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Mint Medical

Presentation

Standardized context-driven
read workflow & structured reporting

Developed in
cooperation with

dkfz.
DEUTSCHES
KREBSFORSCHUNGSZENTRUM

Europe’s Beating Cancer Plan

The use of data and AI in Oncology

[…] Technology can be a lifesaver for thousands of people. We know, for instance, that **the use of artificial intelligence can significantly improve the precision of early diagnosis**. It can be a powerful tool to reduce false positives and negatives.

And we have to better share our data. **Within the data we have, lies an incredible amount of missed opportunities, unknown improvements, potential correction of false hypothesis – but we must use and share these data**. We are now setting up a Common Health Data Space, an infrastructure where scientists and medical clinicians will be able not only to store clinical and research data, but also to access other scientists' data. […]

Ursula von der Leyen – Europe’s Beating Cancer Plan (February 2020)

Structured, annotaded Image Data

„Treasure“ of Radiology

Machine Learning / Artificial Intelligence	*Personalized Medicine / Real World Evidence*	*Value-based Medicine / Quantify Radiology*

Quality of Data is key!

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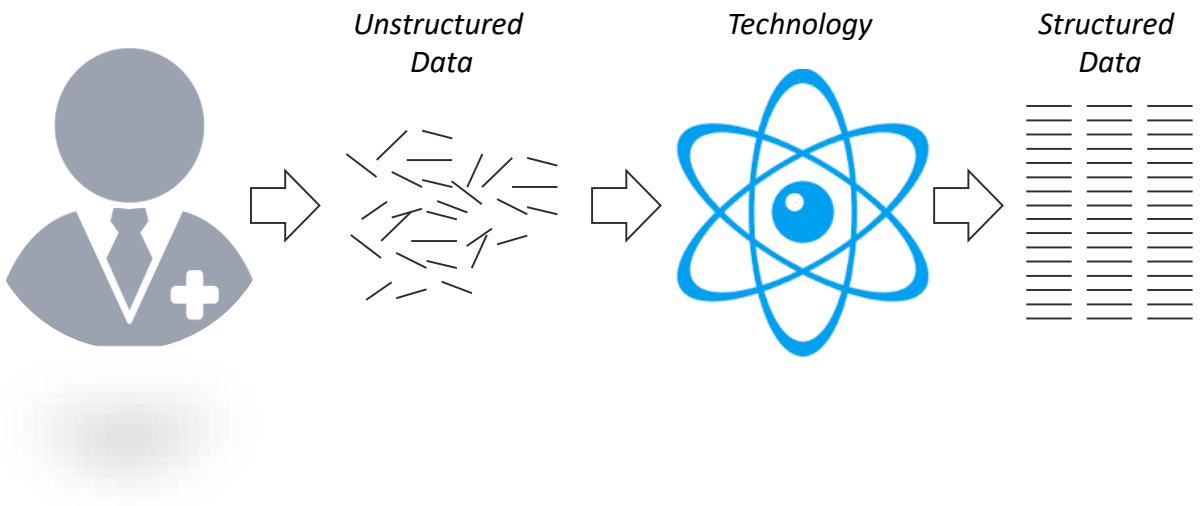
Two Approaches to acquire Structured Data in Medicine

