

ATTRAKTIVE PROGRAMMES
EXCELLENT PROSPECTS



FHN
HOCHSCHULE HEILBRONN
HEILBRONN UNIVERSITY

ENGINEERING

BUSINESS

INFORMATICS

Campus Heilbronn – Sontheim

Campus Heilbronn – Am Europaplatz

Campus Künzelsau
Reinhold-Würth-Hochschule

Campus Schwäbisch Hall

On FHIR: eGK, Glucometer, (Chile)

Patrick Werner – GECKO Institut – Hochschule Heilbronn



FHIR an der Hochschule Heilbronn

- ▶ Einsatz von FHIR in der Lehre im Rahmen eines Praktikums. Begonnen durch Simone Heckmann im WS 2014.
- ▶ Dieses Jahr zweite Teilnahme am Student Track der FHIR Developer Days durch Studentengruppen.
- ▶ Forschungsfokus:
Einsatz von FHIR im Kontext klinischer Forschung in Verbindung mit BPMN 2.0



Student Track – FHIR Dev Days 2015





Student Track – FHIR Dev Days 2015



Henrike Frey, Konstantin Gegier, Andreas Keil





Our mission

- ▶ read glucose measurements from BGM via BLE
- ▶ fhir them to a FHIR server





App

- ▶ Android, requires Lollipop or newer
- ▶ Based on nrfToolbox of Nordic Semiconductor
(<https://github.com/NordicSemiconductor/Android-nRF-Toolbox>)
- ▶ OpenSource:
<https://github.com/t4deon/BloodGlucoseMeteron>



Data mapping

BLUETOOTH SCAN INFORMATION

Name	Device.Narrative
Address	Device.Narrative

DEVICE INFORMATION SERVICE

What	Data type	Mapping to
Flags	8 Bit	Information
Sequence Number	uint16	Observation.Identifier
Base Time	date_time (56 Bit)	Observation.Effective
Glucose Concentration	SFLOAT (16 Bit)	Observation.Value

