Appendix A

Type 2 Diabetes Mellitus Ontology

This appendix briefly describes the structure of the type 2 diabetes mellitus ontology. The ontology is derived directly from the BioTopLite2 (BTL2) ontology. The ontology is also compatible with the Basic Formal Ontology (BFO) offering a mapping between the BTL2 ontology and BFO.

Most of the classes are subclasses of dm2co:Finding, dm2co:Observation and the dm2co:ObservationResult. These relevant classes are subclasses of btl2:Situation, btl2:Action and btl2:InformationObject respectively.

Currently, the labels of the classes are in English and Spanish languages using the property rdfs:label. Most of the classes use the terms of SNOMED-CT therefore the classes are annotated with the corresponding code and the Fully Specified Name (FSN). The properties dm2co:SNOMED_CT_Code and dm2co:SNOMED_CT_FSN are provided for this purpose.

The rules defined in SPIN language are attached to the corresponding classes and the rules of OWL 2 RL profile are imported using the library provided by the TopQuadrant company.

All the ontologies mentioned above are available in https://github.com/gaurgo/DiabetesCare/tree/master/ontologies.

Appendix B
Design and Implementation of an Adaptive, Interoperable and Intelligent Type 2 Diabetes Mellitus Care System

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B.1 Structured Abstract

Background: Complex and relevant process like the Type 2 Diabetes Mellitus caring process can be better supported by informatics systems considering the heterogeneity of the actors involved. Currently, the development of systems starts from the information world and do not follow a methodological framework for describe architecturally the real system which will be supported by the software.

Objective: Demonstrate that using a methodology based on the Generic Component Model is possible to develop a system that improves the support of the caring process of the Type 2 Diabete Mellitus.

Methods: The methodology is base on the architectural approach of the Generic Component Model and integrates important aspects in the system modeling as the system theory, the ontological and the business process description.

Results: Using the described methodology, a prototype of a software system for the glycemic control use case was developed. The system demonstrates adaptability, intelligence, and supports interoperability/collaboration between the heterogeneous actors.

Conclusions: Modelling and developing health systems using traditional methodologies prevents from the easy creation of systems, which support interoperability between heterogeneous actors. The problem is that formal description of domain knowledge is omitted and the models do not follow an architectural approach. The architectural approach presented in this paper helps to build high quality models. Furthermore, the formal description allows to performing logic inferences that are useful in the creation of decision support systems.

B.2 Keywords

Diabetes Mellitus, Health Informatics, Architectural Approach, Ontology-based Systems, Expert Systems

B.3 Body of the Manuscript

B.3.1 Introduction

This paper presents the design and implementation of a software system using a methodology based on the Generic Component Model (GCM) [1]. Relatively few works are demonstrating the advantage of this methodology [2]–[11] and none collects the next features: Consideration of the cross-domain interoperability,

consideration of the system architecture, consideration of ICT-independent real world system [135], adherence to policies and guidelines, decision support, knowledge formalization, inference over knowledge, adaptable to new actors and new knowledge. These features are desired to support by information systems the interoperability/collaboration between actor with a common goal but with heterogeneity as is the case in th Type 2 Diabetes Mellitus (T2DM) care. The used methods seek to achieve these features and are shortly introduced in Section B.3.2. In the first iteration of the design process, the system is modeled at a high level of abstraction (Section B.3.3.1). The obtained model is specialized considering three domains: medical, policy and resource domains. The medical domain of the T2DM care is generically described in Section B.3.3.2, it covers all possible use cases. In order to proceed with the implementation, the generic models are specialized for the use cases. Models for the glycemic control use case are presented in Section B.3.3.3. In the aforementioned sections are used the GCM cuboid diagrams and the Unified Modeling Language (UML) class diagrams. These diagrams only present the static aspects of the system. The dynamic aspect of the system are modeled using Business Process Modeling Notation (BPMN) and are presented in Section B.3.3.5 and B.3.3.6. Section B.3.3.5 addresses the generic system description and the Section B.3.3.6 provides the glycemic control use case description. Policies and rules governing the system in glycemic control use case are formally described in the Section B.3.3.7 using Sparql Inference Notation (SPIN). At this point the ICT independent T2DM care system is described completely. Based on this description, the software development process according to the Rational Unified Process, represented through ISO 10746 Open Distributed Processing – Reference Model (RM-ODP) and its viewpoints is performed. The output of this process is the description of the ICT solution and, finally, the running ICT application system (Section B.3.3.8). Some features of the obtained solution are evaluated in Section B.3.3.9. The advantage of the process and the results are presented in the discussion (Section B.3.5), followed by the conclusions in Section B.3.6.

B.3.2 Objective

The paper’s main objective is to describe the analysis, design, and implementation of a T2DM care system using a methodology that integrates important aspects in the system modeling as the system theory, the ontological and the business process description. Thus, it is expected to demonstrate that this methodology promises advantages in order to develop adaptive, intelligent and interoperable systems.

B.3.3 Methods

B.3.3.1 A General Framework for Systems Architectures

The Generic Component Model (GCM) is a framework for the analysis, design and implementation of systems (in the most general sense), following an architectural approach, derived from the General Systems Theory (GST). It is visualized as a cuboid, (see Fig. B.1), due to its three-dimensional make-up: (i) the domain perspective, (ii) the architectural perspective and (iii) the development process perspective [1]. The domain dimension (domain perspective) represents different perspectives on the system provided by different domain experts using their specific methodology, terminology, and ontology, thereby separating inter-related domains of the system in order to manage them independently. A domain is characterized by common properties of its architectural components. The domain-specific ontologies should be harmonized by an upper-level ontology in order to facilitate interoperability. The architectural perspective describes the system through the decomposition/composition of its components and their functions and relationships. The system's policy describes the system's behavior by selecting components and constraining their functions and relationships according to the current business objective of the system. The architectural perspective considers four different generic levels of granularity. Structural properties of the systems can be described using relationships "is part of" or "is connected with". Granularity is expressed by the relationships "is a" (from more general to more specific descriptions) and "is part of" / "has part" (by describing components and subcomponents at different levels of detail). The last dimension describes the development process, represented by the different views of the system according to ISO 10746 – Open Distributed Processing [12]. The GCM framework additionally considers the "Business View", i.e. the description of a real system (ICT-independently) [13], considering the business process of the system and its use cases. It thereby goes beyond the RM-ODP which always focuses on ICT systems, represented using ICT ontologies.

In order to build a correct, consistent and understandable architecture with the GCM it is needed to take into account the following design principles: orthogonality (not linking independent aspects), generality (not introducing multiple similar entities), parsimony (not introducing irrelevant aspects), and propriety (not restricting inherent aspects) [14]. An important principle derived from the orthogonality is not linking entities at different levels of granularity.

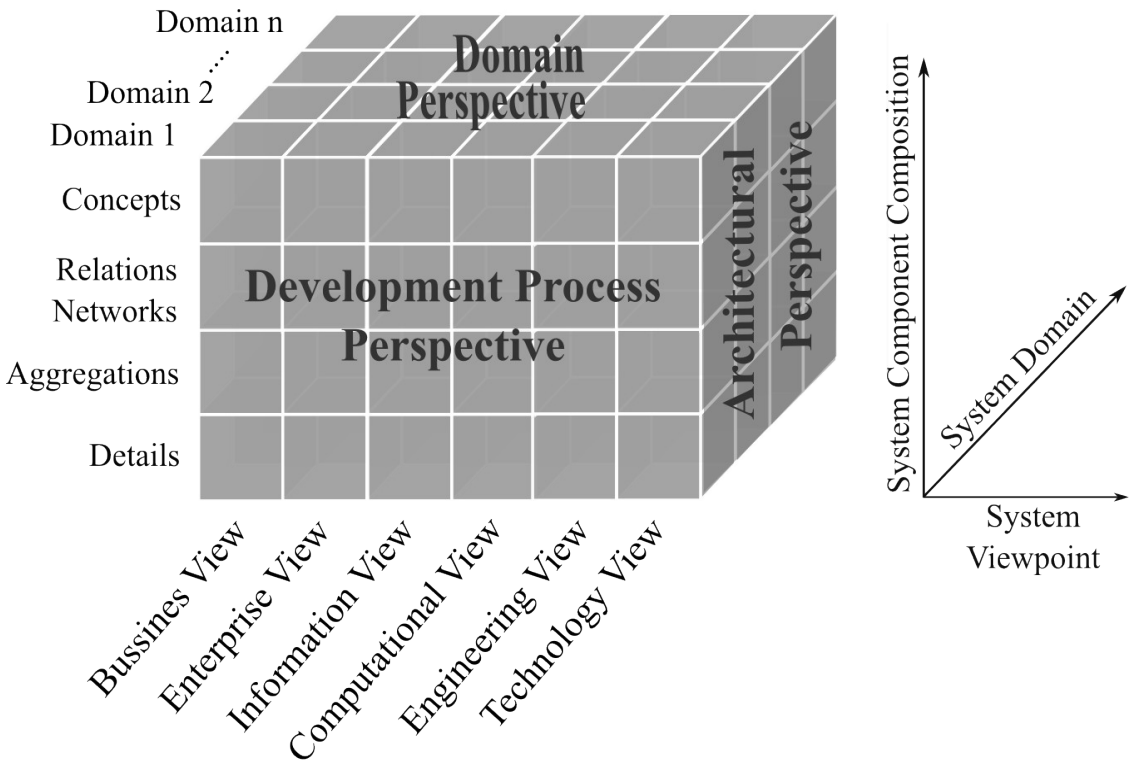

Figure B.1: The Generic Component Model according with [13].

GCM combines system theory and ontology sciences representing the architectural components of a system [15]. In that context, ontological assertions expressed in domain ontologies are amended by functional constraints and relationships specific for the system in consideration [16], [17]. The result is named application ontology and is finally implemented using ICT ontologies [13], [18]. ICT ontologies support the software development process, implementing for example specific software applications.

B.3.3.2 Ontologies

The term “ontology” dates back to ancient Greek philosophy and has since acquired several meanings [19]–[27]. This ambiguity renders its use problematic, especially in the communication between different scientific disciplines, e.g. philosophy and artificial intelligence (AI). Although there seems to be a consensus that ontologies are representational artifacts, it is controversial whether they represent (i) knowledge, (ii) terms, (iii) concepts, or (iv) real entities [25]. The first view is popular in the IA context, whereas the second and the third views refer, primarily, to thesaurus-like, not formally grounded artifacts providing terms and relations close to human language. The last

view has been endorsed by philosophers and popularized in biomedical sciences. It presupposes the existence of an objective, user-independent reality, about which truths can be discovered by scientific methods [28] and to which we have at least partial access. This has recently raised controversies (e.g. [28]–[30]). Nevertheless, a realist stance seems to have some significant advantages: given consensus about the things that exist in a domain of interest, agreement can easily be reached about definitions of classes of entities and, consequently, on what is universally true for all members of that class [25].

The language used for ontological assertions defines its level of decidability and expressiveness. Currently, logic-based languages, first of all Description Logic (DL) languages are frequently used due to their availability for reasoning through deterministic algorithms [31]. The World Web Wide Consortium (W3C) has standardized several DL language used for the Semantic Web. From this language family, Ontology Web Language (OWL) [32] has been widely used.

There are several hierarchies for ontologies considering their level of abstraction or generality. Some examples can be found in [13], [33], [34]. In the cited hierarchies, top-level ontologies (also called upper-level ontologies) introduce general types (kinds, universals) and definitions that help unambiguously categorize the entities of the world into a small set of basic categories and their relations [35]. These ontologies aim at being domain independent and forming a skeleton for the definition of domain-specific ontologies. Examples are Basic Formal Ontology (BFO) [36], Suggested Upper Merged Ontology (SUMO) [37], Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) [38], and General Formal Ontology (GFO) [39]. Each of these top level ontologies follows certain philosophical principles, most of them based on the Aristotelian principle of *genus proximum* and *differentia specifica*. Their similarities and differences have been extensively analyzed [23], [35], [40]–[42]. Several classes and relations are common in the mentioned top-level ontologies, like *Process*, *Quality*, but their definitions differ under a closer scrutiny, so that their harmonization is only possible to a certain level. Each ontology is geared to preferred use cases, e.g., DOLCE for social sciences and BFO for natural sciences [43].

Whereas top-level ontologies are, principally, domain-independent, top-domain ontologies (also called upper-domain ontologies) hold the essential core classes and relations of a domain, such as BioTop [44] and OntoCAPE [45]. The content of domain ontologies is intended to comprehensively describe the universally accepted facts, definitions, and ordering principles of a domain of interest, e.g. the Gene Ontology, ChEBI, or other OBO Foundry ontologies [46]. BioTopLite provides high

compatibility with the top-level ontologies BFO and DOLCE, however considering, additionally, some relevant and general aspects of the biological domain. Two important design criteria for BioTopLite were user-friendliness and the reasoning performance. OntoCAPE is a large-scale ontology for the domain of Computer Aided Process Engineering (CAPE) and is restricted to describe Information and Communications Technology (ICT) systems. Therefore, it is an ICT specific ontology. It contains consensual classes used in the process engineering domain in a generic way such that it can be reused. An important feature of OntoCAPE is the ontological description of the GST classes.

B.3.3.3 Business Process Modeling and Execution

The business process modeling describes the expected behavior of a business and allows to controlling, monitoring or implementing the included processes. This description usually includes the actors involved in the system, the processes realized by the actors and the rules or contracts governing the collaborative system [47]. Some notations and techniques can be extrapolated to describe the behavior of any system and can be complemented with the system architecture approach. For correctly reflecting a system's architecture and its ontological representation, the business process model shall be derived from the system's architectural model.

The Object Management Group (OMG) has developed a standard called Business Process Model and Notation (BPMN) [48]. This notation can consider ICT independent aspects and the partial support of the business process by computer systems, therefore, also presents an execution semantics enabling a standard implementation of the business process.

B.3.3.4 Rules, Languages and Tools

The term "rule" has different meanings, i.e, it refers to variety of concepts [49]. Rules used for analyzing, describing and implementing systems can be expressed in the form "if … then ...". These rules can be classified in two groups. The first one is named "production rules" and the second one "declarative rules" (also known as inference rules). Production rules determine a behavior plan. If a certain condition holds, then some action is performed (e.g. "If the body temperature measurement is greater than 37.5 centigrade, then take a pill."). The declarative rules state a fact about the world (e.g. "If the body temperature measurement is greater than 37.5 centigrade, then is a fever finding") [50]. These two types of rules can be described deploying different languages such as Semantic Web Rule Language (SWRL) [51], SPARQL Inference Notation (SPIN) [52], or Rule Interchange Format (RIF) [53] and

then be processed by rule engines as Drools [54], Jess [55], or IBM Operational Decision Manager [56]. The mentioned rule engines were designed focusing on production rules, and this is done independently of ontology languages such as the Web Ontology Language (OWL) [57] or the Resource Description Framework (RDF) [58]. SPIN, SWRL, and more recently RIF, are languages that allow the definition of rules using ontologies. The RIF language is an W3C standard based on the commonalities of all the current solutions, in order to allow sharing rules between systems. Unfortunately, RIF standard implementations are still immature [59].

In the medical domain, there are several domain specific languages for describing rules in the context of the medical guidelines definition. Some examples are PROforma [60], Arden Syntax [61], Asbru [62], Guideline Interchange Format (GLIF) [63] and SAGE [64]. These solutions are compared and discussed in [65], [66]. All these solutions have many similarities. However, the SAGE system synthesizes prior work as GLIF, PROforma and Arden Syntax. An important disadvantage of these solutions is that they are only focused on the medical domain making the harmonization with the administrative, ethical, security and privacy domains difficult. Therefore, in order to harmonize different domains it is convenient to use a general purpose, standardized, and broadly accepted rule language like SPIN.

B.3.4 Results

B.3.4.1 Generic Model of the T2DM Care System

The black-box diagram in system theory describes the most abstract level for a system, defining the inputs and outputs of the system. In Figure B.2, a GCM cuboid is used for this representation, but with adding a set of domains considered in the modeling. For the description of biomedical systems three domains are relevant: the medical, the policy and the resource domains [67]. The medical domain describes the T2DM disease and the process needed for the care of this disease. The policy domain describe rules defined by some authority. This rules govern the behavior of the system. The resource domain, describe the entities involved in the medical care, e.g. actors, physical objects and locations. The interaction between these domains is named cross-domain interoperability and enables the collaboration between the system's actors. Based on the system's description including these domains and its interactions should make any software implementation. It is expected that the software implemented can adapt to changes in politics and knowledge.

