Solution Report: Transient ischemic attack (TIA) + gastrointestinal bleeding (DU) + osteoporosis

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Part 1: Architecture and use

Architecture

Common to all cases

The UJI approach to the management of comorbidities in CIGs uses solely the editing and enacting facilities of the CIG language, in our case PROforma (and its Composer tool). Consequently, no architecture is proposed. Instead, the management of comorbidities is handled by developing specific PROforma fragments that should be considered when jointly using the CIGs of the comorbid conditions. We refer to these fragments as comorbidity management models (CMMs). Note that, for the combined use of the CIGs of the comorbid conditions, a series of adaptations might be required.

CIG representation

Common to all cases

We have represented the CIG in PROforma, using the Composer tool to edit the models. We have designed a CMM to solve the specific scenarios/patient cases proposed (e.g. 76-year old female with TIA and DU in case 1). Note that we have only considered the interactions of the provided scenarios. Moreover, the CMM assumes that all the comorbidities indicated are present. In case additional scenarios are required, the new situations should be modelled as a new CMM to be considered together with the existing one(s).

For a complete solution, it would be necessary to model the CIGs involved and build a final model with such CIGs and the CMMs. This approach is labor intensive since it is necessary to model each possible interaction as a CMM. On the positive side, the interactions will be fully described in the CMM, resulting in self-contained and self-explanatory models.

The descriptions below refer to the elements of the PROforma CIG language. **TODO add paragraph or reference**.

We have followed the following naming conventions. Each time a drug/treatment is prescribed we use a task (usually a plan or an action) with a name beginning with the word “start” followed by the name of the drug/treatment. Each time a drug/treatment needs to be stopped, we have explicitly represented it with a task whose name begins with the word “stop” followed by the name of the drug/treatment. Moreover, if the drug/treatment must be resumed after a period of time, or when the problem is solved, we have also modelled it with a task whose name starts with the word “resume” followed by the name of the drug/treatment. This naming convention helps to realize that there is an action for interaction management and also how it has been solved. In addition, we have associated tasks and data to appropriate SNOMED CT ontology terms.

Apart from that, decisions by the clinician or the patient have been modelled as enquiry tasks. For example, the decision to prescribe or not aspirin will be modelled with a task enquiry_add_aspirin, requesting an answer yes or no from the clinician.

Task preconditions and wait conditions have been fundamental to solve the interactions of the proposed scenarios.

CIG representation

Specific to CASE 1

Here we describe the PROforma CMM to solve the interactions of the Case 1 scenario, a patient with transient ischemic attack (TIA) and then a possible gastrointestinal bleeding (DU) due to TIA treatment and finally a possible osteoporosis, due to DU treatment. Figure 1 shows the top-level plan in PROforma CMM for this scenario.

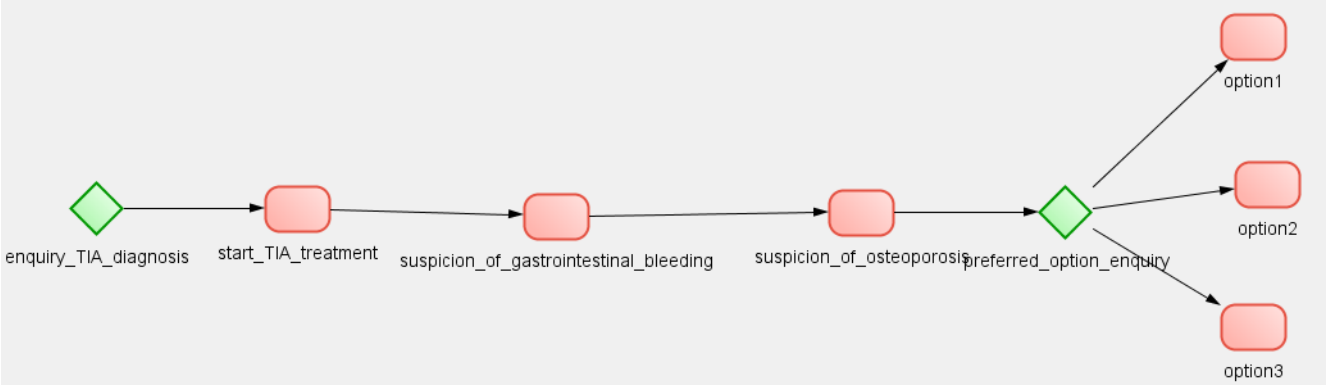

Figure 1: Top-level plan for a patient suffering of TIA + gastrointestinal bleeding + osteoporosis

