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Homework 2 – Conceptual and Logical Design

Master Degree in Computer Engineering
Master Degree in Cybersecurity
Master Degree in ICT for Internet and Multimedia

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Team acronym	RHO	
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Conceptual Design

Variations to the Requirement Analysis

We modified the HW1 "Requirement Analysis" according to the feedback given during the evaluation. Specifically, we add to the "Non-Functional Requirements" section the privacy aspects that must be preserved while dealing with medical information.

Entity-Relationship Schema

Figure 1 shows the entity-relationship schema.

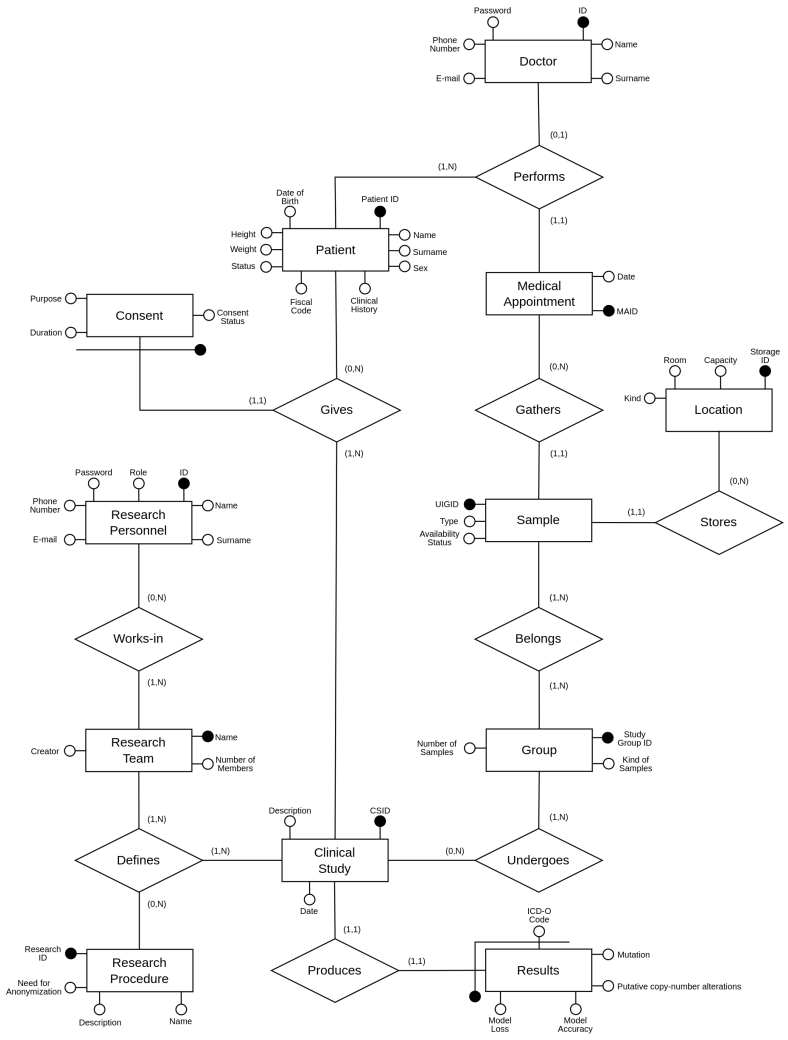

Figure 1: Entity-Relationship Schema.

Data Dictionary

Entities Table

Entity	Description	Attributes	Identifier
Clinical Study	Research study performed on samples, conducted by RHO's Research Team (Data Scientists and Clinical Engineers).	• CSID (Clinical Study ID): identifier of the Clinical Study. (text) • Date: the date on which the Clinical Study has been performed. (date range) • Description: a brief explanation of the study's objectives and main features. (text)	CSID
Consent	The consent the patient must provide during the medical appointment, according to the directives of the GDPR, for processing her/his data, which would then be involved in Clinical Studies if such consent is given.	• Consent Status: tells whether the patient has given the Consent for her/his data to be processed or not. (boolean) • Duration: the period of time for which the Consent provided by the patient is maintained. (date range) • Purpose: the reason why the patient is asked for Consent. (text)	• Patient ID (from Patient) • CSID (from Clinical Study)

