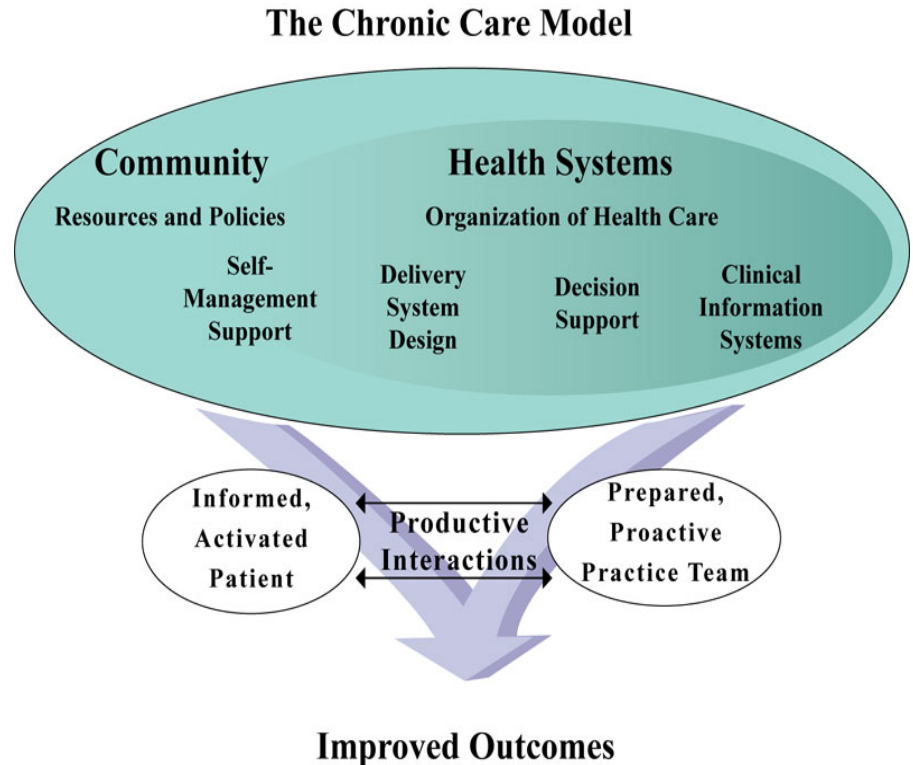


# A Model Driven Approach to Care Planning Systems for Consumer Engagement in Chronic Disease Management

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The University of Auckland

# Motivation

- Rise in rate of chronic illness
  - Better outcomes through consumer engagement
  - And we want to engage people is staying well
- So we want a care plan that the consumer can see (at least part of) and can engage with



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“Wagner” chronic care model

# Inspiration / focus

- Main focus areas
  - Diabetes, pre-diabetes, diet/weight/exercise
  - Medication adherence
  - Home monitoring
  - Using equipment (e.g., home oxygen)
- We are seeing islands of great solutions in this domain
  - STOMP – quit smoking programme via txt (with HealthPhone)
  - Telemedcare Systems (home telemonitoring with touchscreen hub)
  - Pen Computer Systems' Ferret

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# Why model-driven architecture?

- No single device is always best
    - Might engage via PC at home, via cell phone or various convergence devices (PDA, tablet)
      - Or via the touchscreen of a home healthcare robot
  - The principles of care planning are somewhat stable
    - Constant underlying conceptual model
    - Reasonably constant data model
  - So we want to iteratively refine a model that we can implement onto numerous specific devices
-