There is a plan for the recommended TIA treatment (see Figure 2). Considering a patient not allergic to aspirin, there are 3 options for treating the patient: (1) only aspirin, (2) a combination of aspirin+dipyridamole, or (3) only clopidogrel. Clopidogrel is also the recommended treatment in case of allergy to aspirin. In Figure 2, there are explicit scheduling constraints modelling the options (1) and (2). For option (3), there is an implicit sequencing from enquiry_add_aspirin to the action start_clopidogrel. This has been modelled in the precondition of this task based on the answers from the clinician: allergic_to_aspirin = "yes" OR adding_aspirin = "no". Note that the option of using a scheduling constraint from enquiry_add_aspirin to the action start_clopidogrel would not be correct.

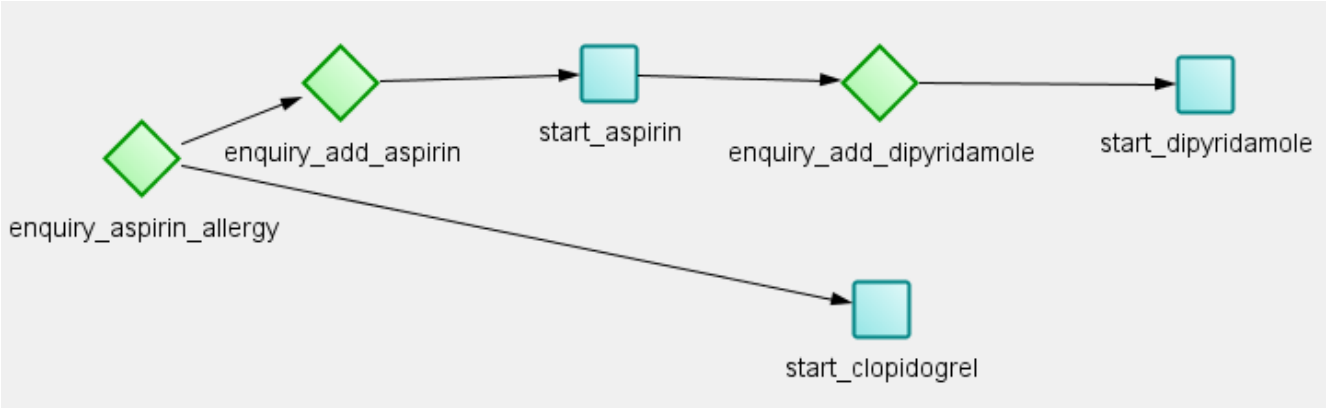

Figure 2: Content of the plan TIA_treatment

The interaction between the aspirin treatment and the gastrointestinal bleeding has been solved with preconditions. Therefore, the plan suspicion_of_gastrointestinal_bleeding has as precondition the completion of the action start_aspirin. Therefore, this CMM only considers duodenal ulcers due to treatment with aspirin. The plan suspicion_of_gastrointestinal_bleeding (Figure 3) inquires if there is gastrointestinal bleeding due to aspirin treatment. If so, the plan manages the bleeding by stopping aspirin and restarting the treatment again. After that, long term PPI therapy is prescribed.