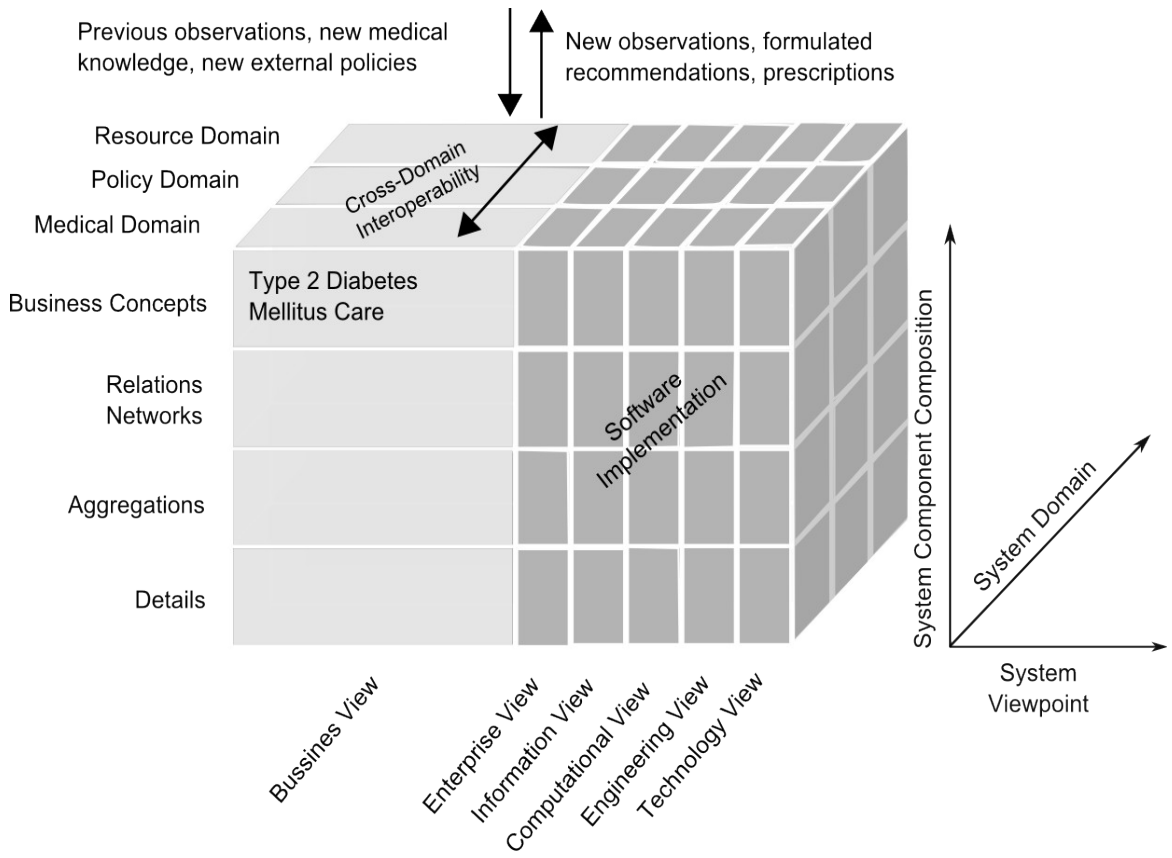

Figure B.2: Abstract description of the system

B.3.4.2 Representation of T2DM Care Medical Domain

The description of this domain is divided in the sub-domains corresponding to the level of complexity in the care process (Figure B.3). A high complexity is inherent to the hospital sub-domain involving the collaboration of many disciplines. The simples sub-domain is the self-care involving only the tasks performed by the patient. The processes of the medical disciplines are composed of the processes performed in the health-care services. This processes are composed of specific tasks and these task correspond to the lowest level of the system's description. It is important to highlight that the terms and some relationships used in the description are derived from SNOMED-CT [68], LOINC [69] and top-level ontologies like BioTopLite2 [44] and Basic Formal Ontology (BFO) [36].

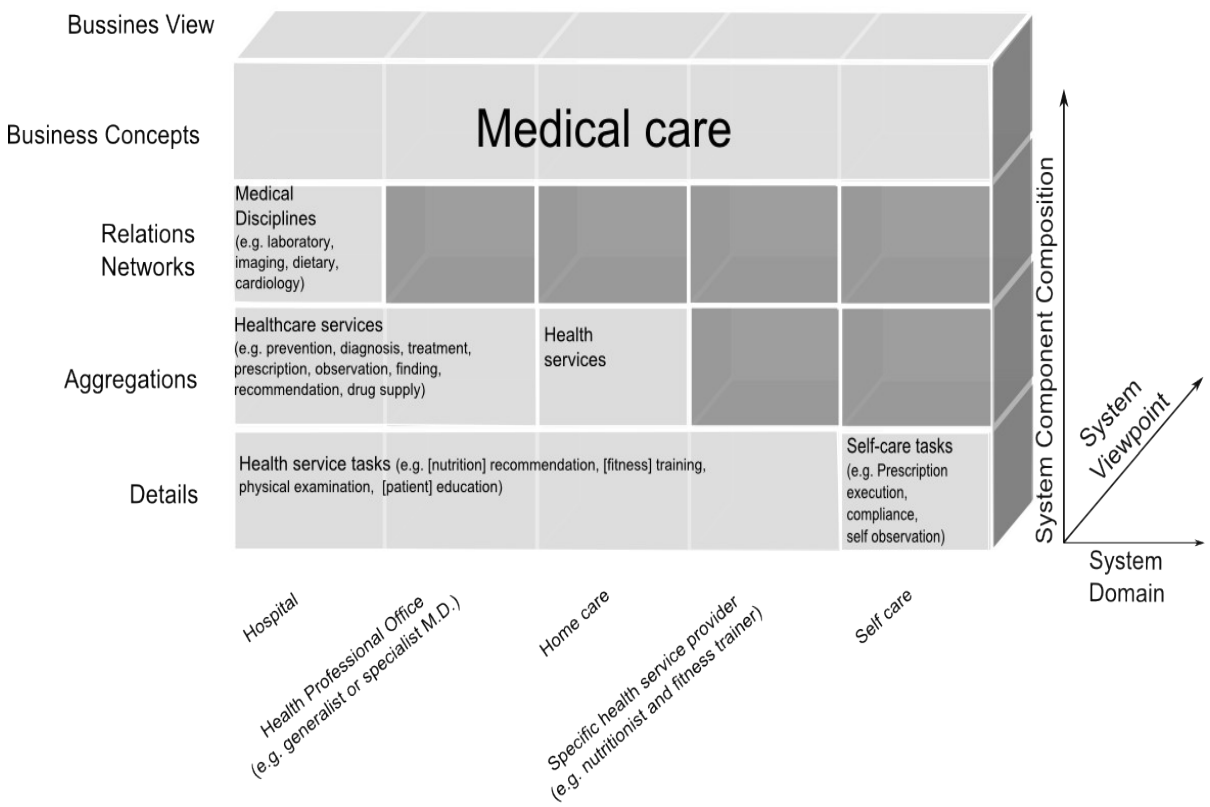

Figure B.3: Medical domain GCM business view representation

Figure B.4 shows the relationships between the considered domains. This model demonstrates that the relations between medical care and the resource classes are regulated by the policy class. It means that the resource participating in the medical care process is ruled by the defined policies. Medical discipline and organization class instances are regulated by composite policies due their multi-disciplinary nature.

Person, device and applications are regulated by the basic policies and their specializations [70] in order to perform health care service or health care instances. Finally, specific statements can be used to rule the specific tasks.

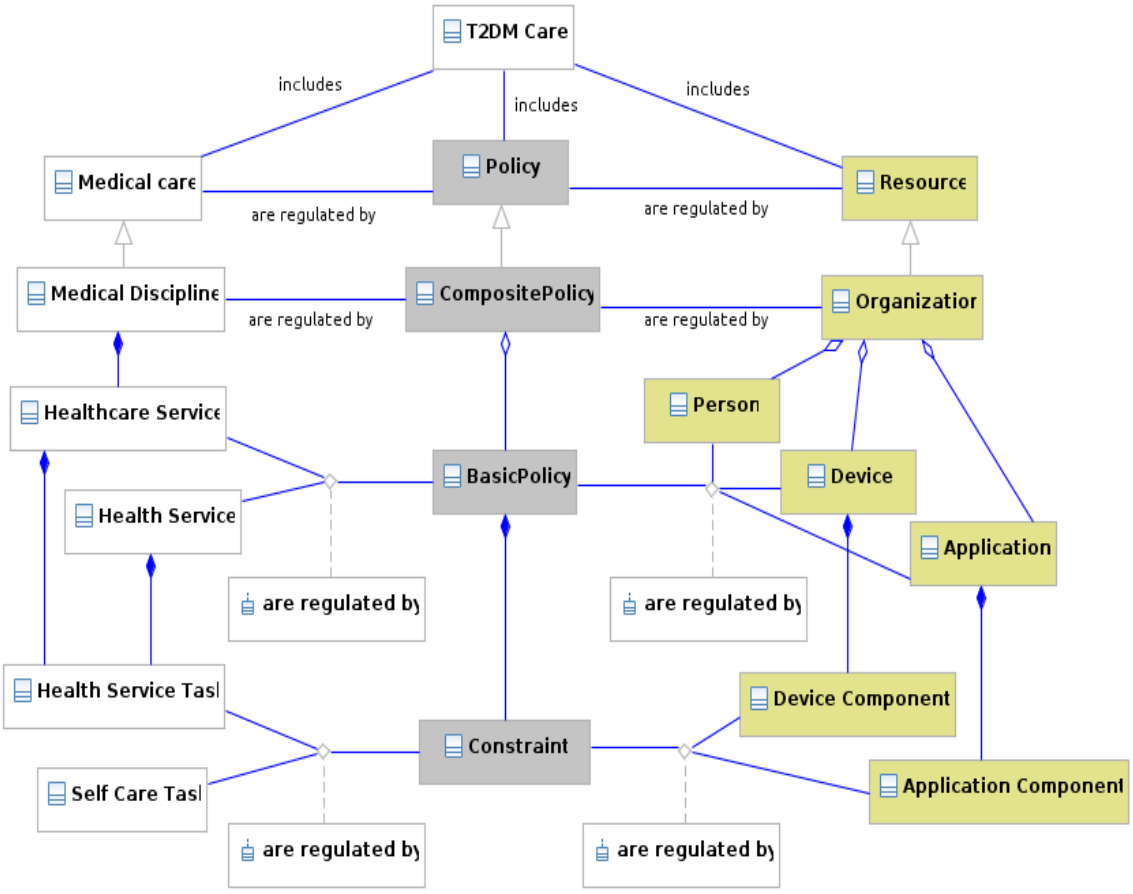

Figure B.4: Inter-domain class diagram

B.3.4.3 Specialization of the Medical Domain in the Glycemic Control

Figure B.5 shows the medical domain of the use case. At the Relations Networks level, the medical disciplines related with the glycemic control are: general medicine, internal medicine, endocrinology, emergency, nursing and laboratory. Health services provided by those medical disciplines are exemplified in the Aggregations level. A comprehensive list of health services is given in Table B.1.

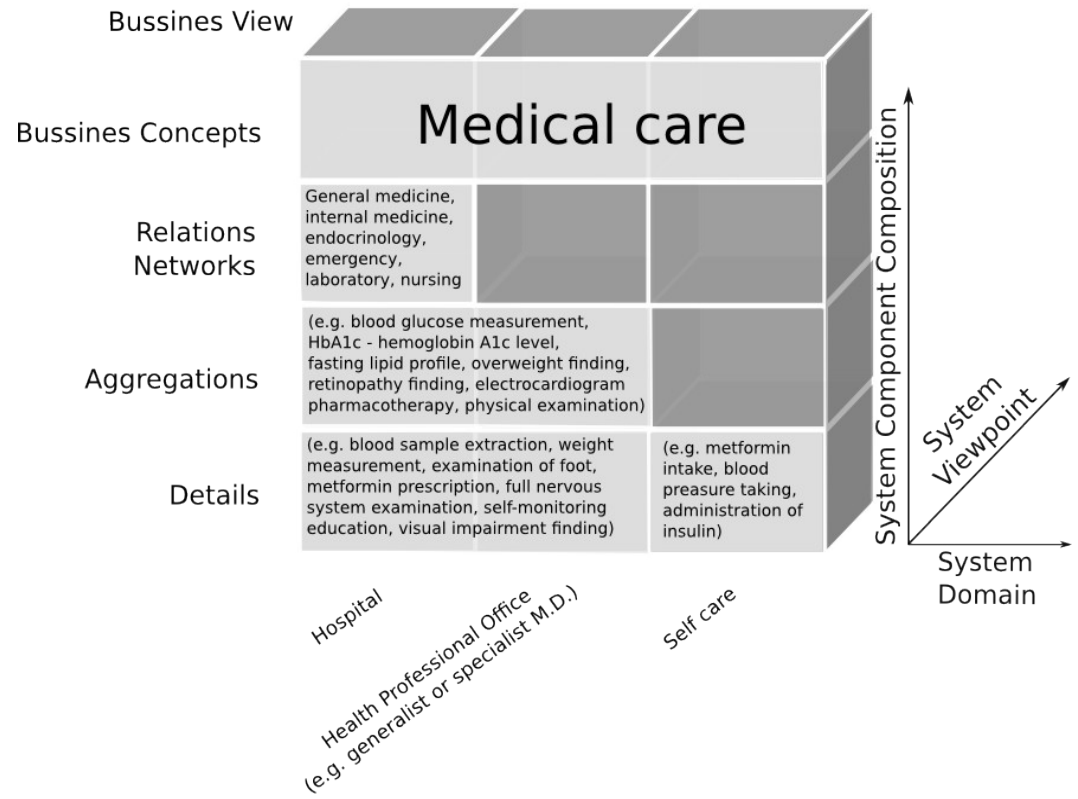

Figure B.5: GCM representation of the medical care domain

Table B.1: Health services in the glycemic control

Observations

- Clinical history evaluation
- Anamnesis
- Physical examination
- Blood glucose measurement
  - Fasting blood glucose measurement
  - Post-prandial blood glucose measurement
- Evaluation of self-monitoring of blood glucose
- HbA1c - Hemoglobin A1c level
- Fasting lipid profile
- Urinalysis
- Microalbuminuria measurement
- Creatinine serum measurement
- Electrocardiogram
  - Resting electrocardiogram
  - Exercise electrocardiogram stress testing

Findings

- Overweight
- Systemic arterial hypertension
- Retinopathy
- Neuropathy
- Dyslipidemia
- Hypoglycemia
- Hyperglycemia
- Ventricular hypertrophy
- Peripheral arterial disease
- Coronary artery disease
- Nephropathy
- Diabetic foot

Treatments
- Pharmacotherapy

Recommendations
- Self-monitoring recommendation
- Patient education[2]
- Diagnosis support

Facilities supply
- Glucometer supply
- Lancet supply
- Blood testing strips supply
- Insulin injector supply
- Needle for insulin injector supply
- Orthopedic device supply
  - Stick supply
  - Walker supply

Prescriptions
- Drug prescription[1]

Drug supply
- Drug supply

These health services are composed for simple tasks. Many of them have specific names in the medical domain and are represented in the GCM Details level. For example the components of physical examination are: General inspection; observation of vital signs; temperature; pulse; breath frequency; arterial blood pressure; measuring height of patient; weight and body mass assessment procedure; measurement of circumference of waist; random blood glucose measurement; examination of head and neck; ophthalmoscopy (eye fundus examination); oral examination; ear, nose and throat examination; examination of neck; cardiovascular physical examination; examination of respiratory system; exploration of abdomen; exploration of skin; examination of foot and full nervous system examination (special care to retina, deep reflexes and neuropathy in lower extremities).