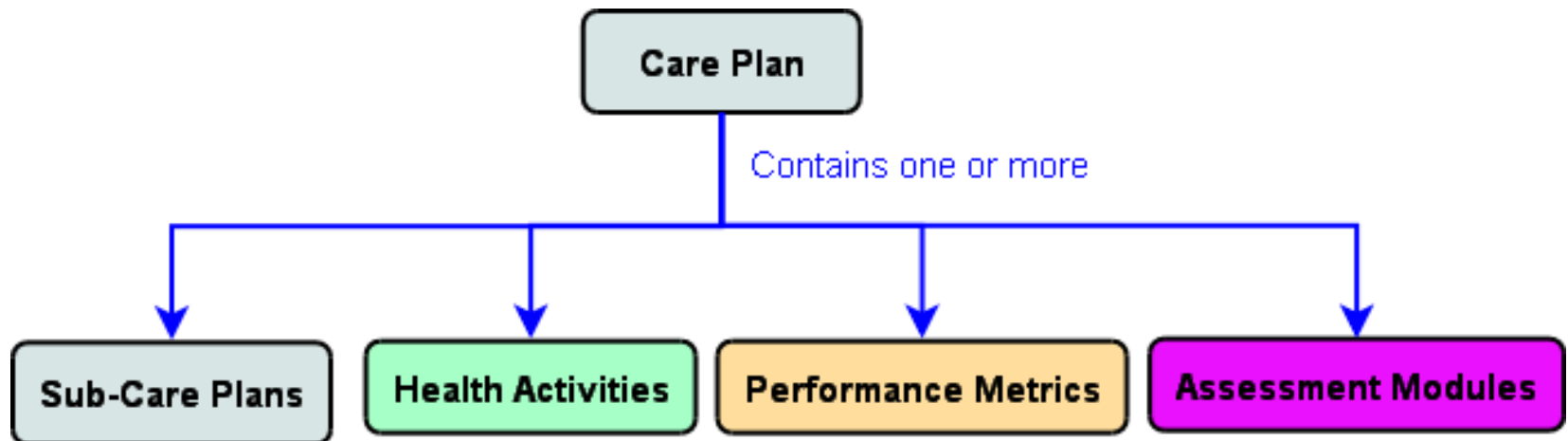
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# Tools of Model-Driven Architecture (MDA)

- Domain-specific language (DSL)
    - We use the Marama tool to create a language for defining care plans
      - As XML
      - And as a visual language
  - We program user interface components to map to objects in the DSL
  - From the DSL we generate high level scripts (e.g., OpenLaszlo) that can map to a target set of environments (Flash and DHTML for OpenLaszlo)
-

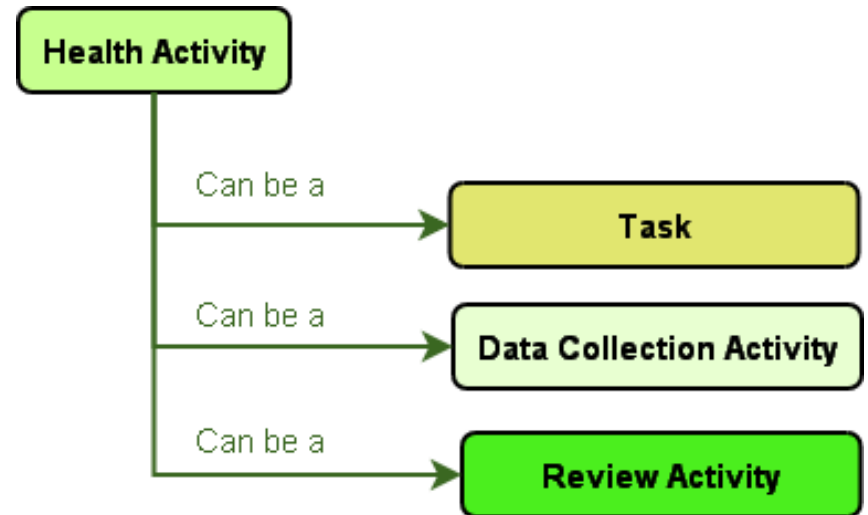
# Model

- A care plan involves
  - Activities
  - Measure (targets and ongoing observations)
- And it can recursively contain other care plan structures