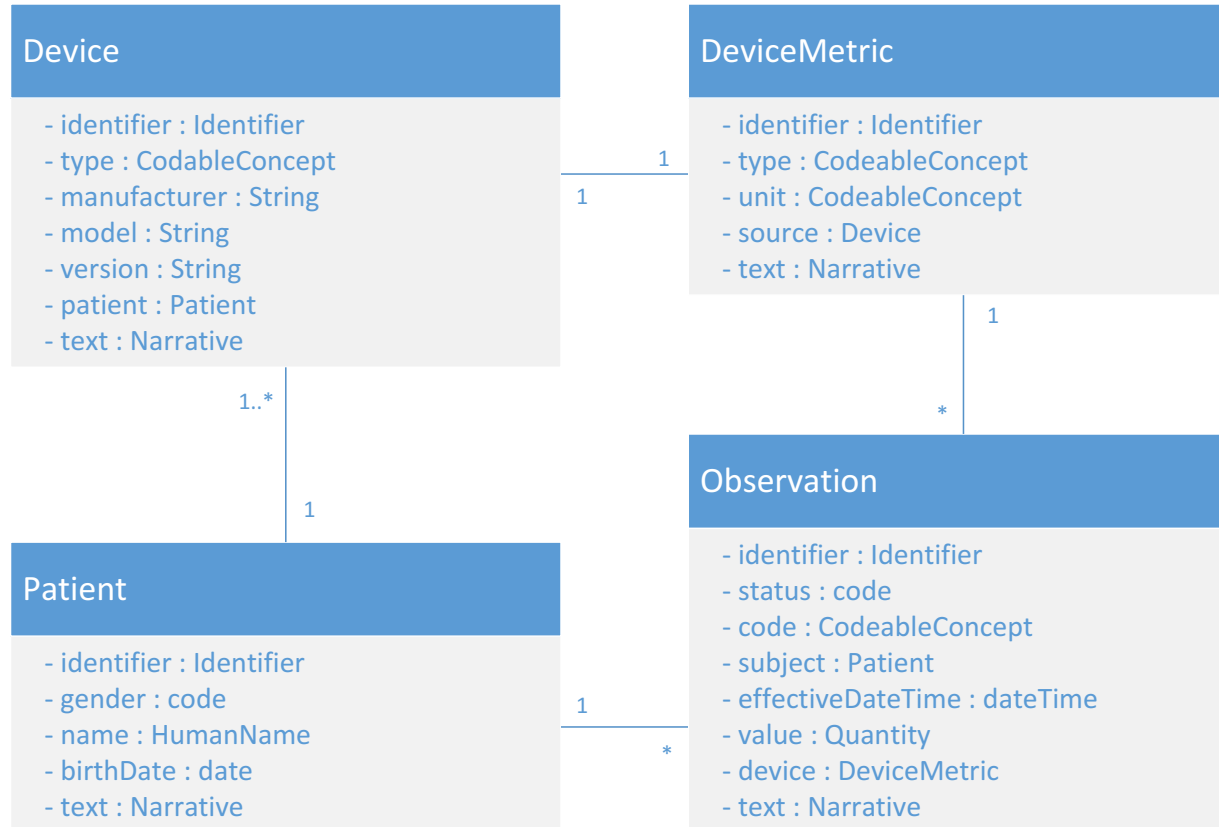
GLUCOSE SERVICE

What	Data type	Mapping to
Manufacturer Name String	String	Device.Manufacturer
Model Number String	String	Device.Model
Serial Number String	String	Device.Narrative
Firmware Revision String	String	Device.Version
System ID	Long (64 Bit)	Device.Identifier

Source:
BLE GATT Glucose
Profile
<https://developer.bluetooth.org/gatt/profiles/Pages/ProfileViewer.aspx?u=org.bluetooth.profile.glucose.xml>



Resources





Observation (1)

```
{
  "resourceType": "Observation",
  "id": "64",
  "meta": {
    "versionId": "11",
    "lastUpdated": "2015-11-08T08:42:05+01:00",
    "profile": [
      "http://hl7.org/fhir/StructureDefinition/devicemetricobservation"
    ]
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns='http://www.w3.org/1999/xhtml'><p><b>Generated Narrative with Details</b></p><p><b>meta</b>: </p><p><b>identifier</b>: 5</p><p><b>status</b>: final</p><p><b>code</b>: Glucose [Mass/volume] in Blood <span style='background: LightGoldenRodYellow'>(Details : {LOINC code &quot;2339-0&quot; := &quot;2339-0&quot;, given as &quot;Glucose [Mass/volume] in Blood&quot;})</span></p><p><b>subject</b>: <a href='https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124'>https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124</a></p><p><b>value</b>: 0.0020600000862032175 mol/L<span style='background: LightGoldenRodYellow'>(Details: http://unitsofmeasure.org code mol/l := &quot;mol/l&quot;)</span></p><p><b>device</b>: <a href='https://fhir.iap.hs-heilbronn.de/baseDstu2/DeviceMetric/17'>https://fhir.iap.hs-heilbronn.de/baseDstu2/DeviceMetric/17</a></p></div>"
  },
  "identifier": [
    {
      "system": "http://mi.hs-heilbronn.de/fhir/pmk/android/devices/-4478226201846390784",
      "value": "5"
    }
  ],
  "status": "final",
  "code": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "2339-0",
        "display": "Glucose [Mass/volume] in Blood"
      }
    ]
  },
  "subject": {
    "reference": "https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124"
  },
  "effectiveDateTime": "2015-11-08T08:42:05+01:00",
  "valueQuantity": {
    "value": 0.0020600000862032175,
    "unit": "mol/L",
    "system": "http://unitsofmeasure.org",
    "code": "mol/l"
  },
  "device": {
    "reference": "https://fhir.iap.hs-heilbronn.de/baseDstu2/DeviceMetric/17"
  }
}
```

Device metric observation profile



Observation (2)

Generated Narrative with Details

meta:

identifier: 5

status: final

code: Glucose [Mass/volume] in Blood (Details : {LOINC code "2339-0" := "2339-0", given as "Glucose [Mass/volume] in Blood"})

subject: <https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124>

value: 0.0020600000862032175 mol/L (Details: <http://unitsofmeasure.org> code mol/l := "mol/l")

device: <https://fhir.iap.hs-heilbronn.de/baseDstu2/DeviceMetric/17>



Patient

```
{
  "resourceType": "Patient",
  "id": "124",
  "meta": {
    "versionId": "7",
    "lastUpdated": "2015-11-17T16:30:12.144+01:00"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns='http://www.w3.org/1999/xhtml'><p><b>Generated Narrative with Details</b></p><p><b>Identifier</b>: 1170</p><p><b>birthDate</b>: 1/1/1970</p></div>"
  },
  "identifier": [
    {
      "system": "http://mi.hs-heilbronn.de/fhir/pmk/android/patients/",
      "value": "1170"
    }
  ],
  "birthDate": "1970-01-01"
}
```