B.3.4.4 Ontological Representation of the Medical Domain

Ontologies are used for naming and describing the types of components they represent as well as basic relations in the system architecture. The composition / decomposition hierarchy follows architectural principles of the system in question, thus constituting a mereological order, opposed to the taxonomic backbone of the ontology. In the medical domain, several terminologies and ontologies describe the basic concepts of the medical domain and the terms used. Some examples are LOINC [69], ICD10 [71], OBO Foundry ontologies and SNOMED CT [68]. Current medical ontologies do not meet all the criteria desired for interoperability [72]. Nevertheless, SNOMED CT is the most comprehensive ontological effort in this field

1 The list of drugs used in the glycemic control will be introduced below
2 Due its complexity is considered in a separate use case

and therefore is used as main domain ontology. Nevertheless, other terminologies or ontologies can be used for sub-domains (e.g. LOINC in the laboratory discipline). Evidence-based axioms related to the T2DM disease (e.g. if you have metabolic syndrome then you are at risk of suffering from T2DM) are not present in the current ontologies. This kind of knowledge is beyond what is commonly considered ontological, nevertheless it needs to be declared in a formal language like SPIN language. The professional (occupational) roles of human actors are defined in the International Standard Classification of Occupations (ISCO) of the International Labor Organization (ILO) [73] and specialized for health informatics in ISO 21298 Health informatics – Functional and structural roles [7]. The occupations considered for the description of the T2DM care system are medical doctor, nutritionist, dietitian, nurse, psychologist and pharmacist. Medical doctors can be generalist medical practitioner or specialist medical practitioner. Specialist medical practitioners in the context of T2DM are nephrologists, cardiologists, neurologists, surgeons and ophthalmologists. Furthermore, some additional roles are considered like family roles.

B.3.4.5 Medical Business Process Description

The behavior of the system is represented by BPMN diagrams. These diagrams consider the granularity levels, therefore, each level of granularity uses the knowledge defined by the upper granularity level, keeping the consistency of the description and reducing the repetition of relationships of similar entities. It is important to highlight that the process are ad-hoc due to the execution order can change according to politics defined by authorities. This feature facilitates the adaptive nature of the system.

Figure B.6 presents the business process of the relations networks corresponding with the care at discipline level. This process is usually performed by a hospital. However, the representation is valid for any collaborative interdisciplinary organization. The sub-process workflow fixes the 'natural' functionality of the system including the most relevant specialties in the T2DM care. The starting point in the care is frequently the General Practitioner. This health professional defines the disciplines needed for the care of the particular patient. The next step can be the emergency discipline, the diagnosis support disciplines (i.e. laboratory and imaging), or the other T2DM medical specialties. A special case is given by preventive disciplines, which can be connected with other disciplines in different ways according to the organization and contextual policies.

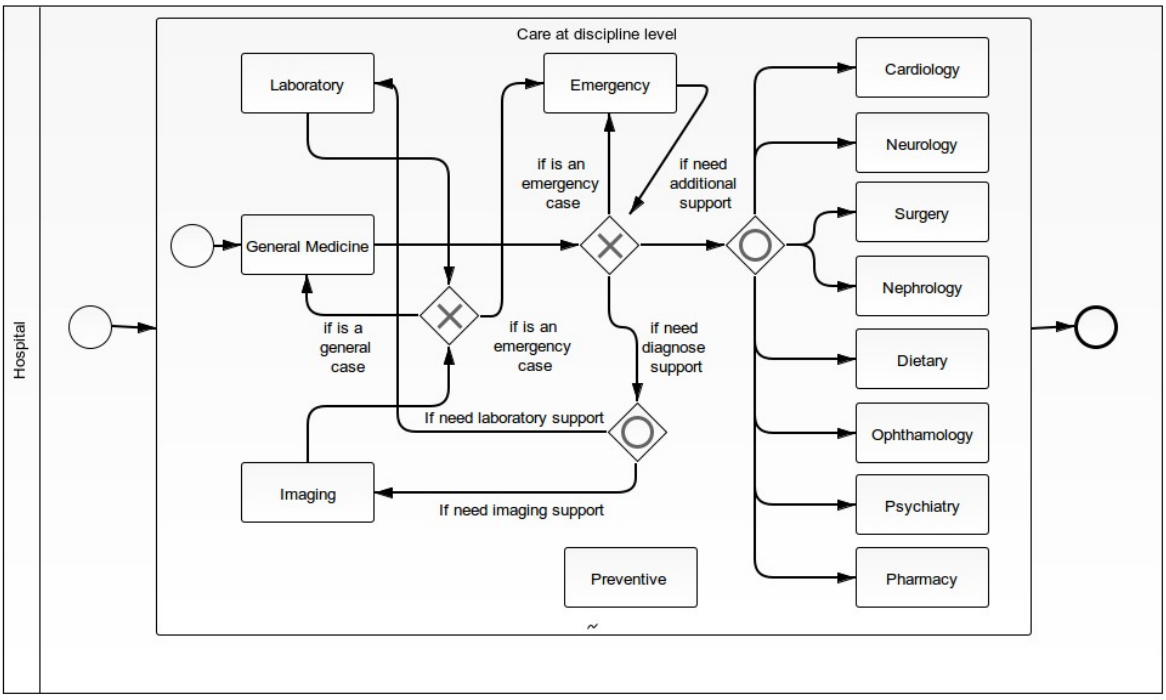

Figure B.6: Relation networks business process diagram

Figure B.7 shows the business process at a detailed granularity level. This corresponds with the care at task level and represents the tasks needed for accomplishing the services represented in the aggregation level. The relevant part of the diagram is the representation of the collaboration with the patient. Basically, the patient realizes self-observations and performs the prescription/recommendation execution. A special prescription execution is the self-monitoring due is the unique case where the patient is allowed to report self-observations without the direct presence of one health professional. The compliance task is a feedback for the health professional about the satisfactory execution of the prescription.

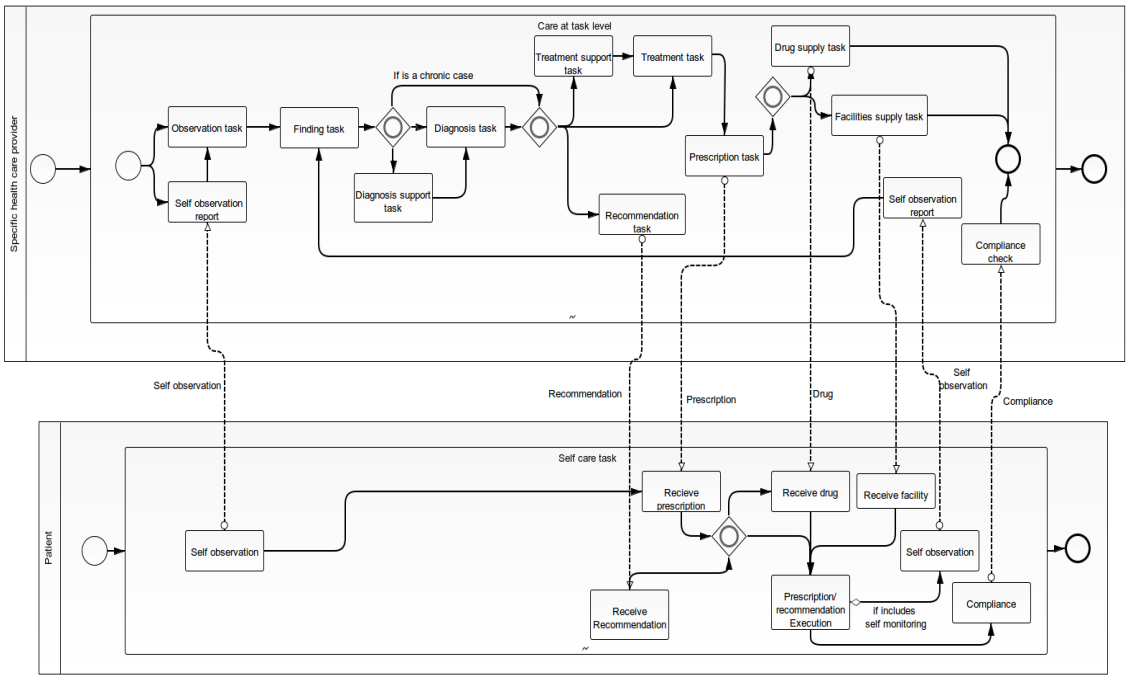

Figure B.7: Details business process diagram

B.3.4.6 Glycemic Control Business Process Description

The general medical specialties considered in the generic architecture are not restricted to the ones engaged in glycemic control, i.e. general medicine, laboratory, imagine, emergency, internal medicine, endocrinology and dietary. The dietary specialty must collaborate in the glycemic control despite the patient is treated with a pharmacological means. Figure B.8 shows the expected medical work flow in the glycemic control at the medical specialties level. The internal medicine specialty plays an important role in the disease treatment due its holistic and deep view on the body metabolism.

As presented in the GCM and UML diagrams, the medical specialty processes are composed of a set of health care services. The health care services related with the glycemic control use case are presented in the Table B.1. Figure B.9 describes the business process for the observation heath care service. The processes in this figure correspond with the Colombian medical guidelines [74].

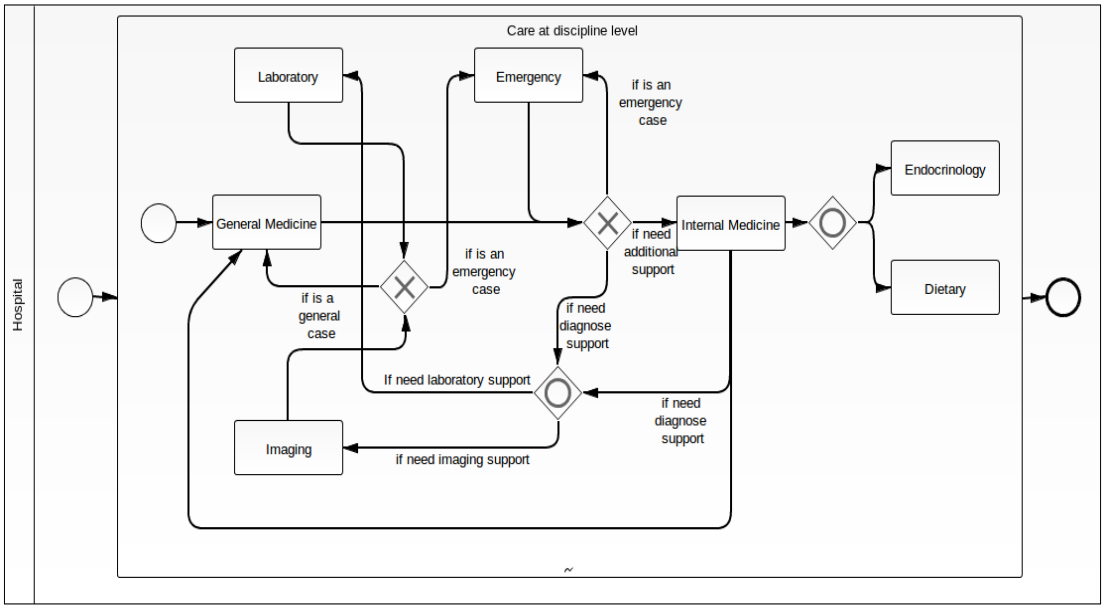

Figure B.8: GCM's Relation networks business process model

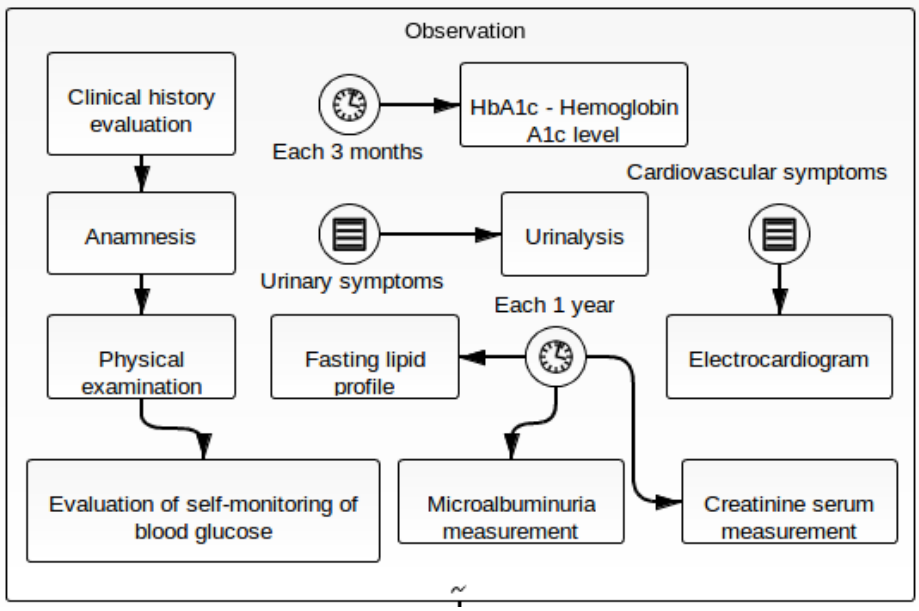

Figure B.9: Observation business process at the GCM's aggregation level

In the clinical history evaluation and in the anamnesis, the medical doctor retrieve information related with the progress of the disease from the previous document or directly from the patient's narrative. The physical examination is performed directly

over the patient's body. The self-monitoring evaluation provides to the medical doctor the information obtained by monitors as glucometers and podometers. There are some periodic examinations as HbA1c, Electrocardiogram, Urinalysis, Fasting lipid profile, Microalbuminiuria and Creatinine serum measurement.

The physical examination performed in the glycemic control is composed of a set of procedures and their execution order is presented in the Figure B.10. The main goals of those examinations are to check the general health status, to check the fulfillment of the glycemic goal, and to avoid complications associated with T2DM.

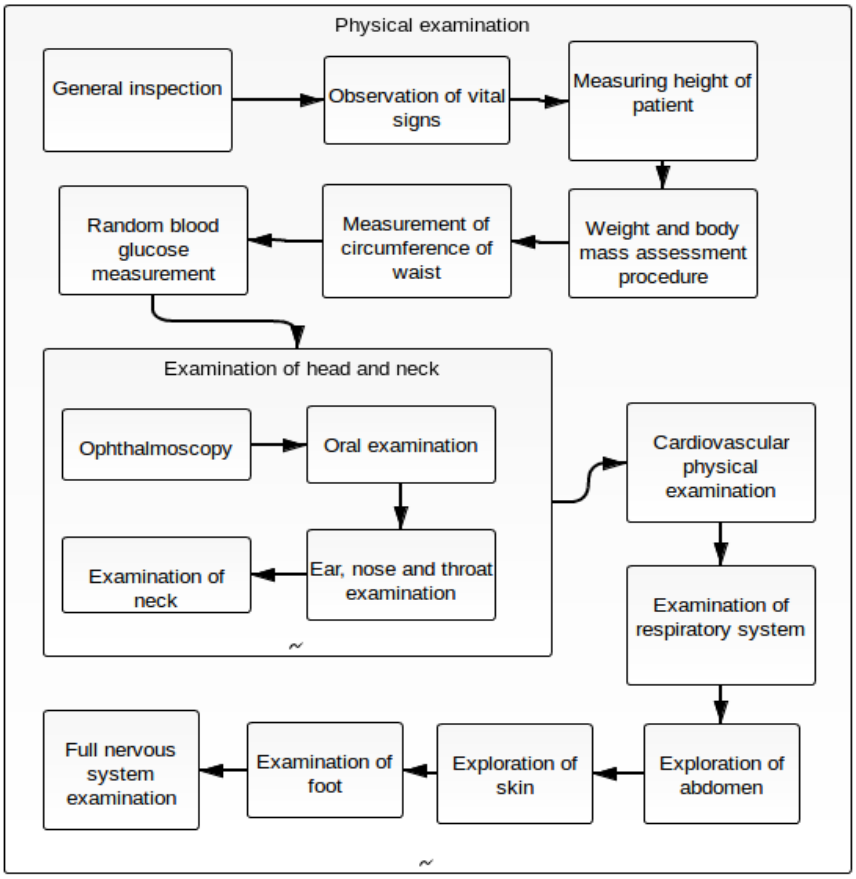

Figure B.10: Physical examination business process at the GCM's aggregation level

B.3.4.7 Medical Related Policies Definition

As was mention in previous section, the rules governing the behavior of the system are described using the SPIN language. Table B.2 give two examples, in the left column a detection of an alert case and in the right column a detection of an

emergency case.