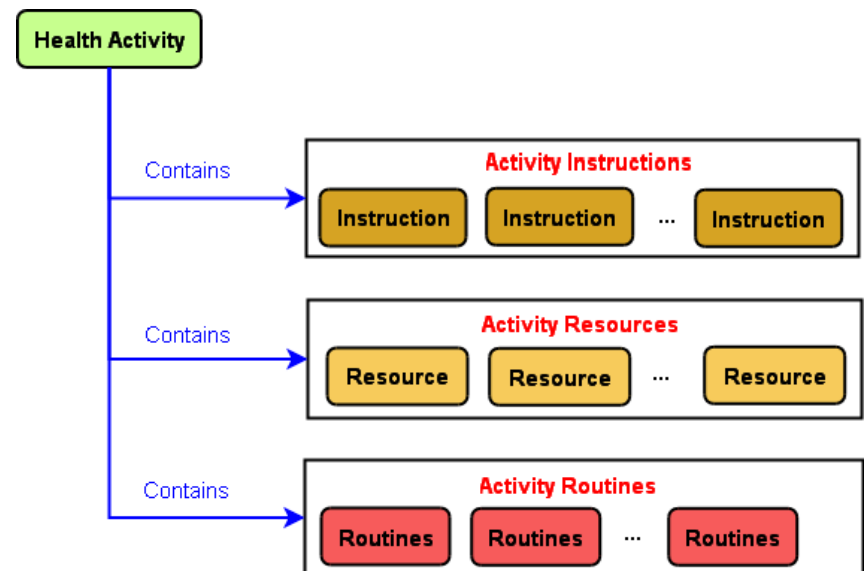
# Activities

- **Tasks**
  - Things to do in the real world
- **Data Collection**
  - Where we collect information
- **Review**
  - Assessing progress and possibly re-planning



# More on activities

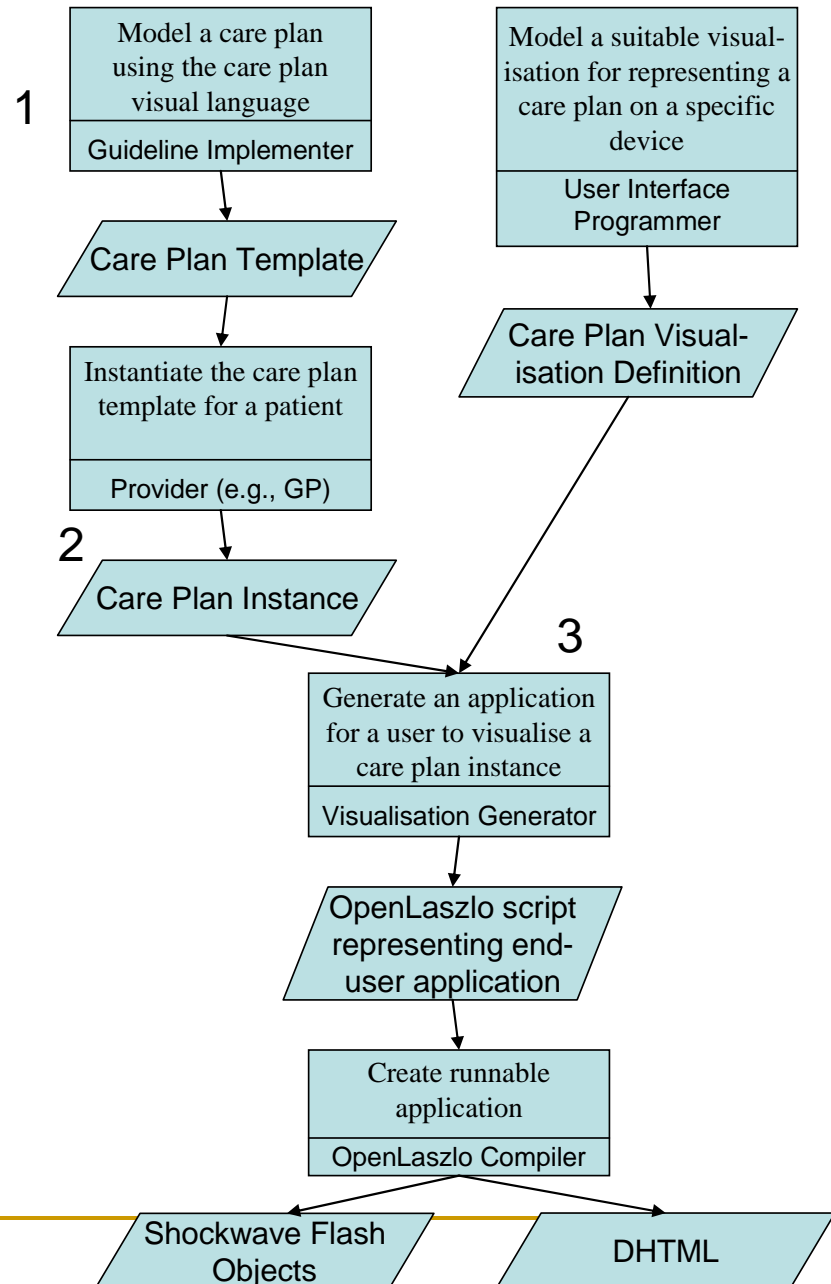
- Instructions
  - Can include multimedia or HTML/URL components of arbitrary complexity (e.g., 'how to' videos)
- Resources
  - Identifies things one must have (e.g., supplies)
- Routines
  - Defines patterns (e.g., each morning for a pill, or M-W-F afternoon exercise)