Generated Narrative with Details

identifier: 1170

birthDate: 1/1/1970



Device (1)

```
{
  "resourceType": "Device",
  "id": "10",
  "meta": {
    "versionId": "11",
    "lastUpdated": "2015-11-17T16:30:13.015+01:00"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns='http://www.w3.org/1999/xhtml'>xmlns='http://www.w3.org/1999/xhtml'&quot;&gt;<p><b>Generated Narrative with Details</b></p><p><b>identifier</b>: -4478226201846390784</p><p><b>type</b>: Glukose-Analysegeraet <span style='background: LightGoldenRodYellow '>(Details : {http://umdn<br>s.org code &quot;15-102&quot; := &quot;15-102&quot;, given as &quot;Glukose-Analysegeraet&quot;})</span></p><p><b>manufacturer</b>: Roche</p><p><b>model</b>: 483</p><p><b>version</b>: 5.87</p><p><b>patient</b>: <a href='https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124'>https://fhir.iap.hs-heilbronn.de/base<br>Dstu2/Patient/124</a></p><br><strong>Serial Number: </strong>00318145<br><strong>Name: </strong>Accu-Chek<br><strong>MAC Address: </strong>00:60:19:24:D<br>A:C1</div>"
  },
  "identifier": [
    {
      "system": "http://mi.hs-heilbronn.de/fhir/pmk/android/devices/",
      "value": "-4478226201846390784"
    }
  ],
  "type": {
    "coding": [
      {
        "system": "http://umdns.org",
        "code": "15-102",
        "display": "Glukose-Analysegeraet"
      }
    ]
  },
  "manufacturer": "Roche",
  "model": "483",
  "version": "5.87",
  "patient": {
    "reference": "https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124"
  }
}
```



Device (2)

Generated Narrative with Details

identifier: -4478226201846390784

type: Glukose-Analysegeraet (Details : {http://umdns.org code "15-102" := "15-102", given as "Glukose-Analysegeraet"})

manufacturer: Roche

model: 483

version: 5.87

patient: <https://fhir.iap.hs-heilbronn.de/baseDstu2/Patient/124>

Serial Number: 00318145

Name: Accu-Chek

MAC Address: 00:60:19:24:DA:C1



DeviceMetric (1)

```
{
  "resourceType": "DeviceMetric",
  "id": "17",
  "meta": {
    "versionId": "7",
    "lastUpdated": "2015-11-17T16:30:13.827+01:00"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns='http://www.w3.org/1999/xhtml'><p><b>Generated Narrative with Details</b></p><p><b>type</b>: MDC_CONC_GLU_GEN <span style='\"backg
round: LightGoldenRodYellow '\">(Details : {https://rtmms.nist.gov code &quot;160020&quot; := &quot;160020&quot;, given as &quot;MDC_CONC_GLU_GEN&quot;})</spa
n></p><p><b>identifier</b>: glucosemillimolperliter</p><p><b>unit</b>: MDC_DIM_MILLI_MOLE_PER_L <span style='\"background: LightGoldenRodYellow '\">(Details :
{https://rtmms.nist.gov code &quot;266866&quot; := &quot;266866&quot;, given as &quot;MDC_DIM_MILLI_MOLE_PER_L&quot;})</span></p><p><b>source</b>: <a href
='https://fhir.iap.hs-heilbronn.de/baseDstu2/Device/10'>https://fhir.iap.hs-heilbronn.de/baseDstu2/Device/10</a></p><p><b>category</b>: measurement</p></d
iv>"
  },
  "type": {
    "coding": [
      {
        "system": "https://rtmms.nist.gov",
        "code": "160020",
        "display": "MDC_CONC_GLU_GEN"
      }
    ]
  },
  "identifier": {
    "system": "http://mi.hs-heilbronn.de/fhir/pmk/android/metric/",
    "value": "glucosemillimolperliter"
  },
  "unit": {
    "coding": [
      {
        "system": "https://rtmms.nist.gov",
        "code": "266866",
        "display": "MDC_DIM_MILLI_MOLE_PER_L"
      }
    ]
  },
  "source": {
    "reference": "https://fhir.iap.hs-heilbronn.de/baseDstu2/Device/10"
  },
  "category": "measurement"
}
```




DeviceMetric (2)

Generated Narrative with Details

type: MDC_CONC_GLU_GEN (Details : {<https://rtmms.nist.gov> code "160020" := "160020", given as "MDC_CONC_GLU_GEN"})

identifier: glucosemillimolperliter

unit: MDC_DIM_MILLI_MOLE_PER_L (Details : {<https://rtmms.nist.gov> code "266866" := "266866", given as "MDC_DIM_MILLI_MOLE_PER_L"})

