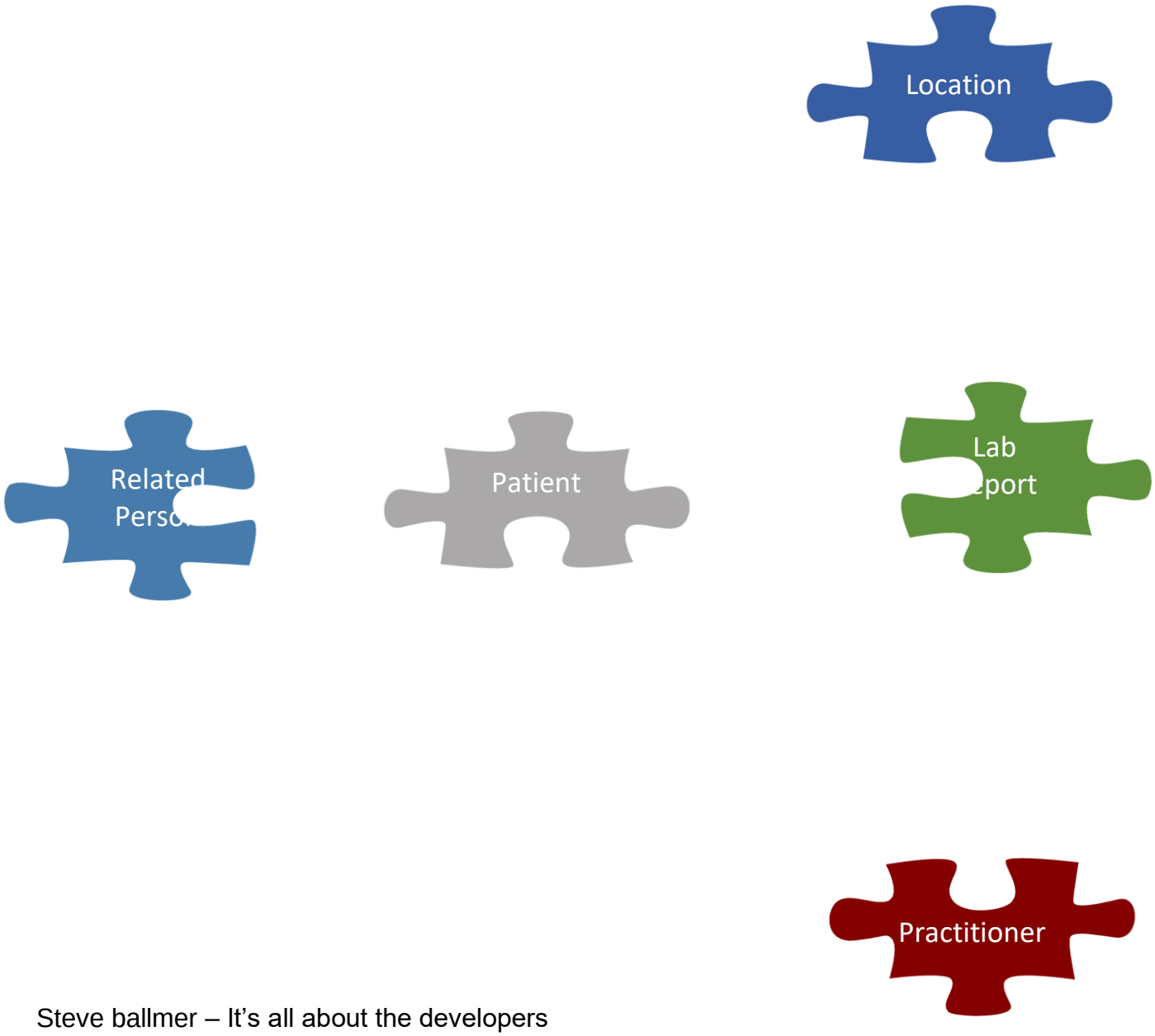
- Specification prefers XML because of comments (no comments in JSON)
- RDF research interest for rich hospitals. Ignore it

```xml
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>
  <extension url="http://example.org/StructureDefinition/tria
    <valueCode value="renal"/>
  </extension>
  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"
    <value value="123456"/>
  </identifier>
  <active value="true"/>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
</Patient>
```

```json
{
  "resourceType": "Patient",
  "id": "glossy",
  "meta": {
    "lastUpdated": "2014-11-13T11:41:00+11:0
  },
  "text": {
    "status": "generated",
    "div": "<div>\n      <p>Henry Levin the
</div>"
  },
  "extension": [
    {
      "url": "http://example.org/StructureDe
      "valueCode": "renal"