Table B.2: Rules for the blood glucose measurement results

```
# If  (greater than 200 mg / dL) then Hyperglycemia finding (alert case)
CONSTRUCT {
   ?patient btl2:isParticipantIn _:b0 .
   _:b0 a dm2co:Hyperglycemia .
   _:b0 a dm2co:MedicalAlert .
   ?this btl2:represents _:b0 .
}
WHERE {
   ?patient btl2:isBearerOf ?blood_glucose .
   ?this btl2:represents ?blood_glucose .
   ?this dm2co:hasValueIn_mg_dL ?value .
   FILTER ((?value >= 200.0) && (?value < 300.0)) .
}
```

```
# If  (less than 50 mg / dL) then Hypoglycemia finding (emergency case)
CONSTRUCT {
   ?patient btl2:isParticipantIn _:b0 .
   _:b0 a dm2co:Hypoglycemia .
   _:b0 a dm2co:MedicalEmergency .
   ?this btl2:represents _:b0 .
}
WHERE {
   ?patient btl2:isBearerOf ?blood_glucose .
   ?this btl2:represents ?blood_glucose .
   ?this dm2co:hasValueIn_mg_dL ?value .
   FILTER (?value <= 50.0) .
}
```

The alert situation implies that the patient needs an attention by the medical doctor as soon as possible. The emergency situation implies that the patient must be attended immediately by an emergency health provider.

Other example of glycemic control alerts are represented in the Table B.3. In this case corresponds with the blood pressure result alerts. The left rule infers an alert by a hypertension situation represented in a diastolic blood pressure measurement result. The right rule infers an alert by a hypotension situation represented in a systolic blood pressure measurement result.

Table B.3: Rules for blood pressure results

```
# If  (Diastolic blood pressure greater than 90 mmHg) then Hypertension finding (alert case)
CONSTRUCT {
   ?patient btl2:isParticipantIn _:b0 .
   _:b0 a dm2co:Hypertension .
   _:b0 a dm2co:MedicalAlert .
   ?this btl2:represents _:b0 .
}
WHERE {
   ?patient btl2:isBearerOf ?blood_pressure .
   ?this btl2:represents ?blood_pressure .
   ?this dm2co:hasValueIn_mmHg ?value .
   FILTER (?value >= 90.0) .
}
```

```
# If  (Systolic blood pressure less than 60 mmHg) then Hypotension finding (alert case)
CONSTRUCT {
   ?patient btl2:isParticipantIn _:b0 .
   _:b0 a dm2co:Hypotension .
   _:b0 a dm2co:MedicalAlert .
   ?this btl2:represents _:b0 .
}
WHERE {
   ?patient btl2:isBearerOf ?blood_pressure .
   ?this btl2:represents ?blood_pressure .
   ?this dm2co:hasValueIn_mmHg ?value .
   FILTER (?value <= 90.0) .
}
```

B.3.4.8 Implementation of the Architectural Models

Currently, two implementation methods have been identified that could satisfy the principles of the GCM: The model-driven architecture approach and the semantic web

approach.

MDA models have a correspondence with the GCM viewpoints. CIM partially corresponds to the business viewpoint, and even more to the enterprise viewpoint, as those viewpoints are computation independent. However, the GCM business viewpoint describes a real world system independent of ICT ontologies, while MDA establishes an ICT development process. PIM corresponds to the informational and computational viewpoints, which are independent of any platform. PSM correspond to the technology and engineering viewpoints which relate to a specific platform.

The description of the system is divided in three aspects: structural, behavioral and functional aspects [75]–[80]. Structural (static) aspects describe time independent statements about the system. Behavioral (dynamic) aspects describe the plan of execution for the system. Functional aspects describe the purpose of the system. UML structural diagrams are used for describing the structure of the business and the related ICT system. UML activity diagrams and BPMN models are used to represent the behavioral aspect of the real system. UML use case diagrams are frequently deployed to represent functional aspects.

The full MDA approach shows difficulties to complete the automatic transformation between models, especially because automatic transformation is highly dependent of the source and target models. For example, a change in the CIM model requires a change in the subsequent transformations and in the definition of the target models. This feature makes the MDA approach less flexible. Furthermore, the languages used for the system modelling are semi-formal which entails weak semantics and lack of reasoning capabilities. Accordingly, the logic deductions that the system is capable to perform are reduced and most of the logic is hard-coded; affecting flexibility, adaptability and reuse.

The semantic web approach is based on the technologies stack [81]. Ontologies have become a key element for the development of knowledge-based systems in the web. Ontology-based systems are often combined with the definition of rules in order to achieve a formal description of the system and its service-functional requirements [6], [171], [172].

All the logic of these applications is managed by queries, ontologies and rules. This approach has strong logic formalization, and the developed systems are able to perform intelligent deductions. However, this approach shows difficulties in representing behavioral aspects [80]. There are many alternatives to RIF/SWRL for defining rules as presented in Section 1.5.5, and the SPIN language is a standardized

alternative working with SPARQL, OWL and RDFS.

In this paper is proposed a hybrid approach in order to avoid the weaknesses of these approaches. This combines the BPMN and ontologies framed into the GCM principles to transform the initial models into executable models. For each GCM viewpoint, the models are adapted according to some inputs required for the development process (Figure B.11).

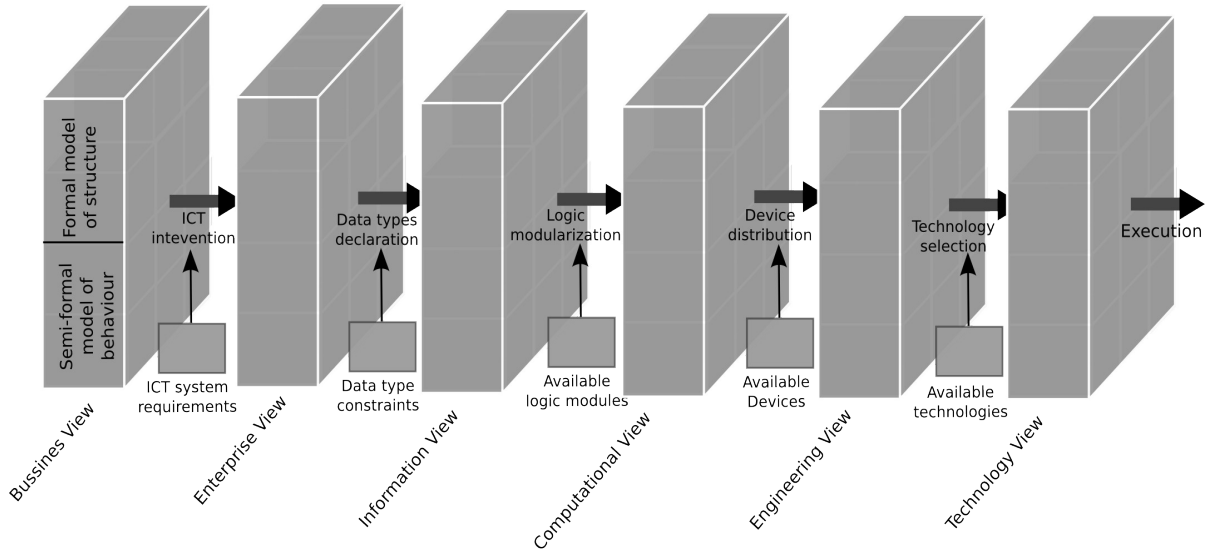

Figure B.11: Proposed approach

In the approach, the Business View corresponds with the architectural description presented in previous sections. This description includes formal models using OWL and SPIN languages, and semi-formal models of the behavior using BPMN languages.

The Enterprise View defines the roles, activities and policies statements of the specified system [84]. The actors' roles into the system can be classified with the following classes: health organization staff, self-care actor, organizational administrator, and resource chief. The actors with the health organization role perform the medical discipline processes. The specific process and policies for each individual role are defined in the system's rules. Self-care actor role represents the actors that are involved in the self-care task, e.g. the patient or the caregiver. Actors with the organization administrator role defines rules governing the organization where the medical processes are performed. The “Resource Chief” role inheres in the all the actors in charge to perform the resource management, i.e. location chief, human resource chief, software chief, device chief, equipment chief, and pharmacist. The actor with the role “Resource Chief” are in charge of managing the entities

represented in the resource domain.

Information View defines the semantics of information [84], this was already defined in the ontology. The description provided was computation independent. Therefore, the datatypes of the information were ignored. In our approach, the entities representing data are btl2:InformationObject individuals. These entities are the only ones that use datatypes in a computation sense. The next table shows some examples of datatypes constraints.

Class	Datatype Property	Range
dm2co:BloodGlucoseMeasurementResult	dm2co: hasValueIn_mg_dL	xsd:float
	dm2co:hasValueIn_mmol_L	xsd:float
btl2:InformationObject	dm2co:hasValue	xsd:string
btl2:represents some dm2co:Age	dm2co:hasValueIn_years	xsd:positiveInteger
dm2co:BloodPressureMeasurementResult	dm2co:hasValueIn_mmHg	xsd:float

Table B.4: Datatype constraints

Computation View corresponds with the functional decomposition of the system [84]. A functional decomposition can be performed based on the information cycle given in any collaboration [85], [86]. Figure B.12 shows the cycle and the functional components of the system (in italics and gray).

In the information cycle, the data is interpreted to get information, based on the information, a decision is made and then the corresponding actions are performed. Finally, the actions are observed in order to obtain new data. All the cycle is based on the knowledge of the executor. Computational systems that support collaboration need to implement that cycle. The DataRepository component is in charge of the data storage. The DataInterpreter is in charge to perform the interpretation of the data, obtaining the information according to the knowledge formalized. The DataMapper component maps the information to the knowledge of other actors involved in the current process. The Planner component is in charge of the decision-making process. This functional component creates an execution plan based on the information. The ExecutionController takes as input the plan, proceeds to assist the actors in the execution of that plan and performs the actions that he is able to do. Finally, the ExecutionListener is in charge of the observation of the process execution in order to get new information relevant in the collaboration. Additionally to these components are defined the ExecutionEngine, the Reasoner and the UserInterfaces components, that are implemented and available as open-source projects.

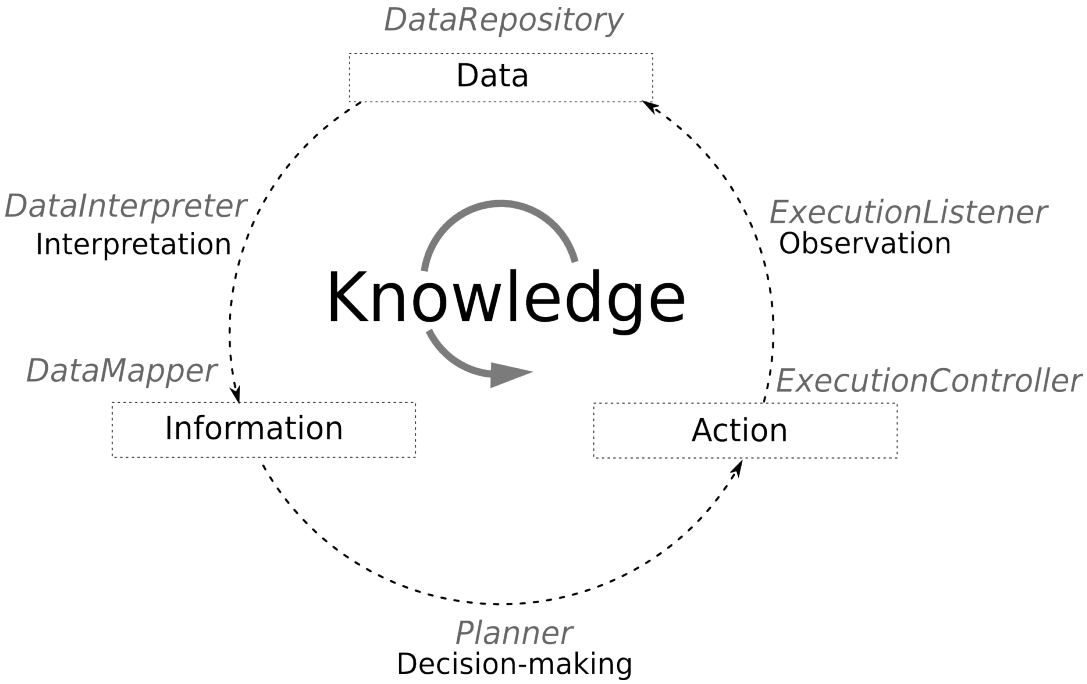

Figure B.12: Functional components based on the information cycle, after [85] (changed)

Engineering View enables the modelling of the service machine that supports the execution of the computational specification [84]. This model is usually provided to identify the distributed nodes (devices) in the system that supports the computational view. The devices of the self-care actors and the devices of the health professional staff are clients of the user interfaces. Each actor, can only use the interfaces to enable its corresponding contributions. There are a “Middleware Node” including most of the computational components except the DataRepository that is allocated in its corresponding node.

Finally, the technology view describes the implementation of the system in terms of a configuration of technology objects representing the hardware and software components of the implementation [84]. In this view, the technologies used to implement the functional components are selected. For the ExecutionEngine functional component was selected the CamundaBPMN version 7.3 [87], for the Reasoner component was selected the SPIN Rule Reasoner in its version 1.4 and for the DataRepository was selected the VirtuosoOpenlink Server version 6.1 [88]. The rest of the functional component were implemented using the Spring Framework version 4.1.7 [89].

B.3.4.9 Service Pilot Evaluation

The quantitative formal experiment was selected using the criteria in the method selection table provided by the DESMET methodology [90], which includes the evaluation context, the nature of the research object, the impact, maturity and learning curve of the service and the researchers capability undertaking the evaluation. The experiment design follows the recommendations of the method for software engineering planning described by Wohlin et al. [91]. The objective of the experiment is to evaluate the interoperability of the proposed system by analyzing the effectiveness of the recommendations offered by the system to the users (actors) in order to support their decision making process. Figure B.13 outlines the experiment.

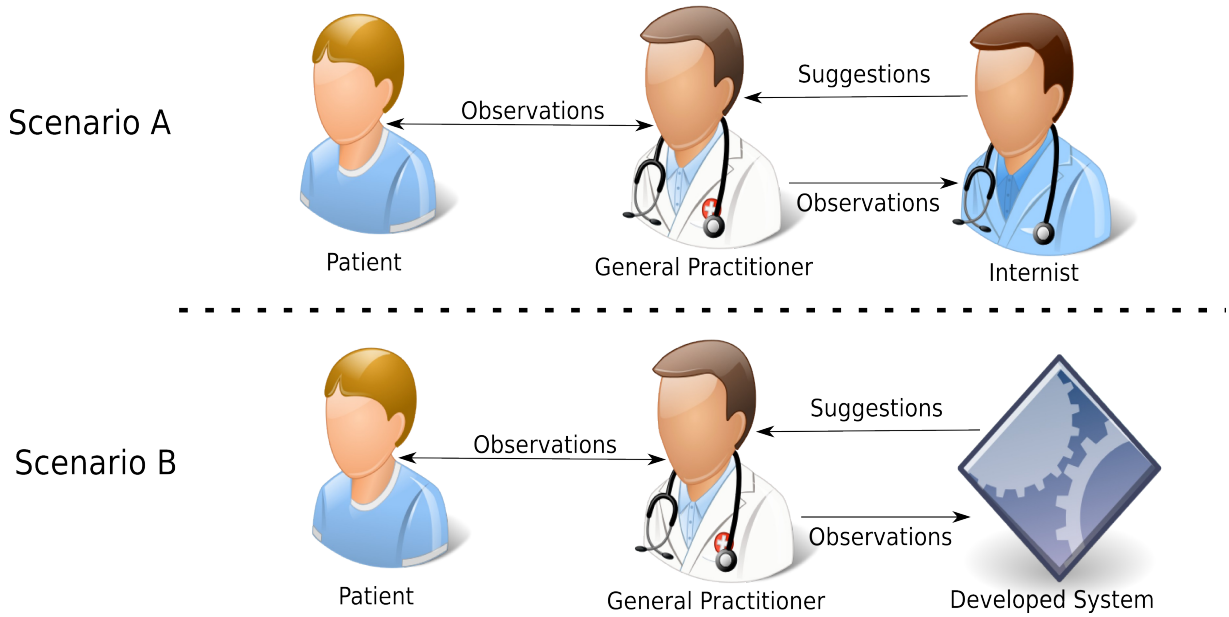

Figure B.13: Description of the experiment design

The experiment compares the outcome of two different scenarios. Scenario A is the collaboration between a general practitioner and an internist. This is a common scenario in the Colombian context where the endocrinologist (medical specialist in charge of caring diabetes patients) is replaced by a physician specialized in internal medicine (internist) due to the lack of endocrinologists. In this scenario, the general practitioner performs general observations and the internist offers suggestions to the general practitioner in order to take the appropriate decisions in the caring process. In scenario B, the internist is replaced by our developed system suggesting the appropriate actions. The effectiveness of the scenario B is evaluated using the outcome of the scenario A as gold standard. Therefore, the effectiveness is quantified using the precision, recall and F-measure metrics [92].