source: <https://fhir.iap.hs-heilbronn.de/baseDstu2/Device/10>

category: measurement



BGM

PLEASE CONNECT TO DEVICE FIRST

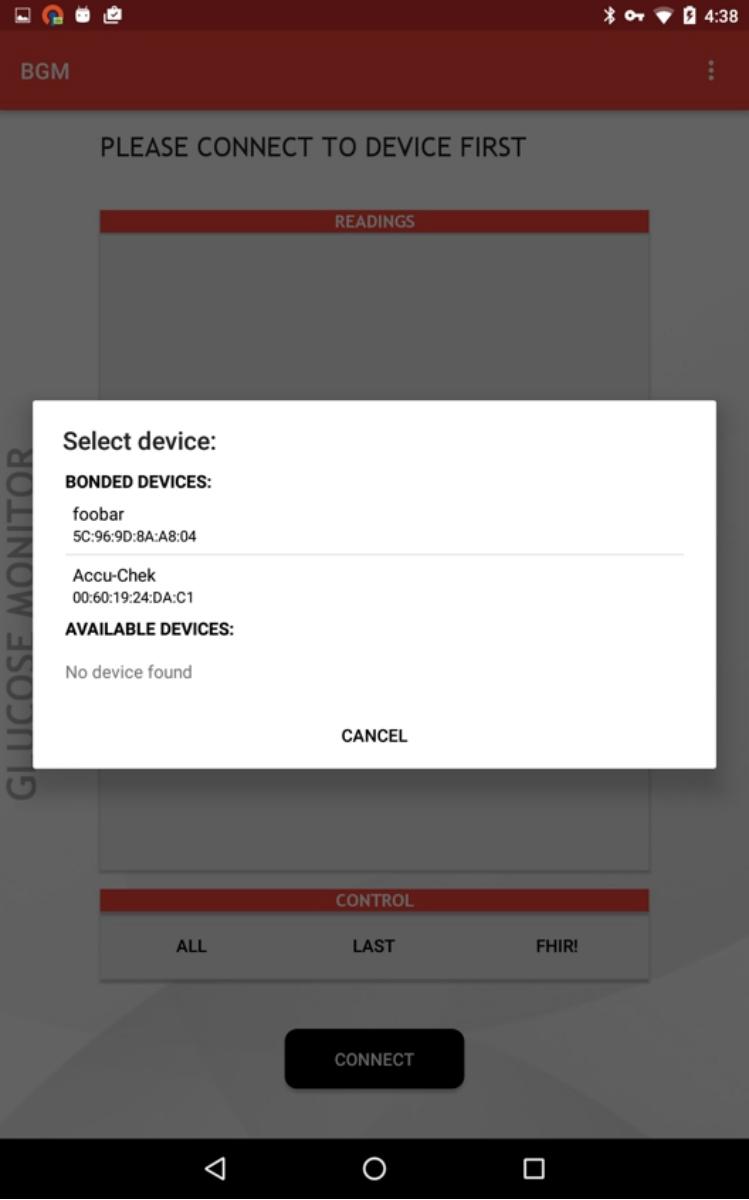
GLUCOSE MONITOR

READINGS	mg/dl
25 Sep 2015 at 10:47:01	85.0
27 Oct 2015 at 11:13:02	204600000.0
6 Nov 2015 at 13:19:03	101.0
7 Nov 2015 at 16:49:04	82.0
8 Nov 2015 at 08:42:05	206.0
8 Nov 2015 at 13:42:06	92.0
13 Nov 2015 at 12:29:07	101.0
13 Nov 2015 at 12:32:08	133.0
13 Nov 2015 at 12:35:09	144.0
17 Nov 2015 at 14:22:10	118.0

CONTROL

ALLLASTFHIR!

CONNECT





BGM

PLEASE CONNECT TO DEVICE FIRST

READINGS	mg/dl
25 Sep 2015 at 10:47:01	85.0
27 Oct 2015 at 11:13:02	204600000.0
6 Nov 2015 at 13:19:03	101.0
7 Nov 2015 at 16:49:04	82.0
8 Nov 2015 at 08:42:05	88.0
13 Nov 2015 at 12:32:08	133.0
13 Nov 2015 at 12:35:09	144.0
17 Nov 2015 at 14:22:10	118.0

CONTROL

ALLLASTFHIR!

CONNECT

Please wait...
while I'm fhirng your data.



BGM

PLEASE CONNECT TO DEVICE FIRST

READINGS	mg/dl
25 Sep 2015 at 10:47:01	85.0
27 Oct 2015 at 11:13:02	204600000.0
6 Nov 2015 at 13:19:03	101.0
7 Nov 2015 at 16:49:04	82.0

Success

Data was fhiired successfully.

GREAT

13 Nov 2015 at 12:35:09	144.0
17 Nov 2015 at 14:22:10	118.0

CONTROL

ALLLASTFHIR!