    }
  ],
  "identifier": [
    {
      "use": "usual",
      "type": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/v
            "code": "MR"
          }
        ]
      },
      "system": "http://www.goodhealth.org/i
      "value": "123456"
    }
  ],
  "active": true,
  "name": [
    {
      "family": [
        "Levin"
      ],
      "given": [
        "Henry"
      ],
      "suffix": [
        "The 7th"
      ]
    }
  ],
  "gender": "male",
  "birthDate": "1932-09-24",
  "careProvider": [
```

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>
  <extension url="http://example.org/StructureDefinition/trials">
    <valueCode value="renal"/>
  </extension>
  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"/>
    <value value="123456"/>
  </identifier>
  <active value="true"/>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
</Patient>
```

Web of resources



Steve ballmer – It's all about the developers

References

Procedure xmlns="http://hl7.org/fhir">

<subject>

<reference value="Patient/23"/>

</subject>

- Resources are independent – don't need to other resources to correctly interpret a resource
- But resources reference each other extensively to form a web of information
- Need to resolve references to fully understand the data
- Reference is relative to server base URL

Rules for references

- References can be relative or absolute
- References don't have to be to the same server
- Server does not have to enforce integrity
- Clients need to cater for broken links

Narrative

- All resources carry an html representation of their content
- It's a clinical safety issue