Secondary vs. Primary Approach

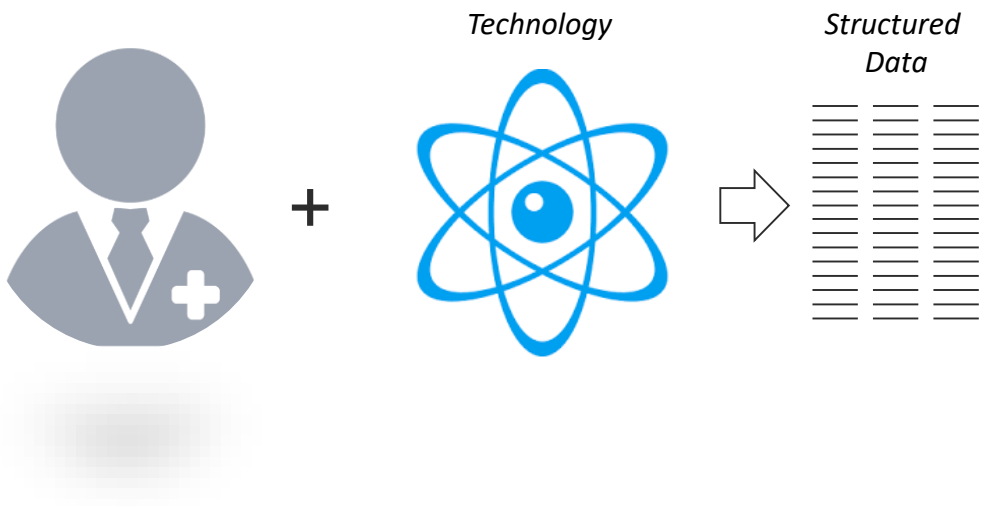
Secondary Approach

Structure data after it has been collected in an unstructured manner



Primary Approach

Structure data in the moment when you collect it



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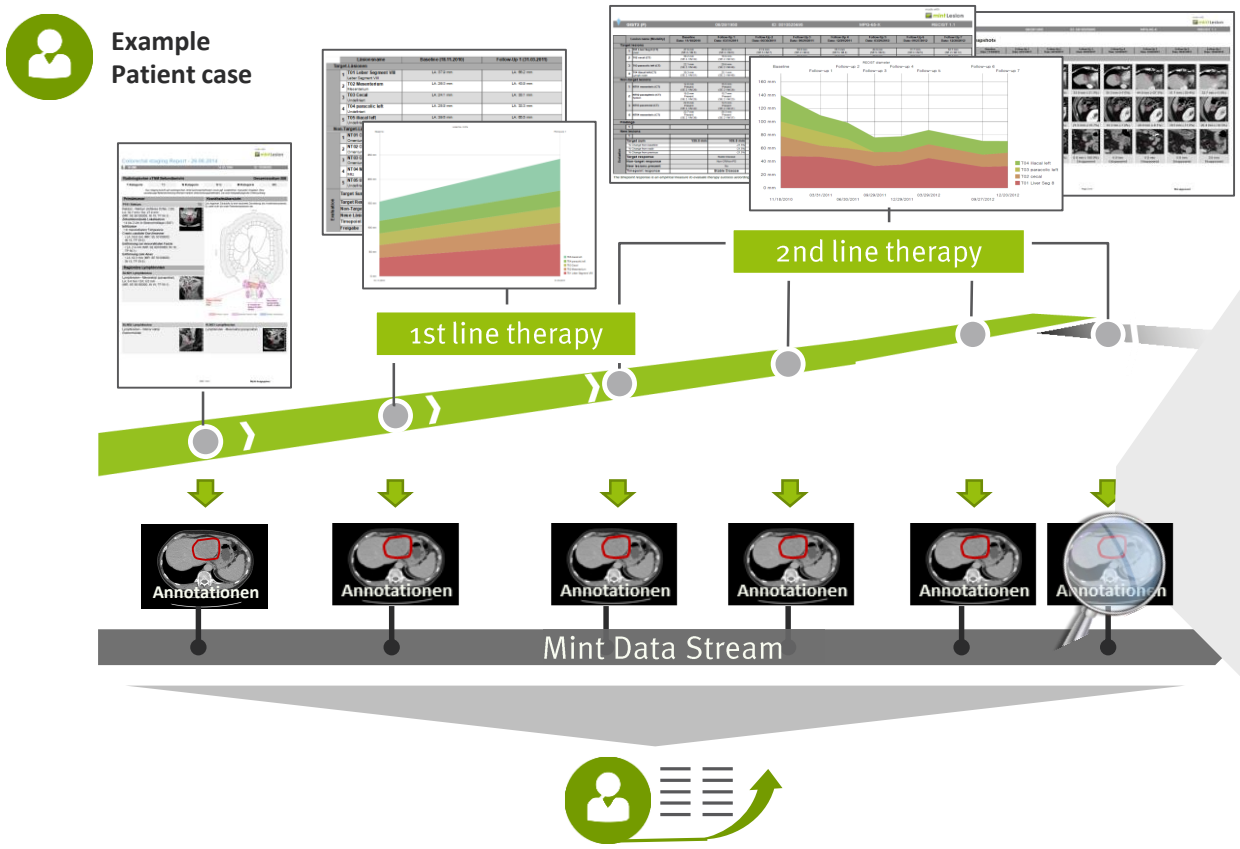
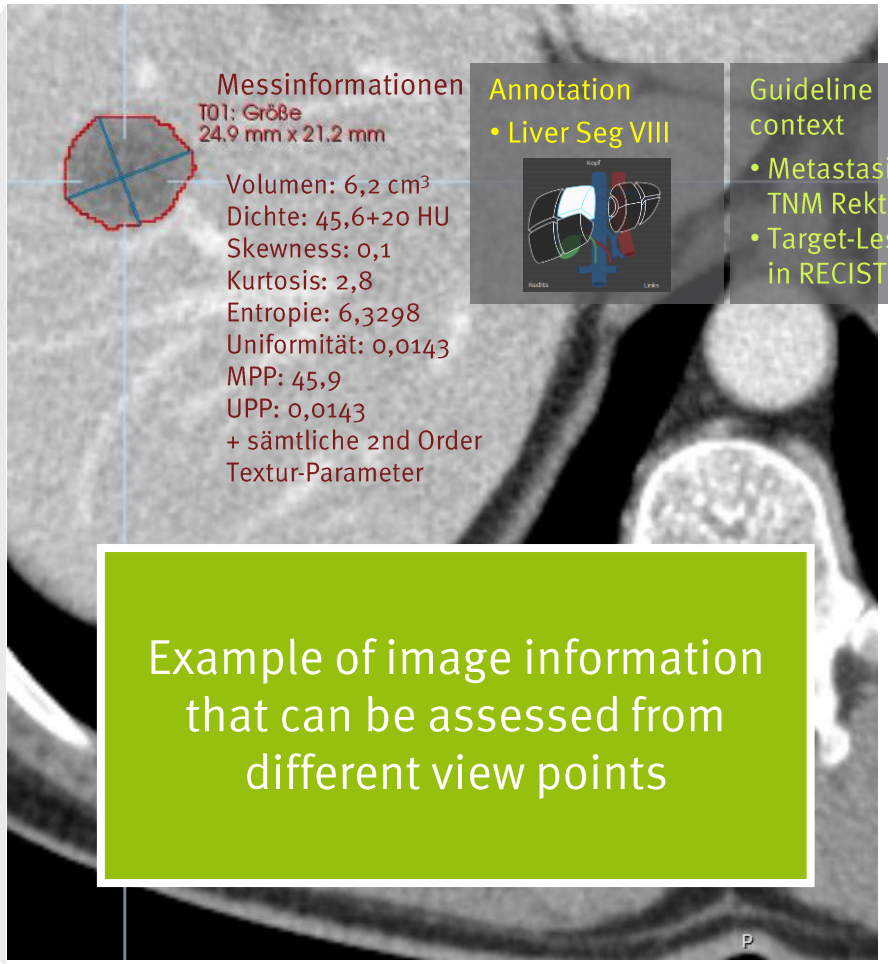
Huge Potential for Radiology

The combination of radiomics, annotated image information and clinical guidelines in structured data





Machine Learning / Artificial Intelligence

Personalized Medicine / Real World Evidence

Value-based medicine / Quantify Radiology

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Overview
Mint Medical Company Information

Company

Software platform

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User groups & fields of application

Mint Medical GmbH / Mint Medical Inc.