CONNECT

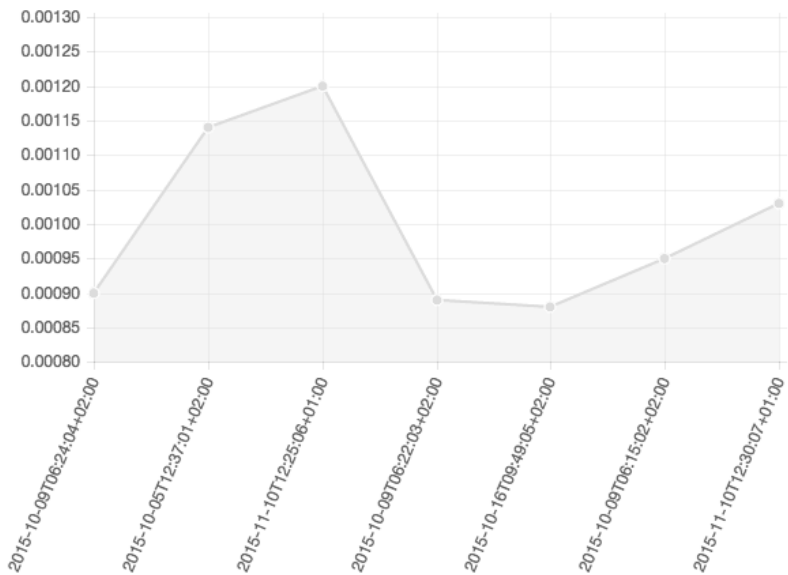


webapp

Generated Narrative with Details

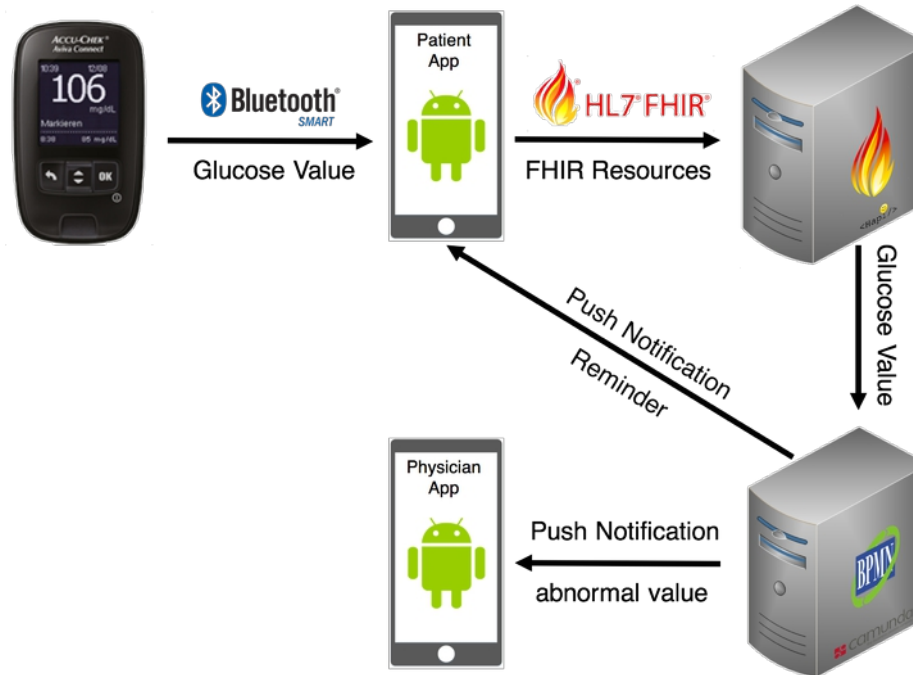
name: Charles Chartington

birthDate: 11/2/2015





Weiterentwicklung



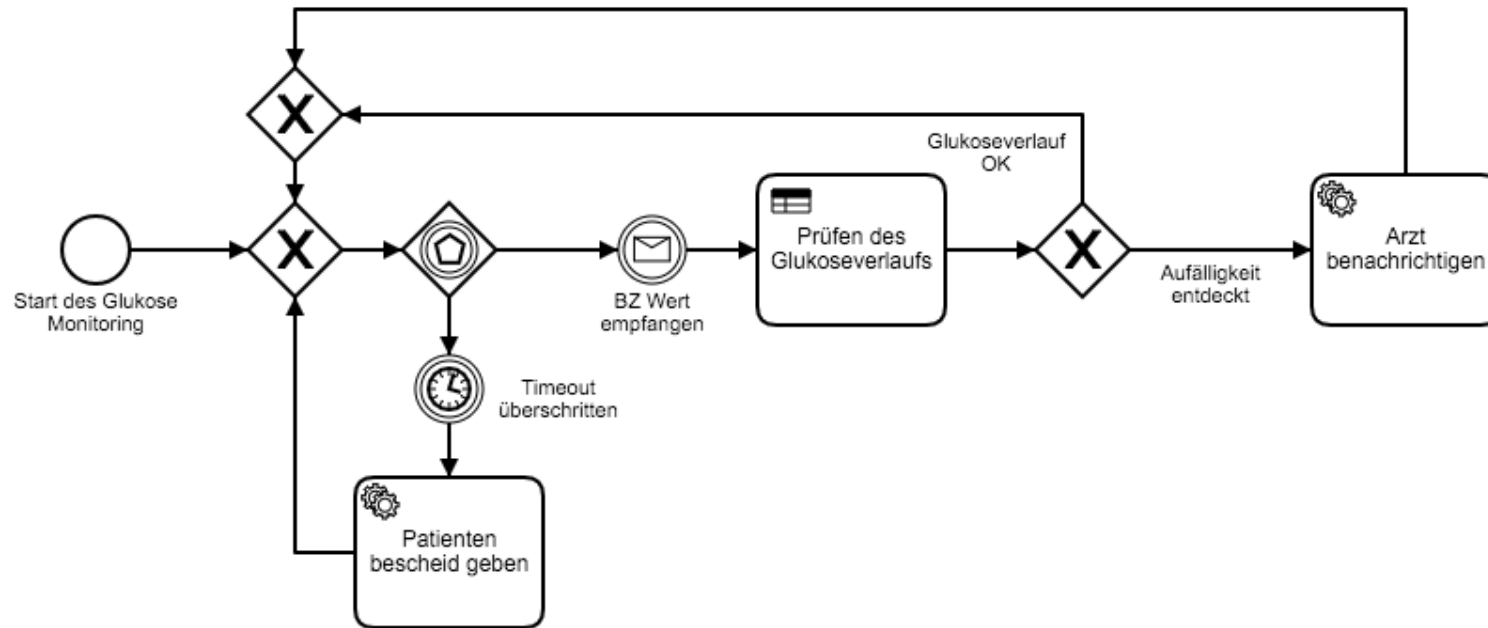


Eingesetzte Bibliotheken und Frameworks