    - The receiver has a fall back option if the system is not sure it fully understands the content
- It is not mandatory, but SHOULD be present
- In a closed eco-system, with extremely tight control and strong conformance testing, it may not be necessary
    - But things often change over time
    - So using narrative is highly recommended
    - Saves a lot of money downstream from the author

Narrative XHTML

- Narrative is XHTML. Formatting allowed:
    - Tables, lists, divs, spans
    - Bold, Italics, styles etc

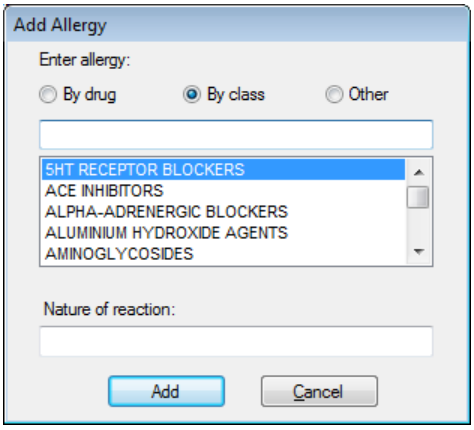
        - E.g. all static content
    - Features not allowed:
        - Objects, scripts, forms – any active content
        - Links, Stylesheets, iframes – web context
        - Local storage, Microdata (no active content)
    - Concerns are security and clinical safety

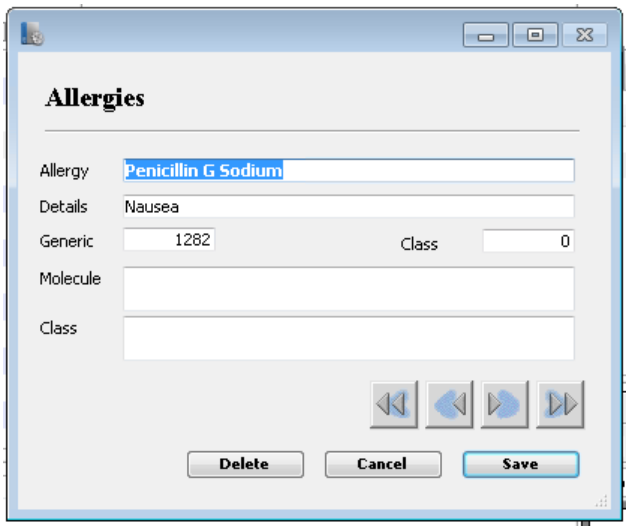