- Founded in 2010 as spin-off of German Cancer Research Center
  Fully independent and profitable, no venture capital involved
- Located in Heidelberg/Germany (HQ) and Hamilton, NJ/USA
  Holistic software development in Heidelberg
- Currently more than 50 people driving the growth of Mint
  Software engineers, physicians, clinical trial experts, business experts, …

Mission Statement

Enabling data-driven radiology

Solving communication problems

mint Lesion™ leaves no data behind on the image

Transforming images to data and data to knowledge

Being an innovative, long-term partner

Overview

Software platform **mint** Lesion™

Company

Software platform

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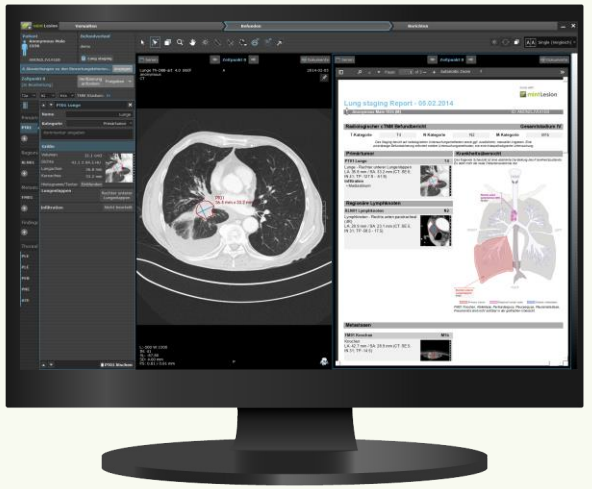
User groups & fields of application

Current approach in radiology

3 different, non-integrated instruments

image viewer | reporting | booklet with guidelines

Approach with mint Lesion as a cognitive radiological assistent



Artificial intelligence

→ Knowledge modelling

→ Machine learning

- ✓ Criteria-conform reading & reporting
- ✓ Image and reading process in one system
- ✓ Machine-readable data (AI-ready)
- ✓ Configurable reading profiles

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Overview

User groups & fields of application

Company

Software platform

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User groups & fields of application

User groups & fields of application

›100 customers worldwide

Practices	Hospitals	Cancer Centers	Imaging CROs	Pharma / Biotech
Routine reads	Routine reads	Routine reads		
	Sponsored trial site reads	Sponsored trial site reads	Sponsored trial central reads	Web-based data capture / data monitoring
		Imaging Biomarker research reads	Imaging Biomarker research reads	Imaging Biomarker research reads

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One platform – three solutions

Choose your field of application

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Management of clinical trial site reads

(generally in a secondary read workflow)

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Structured reporting in clinical routine

(in a primary read workflow)

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Imaging research / Radiomics

(in a secondary read workflow)

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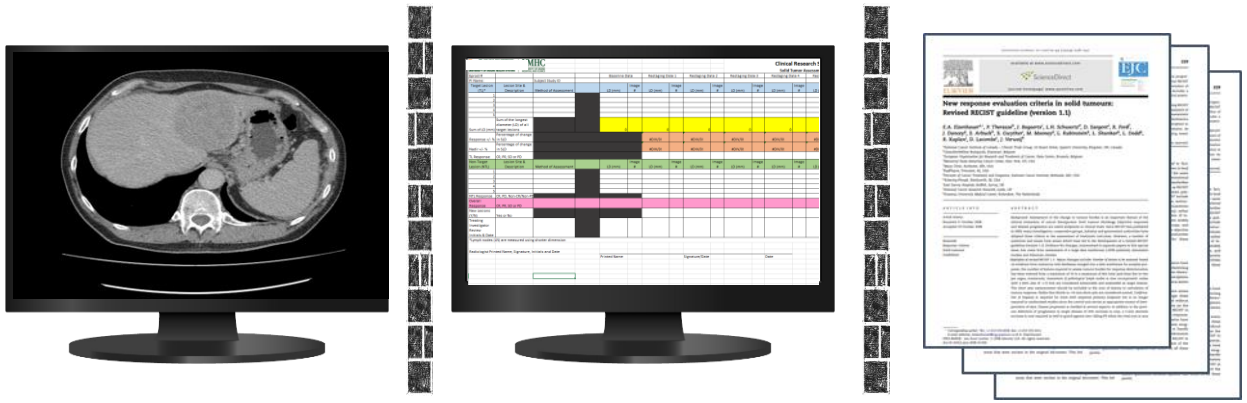
Initial situation

Three different non-integrated tools

Management of clinical trial site reads | Structured reporting in clinical routine | Imaging research / Radiomics



PACS viewer | excel or paper | scientific papers/manuals

e.g., RECIST 1.1

- Large manual effort to collect all necessary data and to calculate correct timepoint response
- Large number of complex therapy evaluation criteria that are constantly updated and changing
- No direct link of documented measurement parameter in Excel with measured finding