- ▶ HAPI FHIR (Client/Server/Android)
- ▶ Erfassende App: Android native
- ▶ Arzt App: Ionic & client-js (smart on fhir)
- ▶ Webapp: client-js
- ▶ BPMN-Prozessengine: Camunda



BPMN Prozess der Glukoseüberwachung





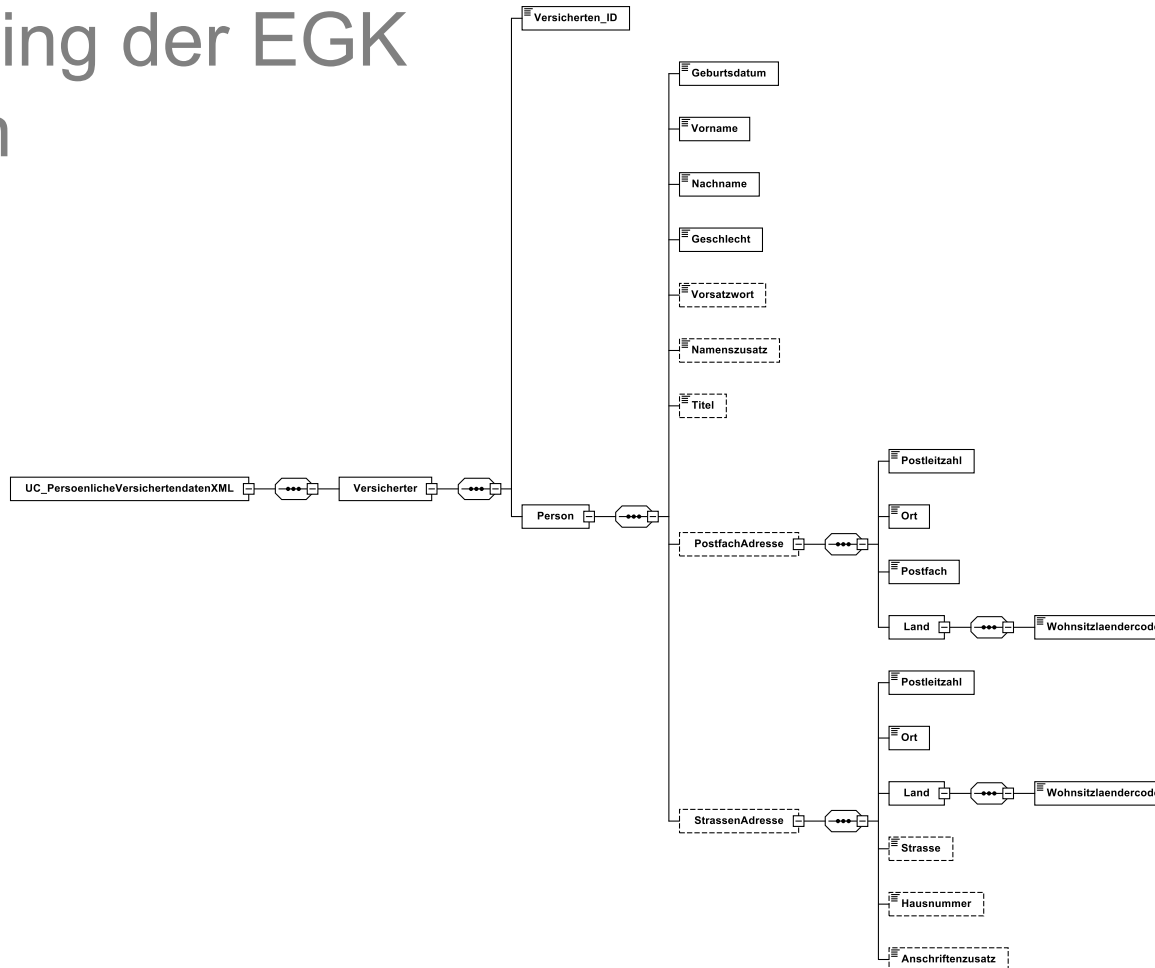
Wie starte ich solch einen Prozess?