Doctor	Medical employee of the RHO, responsible for performing medical examinations on patients, registering their data, and taking care of their medical treatment.	• ID: identifier of the Doctor. (text) • E-mail: the e-mail address of the Doctor. (text) • Name: the name of the Doctor. (text) • Password: the login hashed password of the Doctor. (text) • Phone Number: the phone number of the Doctor. (text) • Surname: the surname of the Doctor. (text)	ID
Group	The group to which each Sample can belong.	• Study Group ID: identifier of the Group to which the Sample belongs. (text) • Kind of Samples: the type of Sample collected, e.g., blood samples, tissues, genome type. (text) • Number of Samples: the number of samples that a Group contains. (integer)	Study Group ID

Location	The physical location in which each Sample is stored.	• Storage ID: identifier of the Location where the sample is stored. (text) • Capacity: the number of samples each Location can contain. (integer) • Kind: the type of sample storage Location, e.g., refrigerator and boxes. (text) • Room: the room where samples can be stored. (text)	Storage ID
Medical Appointment	The medical examination that a doctor performs on a patient. Thanks to it, the doctor can enter and/or update patient information and (if necessary) collect one or more biological samples for further analysis.	• MAID (Medical Appointment ID): identifier of the Medical Appointment. (text) • Date: the date on which the Medical Appointment has been performed. (date range)	MAID

Patient	Person who undergoes a medical examination at the RHO Institute to receive a diagnosis and (if necessary) a treatment for her/his oncological pathology. In addition, the patient should consent for the RHO's researchers to study his/her biological samples.	• Patient ID: identifier of the Patient. (serial) • Clinical History: a description of the clinical history (medical appointments, treatments) of the Patient. (text) • Date of Birth: the date of birth of the Patient. (date range) • Fiscal Code: the fiscal code of the Patient. (text) • Height: the height of the Patient. (float) • Name: the name of the Patient. (text) • Sex: the sex of the Patient. (text) • Status: identifies whether the Patient is sick or healthy. (boolean) • Surname: the surname of the Patient. (text) • Weight: the weight of the Patient. (float)	Patient ID

Research Personnel	Entity that groups all the RHO researchers (Clinical Engineers and Data Scientists) involved in research activities and analyses.	• ID: identifier of the Research Personnel member. (text) • E-mail: the e-mail address of the Research Personnel member. (text) • Name: the name of the Research Personnel member. (text) • Password: the log-in hashed password of the Research Personnel member. (text) • Phone Number: the phone number of the Research Personnel member. (text) • Role: identifies whether the researcher is a Clinical Engineer or a Data Scientist. (boolean) • Surname: the surname of the Research Personnel member. (text)	ID

Research Procedure	The statistical and/or biochemical methodology that Clinical Engineers and Data Scientists use to conduct a Clinical Study.	• Research ID: identifier of the Research Procedure. (text) • Description: a brief explanation of the objectives and the main features of the Research Procedure. (text) • Name: identifier of the Procedure adopted. (text) • Need for Anonymization: identifies whether the Research Procedure used has to be anonymized or not. (boolean)	Research ID
Research Team	A group of researchers, composed of Clinical Engineers and Data Scientists, that performs the analyses required by a Clinical Study.	• Name: identifier of the Research Team. (text) • Creator: the researcher who created the Research Team. (text) • Number of Members: the number of members of the Research Team. (integer)	Name

Results	The set of statistical and biochemical results obtained at the end of a Clinical Study.	• ICD-O Code: identifier of the Results obtained. (text) • Model Accuracy: the value of the accuracy metric that describes the performance of the statistical model used. (float) • Model Loss: the value of the loss metric for the statistical model used. (float) • Mutation: number of mutations discovered. (integer) • Putative copy-number alterations: a measure of genomic instability. (float)	• ICD-O Code • CSID (from Clinical Study)
Sample	A biochemical sample, e.g., blood, tissue, or genome, that a doctor collects from a patient during a medical appointment and that will be analyzed in a Clinical Study together with its Group.	• UIGID (Unique Incrementally Generated ID): identifier of the Sample. (serial) • Availability Status: identifies whether the Sample is available or not. (boolean) • Type: the type of the Sample. (text)	UIGID