The hypothesis of the experiment is that the efficiency of the system's recommendation, measured through the F-measure, is higher than 0.71 using as gold standard the suggestions provided by an internist.

The threshold of 0.71 corresponds with the F-measure average of the algorithms C4.5 and CART evaluated for the diagnosis of diabetes [93].

The system of reference includes a medical internist working in a private health care institution of Popayán, Colombia. This internist is also professor at the University of Cauca. The internist provided 20 anonymized medical records including its observations and decisions made for these patients. The decisions made by the internist are considered equivalent to the suggestions given by him to a general practitioner.

For the scenario B the medical observations were manually introduced into the system using the user interfaces available (in English language), e.g. as demonstrated in Figure B.14.

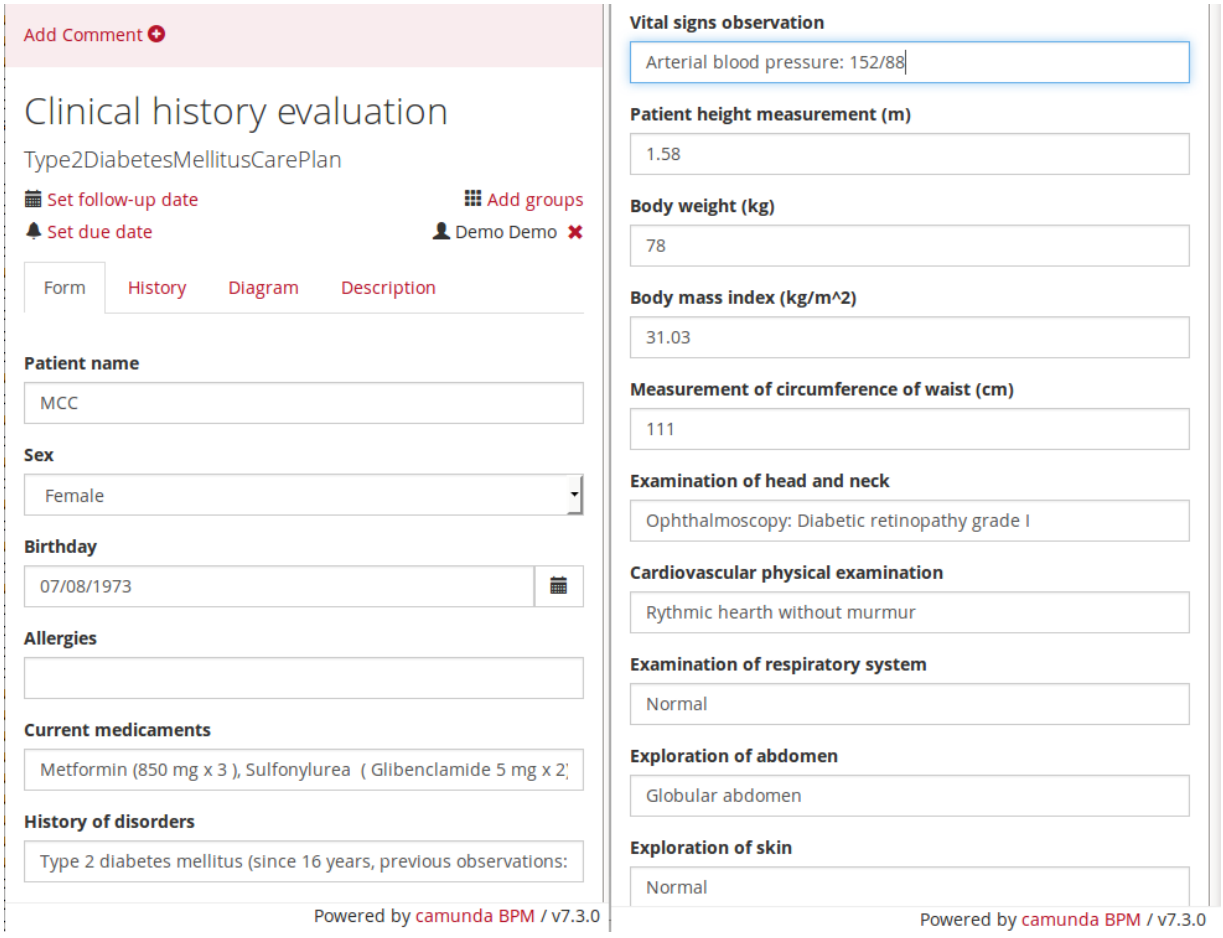

Figure B.14: Screenshots introducing the medical records

After entering all the 20 medical records the system provides as outcome, some diagnosis suggestions. Some diagnoses however, correspond to not-diabetic complications therefore are not asserted and not included in the calculation of the F-measure (e.g. Chondromalacia of patella, Mild malnutrition). Other diagnoses have not been asserted due to the difficulty to infer them using rules (e.g. No chronic complications, uncomplicated diverticular disease colon, probable primary hypothyroidism). In a first round the system infer irrelevant diagnosis (bold in Table B.5). Irrelevant diagnoses generated by the system correspond to real states of the patient, however, those diagnoses were considered medically irrelevant the context of the Colombian health systems. One reason is that those diagnoses, generally, are not included in the ICD10, which is used to classify the relevant medical diagnosis in Colombia. Therefore, in order to improve the precision of the system a new rule was implemented asserting only diagnosis included in the ICD10.

Medical doctor diagnosis	Developed system diagnosis
Type 2 diabetes mellitus	Type 2 diabetes mellitus
Peripheral diabetic neuropathy	Peripheral diabetic neuropathy
Hypertension stage 2	Hypertension stage 2
Overweight	Overweight
Scleral and hypertensive cardiopathy	Metabolic syndrome
Congestive heart failure stage II – C	Hypertriglyceridemia
Coronary artery disease	Raised fasting plasma glucose
Hypertriglyceridemia	***Surasiatic central obesity***
Metabolic syndrome	***Decreased ankle reflex***
Raised fasting plasma glucose	***Medical alert – hyperglycemia***
	Hypoesthesia
	Medical alert – hypertension

Table B.5: Comparison of medical doctor and developed system diagnosis

The results are shown in Table B.6 and Figure B.15. The mean F-measure obtained was 0.88, with a minimum value of 0,57 and a maximum value of 1. The F-measure has a standard deviation of 0.12. The mean precision is 1 and Recall is 0,82, therefore the precision of the system was 100%, and the recall is stable.

The significance of the results was evaluated with a One-Sample T-Test using the IBM SPSS Statistics software. Table B.7 presents the results of the one-sample T-test. The T-test cannot be computed to the precision variable, because the standard deviation 0. The one sample T-Test has a result that applying the new rule, the F-measure and the recall are significantly higher than the threshold value (0,71) with a value of p=0,00 and p=0,02 respectively.

	Precision	Recall	F-Measure
N			
Mean	1,00	0,82	0,89
Std. Deviation	0,00	0,19	0,13
Minimum	1,00	0,40	0,57
Maximum	1,00	1,00	1,00

Table B.6: Descriptive statistics with improved precision

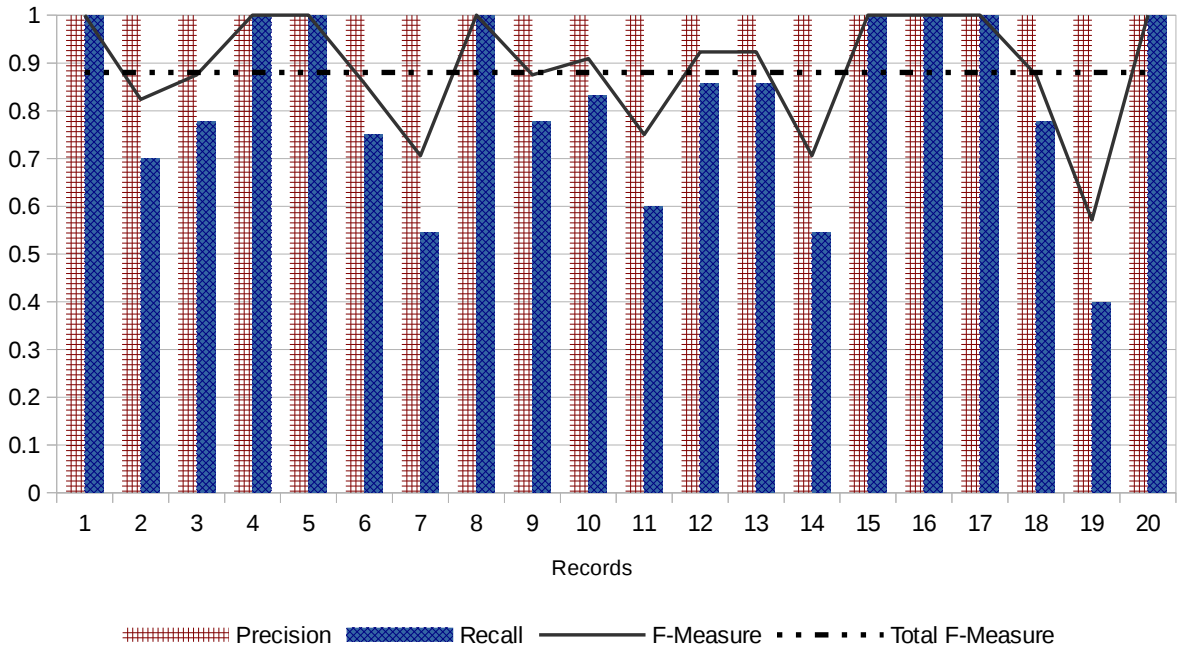

Figure B.15: F-measure results with improved precision

	Test Value = 0.71					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference Lower	Upper
F-Measure	6.46	19	0,00	0,18	0,12	0,24
Recall	2,66	19	0,02	0,11	0,02	0,20

Table B.7: One-Sample Test Improved Precision

B.3.5 Discussion

In this section some important features of the methodology used and the results are highlighted.

The separation in domains is crucial in order to keep each expert in its discipline and to set the framework for the inter-disciplinary collaboration. An important feature of the methodology is the extensive use of standards and top-level ontologies, which increases the probability of maintaining a better collaboration between the different actors.

The recursive use of abstraction and granularity level separation improves the completeness of system description. These practices hide the complexity of the system, thereby keeping up the coherence with the system described at the desired level. Software systems developed using these principles are expected to be of better quality [94] and able to support more precisely the system outside the Information and Communication Technologies (ICT) world.

The correct description of domains and contexts through the rules allows the adaptability of the system. For example, the presented system is developed using a description of the Colombian context, but it can be adapted to any country by the definition of its specific context. Furthermore, the software system is able to adapt to the medical doctor's preferred language and measurement units.

The methodology used help to extract correctly the knowledge of the experts and allow the system to be built on, and run the rules defined by, that knowledge. The presented architecture supports non-stochastic intelligence that is desired in most of the healthcare use cases. For example, the system is able to recognize a blood glucose measurement corresponding with a medical alert and send a message to the medical doctor.

The software developed provides interoperability at least in the following three ways: Controls the execution of the healthcare process according to policies and national medical guidelines and organizational protocols; supports the actors in the decision making process; and maps the information considering the heterogeneous qualities of the actors. Understanding interoperabilty as the relation between/among objects, concretely, a mutual capability necessary to ensure successful and efficient interoperation, supporting cooperation [95] or the successful collaboration between actors to achieve a certain business goal [86].

Traditional development processes like Unified Process (UP) [96] start from user requirements, identify use cases and implements the solution based on those use cases. In this way, the development team is in charge of modelling the system having in mind the types of information generated and shared during the business process. The generated models are semi-formal description of the system and are not

intended to describe the system's domain in a logic way. Therefore, at least the following problems arise:

- The models are highly dependent on the development team knowledge. Heterogeneous models from heterogeneous development teams are obtained, without a clear way of harmonization.
- The models ignore essential parts of the business domain because domain experts usually are not part of the team.
- The models cannot guarantee correct inferences using logic rules.
- Most parts of the models are specific for the correspondent business process, limiting the re-usability of components and reducing the chance of interoperability.
- There is no a clear separation between the business domain description and the description of the information objects. That makes interoperability between information models difficult.

As mentioned in Section B.3.4.3, MDA and the semantic web approach solve partially some of these problems. But a complete solution does not yet exist. The presented approach solves the aforementioned problems as follows:

- It uses top-domain and domain ontologies in order to avoid heterogeneous descriptions and allows the harmonization with related models. The ontologies are models verified by domain experts. Therefore they support the correctness of the description.
- It uses formal languages in order to enable reasoning over the models.
- It follows an architectural approach, which offers a generic description, enabling high re-usability of components and increasing the chance of interoperability.
- The viewpoints separation allows a clear distinction between business and information aspects. This is essential to provide smooth information model interoperability.

The proposed implementation process generates software solutions demanding high processing capabilities. Therefore, a large-scale evaluation is needed. Such evaluation is out of scope of the present work and is part of the proposed future work.

The efficiency of the system's recommendation, measured through the F-measure, is significantly higher than 0.71 (mean = 0,88) using as gold standard the suggestions

provided by an internist. Therefore, it can be concluded that the suggestions provided by the system are true assertions about the patient and the quality of the suggestions is unlikely to occur by chance. The precision (mean = 1) and recall (mean =0,82) are also significantly higher than the threshold value in the second test scenario. Therefore, the very high precision means that the system returned substantially more relevant recommendations than irrelevant, and the relatively high recall means that the system returned most of the relevant recommendations.

In order to improve even more the F-measure is possible to add the entities and rules corresponding with the diabetic complications and all the related findings. The definition of these entities and rules is only limited by the logic used (description logics - expressivity $\mathcal{SI}(\mathcal{D})$) and the SPIN language. However, the implementation of that entities and rules is out of scope of the present work.

Two special diagnoses found by the doctor are “No chronic complications” and “Uncomplicated diverticular disease colon” because correspond with the absence of one medical condition. Currently is unknown the mechanism to assert the medically relevant diagnoses about absence conditions, probably a machine learning algorithm can play a better role in this task.

The study had some limitations as the number of samples used, due to the difficulties to get access to patient data. A larger study with a larger number of data is recommended.

B.3.6 Conclusions

The following are the main conclusions of the paper:

- The description of systems using the GCM principles integrates the computer independent aspects that have been ignored in most alternative solutions. This enables use the formal knowledge and perform inferences, facilitating the creation of decision support systems. These types of systems are relevant for providing health services in underserved areas, where often qualified health care personal is not available.
- The architecture-centric approach considers the compositional nature of the real world system and its functionalities in the sense of a system-theoretical White Box approach, and therefore, guarantees coherence of the system model also under the perspectives of multiple different domains.
- The consideration of the top-domain and standardized ontologies facilitates the harmonization between the different domains involved in the system and

enables correct inferences for running the information cycle inherent to any collaboration.

- The level of generality used in the generic description facilitates the adaptive nature of the system and the components re-usability.
- The methodology allows considering relevant factors in order to improve the health of the T2DM patient such as clinical guidelines, alert conditions, patient safety, and emergency management.
- A method combining principles of the MDA, the Semantic Web and the Business Process description was proposed, to implement the principles of the GCM in a software solution. This method solves some problems present in traditional development processes and helps to build high quality systems. The proposed method was used to build a system working according to the models provided. The implemented system supports the collaboration between actors involved in the glycemic control use case.
- The implemented system demonstrates adaptability, intelligence, and interoperability.

