Structured reporting system

Paweł Paczuski
p.paczuski@stud.elka.pw.edu.pl

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Outline

Introduction

- Problems of modern medicine
- Standards
- Typical workflow of a radiologist

Design and implementation of Structured reporting system

- Radiological report as a tree
- Technological stack
- User interface

Validation

Plans for the future

Areas of interest of modern medicine

- increasing variety of diagnostic techniques and procedures
- unsatisfiable demand for medical services
- bureaucracy
- huge volumes of data to process and store. Healthcare Informatics

Healthcare Informatics vs Computer Science

Computer Science	**Healthcare Informatics**
general field	information engineering applied to the health care
data structures, algorithms	flow of information
ways of persistently storing data	ways of presenting data at proper time to proper person

Healthcare standards

- medical nomenclature SNOMED CT, LOINC
- exchange protocols and formats HL7, DICOM

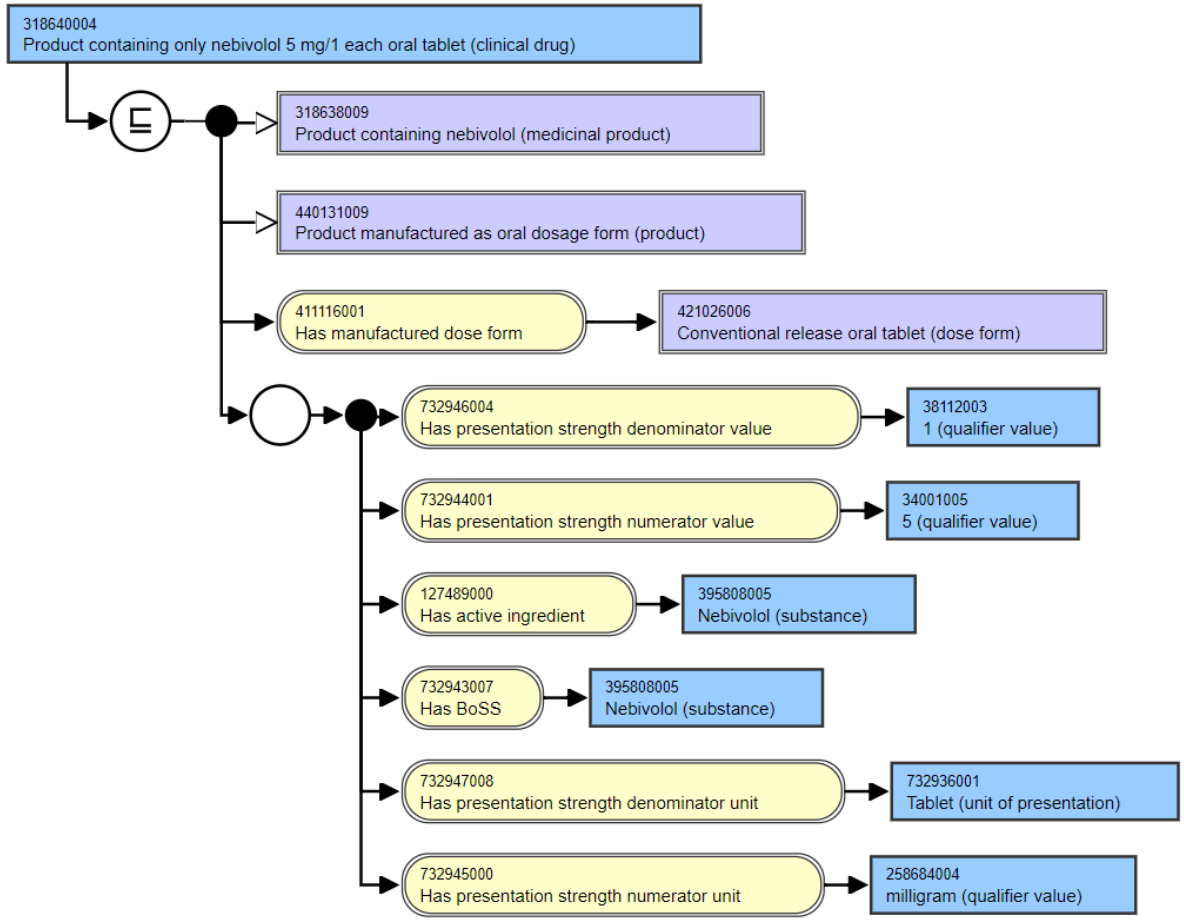


Figure: Drug product example in SNOMED CT

Typical workflow of a radiologist

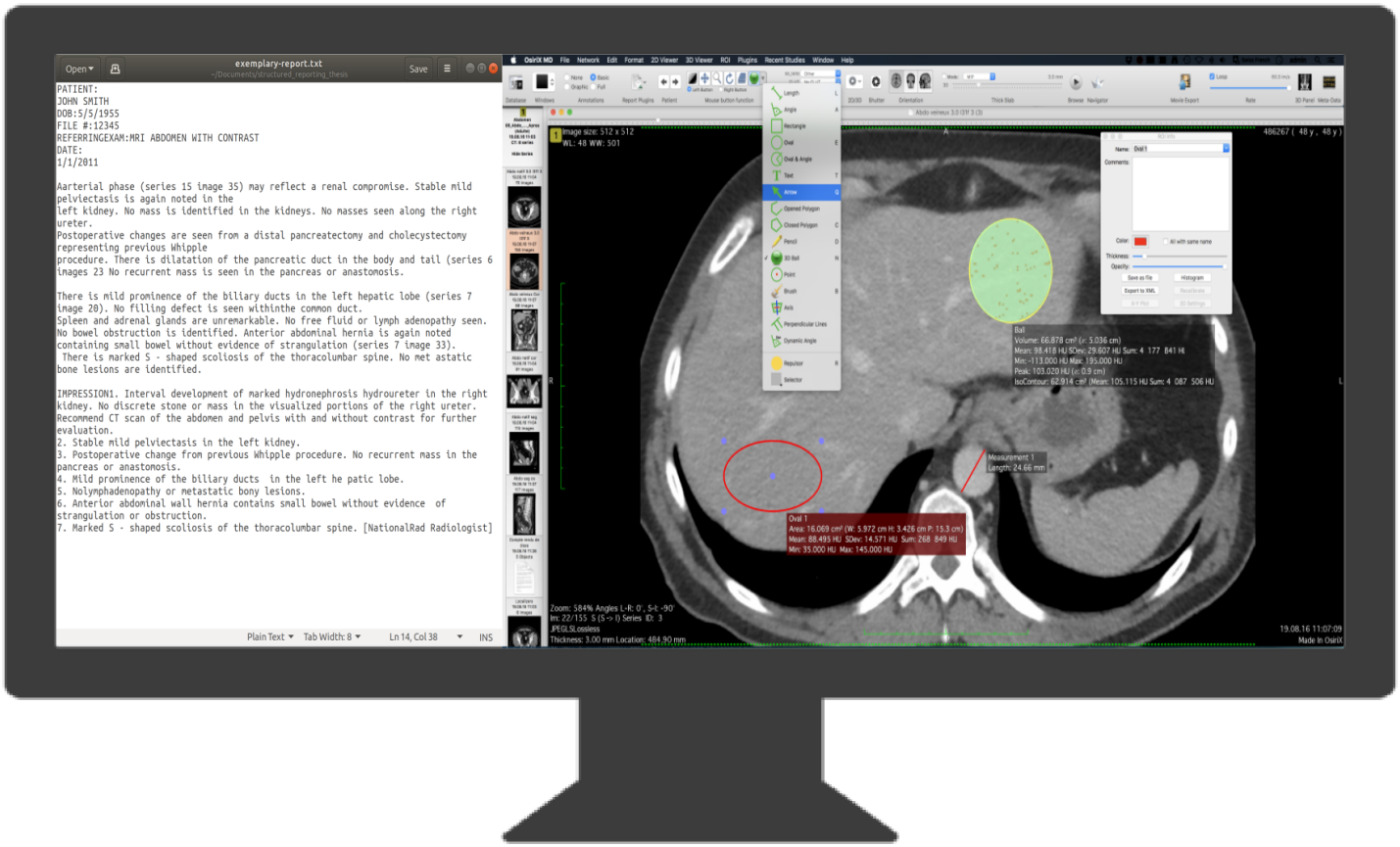


Figure: Typically, a radiologist analyzes medical images and creates report's text simultaneously

Areas of optimization

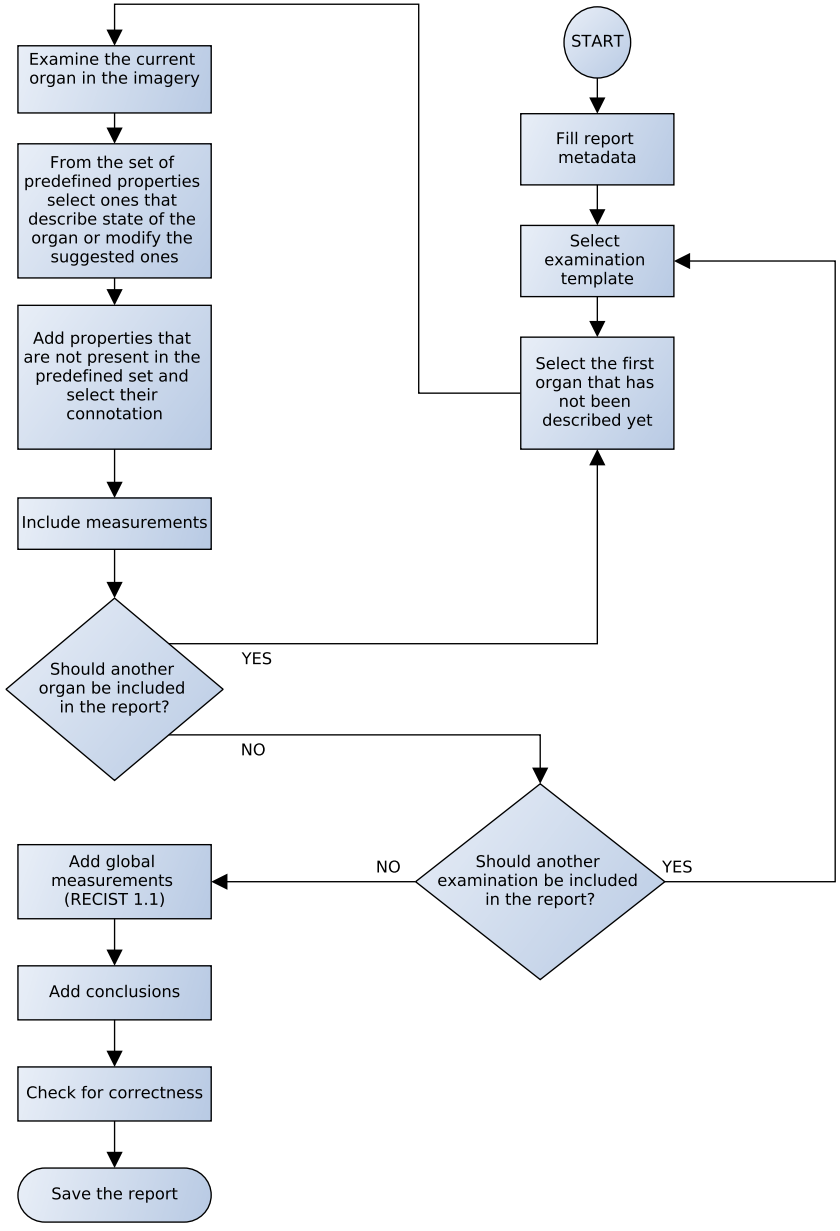
What can be improved:

- radiologists are very BAD at typing on keyboard
- speech recognition has problems with capturing medical language
- reporting quality

How:

- typing on keyboard replaced by checking boxes with predefined phrases
- reports represented as trees that have relations between causes and effects
- workflow organized around set of checklists and templates

Modified workflow



Reporting ontology

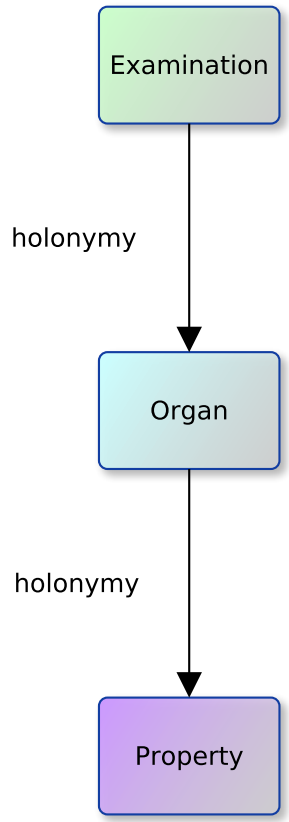
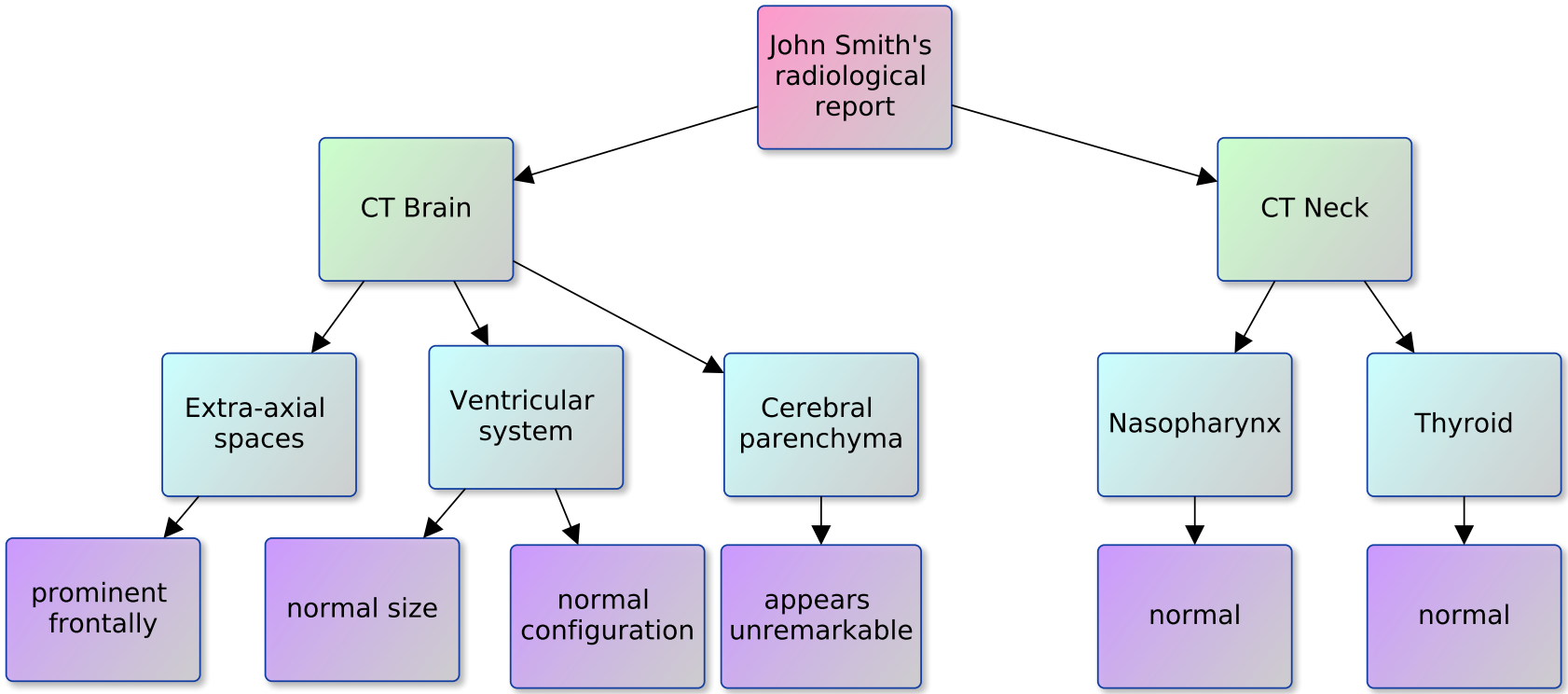


Figure: Types of entities and relations between them

Radiological report as a tree



Textual representation

John Smith

date: 02.04.2005

CT Brain

Extra-axial spaces: prominent frontally.
Ventricular system: normal size; normal configuration.
Cerebral parenchyma: appears unremarkable.