Relationships Table

Relationship	Description	Component Entities	Attributes
Belongs	It associates a collected Sample with the Group to which it belongs.	• Group (1, N). • Sample (1, N).	—

Defines	It associates a Research Team, the Clinical Study in which its members are involved, and the Research Procedure followed to perform it.	• Clinical Study (1, N). • Research Procedure (0, N). • Research Team (1, N).	—
Gathers	It associates a biochemical Sample with the Medical Appointment, during which it could be collected from the patient for further analyses.	• Medical Appointment (0, N). • Sample (1, 1).	—
Gives	It associates the Patient with the Consent she/he could give for her/his data to be used in the relevant Clinical Study.	• Clinical Study (1, N) • Consent (1, 1). • Patient (0, N).	—
Performs	It associates a Doctor with a Patient and the Medical Appointment that can be performed on her/him.	• Doctor (0, 1). • Medical Appointment (1, 1). • Patient (1, N).	—
Produces	It associates a Clinical Study with the Results obtained from its procedures and analyses.	• Clinical Study (1, 1). • Results (1, 1).	—
Stores	It associates a collected Sample with the physical Location where it is stored.	• Location (0, N). • Sample (1, 1).	—
Undergoes	It associates a Group of samples with the Clinical Study in which they will be analyzed.	• Clinical Study (0, N). • Group (1, N).	—

Works-in	It associates the Research Personnel members with the Research Team in which they participate.	• Research Personnel (0, N). • Research Team (1, N).	—

External Constraints

- Each research team must comprise at least one clinical engineer and one data scientist from the research personnel.
  Moreover, the attribute 'Number of Members' of the 'Research Team' entity must be updated each time a new member gets added or removed from the group.
- A medical appointment can produce a sample only before having the consent form from the patient.
- The attribute 'Number of Samples' of the 'Group' entity must be updated each time a new sample gets added or removed from the group.
- A clinical study can be carried out insofar as it stays between the boundaries provided by the "Comitato Etico Unico Regionale" (CEUR) and not for other scopes.

Functional Requirements Satisfaction Check

Considering the Functional Requirements from HW1 and intending to improve the clarity of this section, we divide the data that the database must store into four categories of data, namely **Organizational**, **Patient**, **Personnel**, and **Research**.

- **Organizational** data, i.e., data related to the logistics aspects at the RHO Institute.

  Group of sample data, including:

  - The kind of Samples in the group.
  - The study Group ID.

  Location of samples storing data, including:

  - The capacity of the storing device.
  - The storing device.
  - The room where the sample is stored.

  Medical appointment data, including:

  - The date the medical appointment is performed.

  Sample data, including:

  - Biological data concerning the typology of the sample.

  - The availability of the sample.

  Such information is stored in the *Group*, *Location*, *Medical Appointment*, and *Sample* entities, respectively. On the one hand, the *Gathers* relationship defines the association between the medical appointment in which a sample is collected; on the other hand, the *Stores* relationship keeps the information concerning where the samples are held. The relationship *Belongs* defines the information about which sample is part of one or more Sample Groups.

- **Patient** data, i.e., data from individuals who arrive at the RHO Institute.

  Consent data, including:

  - Consensus status.
  - Duration.
  - Purpose.

  Patient data, including:

  - Clinical history.
  - Date of birth.
  - Fiscal code.
  - Height.
  - Name.
  - Sex.
  - Status.
  - Surname.
  - Weight.

  Such information is stored in the *Consent* and *Patient* entities, respectively. The relationship *Gives* links the consent to each patient and the respective Clinical Study.

- **Personnel** data, i.e., data connected to the individuals that work in the RHO Institute.

  Doctors data:

  - Contact info (E-mail and phone number).
  - Name.
  - Surname.
  - Hashed password for login.

  Research personnel data:

  - Contact info (E-mail and phone number).
  - Name.

- Surname.
- Role.
- Hashed password for login.