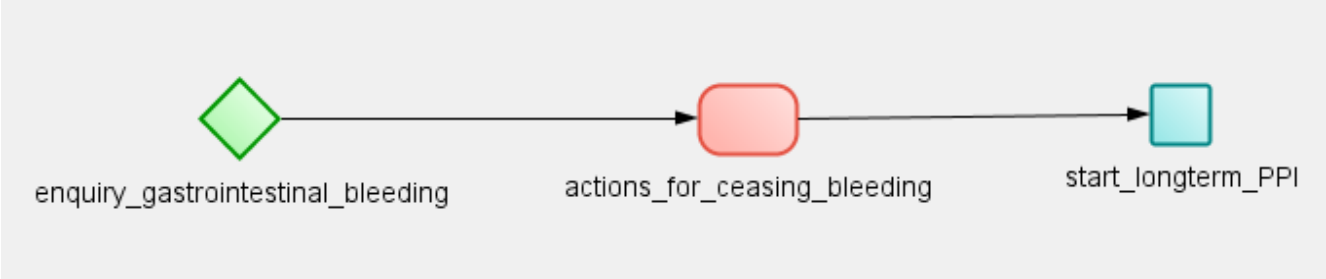

Figure 3: Content of the plan suspicion_of_gastrointestinal_bleeding

The plan actions_for_ceasing_bleeding (see Figure 4) stops aspirin treatment for 3 days and then asks if bleeding has ceased. This task is repeated every day until the bleeding stops or after 7 days without aspirin treatment. This recommendation has been modelled with a cyclical task enquiry_gastrointestinal_bleeding_rep, that includes a wait condition. The relevant details of this task are shown in Figure 5.

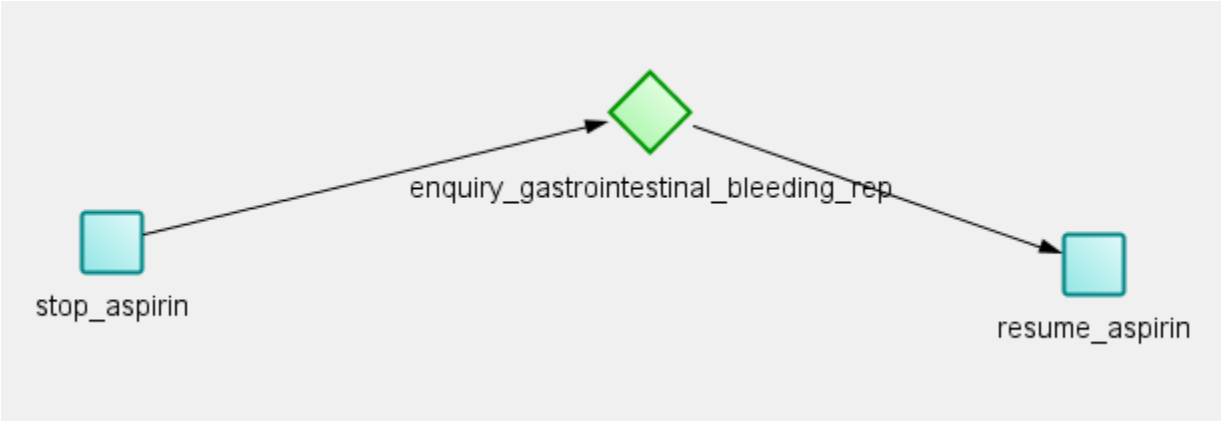

Figure 4: Content of the plan actions_for_ceasing_bleeding_rep

Task common properties	
Name	enquiry_gastrointestinal_bleeding_rep
Caption	
Description	
Ontology coding	
Control properties	
Wait condition	date_diff_days(now(), completed_time(stop_aspirin))>=3
Event trigger	
Precondition	Not set
Postcondition	Not set
Task repeat properties	
Task repeat interval	1
Repeat interval unit	Days
Repeat until	date_diff_days(now(), completed_time(stop_aspirin))>=7 OR gastrointestinal_bleeding = "no"
or number of repetitions	Not set

Figure 5: Wait condition and task repeat properties of the task enquiry_gastrointestinal_bleeding_rep

The plan suspicion_of_osteoporosis in the top level plan (see Figure 1) investigates if there is osteoporosis and the possible secondary causes for it. Finally it asks the clinician to confirm if the secondary cause of osteoporosis is long-term PPI treatment (Figure 6).