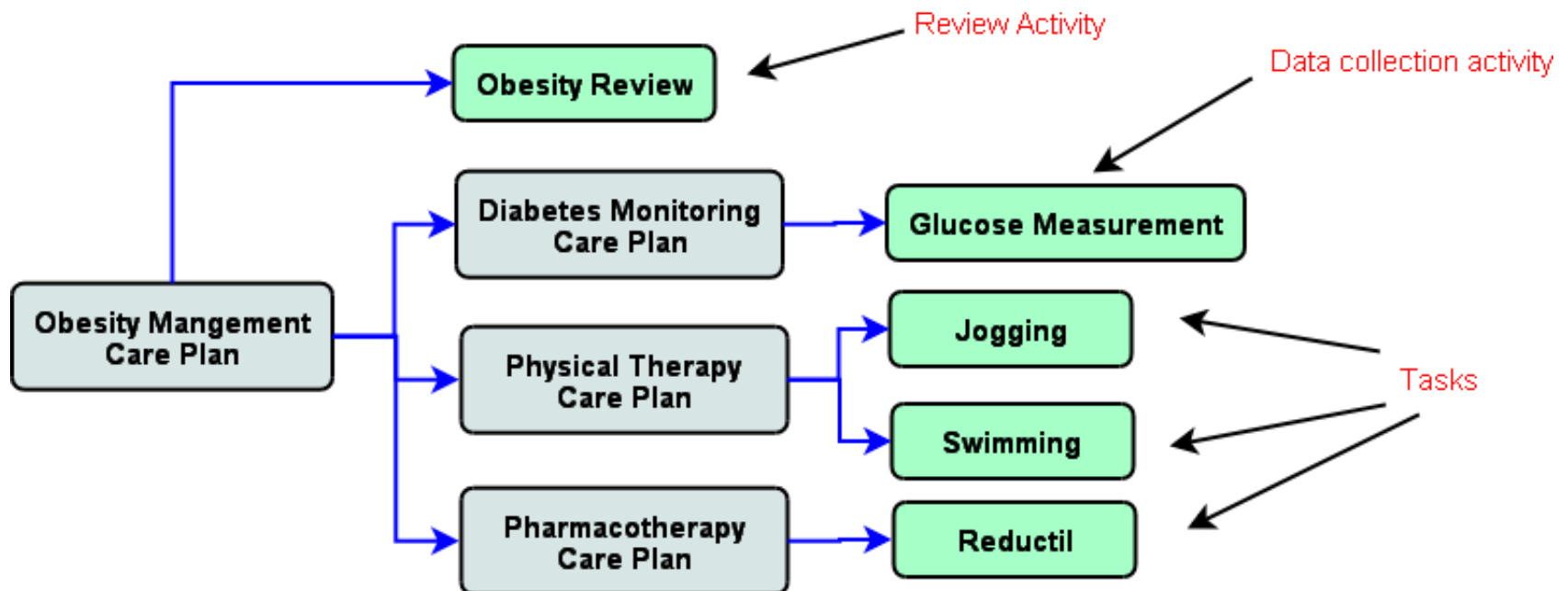
# Process

1. Build guideline (“care plan template”)
  - Once in a great while
2. Instantiate guideline on a patient
  - By a GP or other providers – maybe once a year
3. Generate application on an instance
  - For each device relevant to this patient