Such information is stored in the *Doctor* and *Research Personnel* entities. In this case, there is a need for a distinction in the roles of the RHO employees since the Research personnel does not perform medical appointments or enroll patients in the systems, while the doctors do not define research procedures or create research teams. The relationship *Performs* defines which medical appointment is related to which doctor.

- **Research** data, i.e., data related to the Oncological research aspects carried out in the RHO Institute.

  Clinical studies data:

  - Description of the Oncological Research Study performed.
  - The period of time on which the Clinical Study is performed.

  Research procedures data:

  - Name of the procedure adopted.
  - Need for anonymization of the sensitive information used in the clinical study.
  - Description and direction of the Research Pipeline.

  Research team data:

  - Creator of the Team.
  - Name of the Team.
  - Number of members in the Team.

  Results data:

  - Model statistics after the experiments.
  - Number of mutations computed.
  - Value of genomics instability obtained.

  Such information is stored in *Clinical Study*, *Research Procedure*, *Research Team*, and *Results* entities, respectively. The relationship *Works-in* defines the relations between the individual research employee and the Research team in which he/she works. Moreover, the relationship *Produces* stores the information between the experiments and the results, i.e., the Clinical Studies and the results.

Moreover, the system must allow:

- **Doctors, Clinical Engineers, and Data Scientists to log in and sign up, managing different user roles for them.** The information is stored in the entities *Doctor* and *Research personnel* and the relationships *Perform* and *Works-in* allow the system to differentiate between the different roles.

- **Doctors to register and update patients' personal and medical information and perform medical appointments for each patient.** The information is stored in the entities *Medical Appointment* and *Patient*. The relationship *Performs* allows the system to keep track of the information of the medical appointment performed on the patient.
- **Clinical Engineers to label and store samples.** The data is stored in the *Location* and *Sample* entities. The information is defined in the relationship *Stores*.
- **Clinical Engineers perform clinical studies for each sample and update their biochemical data.** The information is available in the *Results* produced by different Clinical Studies, via the relationship *Produces*.
- **Data Scientist to access the biochemical and clinical data of the samples, updating statistical studies.** The data is stored in entity *Results*, where the statistical information of the Clinical study is reported.
- **Researchers (Clinical Engineers and Data Scientists) to create/join a Research Team.** The relationship *Works-in* allows the system to organize the distribution of the research teams. The data is stored in the *Research Team* entity.

Logical Design

Transformation of the Entity-Relationship Schema

Redundancy Analysis

The schema does not contain any cycle of entities.

Choice of Principal Identifiers

The main identifiers comply with the selection criteria.

Analysis of Database Load

If we consider the *Research Team*'s attribute "Number of Members" as derived, we can have the following two operations that involve that redundant attribute:

O1 Store Research Personnel data and the Research Team he/she belongs to.

O2 Print data about a Research Team with the Number of Members it includes.

In Table 4, the two operations are described. Both **O1** and **O2** are online since the Research Personnel data need to be stored right after the Research Personnel register and join a Research Team, and Research Team data are retrieved on the fly.

Operation	Description	Frequency	Type

O1: Store Research Personnel data	Store data about a Research Personnel including the Research Team she/he belongs to	50/week	Online
O2: Print data about a Research Team	Print data about a Research Team, including the Number of Members	10/week	Online

Table 4: Operations description and frequency.

In Table 5, we report the access/volume data related to **O1** with redundancy. The *Research Team* entity has a read access to get the current value for the Number of Members attribute and a write access to update this value.

Operation O1: 50/week				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Research Personnel	Entity	1	W	$1 \times 50 \times 2 = 100$
Works-in	Relationship	1	W	$1 \times 50 \times 2 = 100$
Research Team	Entity	1	R	$1 \times 50 \times 1 = 50$
Research Team	Entity	1	W	$1 \times 50 \times 2 = 100$
Total access				350

Table 5: Access/volume Table for Operation 1 with redundancy.

In Table 6, we report the access/volume data related to **O2** with redundancy. The presence of redundancy allows us to perform one access to the Research Team entity to get all the required information.

Operation O2: 10/week				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Research Team	Entity	1	R	$1 \times 10 \times 1 = 10$
Total access				10

Table 6: Access/volume Table for Operation 2 with redundancy.