EGKfhir → EGKfeuer

- ▶ Liest eine EGK mittels Kartenleser aus
- ▶ Mapping der eingelesenen Daten auf (profilierte) FHIR Ressourcen
 - ▶ Patient
 - ▶ Coverage
 - ▶ Organization
- ▶ Versand der Ressourcen an einen FHIR Endpunkt



Mapping der EGK Daten





Mapping der EGK Daten



Slice: *Unordered, Closed, by type.coding.system*

Fixed Value: <http://hl7.de/fhir/KVNR>

Slice: *Unordered, Closed, by type*

Fixed Value: postal

Postfach

Example: Postfach Nr.: 123

Example: Musterstadt

Example: 12345

Binding: <http://fhir.de/ValueSet/gkv/countries> (DEÜV Anlage 8)

Fixed Value: physical

Example: Musterstraße 21

Example: Musterstadt

Example: 54321

Binding: <http://fhir.de/ValueSet/gkv/countries> (DEÜV Anlage 8)



Mapping der EGK Daten

PD	FHIR
Person.Geburtsdatum	Patient.birthdate
Person.Vorname	Patient.name.given
Person.Nachname	Patient.name.family
Person.Geschlecht	Patient.gender
Person.Vorsatzwort	Patient.name.EXTENSION
Person.Namenszusatz	Patient.name.suffix
Person.Titel	Patient.name.prefix



Mapping der EGK Daten (Alternative)

Vorsatzwort ist ein gelöstes Problem

<http://fhir.de/StructureDefinition/kbv/egk/vorsatzwort>

Extension:

<http://hl7.org/fhir/StructureDefinition/iso21090-EN-qualifier>

Nutzt:

Value Set <http://hl7.org/fhir/ValueSet/name-part-qualifier>

Subset von:

<http://hl7.org/fhir/v3/EntityNamePartQualifierR2>

Enthält: PFX prefix



Mapping der EGK Daten (Alternative)

Problem:

- ▶ PFX prefix ist (noch?) nicht im FHIR ValueSet enthalten

- ▶ Erhöht die Komplexität des Patienten Profils:
 - ▶ Patient.name.prefix wird schon für den Titel des Patienten genutzt
 - ▶ Patient.name.prefix muss gesliced werden
 - ▶ Discriminator: Extension? Profile?



Mapping der EGK Daten

PD (Person.Strassenadresse)	FHIR (Patient.address)
Postleitzahl	postalCode
Ort	city
Land	country
Strasse	EXTENSION (iso21090-ADXP-streetName)
Hausnummer	EXTENSION (iso21090-ADXP-houseNumber)
Anschriftenzusatz	- (zukünftig in an line angehängt)
Strasse + Hausnummer	line



Genutzte Identifier Namespaces

- ▶ **Krankenversichertennummer**
- ▶ <http://fhir.de/NamingSystem/gkv/kvnr>
- ▶ genutzt → Patient.identifier & Coverage.identifier

- ▶ **IK-Nummer**
- ▶ <http://fhir.de/NamingSystem/arge-ik/iknr>
- ▶ genutzt → Organization.identifier



Genutzte Profile & Extensions

▶ **Profile**

- ▶ <http://fhir.de/StructureDefinition/kbv/persoенlicheVersicherungsdaten>
- ▶ <http://fhir.de/StructureDefinition/kbv/egk/vorsatzwort>