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Our approach with Mint

The intelligent radiological assistant

Management of clinical trial site reads | Structured reporting in clinical routine | Imaging research / Radiomics

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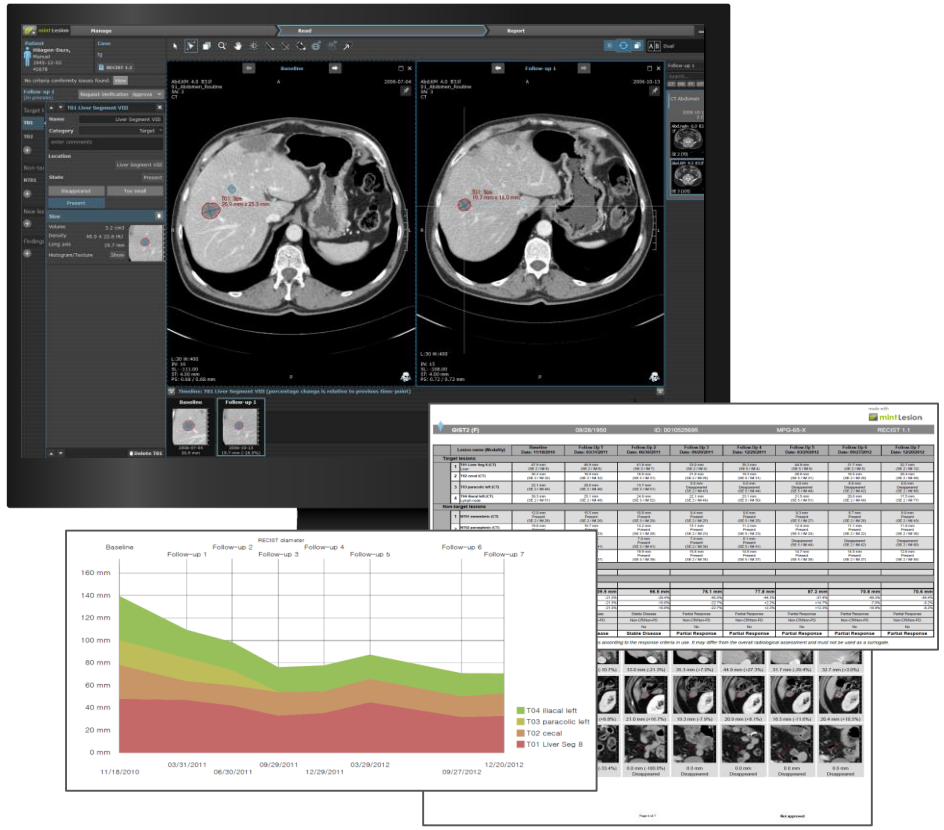
knows all evaluation criteria in detail and supports my analysis



Clinical Trials

Therapy Response Assessment

RECIST 1.1	RECIST 1.0
irRECIST	iRECIST
imRECIST	mRECIST HCC
irRC	mRECIST Mesothelioma
Cheson	RANO / RANO-BM
CHOI	Lugano
PCWG3	WHO
LYRIC	IWCLL
	RECIL (upcoming)
	PERCIST (upcoming)

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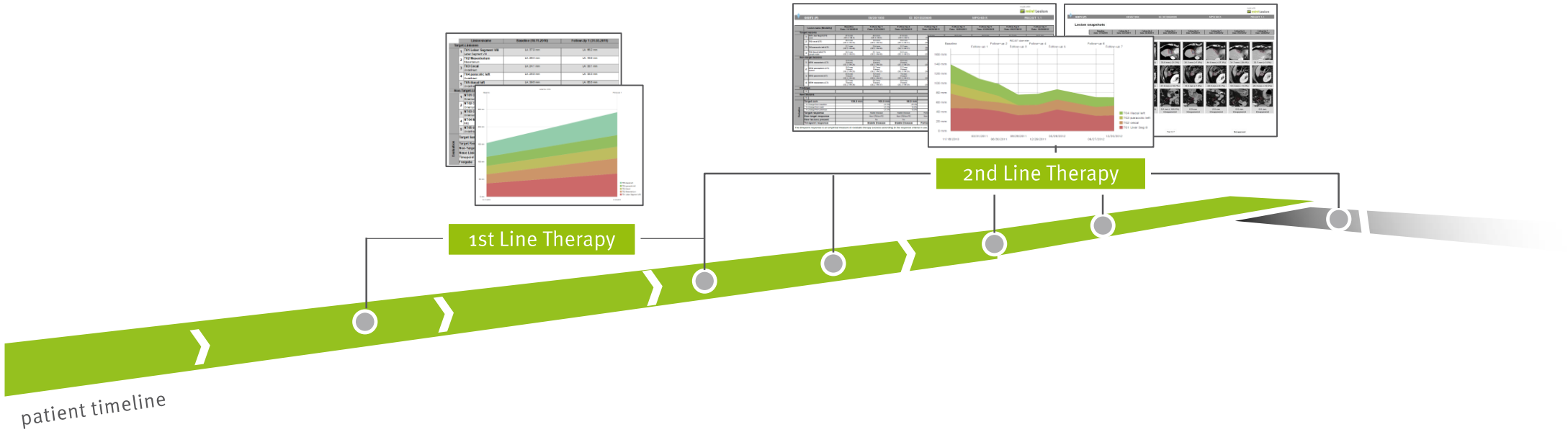
Our approach with Mint

Collection of longitudinal structured data

Management of clinical trial site reads | Structured reporting in clinical routine | Imaging research / Radiomics