In Table 7, we report the access/volume data related to **O1** without redundancy. In this case, we have to consider the insertion of a new instance in Research Personnel and the insertion of a new instance in Work-in to store the Research Team that the Research Personnel instance has joined.

Operation O1: 50/week				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Research Personnel	Entity	1	W	$1 \times 50 \times 2 = 100$
Works-in	Relationship	1	W	$1 \times 50 \times 2 = 100$
Total access				200

Table 7: Access/volume Table for Operation 1 without redundancy.

In Table 8, we report the access/volume data related to **O2** without redundancy. We considered 25 Research Personnel members on average for each Research Team.

Operation O2: 10/week				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Research Team	Entity	1	R	$1 \times 10 \times 1 = 10$
Works-in	Relationship	25	R	$25 \times 10 \times 1 = 250$
Total access				260

Table 8: Access/volume Table for Operation 2 without redundancy.

In Table 9, we report the final access count with and without redundancy. According to the obtained results, maintaining the derived attribute *Number of Members* improves the load analysis.

Comparison		
Operation	**With Redundancy**	**Without Redundancy**
O1	350	200
O2	10	260
Total Accesses/week	**360**	460

Table 9: Comparison of the number of accesses for each operation.

Similarly, it is possible to consider another example for a better understanding of the analysis of the database load. The *Group*'s attribute "Number of Samples" can be seen as derived and involved in the following two operations:

O3 Store Sample data and the Group it belongs to.

O4 Print data about a Group of samples, with the Number of Samples included.

These two operations are reported in Table 10. Both **O3** and **O4** are online since the Sample data need to be stored immediately after being registered and assigned to a Group whose data are retrieved in real-time.

Operation	**Description**	**Frequency**	**Type**
O3: Store Sample data	Store data about a Sample including the Group it belongs to	500/day	Online
O4: Print Group data	Print data about a Group, including the Number of Samples that compose it	100/day	Online

Table 10: Operations description and frequency.

In Table 11, the access/volume data related to **O3** with redundancy are reported. For this operation, the *Group* entity has both a Read-type access to get the current value for the Number of Samples attribute and a Write-type access to update this value. The *Sample* entity and the *Belongs* relationship have both a Write-type access because of the Sample and Group data storage.

Operation O3: 500/day				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Sample	Entity	1	W	$1 \times 500 \times 2 = 1000$
Belongs	Relationship	1	W	$1 \times 500 \times 2 = 1000$
Group	Entity	1	R	$1 \times 500 \times 1 = 500$
Group	Entity	1	W	$1 \times 500 \times 2 = 1000$
Total access				3500

Table 11: Access/volume Table for Operation 3 with redundancy.

In Table 12, the access/volume data related to **O4** with redundancy are reported. The presence of the redundant attribute allows only one access to the Group entity to get all the required information.

Operation O4: 100/day				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Group	Entity	1	R	$1 \times 100 \times 1 = 100$
Total access				100

Table 12: Access/volume Table for Operation 4 with redundancy.

In Table 13, the access/volume data related to **O3** without redundancy are reported. In this case, the insertion of a new instance in the Group entity and of a new instance in the Belongs relationship have to be considered, to store properly the Group to which the Sample has been assigned.

Operation O3: 500/day				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Sample	Entity	1	W	$1 \times 500 \times 2 = 1000$
Belongs	Relationship	1	W	$1 \times 500 \times 2 = 1000$
Total access				2000

Table 13: Access/volume Table for Operation 3 without redundancy.

In Table 14, the access/volume data related to **O4** without redundancy are reported. The average number of Samples for each Group considered to perform the analysis is 50, corresponding to the number of accesses for the Belongs relationship.

Operation O4: 100/day				
Concept	**Construct**	**Access**	**Type**	**Average Access**
Group	Entity	1	R	$1 \times 100 \times 1 = 100$
Belongs	Relationship	50	R	$50 \times 100 \times 1 = 5000$
Total access				5100

Table 14: Access/volume Table for Operation 4 without redundancy.