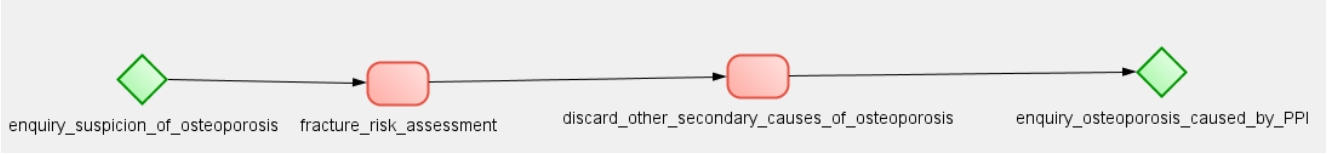

Figure 6: Content of the plan suspicion_of_osteoporosis

There are three options to treat the interaction TIA+DU+Osteoporosis, depending on the patient and her preferences. To model this, there is an enquiry task in the top-level plan that asks the desired option. This enquiry has the following precondition:

is_completed(start_aspirine) and is_completed(longterm_PPI_therapy) and secondary_cause_osteoporosis="PPI_therapy"

The precondition corresponds to the scenario considered in this case, that is, a patient having aspirin, on a long-term PPI therapy and with osteoporosis due to the latter treatment.

Although the three proposed options share adding a treatment for preventing the risk of fracture. For the sake of clarity, we have modelled each option separately. In option1 (see Figure 7), treatment for TIA, DU and osteoporosis are targeted.

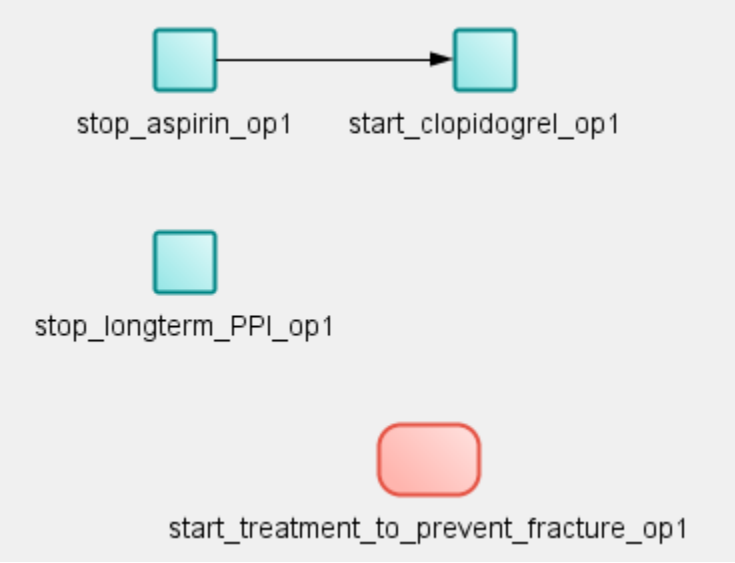

Figure 7: Content of the plan option1

In option 2, the treatment is not changed, only a treatment to reduce risk of fracture is added. Finally in option 3, aspirin is kept but PPI is stopped, so DU management is not considered

Domain knowledge representation

Common to all cases

As mentioned above, we have associated tasks and data to appropriate SNOMED CT ontology terms when possible.

Mode of use

Common to all cases

The system could be used to develop a PROforma-based DSS system. It could be used for simulation but also at the moment of the patient encounter.

Strengths of the approach

Common to all cases

Does the approach have very good support for particular features? Which? Please justify. What is the singular point of strength of your approach?

- Explainability: Interactions are fully described in the CMM, resulting in self-contained and self-explanatory models
- Ontology binding
- Support for both automated decisions and for decisions by the clinician or the patient

Part 3: Implementation of the Case Studies

N/A.