Therefore, due to the advantages shown in this paper, the methodology used need to be evaluated in more detail, for example performing a large scale evaluation or a benchmarking with other methodologies.

B.3.7 Authors' Contribution

B. Blobel is the leadership in the expansion of the architectural approach of the GCM. He proposed to D. López and G. Uribe demonstrate the advantages of this methodology in the context of the T2DM. The project was developed during the PhD studies of G. Uribe under the direction of D. López and B. Blobel. During a six months stay in the Medical University of Graz, S.Schulz review and improve the ontological part of the project. A. Ruiz actuates as T2DM expert, was an important actor in the modeling of the ICT-independet modeling and contributes with the health records used in the evaluation process.

B.3.8 Acknowledgments

The work is partially funded by Colciencias grant “Crédito Educativo Condonable Programa Nacional de Formación de Investigadores – Convocatoria 528” and University of Cauca (Project ID 4092).

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Appendix C Medical Records

C.1 Medical Observations Results

C.1.1 Medical Record 1

Observation		Result
Clinical History Evaluation	Name	MCC
	Patient sex	Female
	Age	42 years
	Number of previous induced termination of pregnancy	2
	Gravida	4
	Parity	2
	Age of menopause	Unknown
	History of disorders	Type 2 diabetes mellitus (since 16 years, previous observations: { HbA1c 8.2% - 8.13% , Total cholesterol: 246 mg/dL – HDL cholesterol: 32 mg/dL – Triglyceride: 346 mg/dL, microalbuminuria measurement: 44 mg/dL, creatinine serum measurement: 1.1 mg/dL })
	Current medicaments	Metformin (850 mg x 3)
		Sulfonylurea - Glibenclamide (5 mg x 2)
	Allergies	Unknown
	Operations	Unknown

Observation		Result
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Unknown
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Acute painful diabetic neuropathy in lower limps
	Cigarette consumption	0
	Sedentary lifestyle	Unknown
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 86 pulses per minute
		Arterial blood pressure: 152/88 mmHg
	Measuring height of patient	1.58 m
	Body weight	78 Kg
	Body mass index	31.03 Kg/m2
	Circumference of waist	111 cm
	Examination of head and neck	
	Ophthalmoscopy	Diabetic retinopathy grade I
	Cardiovascular physical examination	Rythmic hearth without murmur
	Examination of respiratory system	Unknown
	Exploration of abdomen	Globular abdomen
	Exploration of skin	Unknown
	Examination of foot	Decreased pulses in the lower limbs

Observation		Result
	Full nervous system examination	Touch and vibratory hypoesthesia
		Decreased ankle reflex
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	175 mg/dL
	Average post-prandial blood glucose measurement	231 mg/dL
HbA1c – Hemoglobin A1c level		7.76%
Urinalysis		Proteinuria ++
		Glucosuria ++
Electrocardiogram		Left ventricular hypertrophy
		Diffuse repolarization abnormalities
Fasting lipid profile	Total cholesterol	217 mg/dL
	HDL cholesterol	37 mg/dL
	Triglyceride	278 mg/dL
Microalbuminuria measurement		27 mg/dL
Creatinine serum measurement		1.07 mg/dL
Diagnosis		
Type 2 diabetes mellitus (Poorly controlled)		
Peripheral diabetic neuropathy		
Hypertension stage 1		
Obesity class I		
Metabolic syndrome		
Hypertriglyceridemia		
Raised fasting plasma glucose		

C.1.2 Medical Record 2

Observation		Result
Clinical History Evaluation	Name	AAFE
	Patient sex	Male
	Age	64 years
	History of disorders	Type 2 diabetes mellitus (since 30 years, many hospitalization due to hypertensive crisis and

Observation		Result
		anginal pain, previous observations: { HbA1c 8.1% - 8.0% , Total cholesterol: 189 mg/dL – HDL cholesterol: 30 mg/dL – Triglyceride: 278 mg/dL, microalbuminuria measurement: 78 mg/dL, creatinine serum measurement: 1.67 mg/dL })
	Current medicaments	Insulin (glargine 28 UI x night)
		Enalapril (20 mg x day)
		Furosemida (100 mg x day)
		Metoprolol (100 mg x day)
		Aspirin (100 mg x day)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Unknown
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	Yes
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 59 pulses per minute
		Arterial blood pressure:

Observation		Result
		174/92 mmHg
	Measuring height of patient	1.75 m
	Body weight	82 Kg
	Body mass index	26.7 Kg/m2
	Circumference of waist	102 cm
	Examination of head and neck	
	Ophthalmoscopy	Diabetic retinopathy grade III
	Cardiovascular physical examination	Cardiovascular poor functional capacity
	Examination of respiratory system	Sign of hypertrophy of VI
		Alveolar basal stertor
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Grade I edema of the lower limbs
	Full nervous system examination	Touch and vibratory hypoesthesia
		Decreased ankle reflex
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	189 mg/dL
	Average post-prandial blood glucose measurement	233 mg/dL
HbA1c – Hemoglobin A1c level		7.70%
Urinalysis		Proteinuria +
		Glucosuria +
		Waxy casts +
Electrocardiogram		Antigua necrosis underside
		No arrhythmia or acute ischemia
		Diffuse repolarization abnormalities
Fasting lipid profile	Total cholesterol	193 mg/dL
	HDL cholesterol	28 mg/dL
	Triglyceride	312 mg/dL
Microalbuminuria measurement		123 mg/dL
Creatinine serum measurement		1.72 mg/dL

Diagnosis
Type 2 diabetes mellitus
Peripheral diabetic neuropathy
Hypertension stage 2
Overweight
Scleral and hypertensive cardiopathy
Congestive heart failure stage II – C
Coronary artery disease
Metabolic syndrome
Hypertriglyceridemia
Raised fasting plasma glucose

C.1.3 Medical Record 3

Observation		Result
Clinical History Evaluation	Name	ABSG
	Patient sex	Female
	Age	74 years
	Number of previous induced termination of pregnancy	0
	Gravida	5
	Parity	5
	Age of menopause	51 years
	History of disorders	Hypertension (since 24 years)
		Cardiac arrhythmia (paroxysmal atrial fibrillation, few symptomatic)
		Chronic kidney disease stage 3
		Type 2 diabetes mellitus (since 24 years, previous observations: { self-monitoring blood glucose: 167 mg/dL ,HbA1c 9.3% - 8.9% , Total cholesterol: 181 mg/dL – HDL cholesterol: 34 mg/dL – Triglyceride: 242 mg/dL, microalbuminuria

Observation		Result
		measurement: 67 mg/dL, creatinine serum measurement: 0.98 mg/dL, ECG: sinus rhythm })
	Current medicaments	Warfarin (5 mg x day)
		Metopolol (50 mg x day)
		Valsartan (160 mg x day)
		Furosemide (20 mg x day)
		Amlodipine (10 mg x day)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Unknown
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Refers not abnormal bleeding from skin or mucous membranes
	Observation of vital signs	Pulse: 73 pulses per minute
		Arterial blood pressure: 162/86 mmHg
	Measuring height of patient	1.52 m
	Body weight	68 Kg

Observation		Result
	Body mass index	29.45 Kg/m2
	Circumference of waist	107 cm
	Examination of head and neck	
	Ophthalmoscopy	Unknown
	Oral examination	Hydrated, oral candidiasis and buccal mucosa candidiasis
	Cardiovascular physical examination	Rythmic hearth without murmur
	Examination of respiratory system	Unknown
	Exploration of abdomen	Globular abdomen
		Small left inguinal hernia
	Exploration of skin	Bruising in forearms (few)
	Examination of foot	Normal pulse
		No edema
	Full nervous system examination	Touch and vibratory hypoesthesia
		Normal reflex
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	178 mg/dL
	Average post-prandial blood glucose measurement	198 mg/dL
HbA1c – Hemoglobin A1c level		8.20%
Urinalysis		Proteinuria -
		Leukocytes +
		Bacteria ++
		Glucosuria -
Electrocardiogram		Sinus rhythm (74 per minute, PR: 0.17 ms)
		No arrhythmias, no ischemia without signs of LVH
Fasting lipid profile	Total cholesterol	174 mg/dL
	HDL cholesterol	35 mg/dL
	Triglyceride	267 mg/dL
Microalbuminuria measurement		46 mg/dL
Creatinine serum measurement		0.99 mg/dL

Diagnosis
Type 2 diabetes mellitus (Poorly controlled)
Peripheral diabetic neuropathy
Hypertension stage 2
Overweight
Controlled paroxysmal atrial fibrillation
Oral candidiasis
Scleral and hypertensive cardiopathy
Metabolic syndrome
Hypertriglyceridemia
Raised fasting plasma glucose

C.1.4 Medical Record 4

Observation		Result
Clinical History Evaluation	Name	JAGT
	Patient sex	Male
	Age	35 years
	History of disorders	Type 2 diabetes mellitus (since 3 years, asymptomatic, previous observations: { HbA1c 7.15% - 7.3% , Total cholesterol: 176 mg/dL – HDL cholesterol: 35 mg/dL – Triglyceride: 120 mg/dL, microalbuminuria measurement: 15 mg/dL, creatinine serum measurement: 0.5 mg/dL })
	Current medicaments	None
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown

Observation		Result
	Occupation	Bank employee
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Pressure pain in medial aspect of right knee
		Cracking sound in flexion of right knee
	Observation of vital signs	Normal pulse
		Normal arterial blood pressure
	Measuring height of patient	Unknown
	Body weight	Unknown
	Body mass index	Normal BMI
	Circumference of waist	Unknown
	Examination of head and neck	
	Ophthalmoscopy	Unknown
	Cardiovascular physical examination	Cardiovascular poor functional capacity
	Examination of respiratory system	Sign of hypertrophy of VI
		Alveolar basal stertor
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Grade I edema of the lower limbs
	Full nervous system examination	Touch and vibratory hypoesthesia
		Decreased ankle reflex

Observation		Result
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	126 mg/dL
	Average post-prandial blood glucose measurement	178 mg/dL
HbA1c – Hemoglobin A1c level		7.10%
Urinalysis		No Proteinuria
		No Glucosuria
		Normal
Electrocardiogram		Normal
		No arrhythmia or ischemia or hypertrophy
Fasting lipid profile	Total cholesterol	134 mg/dL
	HDL cholesterol	38 mg/dL
	Triglyceride	92 mg/dL
Microalbuminuria measurement		15 mg/dL
Creatinine serum measurement		0.5 mg/dL
Diagnosis		
Type 2 diabetes mellitus (Controlled)		
Chondromalacia of patella		
Raised fasting plasma glucose		

C.1.5 Medical Record 5

Observation		Result
Clinical History Evaluation	Name	JEMN
	Patient sex	Female
	Age	19 years
	Number of previous induced termination of pregnancy	0
	Gravida	0
	Parity	0
	Age of menopause	Unknown
	History of disorders	Diabetic cetoacidosis (hospitalization per four days)
		Type 1 diabetes mellitus (since 1 year 15 months, previous observations:

Observation		Result
		{ HbA1c 10.4% - 10.1% , Total cholesterol: 187 mg/dL – HDL cholesterol: 32 mg/dL – Triglyceride: 345 mg/dL, microalbuminuria measurement: 12 mg/dL, creatinine serum measurement: 0.34 mg/dL })
	Current medicaments	Insulin (Lispro 6 UI x preprandial)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Bachelor
	Place of origin	Unknown
	Occupation	Student
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Anxious and very worried about their disease and its future
		Normal application sites of insulin, no data of local infection

Observation		Result
	Observation of vital signs	Normal pulse
		Normal arterial blood pressure
	Measuring height of patient	1.59 m
	Body weight	45 Kg
	Body mass index	17.71 Kg/m2
	Circumference of waist	65 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Normal
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Normal
	Exploration of skin	Normal
	Examination of foot	Normal
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	234 mg/dL
	Average post-prandial blood glucose measurement	351 mg/dL
HbA1c – Hemoglobin A1c level		9.60%
Urinalysis		Glucosuria ++
Electrocardiogram		Normal
		No arrhythmia or ischemia or hypertrophy
Fasting lipid profile	Total cholesterol	157 mg/dL
	HDL cholesterol	34 mg/dL
	Triglyceride	324 mg/dL
Microalbuminuria measurement		14 mg/dL
Creatinine serum measurement		0.4 mg/dL
Diagnosis		
Type 1 diabetes mellitus (Partially controlled)		
Mild malnutrition		
Underweight		

Observation	Result
Hypertriglyceridemia	

C.1.6 Medical Record 6

Observation		Result
Clinical History Evaluation	Name	BERP
	Patient sex	Female
	Age	49 years
	Number of previous induced termination of pregnancy	0
	Gravida	4
	Parity	4
	Age of menopause	Unknown
	History of disorders	Hyperglycemia in diabetic type PRT hysterectomy (five years ago)
		Type 2 diabetes mellitus (since 5 years, previous observations: {HbA1c 7.8% - 7.4% , Total cholesterol: 183 mg/dL – HDL cholesterol: 46 mg/dL – Triglyceride: 109 mg/dL, microalbuminuria measurement: 31 mg/dL, creatinine serum measurement: 0.89 mg/dL })
		No previous hypertension or hyperglycemia
	Current medicaments	Sulfonylurea (Glimepiride 4 mg x 2 before breakfast and lunch)
	Allergies	Penicillin
		Local anesthetics
	Operations	Hysterectomy
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown

Observation		Result
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Unknown
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 67 pulses per minute
		Arterial blood pressure: 137/87 mmHg
	Measuring height of patient	1.54 m
	Body weight	58 Kg
	Body mass index	24.3 Kg/m2
	Circumference of waist	65 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Unknown
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Abdomen soft
		Hysterectomy scar type pfannenstiel
	Exploration of skin	Unknown
	Examination of foot	Normal
	Full nervous system	Normal

Observation		Result
	examination	
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	132 mg/dL
	Average post-prandial blood glucose measurement	189 mg/dL
HbA1c – Hemoglobin A1c level		7.10%
Urinalysis		Normal
Electrocardiogram		Normal
Fasting lipid profile	Total cholesterol	156 mg/dL
	HDL cholesterol	44 mg/dL
	Triglyceride	97 mg/dL
Microalbuminuria measurement		23 mg/dL
Creatinine serum measurement		0.9 mg/dL
Diagnosis		
Type 2 diabetes mellitus (controlled)		
No chronic complications		
Climacteric		
History of allergies to local anesthetics		
Prehypertension		
Raised fasting plasma glucose		

C.1.7 Medical Record 7

Observation		Result
Clinical History Evaluation	Name	JCV
	Patient sex	Male
	Age	56 years
	History of disorders	Extreme wound healing delay
		Type 2 diabetes mellitus (since 8 years, previous observations: { HbA1c 8.4% - 8.4% , Total cholesterol: 195 mg/dL – HDL cholesterol: 27 mg/dL – Triglyceride: 322 mg/dL, microalbuminuria measurement: 75 mg/dL, creatinine serum

Observation		Result
		measurement: 1.26 mg/dL })
		Hypertriglyceridemia
		Does not meet dietary guidelines
		Recurrent prostatitis
		Heavy smoker
		Chronic cough (since 3 years)
	Current medicaments	Metformin (850 mg x 2)
		Depeptidyl peptidase IV inhibitor (sitagliptin 50 mg x day, since 7 months)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Rural area of Popayan
	Occupation	Stock clerk
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	>20
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Small linear hypertrophic scars
	Observation of vital signs	Pulse: 89 per min
		Arterial blood pressure: 144/94 mmHg

Observation		Result
	Measuring height of patient	1.66 m
	Body weight	76 Kg
	Body mass index	27.4 Kg/m2
	Circumference of waist	Unknown
	Examination of head and neck	
	Ophthalmoscopy	Chronic conjunctivitis
	Cardiovascular physical examination	P2 reinforced
		Tricuspid diastolic murmurs
	Examination of respiratory system	Breath sounds in both lungs
		No rales or wheezing
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Grade I pedal edema
		Decreased pulse in lower limbs
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	156 mg/dL
	Average post-prandial blood glucose measurement	208 mg/dL
HbA1c – Hemoglobin A1c level		8.20%
Urinalysis		Proteinuria -
		Glucosuria +
		Waxy casts +
		Erythrocytes eumorphic 10 x field
Electrocardiogram		Rhythm sinus
		QRS axis shifted to the right
		Lock right branch of bundle of Hiss
		No ischemia
		Probable bi-ventricular overload
Fasting lipid profile	Total cholesterol	177 mg/dL
	HDL cholesterol	28 mg/dL