Extensions

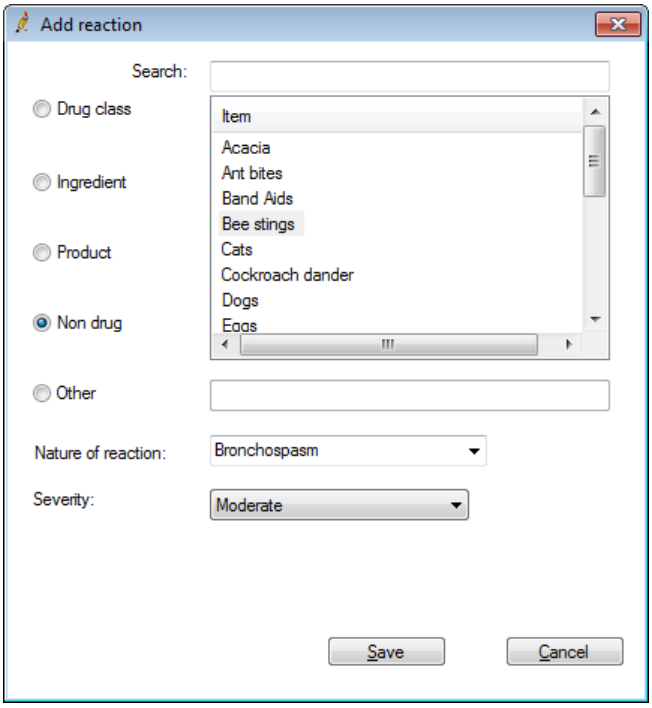
- FHIR has a standard framework for extensions
- Every FHIR element can be extended
- Every extension has:
    - Reference to a computable definition
    - Value – from a set of known types
- Every system can read, write, store and exchange all legal extensions
- All extensions are valid by schema etc.

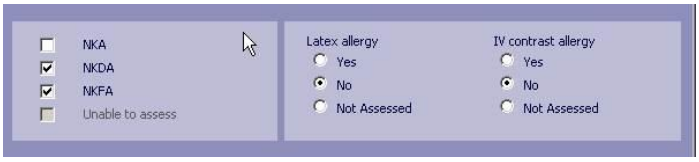
Problems we face

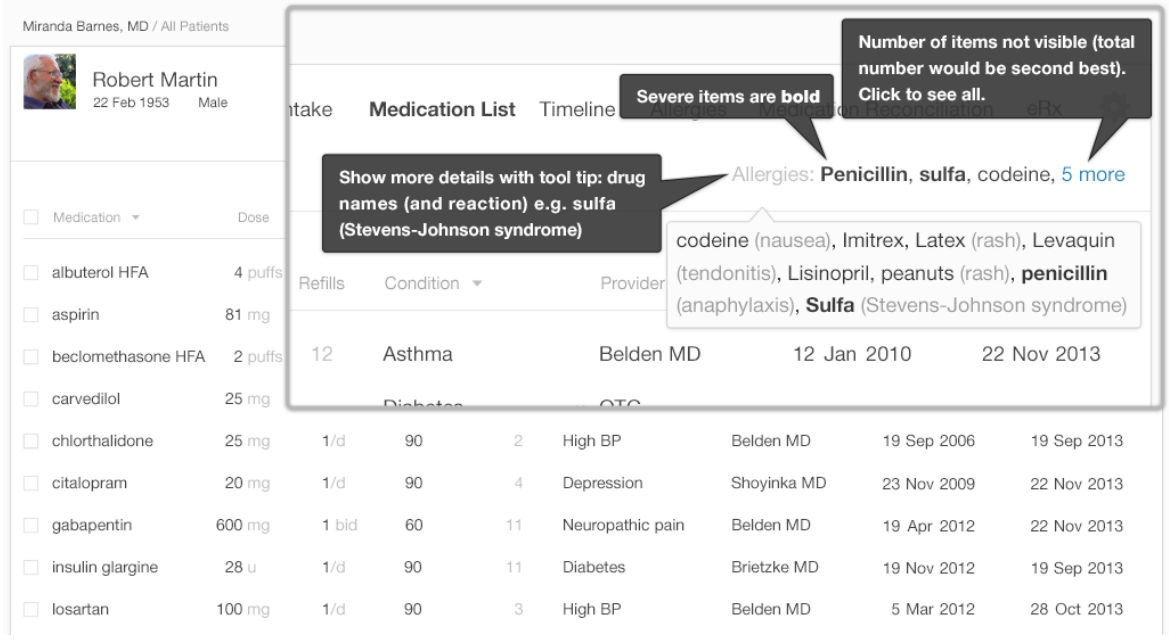
- No central authorities
- High variation due to culture / jurisdiction
- Permutation of biological and sociological complexity
- Fractal use cases
- Economics favours balkinization
- Externalizing complexity
- Much confusion about the problem
- Bad Legacy design

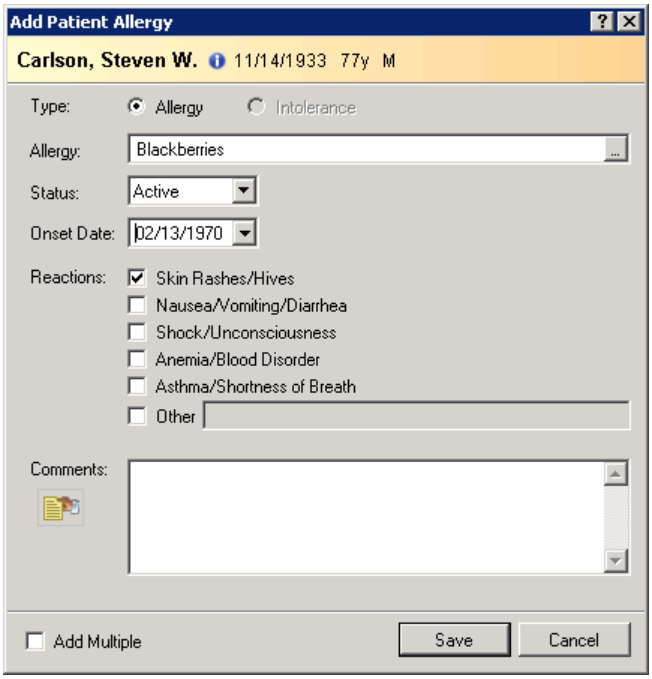

Add Allergy
Enter allergy:
By drug
By class
Other