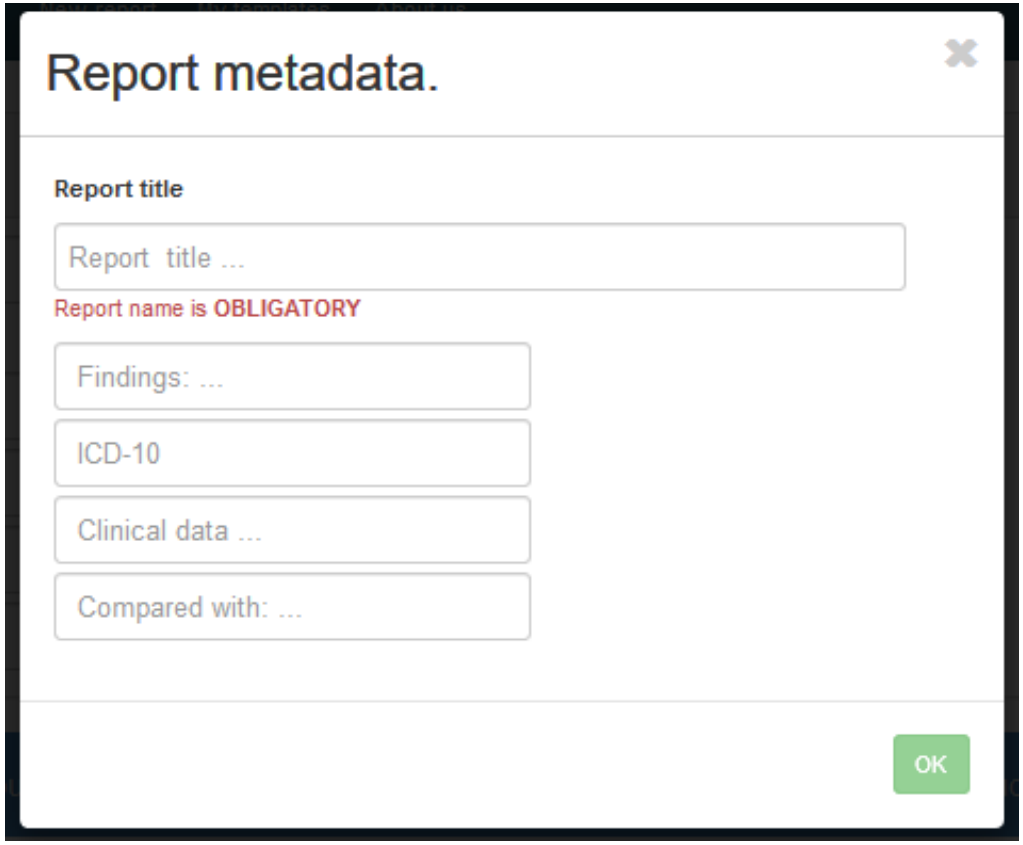
CT Neck

Nasopharynx: normal.
Thyroid: normal.

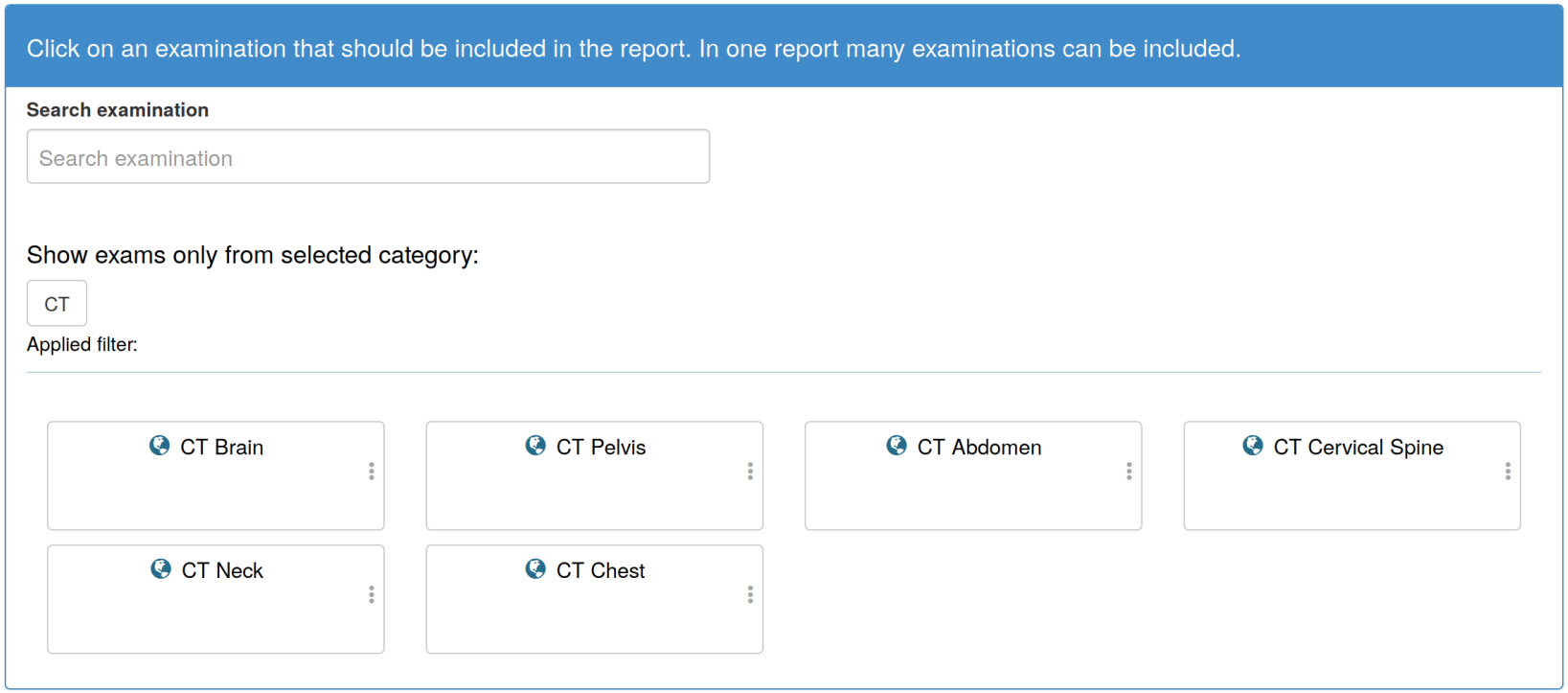
Technological stack

- backend
  - C#
  - ASP.NET
  - MS SQL
- frontend (hybrid approach)
  - AngularJS, ES5