Observation	Result
Triglyceride	286 mg/dL
Microalbuminuria measurement	71 mg/dL
Creatinine serum measurement	1.28 mg/dL

Diagnosis
Type 2 diabetes mellitus
Chronic obstructive pulmonary disease and chronic bronchitis
Active heavy smoker
Chronic prostatitis
Pulmonary arterial hypertension
Hypertriglyceridemia
Arteriosclerosis
Chronic cor pulmonale
Hypertension stage 1
Overweight
Raised fasting plasma glucose

C.1.8 Medical Record 8

Observation		Result
Clinical History Evaluation	Name	JBT
	Patient sex	Male
	Age	48 years
	History of disorders	Very poor diet
		Type 2 diabetes mellitus (since 8 years, polydipsia, polyuria, slow increase in weight, previous observations: { HbA1c 7.7% - 7.6% , Total cholesterol: 193 mg/dL – HDL cholesterol: 32 mg/dL – Triglyceride: 203 mg/dL, microalbuminuria measurement: 78 mg/dL, creatinine serum measurement: 1.1 mg/dL })
	Current medicaments	Metformin (850 mg x 2,

Observation		Result
		it does not follow strictly)
		Acetylsalicylic acid (100 mg x 1, since 2 years, recommended by a friend)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	School teacher
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	Yes
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Normal Pulse
		Normal arterial blood pressure
	Measuring height of patient	Unknown
	Body weight	Unknown
	Body mass index	Normal
	Circumference of waist	Unknown
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Cardiovascular physical examination	Normal

Observation		Result
	Examination of respiratory system	Normal
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Touch and vibratory hypoesthesia
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	188 mg/dL
	Average post-prandial blood glucose measurement	188 mg/dL
HbA1c – Hemoglobin A1c level		7.10%
Urinalysis		Normal
Electrocardiogram		Normal
		No arrhythmia or ischemia or hypertrophy
Fasting lipid profile	Total cholesterol	176 mg/dL
	HDL cholesterol	31 mg/dL
	Triglyceride	221 mg/dL
Microalbuminuria measurement		74 mg/dL
Creatinine serum measurement		1.2 mg/dL
Diagnosis		
Type 2 diabetes mellitus		
Peripheral diabetic neuropathy		
Hypertriglyceridemia		
Raised fasting plasma glucose		

C.1.9 Medical Record 9

Observation		Result
Clinical History Evaluation	Name	NMCh
	Patient sex	Female
	Age	62 years
	Number of previous induced termination of pregnancy	0
	Gravida	1
	Parity	1

Observation		Result
	Age of menopause	Unknown
	History of disorders	Chronic venous insufficiency
		Type 2 diabetes mellitus (since 13 years, previous observations: {HbA1c 7.8% - 7.6% , Total cholesterol: 177 mg/dL – HDL cholesterol: 32 mg/dL – Triglyceride: 231 mg/dL, microalbuminuria measurement: 72 mg/dL, creatinine serum measurement: 1.2 mg/dL })
		pedal and in soleus edema with pain to standing
	Current medicaments	(Dipeptidyl peptidase IV inhibitor (Vildagliptin 50 mg) / metformin 1g) (before breakfast and lunch)
	Allergies	Unknown
	Operations	Cholecystectomy
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Housewife
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	Unknown
	Feeling stressed	Unknown

Observation		Result
	Family history	Unknown
Physical Examination	General Inspection	Grade II colloid goiter
	Observation of vital signs	Pulse: 77 pulses per minute
		Arterial blood pressure: 138/88 mmHg
	Measuring height of patient	1.55 m
	Body weight	78 Kg
	Body mass index	31.26 Kg/m2
	Circumference of waist	119 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Unknown
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Abdomen globular
	Exploration of skin	Unknown
	Examination of foot	Signs of venous insufficiency of the lower limbs
		Grade II edema
		Ulcer right internal supramalleolar
	Full nervous system examination	Decreased ankle reflex
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	167 mg/dL
	Average post-prandial blood glucose measurement	234 mg/dL
HbA1c – Hemoglobin A1c level		7.82%
Urinalysis		Glucosuria +
Electrocardiogram		Normal
Fasting lipid profile	Total cholesterol	183 mg/dL
	HDL cholesterol	31.4 mg/dL
	Triglyceride	247 mg/dL
Microalbuminuria measurement		71 mg/dL

Observation	Result
Creatinine serum measurement	1.12 mg/dL
Diagnosis	
Type 2 diabetes mellitus	
Grade II colloid goiter	
Chronic Hashimoto thyroiditis	
Class I Obesity	
Chronic venous insufficiency	
Lower limb venous ulcer right	
Probable primary hypothyroidism	
Hypertriglyceridemia	
Prehypertension	
Human metabolic syndrome	
Peripheral diabetic neuropathy	
Raised fasting plasma glucose	

C.1.10 Medical Record 10

Observation		Result
Clinical History Evaluation	Name	VFF
	Patient sex	Female
	Age	52 years
	Number of previous induced termination of pregnancy	1
	Gravida	3
	Parity	2
	Age of menopause	Unknown
	History of disorders	Type 2 diabetes mellitus (since 10 years, previous observations: {HbA1c 6.82% - 6.73% , Total cholesterol: 167 mg/dL – HDL cholesterol: 35 mg/dL – Triglyceride: 164 mg/dL, microalbuminuria measurement: 21 mg/dL, creatinine serum measurement: 0.9

Observation		Result
		mg/dL })
	Current medicaments	Sulfonylurea (glibenclamida 5 mg x2)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Cauca urban area
	Occupation	Housewife
	Type of accomodation	Apartment
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Without symptoms of hyperglycemia
		Tendency to loose stools at night
		Paresthesias in the toes, especially in nights
	Cigarette consumption	0
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 69 pulses per minute
		Arterial blood pressure: 140/92 mmHg
	Measuring height of patient	1.62 m
	Body weight	66 Kg
	Body mass index	25 Kg/m2
	Circumference of waist	70 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal

Observation		Result
	Oral examination	Unknown
	Cardiovascular physical examination	No arrhythmias, no murmurs, no signs of LVH
	Examination of respiratory system	Normal
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Touch and vibratory hypoesthesia
	Full nervous system examination	Decreased ankle reflex
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	108 mg/dL
	Average post-prandial blood glucose measurement	119 mg/dL
HbA1c – Hemoglobin A1c level		6.61%
Urinalysis		Normal
Electrocardiogram		Diffuse and non-specific disorders of the ventricular repolarization high side face
Fasting lipid profile	Total cholesterol	161 mg/dL
	HDL cholesterol	31 mg/dL
	Triglyceride	130 mg/dL
Microalbuminuria measurement		19 mg/dL
Creatinine serum measurement		0.88 mg/dL
Diagnosis		
Type 2 diabetes mellitus (controlled)		
Peripheral diabetic neuropathy		
Intestinal autonomic neuropathy		
Stage I Hypertension		
Overweight		
Raised fasting plasma glucose		

C.1.11 Medical Record 11

Observation		Result
Clinical History Evaluation	Name	MTChR
	Patient sex	Female

Observation		Result
	Age	32 years
	Number of previous induced termination of pregnancy	0
	Gravida	3
	Parity	3
	Age of menopause	Unknown
	History of disorders	Type 2 diabetes mellitus (since 2 years, previous observations: {HbA1c 6.8% - 6.71% , Total cholesterol: 142 mg/dL – HDL cholesterol: 37 mg/dL – Triglyceride: 189 mg/dL, microalbuminuria measurement: 32 mg/dL, creatinine serum measurement: 0.56 mg/dL })
		Leukorrhea
		Two urinary infections last year
	Current medicaments	Metformin (850 mg x 3 preprandial)
	Allergies	Unknown
	Operations	Tubal ligation
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	House kepeer
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0

Observation		Result
	Sedentary lifestyle	Yes
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Normal pulse
		Normal arterial blood pressure
	Measuring height of patient	Unknown
	Body weight	Unknown
	Body mass index	Normal
	Circumference of waist	Unknown
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Normal
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Depressible soft abdomen painless
	Exploration of skin	Unknown
	Examination of foot	Unknown
	Gynecological examination	Whitish vaginal discharge compatible with genital candidiasis
		Signs of cystocele (bladder prolapse)
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	167 mg/dL
	Average post-prandial blood glucose measurement	188 mg/dL
HbA1c – Hemoglobin A1c level		6.70%
Urinalysis		Bacterias +++
		Leukocytes 25-50 x field

Observation		Result
		Leukocyte esterase +
		Yeast ++
		Nitrites +++
Electrocardiogram		Normal
Fasting lipid profile	Total cholesterol	140 mg/dL
	HDL cholesterol	36 mg/dL
	Triglyceride	193 mg/dL
Microalbuminuria measurement		29 mg/dL
Creatinine serum measurement		0.52 mg/dL
Diagnosis		
Type 2 diabetes mellitus		
Recurrent urinary tract infection		
Vaginal candidiasis		
Cistocele grado 1		
Hypertriglyceridemia		
Raised fasting plasma glucose		

C.1.12 Medical Record 12

Observation		Result
Clinical History Evaluation	Name	JCER
	Patient sex	Male
	Age	41 years
	History of disorders	No proper diet
		Type 2 diabetes mellitus (since 4 years, polydipsia, polyuria, slow increase in weight, previous observations: { HbA1c 7.31% - 7.48% , Total cholesterol: 231 mg/dL – HDL cholesterol: 32 mg/dL – Triglyceride: 311 mg/dL, microalbuminuria measurement: 102 mg/dL, creatinine serum measurement: 0.9 mg/dL })

Observation		Result
	Current medicaments	Metformin (850 mg x 1, before lunch)
		Insulin (Glargin 18 UI x night)
		Amlodipine (5 mg x day)
		Acetylsalicylic acid (10 mg x day)
		Hydrochlorothiazide (12.5 mg x day)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Popayan, Cauca, Colombia
	Occupation	Urban public vehicle driver
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	Yes
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 89 per min
		Arterial blood pressure: 142/94 mmHg
	Measuring height of patient	1.7 m
	Body weight	83 Kg
	Body mass index	28.57 Kg/m2
	Circumference of waist	98 cm
	Examination of head and neck	

Observation		Result
	Ophthalmoscopy	Retinopathy grade I
	Oral examination	Mucous membranes hydrated without candidiasis
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Unknown
	Full nervous system examination	Mild hearing loss in the right ear
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	166 mg/dL
	Average post-prandial blood glucose measurement	203 mg/dL
HbA1c – Hemoglobin A1c level		7.41%
Urinalysis		Proteinuria - Glucosuria +
Electrocardiogram		Normal
		No arrhythmia or ischemia or hypertrophy
Fasting lipid profile	Total cholesterol	227 mg/dL
	HDL cholesterol	36.3 mg/dL
	Triglyceride	308 mg/dL
Microalbuminuria measurement		73 mg/dL
Creatinine serum measurement		0.98 mg/dL

Diagnosis
Type 2 diabetes mellitus
Overweight
Sensorineural hearing loss
Metabolic syndrome
Hypertension stage 1
Hypertriglyceridemia
Raised fasting plasma glucose

C.1.13 Medical Record 13

Observation		Result
Clinical History Evaluation	Name	NMN
	Patient sex	Female
	Age	50 years
	Number of previous induced termination of pregnancy	0
	Gravida	2
	Parity	2
	Age of menopause	49 years
	History of disorders	Type 2 diabetes mellitus (since 6 years, previous observations: {HbA1c 8.31% - 7.75% , Total cholesterol: 224 mg/dL – HDL cholesterol: 28 mg/dL – Triglyceride: 308 mg/dL, microalbuminuria measurement: 378 mg/dL, creatinine serum measurement: 1.67 mg/dL })
		Seropositive rheumatoid arthritis (take methylprednisolone per 14 months, syntomatic, with polyarticular commitments in wrists, fingers and feet, elbows, knees)
	Current medicaments	Leflunomida (200 mg x day)
		Insulin (glargine 18 – 22 UI x night)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown

Observation		Result
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Teacher
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	Unknown
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination		Cushingoid facies
	General Inspection	Active synovitis in right elbow, both wrists, proximal interphalangeal, distal interphalangeal, metacarpophalangeal, bilateral knees
		Sign bilateral Morton
		Flexion deformity in some proximal interphalangeal
		Vasculitis digital pads
	Observation of vital signs	Pulse: 92 per min
		Arterial blood pressure: 136/78 mmHg
	Measuring height of patient	1.51 m
	Body weight	68 Kg
	Body mass index	29.82 Kg/m2
	Circumference of waist	103 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Normal

Observation		Result
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Unknown
	Exploration of skin	Unknown
	Examination of foot	Unknown
	Full nervous system examination	Decreased ankle reflex Decreased patellar reflex Touch hypoesthesia in distal toes
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	125 mg/dL
	Average post-prandial blood glucose measurement	187 mg/dL
HbA1c – Hemoglobin A1c level		7.43%
Urinalysis		Proteinuria + Glucosuria ++ Microscopic hematuria erythrocytes x 20-30 field Hyaline casts
Electrocardiogram		General low voltage No arrhythmia or ischemia or hypertrophy
Fasting lipid profile	Total cholesterol	198 mg/dL
	HDL cholesterol	33.7 mg/dL
	Triglyceride	254 mg/dL
Microalbuminuria measurement		277 mg/dL
Creatinine serum measurement		1.78 mg/dL
Diagnosis		
Type 2 diabetes mellitus (insulin convenient)		
State cushingoid iatrogenic		
Seropositive rheumatoid arthritis functional state II-III		
Metabolic syndrome		
Probable hyperlipidemia		
Overweight/obesity		
Climacteric		
Prehypertension		

Observation	Result
Raised fasting plasma glucose	

C.1.14 Medical Record 14

Observation		Result
Clinical History Evaluation	Name	AAB
	Patient sex	Male
	Age	59 years
	History of disorders	Severe coronary heart disease
		Type 2 diabetes mellitus (since 8 years, previous observations: { HbA1c 7.02% - 6.95% , Total cholesterol: 176 mg/dL – HDL cholesterol: 32.6 mg/dL – Triglyceride: 102 mg/dL, microalbuminuria measurement: 117 mg/dL, creatinine serum measurement: 1.23 mg/dL })
		Heavy smoker
		Dyslipidemia
		Critical injuries in both coronary arteries
	Current medicaments	(Dipeptidyl peptidase IV inhibitor (Sitagliptin 50 mg) / Metformin (1g)) (1 before breakfast and dinner)
		Metoprolol (50 mg x 2)
		Clopidogrel (75 mg x day)
		Acetylsalicylic acid (100 mg x day)
		Valsartan (160 mg x day)
		(Simvastatin (40 mg)/ Ezetimibe (10 mg)) (1 x night)
	Allergies	Unknown
	Operations	Cardiac catheterization

Observation		Result
		Angioplasty in three injuries with obstructions above 90% and medicated stents placement
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Trader
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	>20
	Sedentary lifestyle	Unknown
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Loss of hair on legs distal
	Observation of vital signs	Pulse: 58 per min
		Arterial blood pressure: 128/66 mmHg
	Measuring height of patient	1.67 m
	Body weight	71 Kg
	Body mass index	25.40 Kg/m2
	Circumference of waist	78 cm
	Examination of head and neck	
	Ophthalmoscopy	Retinopathy grade I
	Examination of neck	Neck without jugular engorgement
	Cardiovascular physical examination	Tortuous and hardened carotid arteries, brachial and