5HT RECEPTOR BLOCKERS
ACE INHIBITORS
ALPHA-ADRENERGIC BLOCKERS
ALUMINIUM HYDROXIDE AGENTS
AMINOGLYCOSIDES
Nature of reaction:
Add
Cancel

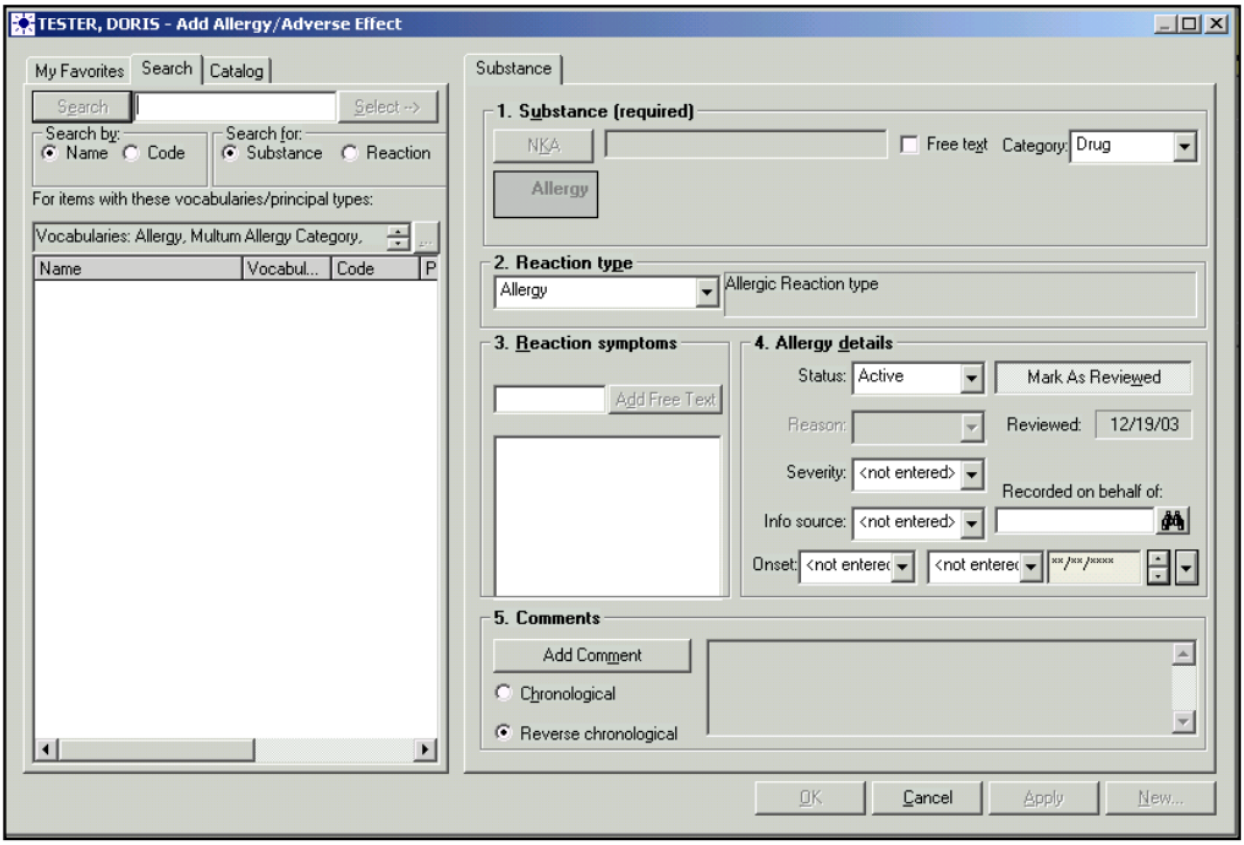

Allergies
Allergy
Penicillin G Sodium
Details
Nausea
Generic
1282
Class
0
Molecule
Class
Delete
Cancel
Save

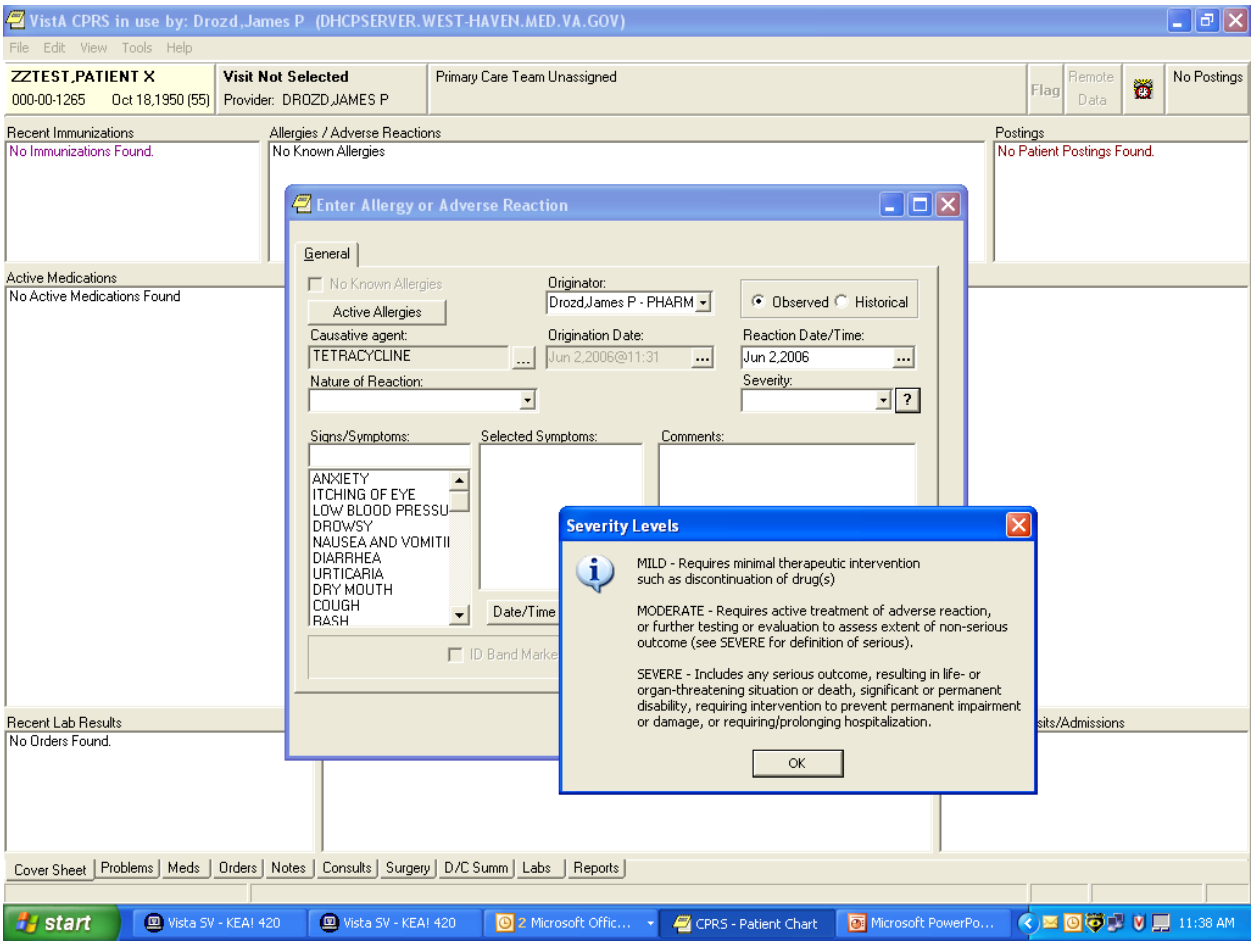

Add reaction
Search:
Drug class
Ingredient
Product
Non drug
Other
Item
Acacia
Ant bites
Band Aids
Bee stings
Cats
Cockroach dander
Dogs
Eggs
Nature of reaction:
Bronchospasm
Severity:
Moderate
Save
Cancel


NKA
NKDA
NKFA
Unable to assess
Latex allergy
Yes
No
Not Assessed
IV contrast allergy
Yes
No
Not Assessed


Miranda Barnes, MD / All Patients
Robert Martin
22 Feb 1953 Male
Medication List
Timeline
Severe items are bold
Number of items not visible (total number would be second best). Click to see all.