In Table 15, the final access counts with and without redundancy are reported. The obtained results suggest maintaining the derived attribute *Number of Samples*, because it significantly improves the load analysis, especially as the assumed value of the attribute increases.

Comparison		
Operation	**With Redundancy**	**Without Redundancy**
O3	3500	2000
O4	100	5100
Total Accesses/day	**3600**	7100

Table 15: Comparison of the number of accesses for each operation.

Relational Schema

Figure 2 shows the relational schema.

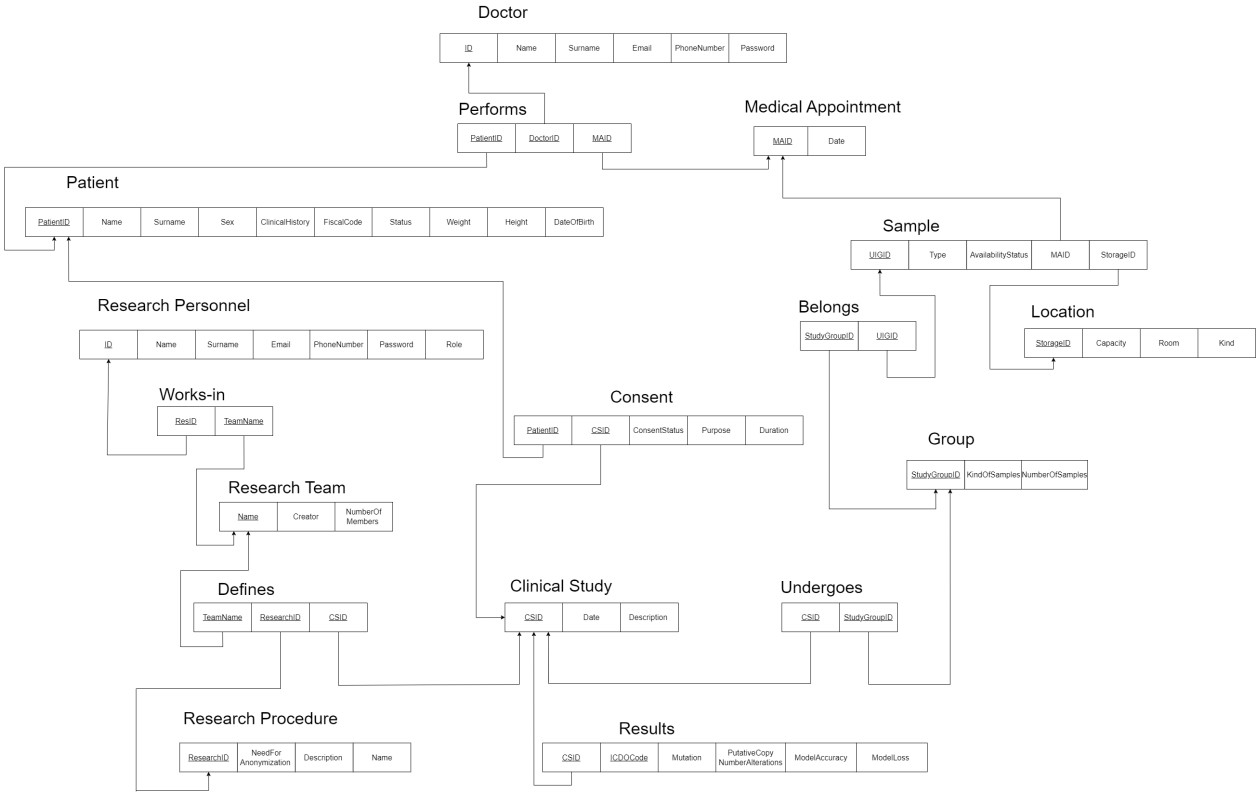

Figure 2: Relational Schema.