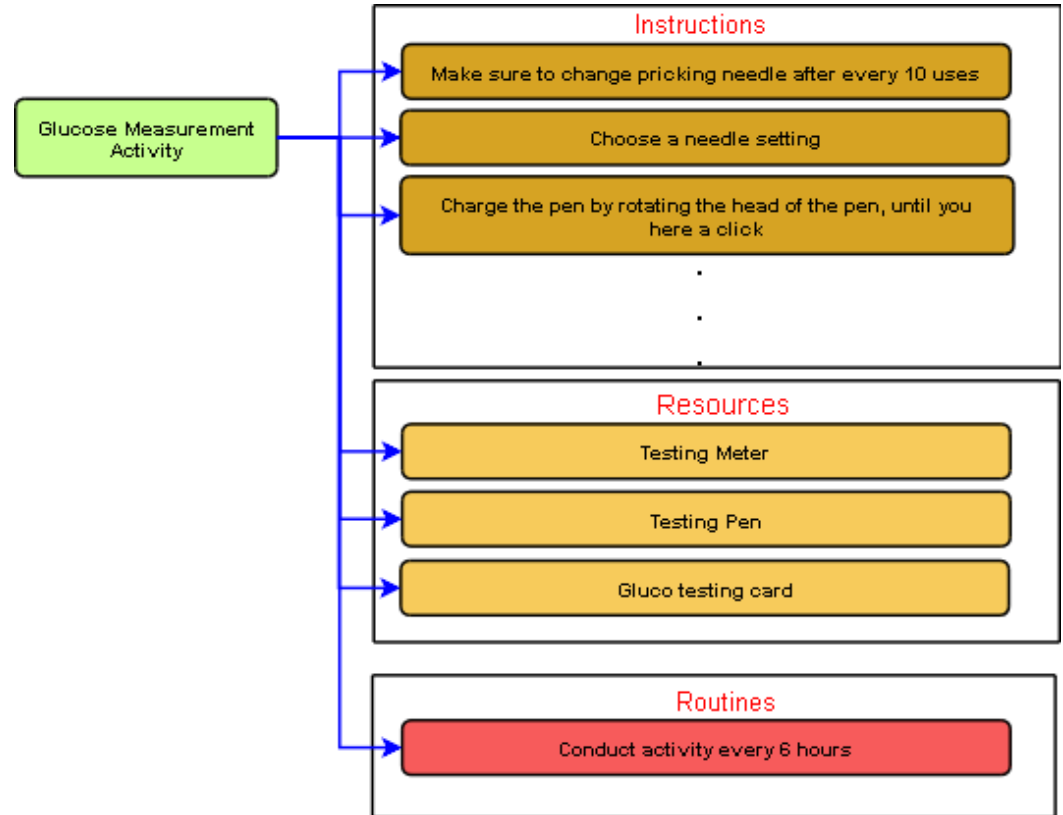
# Example

- Consider a pre-diabetes or Type II / obesity management care plan

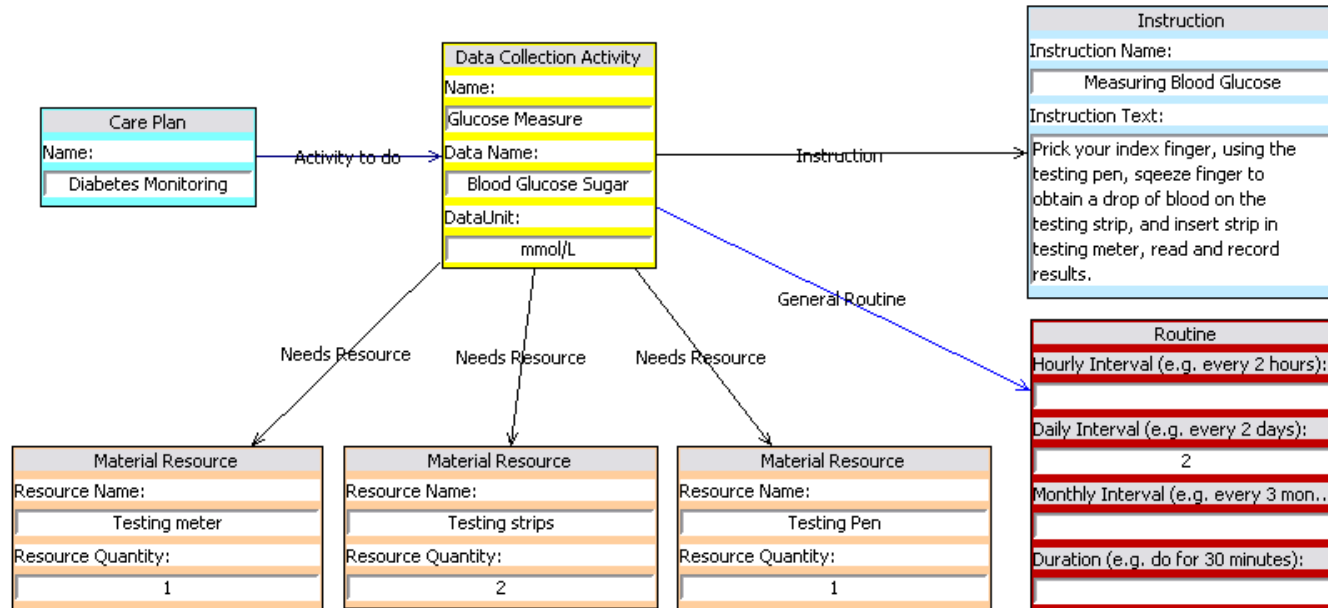


# Example contd.

- Care plan template has been defined with details of the activity
  - ❑ Specifics within the general care plan model / DSL
  - ❑ Defined by a guideline definition group (e.g., NZGG)



# Specific care plan model



- Marama visual presentation of Care Plan DSL showing a template with some specifics

# Storing Care Plans in XML

```
- <CarePlan>
  <CarePlanName>Dietary Therapy</CarePlanName>
  - <TargetConnection>
    <ConnectionIndex>//@children.10</ConnectionIndex>
    <ConnectionType>CarePlanHasCarePlan_Connector</ConnectionType>
  </TargetConnection>
  - <TargetConnection>
    <ConnectionIndex>//@children.11</ConnectionIndex>
    <ConnectionType>CarePlanHasCarePlan_Connector</ConnectionType>
  </TargetConnection>
</CarePlan>
- <CarePlan>
  <CarePlanName>Physical Therapy</CarePlanName>
</CarePlan>
- <CarePlan>
  <CarePlanName>Behavior Therapy</CarePlanName>
</CarePlan>
- <CarePlan>
  <CarePlanName>Pharmacotherapy</CarePlanName>
  - <TargetConnection>
    <ConnectionIndex>//@children.7</ConnectionIndex>
    <ConnectionType>CarePlanHasActivity_Connector</ConnectionType>
  </TargetConnection>
  - <TargetConnection>
    <ConnectionIndex>//@children.8</ConnectionIndex>