Show more details with tool tip: drug names (and reaction) e.g. sulfa (Stevens-Johnson syndrome)
Allergies: Penicillin, sulfa, codeine, 5 more
codeine (nausea), Imitrex, Latex (rash), Levaquin (tendonitis), Lisinopril, peanuts (rash), penicillin (anaphylaxis), Sulfa (Stevens-Johnson syndrome)
Medication
Dose
Refills
Condition
Provider
albuterol HFA 4 puffs 12 Asthma Belden MD 12 Jan 2010 22 Nov 2013
aspirin 81 mg
beclomethasone HFA 2 puffs
carvedilol 25 mg
chlorthalidone 25 mg 1/d 90 2 High BP Belden MD 19 Sep 2006 19 Sep 2013
citalopram 20 mg 1/d 90 4 Depression Shoyinka MD 23 Nov 2009 22 Nov 2013
gabapentin 600 mg 1 bid 60 11 Neuropathic pain Belden MD 19 Apr 2012 22 Nov 2013
insulin glargine 28 u 1/d 90 11 Diabetes Brietzke MD 19 Nov 2012 19 Sep 2013
losartan 100 mg 1/d 90 3 High BP Belden MD 5 Mar 2012 28 Oct 2013


Add Patient Allergy
Carlson, Steven W. 11/14/1933 77y M
Type: Allergy Intolerance
Allergy: Blackberries
Status: Active
Onset Date: 02/13/1970
Reactions: Skin Rashes/Hives
Nausea/Vomiting/Diarrhea
Shock/Unconsciousness
Anemia/Blood Disorder
Asthma/Shortness of Breath
Other
Comments:
Add Multiple
Save
Cancel


TESTER, DORIS - Add Allergy/Adverse Effect
My Favorites
Search
Catalog
Search
Select -->
Search by: Name Code
Search for: Substance Reaction
For items with these vocabularies/principal types:
Vocabularies: Allergy, Multum Allergy Category,
Name
Vocabul...
Code
Substance
1. Substance (required)
NKA
Free text
Category: Drug
Allergy
2. Reaction type
Allergy
Allergic Reaction type
3. Reaction symptoms
Add Free Text
4. Allergy details
Status: Active
Mark As Reviewed
Reason:
Reviewed: 12/19/03
Severity: <not entered>
Recorded on behalf of:
Info source: <not entered>
Onset: <not entered> <not entered> **/**/****
5. Comments
Add Comment
Chronological
Reverse chronological
OK
Cancel
Apply
New...


VistA CPRS in use by: Drozd,James P (DHCPSERVER.WEST-HAVEN.MED.VA.GOV)
File Edit View Tools Help
ZZTEST,PATIENT X
000-00-1265 Oct 18,1950 (55)
Visit Not Selected
Provider: DROZD,JAMES P
Primary Care Team Unassigned
Flag
Remote Data
No Postings
Recent Immunizations
No Immunizations Found.
Allergies / Adverse Reactions
No Known Allergies
Postings
No Patient Postings Found.
Active Medications
No Active Medications Found
Recent Lab Results
No Orders Found.
Enter Allergy or Adverse Reaction
General
No Known Allergies
Active Allergies
Originator:
Drozd,James P - PHARM
Observed Historical
Causative agent:
TETRACYCLINE
Origination Date:
Jun 2,2006@11:31
Reaction Date/Time:
Jun 2,2006
Nature of Reaction:
Severity:
Signs/Symptoms:
Selected Symptoms:
Comments:
ANXIETY
ITCHING OF EYE
LOW BLOOD PRESSU
DROWSY
NAUSEA AND VOMITI
DIARRHEA
URTICARIA
DRY MOUTH
COUGH
RASH
Date/Time
ID Band Marke
Severity Levels
MILD - Requires minimal therapeutic intervention such as discontinuation of drug(s)
MODERATE - Requires active treatment of adverse reaction, or further testing or evaluation to assess extent of non-serious outcome (see SEVERE for definition of serious).
SEVERE - Includes any serious outcome, resulting in life- or organ-threatening situation or death, significant or permanent disability, requiring intervention to prevent permanent impairment or damage, or requiring/prolonging hospitalization.
OK
sits/Admissions
Cover Sheet Problems Meds Orders Notes Consults Surgery D/C Summ Labs Reports
start
Vista SV - KEA! 420
Vista SV - KEA! 420
2 Microsoft Offic...
CPRS - Patient Chart
Microsoft PowerPo...
11:38 AM