Observation		Result
		humeral
	Examination of respiratory system	Markedly diminished breath sounds, some low-pitched wheezing
	Exploration of abdomen	Normal
	Exploration of skin	Unknown
	Examination of foot	No edemas
	Full nervous system examination	Touch and vibratory hypoesthesia in lower and higher members ("in half" and "gloves")
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	113 mg/dL
	Average post-prandial blood glucose measurement	165 mg/dL
HbA1c – Hemoglobin A1c level		6.72%
Urinalysis		Hyaline and granular casts Glucosuria +
Electrocardiogram		Sinus bradycardia
		T-wave inversion in the anteroseptal and lower face
		Sokoloff index (+)
		QRS axis at -30 °
		Left ventricular hypertrophy
Fasting lipid profile	Total cholesterol	164 mg/dL
	HDL cholesterol	35.4 mg/dL
	Triglyceride	Unknown
Microalbuminuria measurement		86 mg/dL
Creatinine serum measurement		1.31 mg/dL
Diagnosis		
Type 2 diabetes mellitus		
Overweight		
Peripheral diabetic neuropathy (predominantly sensory)		
Severe coronary artery disease		
Severe arteriosclerosis		
Peripheral arterial disease		
Heavy smoker		
Chronic obstructive pulmonary disease (predominance of emphysema)		
Sinus bradycardia		

Observation	Result
Raised fasting plasma glucose	

C.1.15 Medical Record 15

Observation		Result
Clinical History Evaluation	Name	FASE
	Patient sex	Male
	Age	47 years
	History of disorders	Active duodenal ulcer (2 years ago)
		Type 2 diabetes mellitus (since 9 years, previous observations: { HbA1c 7.02% - 6.95% , Total cholesterol: 176 mg/dL – HDL cholesterol: 32.6 mg/dL – Triglyceride: 102 mg/dL, microalbuminuria measurement: 117 mg/dL, creatinine serum measurement: 1.23 mg/dL })
	Current medicaments	Insulin (Detemir 24 UI x night)
		Vildagliptin (50 mg x before breakfast and lunch)
		Rosuvastatin (20 mg x night)
		Acetylsalicylic acid (100 mg x day)
		Omeprazole
	Allergies	Unknown
	Operations	Gastroscopy (2 year ago)
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Popayan, Cauca, Colombia

Observation		Result
	Occupation	Lawyer
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Paresthesias (in the posterior aspect of thighs and soleos to sit a while and improves standing)
	Cigarette consumption	0
	Sedentary lifestyle	No
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 78 per min
		Arterial blood pressure: 140/84 mmHg
	Measuring height of patient	1.69 m
	Body weight	74 Kg
	Body mass index	26.02 Kg/m2
	Circumference of waist	84 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Examination of neck	Normal
	Cardiovascular physical examination	Rhythm hearth
	Examination of respiratory system	Normal
	Exploration of abdomen	Mild tenderness in epigastrium
		No masses or organomegaly
	Exploration of skin	Unknown
	Examination of foot	No edemas
	Full nervous system	Decreased ankle reflex

Observation		Result
		Decreased patellar relfex
	examination	Touch and vibratory hypoesthesia ("in half" and "gloves")
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	121 mg/dL
	Average post-prandial blood glucose measurement	154 mg/dL
HbA1c – Hemoglobin A1c level		6.50%
Urinalysis		Normal
Electrocardiogram		Normal
		No arrhythmia or ischemia or hypertrophy
Fasting lipid profile	Total cholesterol	153 mg/dL
	HDL cholesterol	38 mg/dL
	Triglyceride	125 mg/dL
Microalbuminuria measurement		78 mg/dL
Creatinine serum measurement		0.92 mg/dL
Diagnosis		
Type 2 diabetes mellitus		
Overweight		
Peripheral diabetic neuropathy		
Stage I hypertension		
Raised fasting plasma glucose		

C.1.16 Medical Record 16

Observation		Result
Clinical History Evaluation	Name	MJChV
	Patient sex	Female
	Age	55 years
	Number of previous induced termination of pregnancy	0
	Gravida	3
	Parity	3
	Age of menopause	Unknown
	History of disorders	Type 2 diabetes mellitus (since 12 years, previous observations: {HbA1c

Observation		Result
		7.76% - 7.52% , Total cholesterol: 186 mg/dL – HDL cholesterol: 35 mg/dL – Triglyceride: 127 mg/dL, microalbuminuria measurement: 108 mg/dL, creatinine serum measurement: 1.87 mg/dL })
		Gestational diabetes in G4
		Chronic laryngitis (Gastroesophageal reflux)
	Current medicaments	Sulfonylurea (Glimepiride 4 mg x 2)
		Mosapride + omeprazole (1 x night)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	House keeper
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	Unknown
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 88 per min
		Arterial blood pressure:

Observation		Result
		136/75 mmHg
	Measuring height of patient	1.54 m
	Body weight	68 Kg
	Body mass index	28.65 Kg/m2
	Circumference of waist	94 cm
	Examination of head and neck	
	Ophthalmoscopy	Retinal exudates, no hemorrhages
	Oral examination	Congestive larynx
		Edematous uvula
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Abdomen globular pendulum
	Exploration of skin	Unknown
	Examination of foot	Unknown
	Full nervous system examination	Normal reflex
		Touch hypoesthesia in hands
		Touch hypoesthesia in feet
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	109 mg/dL
	Average post-prandial blood glucose measurement	189 mg/dL
HbA1c – Hemoglobin A1c level		7.43%
Urinalysis		Amorphous urate crystals +
		Glucosuria +
		Hyaline casts ++
Electrocardiogram		Sinus rhythm (78 x min)
		No arrhythmia or ischemia or hypertrophy
		QRS axis at -25 °
Fasting lipid profile	Total cholesterol	172 mg/dL

Observation		Result
	HDL cholesterol	36.7 mg/dL
	Triglyceride	102 mg/dL
Microalbuminuria measurement		94 mg/dL
Creatinine serum measurement		1.88 mg/dL
Diagnosis		
Type 2 diabetes mellitus		
Sensory diabetic neuropathy		
Chronic reflux laryngitis		
Gastroesophageal reflux		
Metabolic syndrome		
Overweight		
Prehypertension		
Raised fasting plasma glucose		

C.1.17 Medical Record 17

Observation		Result
Clinical History Evaluation	Name	JABB
	Patient sex	Female
	Age	41 years
	Number of previous induced termination of pregnancy	0
	Gravida	2
	Parity	2
	Age of menopause	Unknown
	History of disorders	Type 2 diabetes mellitus (since 18 months, previous observations: {HbA1c 8.12% - 7.88% , Total cholesterol: 177 mg/dL – HDL cholesterol: 35.4 mg/dL – Triglyceride: 221 mg/dL, microalbuminuria measurement: 14 mg/dL, creatinine serum measurement: 0.62 mg/dL })
		Chronic gastritis
		Diverticular disease of the

Observation		Result
		colon
	Current medicaments	Rifaximine (each month during a week)
		Omeprazole (40 x day)
		Liraglutide (1.2 mg x day)
	Allergies	Unknown
	Operations	Unknown
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Bank secretary
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	yes
	Feeling stressed	Unknown
	Family history	Unknown
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 75 per min
		Arterial blood pressure: 122/68 mmHg
	Measuring height of patient	1.42 m
	Body weight	58 Kg
	Body mass index	28.78 Kg/m2
	Circumference of waist	79 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Unknown

Observation		Result
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Abdomen slightly distended
		No signs of abdominal defense or rebound
		Minimal pain in the left lower quadrant
	Exploration of skin	Unknown
	Examination of foot	Normal
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	137 mg/dL
	Average post-prandial blood glucose measurement	189 mg/dL
HbA1c – Hemoglobin A1c level		7.63%
Urinalysis		Normal
Electrocardiogram		Normal
Fasting lipid profile	Total cholesterol	146 mg/dL
	HDL cholesterol	37.2 mg/dL
	Triglyceride	188 mg/dL
Microalbuminuria measurement		12 mg/dL
Creatinine serum measurement		0.59 mg/dL
Diagnosis		
Type 2 diabetes mellitus (controlled)		
Diverticular disease colon (uncomplicated)		
Chronic atrophic gastritis (stable)		
Overweight		
Prehypertension		
Hypertriglyceridemia		
Raised fasting plasma glucose		

C.1.18 Medical Record 18

Observation		Result
Clinical History Evaluation	Name	BOR
	Patient sex	Male
	Age	53 years
	History of disorders	Heavy smoker
		Type 2 diabetes mellitus (since 23 years, previous observations: { HbA1c 10.12% - 9.6% , Total cholesterol: 322 mg/dL – HDL cholesterol: 21 mg/dL – Triglyceride: 423 mg/dL, microalbuminuria measurement: 453 mg/dL, creatinine serum measurement: 1.67 mg/dL })
		Chronic bronchitis
		Hypertension
	Current medicaments	Insulin (Glargina 22 UI x night)
		Metformin (1 g x before breakfast, lunch and dinner)
		Inhaled formoterol
		Acetylsalicylic acid (100 mg x day)
		Amlodipine (25 mg x day)
		Hydrochlorothiazide (25 mg x day)
	Allergies	Unknown
	Operations	prostatectomy (due to adenocarcinoma, three years ago)
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown

Observation		Result
	Occupation	Trader
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Paresthesias (in the lower limbs at nights, and frankly progressive intermittent claudication)
	Cigarette consumption	>20
	Sedentary lifestyle	yes
	Feeling stressed	yes
	Family history	Unknown
Physical Examination	General Inspection	Central cyanosis
		Nail clubbing
		Chest hyperinflation
	Observation of vital signs	Pulse: 102 per min
		Arterial blood pressure: 145/94 mmHg
	Measuring height of patient	1.65 m
	Body weight	85 Kg
	Body mass index	31.23 Kg/m2
	Circumference of waist	88 cm
	Examination of head and neck	
	Ophthalmoscopy	Unknown
	Examination of neck	Unknown
	Cardiovascular physical examination	Rhythm hearth
		Strengthening the P2 and diastolic tricuspid escape
	Examination of respiratory system	Decreased breath sounds
		Diffuse rhonchi
		Some expiratory wheezing
	Exploration of abdomen	Mild tenderness in epigastrium

Observation		Result
		No masses or organomegaly
		Hepatomegaly
	Exploration of skin	Edemas until the knees
		Acrocyanosis
	Examination of foot	No edemas
	Full nervous system examination	Ankle reflex absent
		Touch hypoesthesia (in fingers and toes)
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	196 mg/dL
	Average post-prandial blood glucose measurement	231 mg/dL
HbA1c – Hemoglobin A1c level		9.30%
Urinalysis		Proteinuria ++
		Glucosuria
		Granular casts +
		Waxy cylinders +
		Normal erythrocytes 10-15 x field
Electrocardiogram		Rate of atrial fibrillation with myocardial revascularization 88 x minute
		Incomplete right bundle branch block
		Left anterior hemiblock
		Left ventricular hypertrophy
		Probable growth of right chambers
		Anteroseptal ischemia
Fasting lipid profile	Total cholesterol	267 mg/dL
	HDL cholesterol	27 mg/dL
	Triglyceride	344 mg/dL
Microalbuminuria measurement		532 mg/dL
Creatinine serum measurement		1.73 mg/dL

Diagnosis
Type 2 diabetes mellitus
Heavy smoker
Left ventricular hypertrophy

Chronic bronchitis
Hypertension
Class I Obesity
Hypertriglyceridemia
Peripheral diabetic neuropathy
Raised fasting plasma glucose

C.1.19 Medical Record 19

Observation		Result
Clinical History Evaluation	Name	MJRE
	Patient sex	Female
	Age	51 years
	Number of previous induced termination of pregnancy	0
	Gravida	0
	Parity	0
	Age of menopause	Unknown
	History of disorders	Type 2 diabetes mellitus (since 18 months, previous observations: {HbA1c 7.31% - 6.9% , Total cholesterol: 161 mg/dL – HDL cholesterol: 52 mg/dL – Triglyceride: 105 mg/dL, microalbuminuria measurement: 11 mg/dL, creatinine serum measurement: 0.45 mg/dL })
		Candida leukorrhea (during 18 months)
	Current medicaments	Dipeptidyl peptidase IV inhibitor (Linagliptin 5mg x before breakfast and lunch)
	Allergies	Unknown
	Operations	Unknown

Observation		Result
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Lawyer
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Unknown
	Cigarette consumption	0
	Sedentary lifestyle	no
	Feeling stressed	yes
	Family history	Unknown
Physical Examination	General Inspection	Fibrous bilateral breast nodules
	Observation of vital signs	Normal pulse
		Arterial blood pressure: 134/83 mmHg
	Measuring height of patient	1.47 m
	Body weight	53 Kg
	Body mass index	24.34 Kg/m2
	Circumference of waist	70 cm
	Examination of head and neck	
	Ophthalmoscopy	Normal
	Oral examination	Unknown
	Cardiovascular physical examination	Normal
	Examination of respiratory system	Normal
	Exploration of abdomen	Plain abdomen
		No pain

Observation		Result
		Without masses
	Exploration of skin	Unknown
	Examination of foot	Normal
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	97 mg/dL
	Average post-prandial blood glucose measurement	149 mg/dL
HbA1c – Hemoglobin A1c level		6.70%
Urinalysis		Yeasts
		Hyphae
		Leukocytes++
		Bacteria +
		Proteinuria -
		Glycosuria -
Electrocardiogram		Normal
Fasting lipid profile	Total cholesterol	145 mg/dL
	HDL cholesterol	55 mg/dL
	Triglyceride	98 mg/dL
Microalbuminuria measurement		13 mg/dL
Creatinine serum measurement		0.45 mg/dL
Diagnosis		
Type 2 diabetes mellitus (controlled)		
Candida leukorrhea (recurrent)		
Fibrocystic breast disease		
Work stress		
Prehypertension		

C.1.20 Medical Record 20

Observation		Result
Clinical History Evaluation	Name	NHYP
	Patient sex	Male
	Age	29 years
	History of disorders	Weight gain for 3 years
		Type 2 diabetes mellitus (since 2 years,

		previous observations: { HbA1c 7.8% - 7.5% , Total cholesterol: 188 mg/dL – HDL cholesterol: 33 mg/dL – Triglyceride: 223 mg/dL, microalbuminuria measurement: 13 mg/dL, creatinine serum measurement: 0.67 mg/dL })
		Occasional smoker
		Gonococcal urethritis (16 years, treated)
	Current medicaments	Metformin (850 mg x before breakfast, lunch and dinner)
	Allergies	Unknown
	Operations	prostatectomy (due to adenocarcinoma, three years ago)
	Ethnic group	Unknown
	Marital or partnership status	Unknown
	Vaccines	Unknown
	Religion	Unknown
Anamnesis	Educational achievement	Unknown
	Place of origin	Unknown
	Occupation	Constructor
	Type of accomodation	Unknown
	Live with pets	Unknown
	Live with parents	Unknown
	Live with partner	Unknown
	Consultation type	Glycemic control
	Symptoms	Asyntomatic
	Cigarette consumption	1 daily
	Sedentary lifestyle	yes
	Feeling stressed	Unknown
	Family history	Family with diabetes mellitus
Physical Examination	General Inspection	Unknown
	Observation of vital signs	Pulse: 94 per min

		Arterial blood pressure: 138/76 mmHg
	Measuring height of patient	1.58 m
	Body weight	78 Kg
	Body mass index	31 Kg/m2
	Circumference of waist	110 cm
	Examination of head and neck	
	Ophthalmoscopy	Unknown
	Examination of neck	Unknown
	Cardiovascular physical examination	Rhythm hearth
		No arrhythmia or ischemia or hypertrophy
	Examination of respiratory system	Bilateral alveolar hypoventilation (minimum)
	Exploration of abdomen	No pain
		No masses
	Exploration of skin	Unknown
	Examination of foot	Normal
	Full nervous system examination	Normal
Evaluation of selt-monitoring of blood glucose	Average fasting blood glucose measurement	145 mg/dL
	Average post-prandial blood glucose measurement	189 mg/dL
HbA1c – Hemoglobin A1c level		7.50%
Urinalysis		Normal
Electrocardiogram		Normal
Fasting lipid profile	Total cholesterol	176 mg/dL
	HDL cholesterol	38 mg/dL
	Triglyceride	177 mg/dL
Microalbuminuria measurement		18 mg/dL
Creatinine serum measurement		0.56 mg/dL

Diagnosis
Type 2 diabetes mellitus
Lung disease from smoking
Metabolic syndrome
Class I Obesity
Hypertriglyceridemia
Prehypertension
Raised fasting plasma glucose
Cigarette smoker