    <ConnectionType>CarePlanHasActivity_Connector</ConnectionType>
  </TargetConnection>
</CarePlan>
```

# Planning interface prototype

- Auto-generated DHTML in this instance
- Could be used directly by a care coordinator
- Might integrate with a GP's PMS if agreed on way to interoperate
  - ❑ Haven't yet explored CDA mapping

The screenshot shows a web-based application titled "Care Plan Modelling". It features a menu bar with "File" and "Tools". The interface is divided into three main sections:

- Loaded Care Plans:** A tree view on the left showing a hierarchy of care plans. The "Physical Therapy" plan is expanded, showing sub-items like "Jogging" and "Swimming", each with an associated "Routine".
- Loaded Care Plan Instances:** A large empty box at the bottom left for displaying instances of the selected care plan.
- Care Plan Details:** A right-hand panel for configuring a selected routine. It includes:
  - Routine Details:** Fields for "Hourly Routine", "Daily Routine", and "Monthly Routine", each with a "Conduct activity every" field and a "Set Schedule" button.
  - Duration:** A field for "Conduct activity for" with a value of "20" and a unit of "minutes".
  - Instantiation:** Fields for "Start date for routine" (set to "Tuesday, 20 November 2007") and "End date for routine" (set to "Wednesday, 20 February 2008").
  - Buttons:** "Save" and "Reset" buttons at the bottom.