+ Patient information

Structured patient data over time

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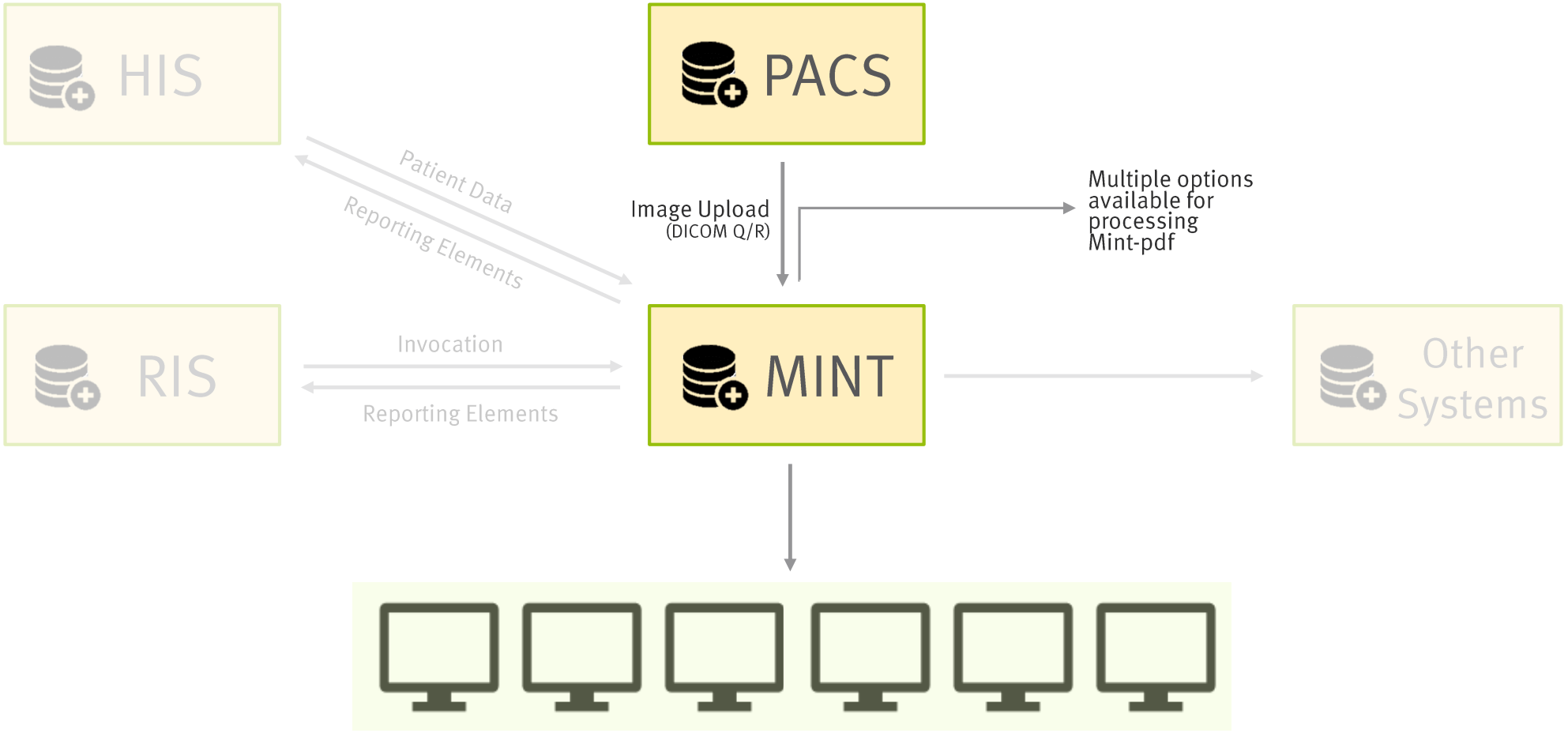
Technical integration

PACS-interface for optimal use of mint Lesion™



Mint Thin Client on Workstations

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One platform – three solutions

Choose your field of application

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Management of clinical trial site reads

(generally in a secondary read workflow)

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Structured reporting in clinical routine

(in a primary read workflow)

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Imaging research / Radiomics

(in a secondary read workflow)

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Our approach with Mint

The intelligent radiological assistant

Management of clinical trial site reads | **Structured reporting in clinical routine** | Imaging research / Radiomics

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Artificial intelligence
- → Knowledge modelling
- → Machine learning

Clinical Routine

Screening & (Re-)Staging

Prostate Screening (PI-RADS v2 + specifics)	Lung Staging (TNM + specifics)
Liver Screening (LI-RADS + specifics)	Colon/Rectum Staging (TNM8 + specifics)
Stomach/Esophagus Staging (TNM8)	Pancreas Staging (TNM8)
COVID-19	Therapy Response Eval. Routine (e.g. RECIST 1.1)
Cervix/Endometrium Staging (TNM8 + FIGO) upcoming	Head/Neck Staging (Pharynx/Larynx/Lip/Oral cavity) upcoming
Urological Cancers (TNM8) upcoming	Pediatric Cancer Staging (Neuro-/Nephro-/Hepatoblastoma + Rhabdomyosarcoma) upcoming

- ✓ Guideline-conform reading & reporting
- ✓ Image and reading process in one system
- ✓ Machine-readable data (AI-ready)
- ✓ Configurable reading profiles