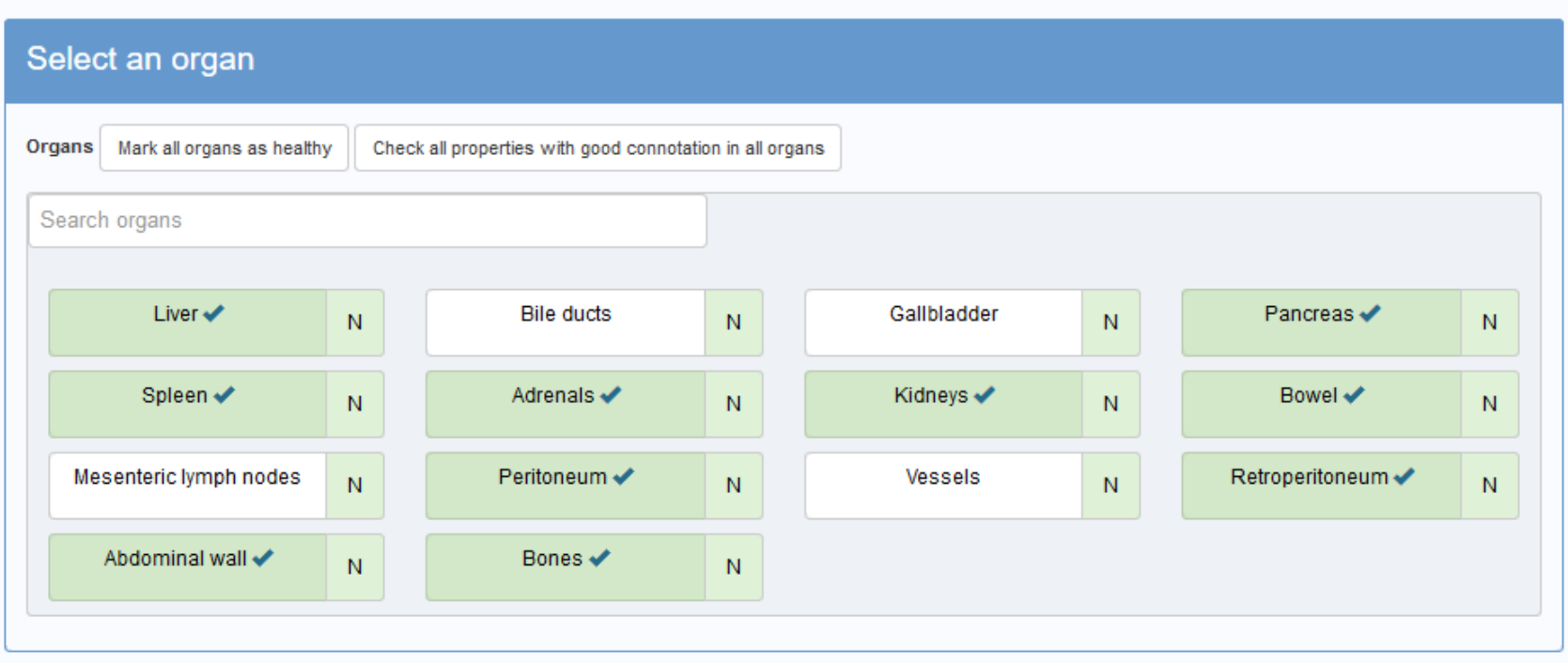
Report metadata



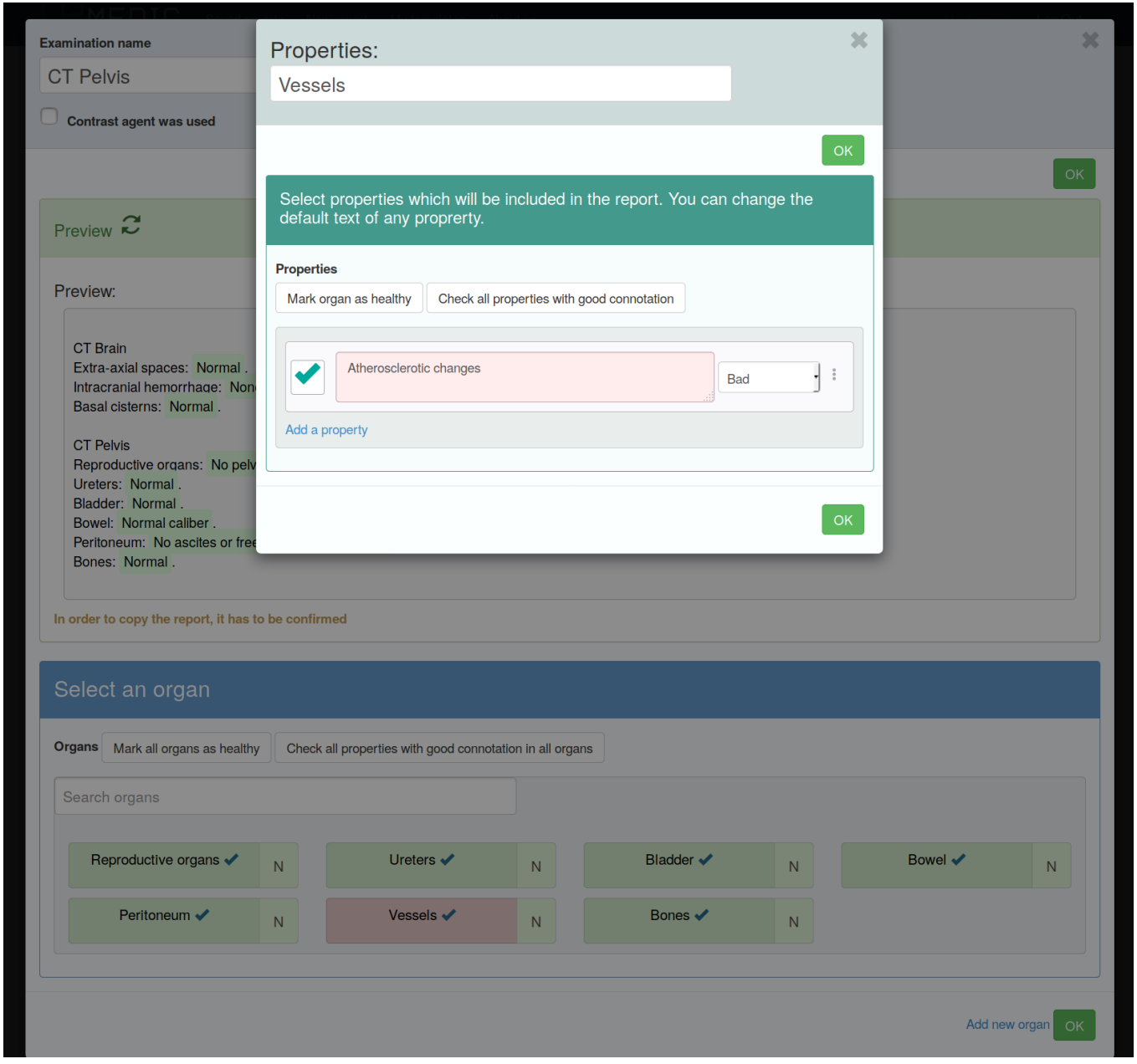
Report editor interface



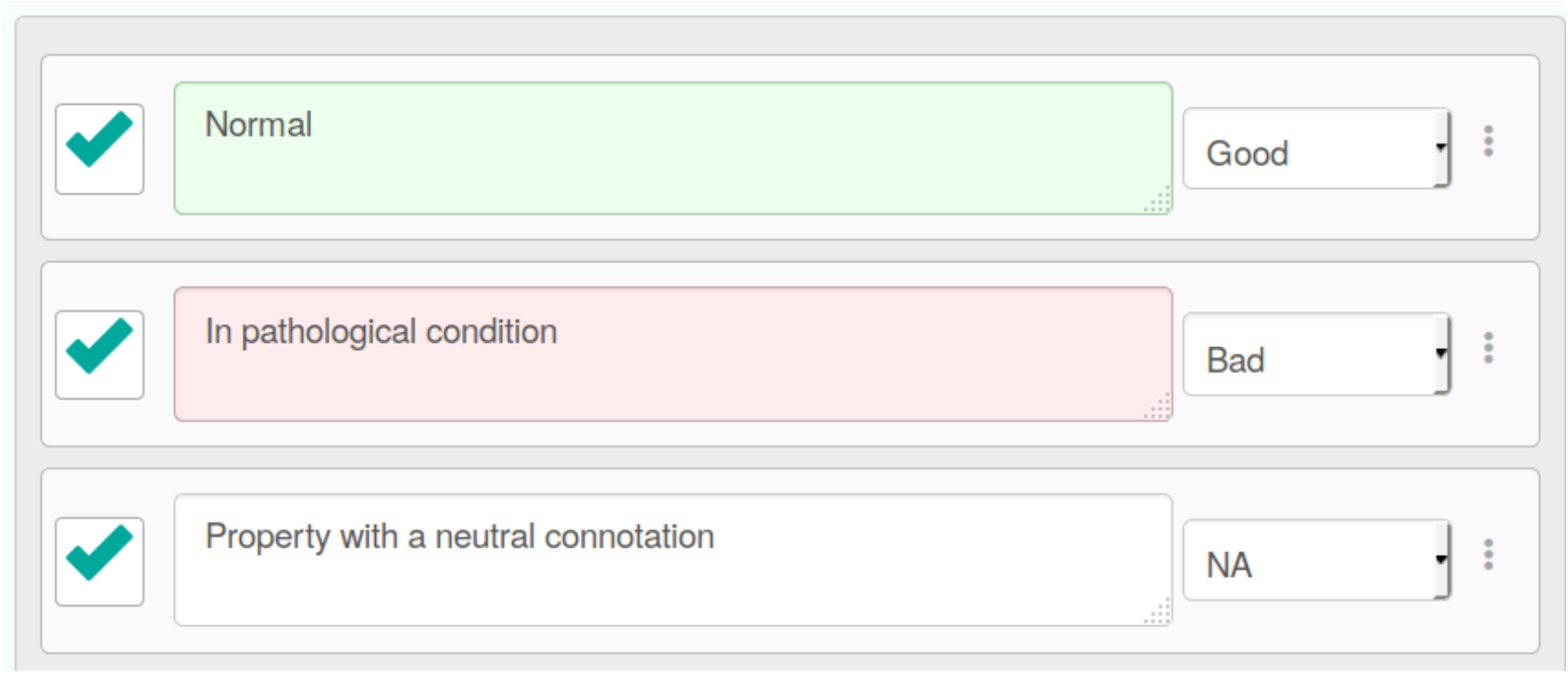
Organ list


Select an organ
Organs
Mark all organs as healthy
Check all properties with good connotation in all organs
Search organs
Liver ✔ N
Bile ducts N
Gallbladder N
Pancreas ✔ N
Spleen ✔ N
Adrenals ✔ N
Kidneys ✔ N
Bowel ✔ N
Mesenteric lymph nodes N
Peritoneum ✔ N
Vessels N
Retroperitoneum ✔ N
Abdominal wall ✔ N
Bones ✔ N