# Storing Care Plan Instances as XML

```
1 <?xml version="1.0" encoding="ISO-8859-1"?>
2 <CarePlanDataSheet versionDate="21/05/2007">
3   <CarePlan CarePlanName="Obesity Management">
4     <Metrics>
5       <PerformanceMetric MetricName="Body Mass Index" MetricUnit="BMI" MetricValue="30"/>
6     </Metrics>
7     <SubCarePlans>
8       <CarePlan CarePlanName="Diet Plan">
13      <CarePlan CarePlanName="Exercise Plan">
18      <CarePlan CarePlanName="Diabetes Monitoring">
19        <Metrics></Metrics>
20        <SubCarePlans></SubCarePlans>
21        <Activities>
22          <Activity ActivityType="DataCollection" ActivityName="Glucose Measure" DataName="Glucose Sugar">
23            <ActivityInstructions>
28            <Resources>
33            <Appointments>
45          </Activity>
46        </Activities>
47      </CarePlan>
48      <CarePlan CarePlanName="Pharmacotherapy Plan">
74    </SubCarePlans>
75    <Activities>
89  </CarePlan>
90  <CarePlan CarePlanName="Smoking Cessation">
95  <CarePlan CarePlanName="Diabetes Management">
100  <CarePlan CarePlanName="Cholesterol Management">
105 </CarePlanDataSheet>
```

# Consumer interface (Flash)

- Care plan can be presented to patient
  - Mostly manifests as a series of tasks for reminder, input and feedback, plus presentation of instructions if desired
  - Flash is a widely deployable and powerful format

The image displays three sequential screenshots of a 'Personal Health Management' application interface, likely a Flash-based web application.

**Screenshot 1 (Left):** Shows a list of 'Glucose Measure' entries with timestamps from 20/05/2007 13:30:00 to 29/05/2007 13:30:00. The entry for 27/05/2007 13:30:00 is highlighted. A 'Back' button is at the bottom.

**Screenshot 2 (Middle):** Shows the 'Glucose Measure Appointment' form. It includes fields for 'Starting time' (27/05/2007 13:30:00), 'Duration' (0 minutes), and 'Enter Glucose Sugar' (5.6 mmol/L). It also has radio buttons for 'Status' (Completed, Could Not Complete, Not Attempted) and a 'Comments' field with the text 'I ate a salad for lunch along with a fruit smoothie.' Buttons for 'Back', 'View Instructions', and 'Save' are at the bottom.

**Screenshot 3 (Right):** Shows the 'Measuring blood sugar' instruction screen. It contains the text: 'Prick the index finger with the testing pen and squeeze a drop of blood onto the testing strip, and insert the the testing strip into the gluco-meter. Do this 1 hour after lunch.' A 'Back' button is at the bottom.



# Conclusions / Where to from here?

- If we're going to see widespread availability of care planning tools...
    - The care plan model should be interpretable by many different platforms
    - We should be able to distribute and tailor the care plan models themselves
    - Support re-use at every level
      - More sustainable – less isolation of projects
  - MDA offers significant potential
    - It'd be good if auto-generated GUIs looked a little nicer, but there's room for extensibility and tailoring in the approach
    - A long way to go to arrive at standards
      - A little more growth in ubiquity of mobile health support applications (e.g., Nokia) should help
-

# What we didn't do / didn't answer

- Align to relevant standards
  - We let the engineers follow path of least resistance for prototyping in this exercise
    - Proof of concept, not industry-ready solution
  - Little reason not to use a CDA (or OpenEHR) structure, HL7 data types and SNOMED CT concept set
- No answer here on distribution of the care plan XML artefacts
  - Governance of templates
  - Storage and versioning / mix of messaging and persistent EHR repositories

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Thank you

Questions?

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