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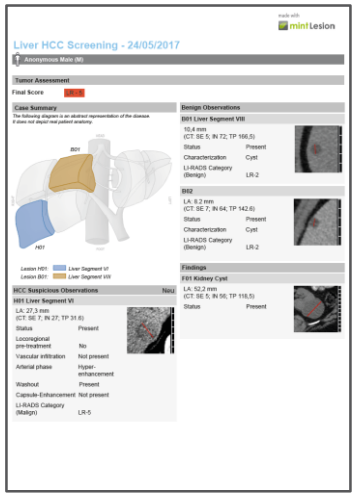
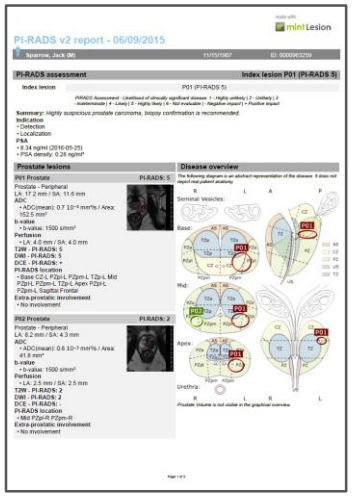
Context-specific Structured Report

Comprehensive, transparent and reproducible

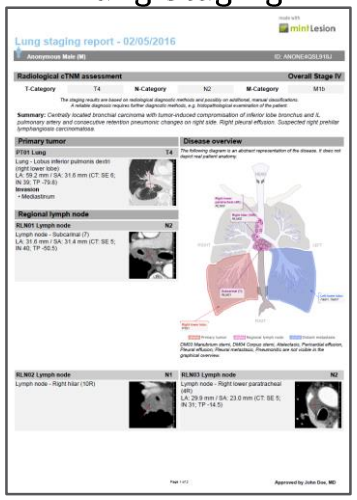
LI-RADS



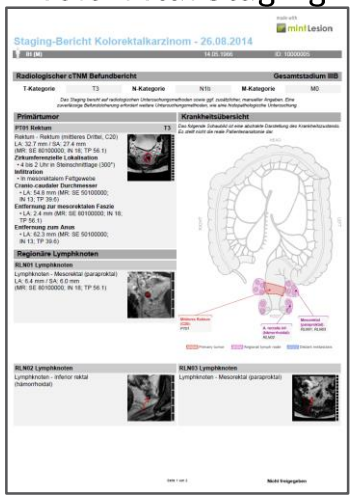
PI-RADS v2.1



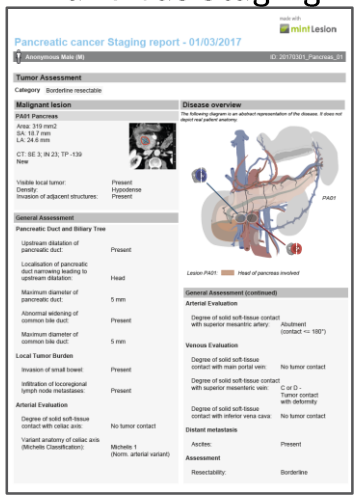
Lung Staging

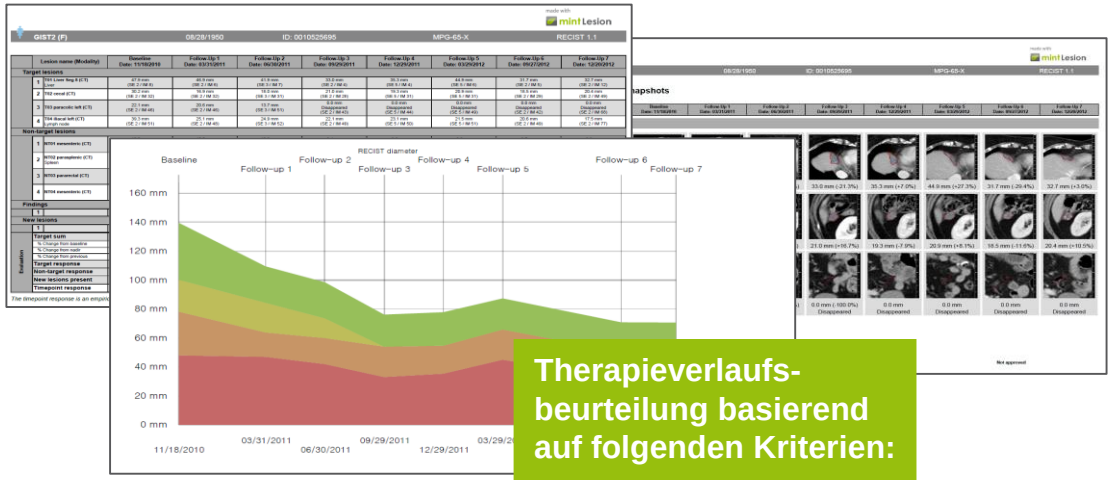


Colorectal Staging



Pancreas Staging



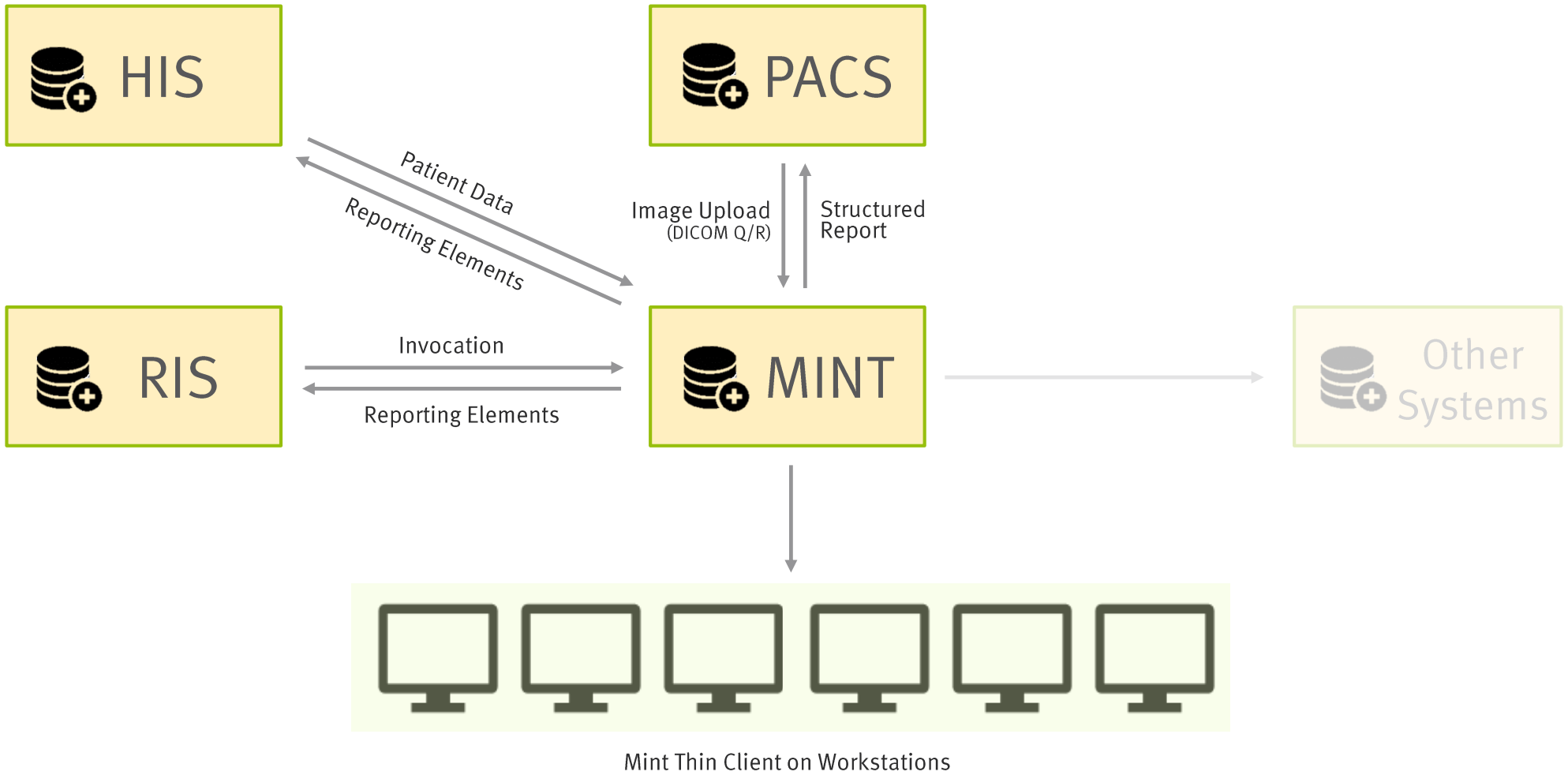


Therapieverlaufs-beurteilung basierend auf folgenden Kriterien:

- RECIST (1.0, 1.1)
- irRECIST
- irRC
- iRECIST
- RANO
- WHO
- Lugano
- Choi
- mRECIST HCC
- mRECIST Mesothelioma
- PCWG2
- …

Technical Integration

Interfaces for optimal use of mint Lesion™



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One platform – three solutions

Choose your field of application

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Management of clinical trial site reads

(generally in a secondary read workflow)

mint Lesion

Structured reporting in clinical routine

(in a primary read workflow)

mint Lesion

Imaging research / Radiomics

(in a secondary read workflow)

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Initial situation
Imaging research / Radiomics

- No direct link of documented measurement parameter in Excel with measured findings
- Different viewers necessary to capture relevant image parameter for research project
- High manual effort to collect all necessary data and to properly document all data sources