Properties


Examination name
CT Pelvis
Contrast agent was used
OK
Preview
Preview:
CT Brain
Extra-axial spaces: Normal .
Intracranial hemorrhage:
Basal cisterns: Normal .
CT Pelvis
Reproductive organs:
Ureters: Normal .
Bladder: Normal .
Bowel: Normal caliber .
Peritoneum:
Bones: Normal .
In order to copy the report, it has to be confirmed
Properties:
Vessels
OK
Select properties which will be included in the report. You can change the default text of any proprerty.
Properties
Mark organ as healthy
Check all properties with good connotation
Atherosclerotic changes
Bad
Add a property
OK
Select an organ
Organs
Mark all organs as healthy
Check all properties with good connotation in all organs
Search organs
Reproductive organs
N
Ureters
N
Bladder
N
Bowel
N
Peritoneum
N
Vessels
N
Bones
N
Add new organ
OK

Connotations

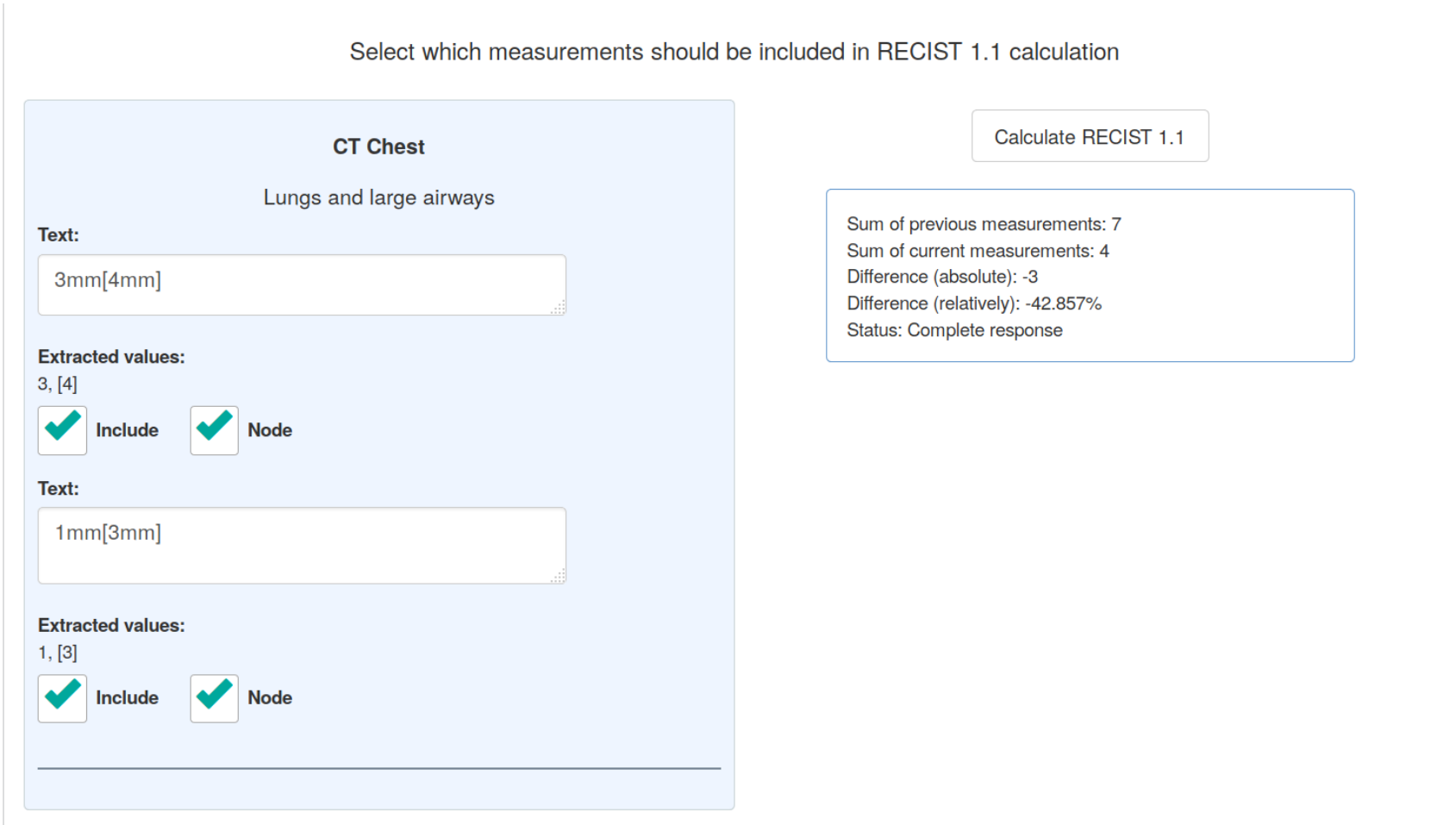


def. RECIST 1.1

- response evaluation criteria in solid tumours
- calculates changes in sizes of solid tumors
- results based on several factors: change, nodes, selection of measurements

Parsing values for RECIST 1.1

Configuring RECIST 1.1



Generated report

Report

Title: **"John Smith"**

Date Created:
2018-4-4 16:14

CT Brain
Extra-axial spaces: Normal .
Intracranial hemorrhage: None .
Basal cisterns: Normal .

CT Pelvis
Reproductive organs: No pelvic masses .
Ureters: Normal .
Bladder: Normal .
Bowel: Normal caliber .
Peritoneum: No ascites or free air; no fluid collection .
Vessels: Atherosclerotic changes .
Bones: Normal .

CT Chest
Lungs and large airways: 3mm[4mm] ; 1mm[3mm] .