Data Dictionary

Relation	Attribute	Description	Domain	Constraints
Belongs	UIGID	Unique identifier of the Sample.	Serial	Foreign key to Sample, Not NULL, primary key with Study Group ID
	StudyGroupID	Unique identifier of the Group to which the Sample belongs.	Text	Foreign key to Group, Not NULL, primary key with UIGID
Clinical Study	CSID	Unique identifier of the Clinical Study.	Text	Primary key
	Date	When the Clinical Study has been performed.	Date range	Not NULL
	Description	The description of the study's objectives and main features.	Text	
Consent	ConsentStatus	It identifies whether the Patient gave or not the Consent for her/his data to be processed.	Boolean	Not NULL
	Purpose	Why the Patient is asked for Consent.	Text	Not NULL
	Duration	Period of time for which the Consent is maintained.	Date range	Not NULL
	PatientID	ID of the patient giving the consent.	Serial	Foreign Key to Patient, Not NULL, primary key with CSID
	CSID	ID of the clinical study requiring the consent.	Text	Foreign Key to Clinical Study, Not NULL, primary key with PatientID
Defines	TeamName	Unique identifier of the Research Team, carrying out the Clinical Study.	Text	Foreign key to Research Team, Not NULL, primary key with CSID and Research ID
	CSID	Unique identifier of the Clinical Study.	Text	Foreign key to Clinical Study, Not NULL, primary key with Name and Research ID
	ResearchID	Unique identifier of the Research Procedure chosen for the Clinical Study.	Text	Foreign key to Research Procedure, Not NULL, primary key with Name and CSID

Doctor	ID	Unique identifier of the Doctor.	Text	Primary key
	Name	The name of the Doctor	Text	Not NULL
	Surname	The surname of the Doctor.	Text	Not NULL
	Email	The e-mail address of the Doctor.	Text	Not NULL
	Password	The log-in hashed password of the Doctor.	Text	Not NULL
	PhoneNumber	The phone number of the Doctor.	Text	Not NULL
Group	StudyGroupID	Unique identifier of the Group to which the Sample belongs.	Text	Primary key
	KindOfSamples	The type of Sample collected.	Text	Not NULL
Location	StorageID	Unique identifier of the Location of the Sample.	Text	Primary key
	Room	The room where the Sample is stored.	Text	Not NULL
	Capacity	The number of Sample each Location can contain.	Integer	Not NULL
	Kind	The type of sample storage Location.	Text	Not NULL
Medical Appointment	MAID	Unique identifier of the Medical Appointment.	Text	Primary key
	Date	The date when the Medical Appointment has been performed.	Date range	Not NULL
Patient	PatientID	Unique identifier of the Patient.	Serial	Primary key
	Name	The name of the Patient.	Text	Not NULL
	Surname	The surname of the Patient.	Text	Not NULL
	DateOfBirth	The date of birth of the Patient.	Date range	Not NULL
	FiscalCode	The fiscal code of the Patient.	Text	
	Height	The height of the Patient.	Integer	Not NULL
	Weight	The weight of the Patient.	Integer	Not NULL
	Sex	The sex of the Patient.	Text	Not NULL
	Status	Identifies if the Patient is sick or healthy.	Boolean	Not NULL
	ClinicalHistory	Description of the Patient's clinical history.	Text	
	ConsentStatus	It identifies whether the Patient gave or not the Consent for her/his data to be processed.	Boolean	Foreign key to Consent

Performs	DoctorID	Unique identifier of the Doctor performing the Medical Appointment.	Text	Foreign key to Doctor, Not NULL, primary key with MAID and PatientID
	MAID	Unique identifier of the Medical Appointment.	Text	Foreign key to Medical Appointment, Not NULL, primary key with ID and Patient ID
	PatientID	Unique identifier of the Patient.	Serial	Foreign key to Patient, Not NULL, primary key with DoctorID and MAID
Research Personnel	ID	Unique identifier of the Research Personnel member.	Text	Primary key
	Name	The name of the Research Personnel member.	Text	Not NULL
	Surname	The surname of the Research Personnel member.	Text	Not NULL
	Email	The e-mail of the Research Personnel member.	Text	Not NULL
	Password	The log-in hashed password of the Research Personnel member.	Text	Not NULL
	PhoneNumber	The phone number of the Research Personnel member.	Text	Not NULL
	Role	Identifies whether the Research Personnel member is a Clinical Engineer or a Data Scientist	Boolean	Not NULL
Research Procedure	ResearchID	Unique identifier of the Research Procedure.	Text	Primary key
	Name	Identifies the adopted procedure.	Text	Not NULL
	Description	Description of objectives and main features of the adopted Research Procedure	Text	Not NULL
	NeedFor Anonymization	Identifies whether the adopted Research Procedure has to be anonymized or not.	Boolean	Not NULL
Research Team	Name	Unique identifier of the Research Team.	Text	Primary key
	NumberOf Members	The number of members of the Research Team.	Integer	Not NULL