▶ **Extensions**

- ▶ <http://hl7.org/fhir/StructureDefinition/iso21090-ADXP-streetName>
- ▶ <http://hl7.org/fhir/StructureDefinition/iso21090-ADXP-houseNumber>
- ▶ <http://fhir.de/StructureDefinition/kbv/egk/vorsatzwort>



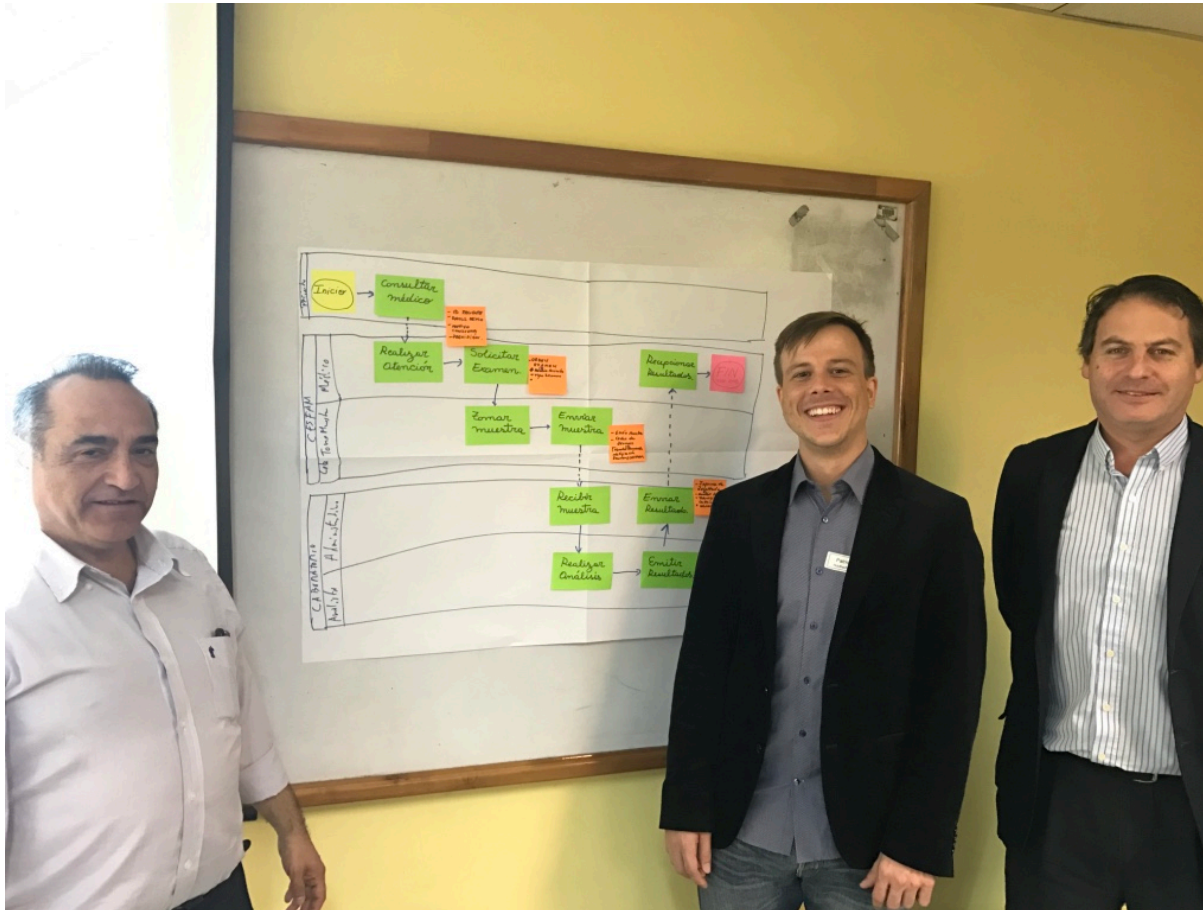
LINKs

- ▶ <https://github.com/elnin0815/EGKfeuer>
- ▶ <https://simplifier.net/PatricksEgkSandbox>
- ▶ <https://github.com/t4deon/BloodGlucoseMeteron>



Chile on FHIR







CHIP Chilean Health Info and Process Challenge



- ▶ Fokus: Software Selbstentwickler (Servicios de Salud) & Gesundheitsministerium
- ▶ Methodik:
 - ▶ Analyse der Prozesse (BPMN) um relevante Punkte für Interoperabilität zu identifizieren
 - ▶ Analyse der zu Übermittelnden Datenstrukturen & Mapping auf FHIR Ressourcen
 - ▶ Vermitteln von FHIR Grundkenntnissen in Theorie und Praxis (JavaScript)
 - ▶ Beginn der Diskussion um eine Basisprofilierung



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