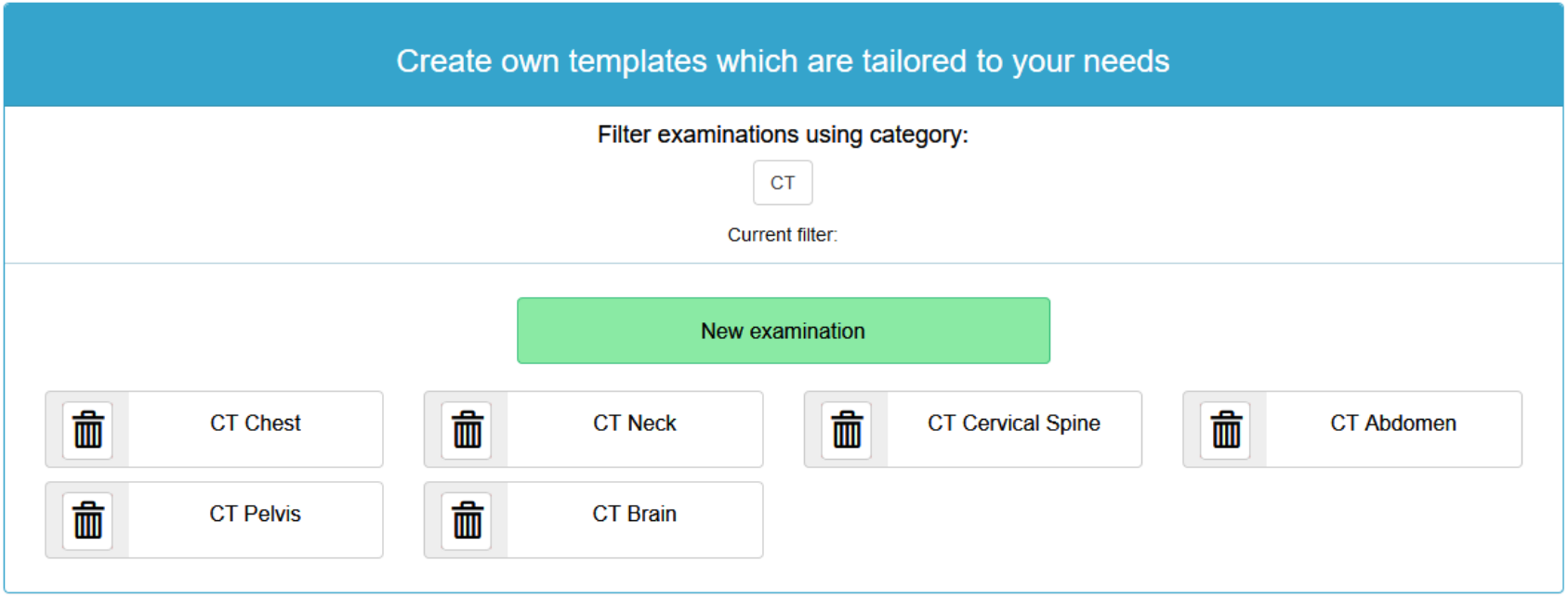
Conclusions: Further observation recommended

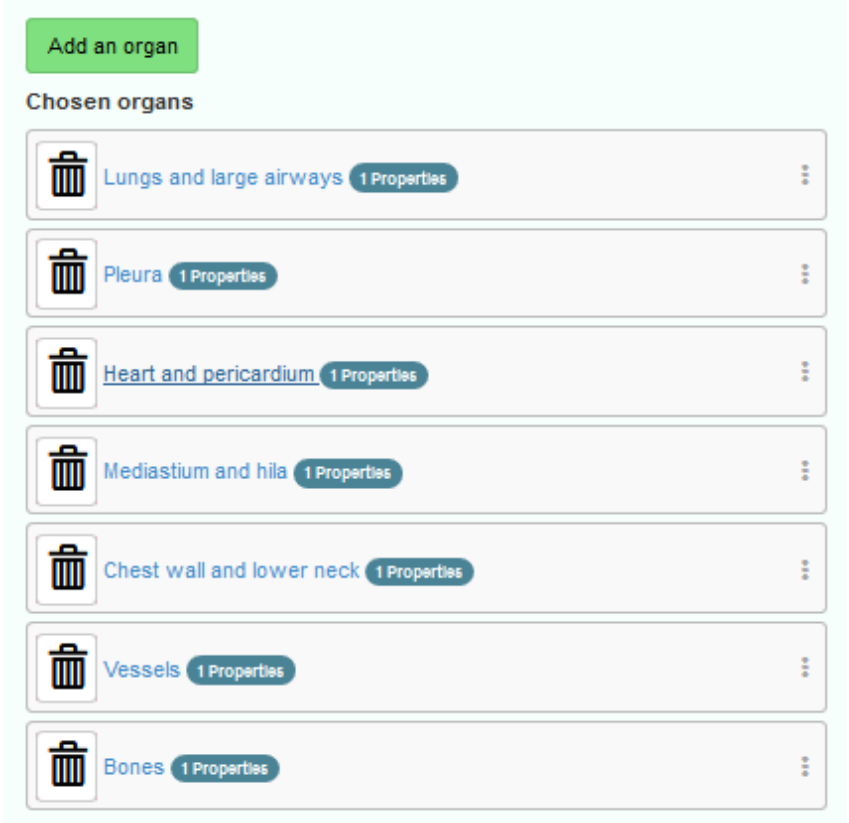
Sum of previous measurements: 7
Sum of current measurements: 4
Difference (absolute): -3
Difference (relatively): -42.857%
Status: Complete response

Pdf | Email | Edit

List of reports

Template editor




Add an organ
Chosen organs
Lungs and large airways 1 Properties
Pleura 1 Properties
Heart and pericardium 1 Properties
Mediastium and hila 1 Properties
Chest wall and lower neck 1 Properties
Vessels 1 Properties
Bones 1 Properties

Validation

Places where the software was used:

- Several independent teleradiologists
- Small hospital in Wieliszew
- Large network of clinics in Łódź

Conclusions:

- Tens of thousands reports generated
- Reports generated 3 times faster

Plans for the future

- develop independent commercial version of the software based on some ideas from this system
- support for more general ontologies
- conform to standards, integrations with existing RIS systems

Q&A

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