Results	ICDOCode	Unique identifier of the Results.	Text	Primary key
	Mutation	Number of mutation of the Sample.	Integer	Not NULL
	PutativeCopy NumberAlterations	Measures the genomics instability.	Float	Not NULL
	ModelAccuracy	Value of the accuracy metric that describes the performance of the statistical model used.	Float	
	ModelLoss	Value of the loss metric of the statistical model used.	Float	
	CSID	Unique identifier of the Clinical Study.	Text	Foreign key to Clinical Study, Not NULL, primary key with ICD-O Code.
Sample	UIGID	Unique identifier of the Sample.	Serial	Primary key
	Type	The type of the Sample.	Text	Not NULL
	AvailabilityStatus	Identifies whether the Sample is available or not.	Boolean	Not NULL
	MAID	Unique identifier of the Medical Appointment.	Text	Foreign key to Medical Appointment
	StorageID	Unique identifier of the Location of the Sample.	Int	Foreign key to Location
Undergoes	StudyGroupID	Unique identifier of the Group which undergoes the Clinical Study.	Text	Foreign key to Group, Not NULL, primary key with CSID
	CSID	Unique identifier of the Clinical Study.	Text	Foreign key to Clinical Study, Not NULL, primary key with Study Group ID
Works-in	ResID	Unique identifier of the Research Personnel member who works in the Research Team.	Text	Foreign key to Research Personnel, Not NULL, primary key with TeamName
	TeamName	Unique identifier of the Research Team.	Text	Foreign key to Research Team, Not NULL, primary key with ResID

External Constraints

- Each research team must comprise at least one clinical engineer and one data scientist from the research personnel: this means that it is important to check the value assumed by the Role attribute for each

Research Personnel tuple to be sure that at least a tuple of the Works-in relation is related to a research personnel member with role "Clinical Engineer", and at least one with role "Data Scientist". Moreover, the attribute 'Number of Members' of the 'Research Team' entity must be updated each time a new member gets added or removed from the group: this update must be done whenever a new tuple, which ResID must match the ID of the correspondent research personnel member, is added to the Works-in relation.

- A medical appointment can produce a sample only before having the consent form from the patient: this means that it is necessary to check in the Consent relation if the patient has given her/his consent for the processing of her/his data (ConsentStatus attribute, which must also have the same value for Patient and Clinical Study).
- The attribute 'Number of Samples' of the 'Group' entity must be updated each time a new sample gets added or removed from the group: in this case, it is necessary to check the Belongs relation to see when a new sample is added to a group or if a sample is no longer available (Availability Status attribute for Sample).
- A clinical study can be carried out insofar as it stays between the boundaries provided by the CEUR and not for other scopes: in this case, to conduct a clinical study and for each tuple of the Consent relation that assumes the value "given" for its ConsentStatus attribute, it is necessary to check the Purpose attribute and verify whether what is reported matches what is established by the CEUR.

Group Members Contribution

- **Campoy Fernandez Pablo Julian:** Data Dictionary (Conceptual Design) + Functional Requirements Satisfaction Check + External Constraints (Logical Design).
- **De Faveri Francesco Luigi:** Variations to the Requirement Analysis + Functional Requirements Satisfaction Check + Transformation of the Entity-Relationship Schema
- **Groenlien Iver:** No participation.
- **Padoan Claudio:** Analysis of Database Load + Relational Schema + Data Dictionary (Logical Design)
- **Petrucci Riccardo:** Entity-Relationship Schema (Conceptual Design) + External Constraints + Data Dictionary (Logical Design)
- **Vezzosi Giacomo:** Data Dictionary (Conceptual Design) + Analysis of Database Load + External Constraints (Logical Design).