Entities:

Medical_Device(<u>serial_number,</u> <u>manufacturer</u>, description)

      Since every manufacturer has their own serial number attribution system, which can be the same for different manufacturers, both serial_number and manufacturer are needed to define the table's primary key.

Actuator(<u>serial_number,</u> <u>manufacturer</u>)
      serial_number, manufacturer: FK(Medical_Device)

Sensor(<u>serial_number</u>, <u>manufacturer</u>)
      serial_number, manufacturer: FK(Medical_Device)

Setting(<u>serial_number</u>, <u>manufacturer</u>, <u>timestamp</u>, value)
      serial_number, manufacturer: FK(Actuator)

Read_Time(<u>serial_number</u>, <u>manufacturer</u>, <u>timestamp)</u>
      serial_number, manufacturer: FK(Sensor)

Data(<u>serial_number</u>, <u>manufacturer</u>, <u>timestamp</u>, <u>name</u>, value)
      serial_number, manufacturer, timestamp: FK(Read_Time)

PAN(<u>internet_domain_name</u>, phone)

Period_of_Time(<u>start_timestamp</u>, <u>end_timestamp</u>)

Person(<u>citizen_number</u>)

Patient(<u>citizen_number</u>)
      citizen_mumber: FK(Person)

Doctor(<u>citizen_number</u>, professional_id)
      citizen_mumber: FK(Person)

Exam_Prescription(<u>patient_citizen_number</u>, <u>date</u>, <u>time</u>)
      patient_citizen_number: FK(follows)

      This was considered a weak entity due to the fact that several exams can be prescribed for the same date and time.

Study(patient_citizen_number, exam_date, exam_time, doctor_citizen_number, date, description, manufacturer, serial_number)

   patient_citizen_number, exam_date, exam_time: FK(Exam_Prescription)
   doctor_citizen_number: FK(Doctor)
   manufacturer, serial_number: FK(Equipment)

   Since the relationships *performs* and *uses* are many-to-one with total participation, it was decided to include the foreign keys to *Doctor* and *Equipment* in this table, which allows the relationships to be defined without the need of extra tables.

Equipment(manufacturer, serial_number, model)

Series(series_id, series_url, name, patient_citizen_number, exam_date, exam_time, study_date, description)

   patient_citizen_number, exam_date, exam_time, study_date, description: FK(Study)

   This was considered a strong entity because it was considered that series_id was unique in the database, and not only amongst a study.
   Since the relationship *collects* is many-to-one with total participation, it was decided to include the foreign key to *Study* in this table, which allows the relationship to be defined without the need of an extra table.

Elements(series_id, index, elements_url)
   series_id: FK(Series)

Signal(series_id, index)
   series_id, index: FK(Elements)

Image(series_id, index)
   series_id, index: FK(Elements)

ROI_Signal(series_id, index, T1, T2)
   series_id, index: FK(Signal)

ROI_Image(series_id, index, X1, X2, Y1, Y2)
   series_id, index: FK(Image)

Relationships:

connects(<u>serial_number</u>, <u>manufacturer</u>, internet_domain_name, <u>start_timestamp</u>, <u>end_timestamp</u>)

      serial_number, manufacturer: FK(Medical_Device)
      internet_domain_name: FK(PAN)
      start_timestamp, end_timestamp: FK(Period_of_Time)

      The keys of *Medical_Device* and *Period_of_Time* are sufficient to define and serve as primary key of *connects*. This is true because each *Medical_Device* is connected only to one *PAN*, during a *Period_of_Time*.

owns(internet_domain_name, <u>citizen_number</u>, <u>start_timestamp</u>, <u>end_timestamp</u>)

      internet_domain_name: FK(PAN)
      citizen_number: FK(Patient)
      start_timestamp, end_timestamp: FK(Period_of_Time)

      The keys of *Patient* and *Period_of_Time* are sufficient to define and serve as primary key of *owns*. The key of *PAN* could be used instead of the key of *Patient*, since each *Patient* only carries one *PAN* and only one *PAN* is worn by a *Patient*, during a *Period_of_Time*.

follows(<u>patient_citizen_number</u>, doctor_citizen_number)

      patient_citizen_mumber: FK(Patient)
      doctor_citizen_mumber: FK(Doctor)

      It was considered as not mandatory for a patient to be followed by a doctor.

Notes:

      The following was not implemented in the ER model in order to maintain its simplicity:

- The doctor that performs the study can't be the same who prescribed the exam.
- The end timestamp of an interval must be later than the start timestamp.