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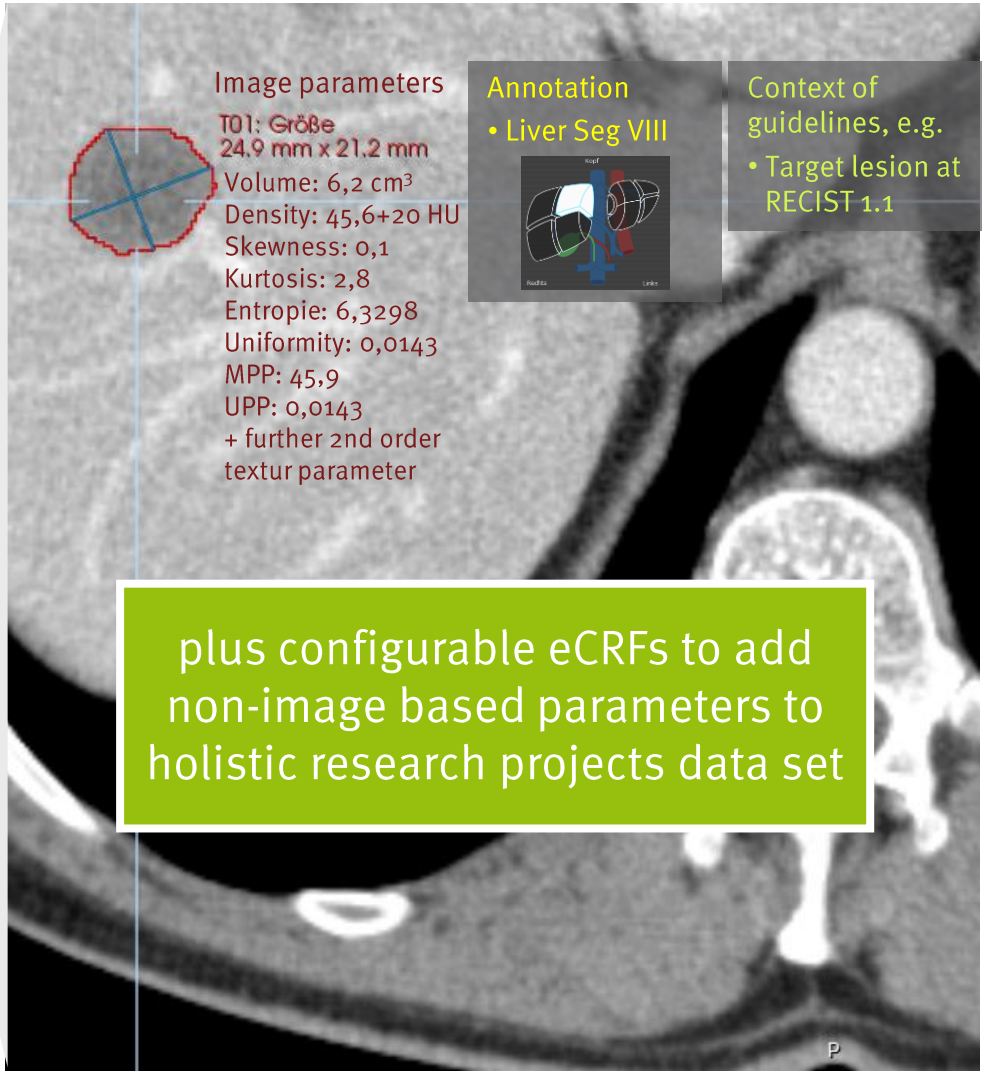
Our approach with Mint
Imaging research / Radiomics

Longitudinal connected, annotated image data sets



Data export directly out of Mint application and ready to run statistics

Release version: 3.4.2						
Patient	Häagen-Dazs, Manuel					
Patient ID	45678					
Date of birt	12.03.1945					
Criteria	RECIST 1.1					
Trial	111					
Trial arm	Read 1					
Assessment		Baseline	Follow-up 1	Follow-up 2	Follow-up 3	Follow-up 4
Date		05.02.2006	07.04.2006	10/13/2006	01/23/2007	04/18/2007
Target lesions						
T01 Liver Segment VIII						
Organ	Liver Segment VIII					
Size						
	LA [mm]	38.9	25. Mai	19. Apr	16. Mai	15. Mrz
	SA [mm]	33.6	21. Mrz	17. Jul	14. Mrz	13. Aug
	Vol. [cm3]	24. Feb	06. Aug	02. Sep	2.0	01. Jul
	Entr.	64.511	64.709	63.662	61.215	65.528
	Kurt.	03. Jun	02. Jul	03. Feb	02. Sep	03. Jan
	Mpp.	61.0	49.2	46.2	55.0	61.7
	Skew.	0.6	0.2	0.1	0.0	0.0
	Upp.	0.0136	0.0129	0.0141	0.0166	0.0124
	Unif.	0.0136	0.0129	0.0142	0.0166	0.0124
State		Present	Present	Present	Present	Present
T02 Liver Segment VIII						
Organ	Liver Segment VIII					
Size						
	LA [mm]	38.7	26.0	19. Mrz	18. Jan	17. Mai
	SA [mm]	29.0	22. Sep	16. Sep	15. Jul	15. Sep
	Vol. [cm3]	16. Apr	06. Apr	02. Apr	02. Jan	2.0
	Entr.	66.416	67.017	61.282	63.043	65.089
	Kurt.	03. Jan	02. Sep	02. Jul	02. Aug	02. Mai
	Mpp.	61.2	58.8	49.8	61.9	68.0
	Skew.	0.1	0.3	-0.1	-0.1	0.0
	Upp.	0.0117	0.0110	0.0164	0.0145	0.0124
	Unif.	0.0117	0.0111	0.0164	0.0145	0.0124
State		Present	Present	Present	Present	Present
Non-target lesions						
NT01 Liver Segment VIII						
Organ	Liver Segment VIII					
Size						
	LA [mm]	29. Apr	15.0	12. Jun	10. Jul	15.0
	SA [mm]	26.0	13. Jun	11. Jul	09. Jun	12. Aug
	Vol. [cm3]	09. Apr	01. Jun	01. Jan	0.5	01. Apr
	Entr.	71.707	63.834	65.178	60.474	67.459
	Kurt.	2.0	02. Aug	02. Feb	02. Aug	03. Mai
	Mpp.	97.0	61.1	71.6	71.4	105.3
	Skew.	-0.1	0.3	0.1	-0.0	-0.4
	Upp.	0.0076	0.0140	0.0122	0.0174	0.0113
	Unif.	0.0076	0.0140	0.0122	0.0174	0.0113
State		Present	Present	Present	Present	Present
Evaluation						
Target sum [mm]		77.5	51.6	38.6	34.6	32.8
Target response		Undefined	Partial Response	Partial Response	Partial Response	Partial Response
Non-target response		Undefined	Non-CR/Non-PD	Non-CR/Non-PD	Non-CR/Non-PD	Non-CR/Non-PD
New lesions present		No	No	No	No	No
Timepoint response		Undefined	Partial Response	Partial Response	Partial Response	Partial Response
Approval		Not approved	Not approved	Not approved	Not approved	Not approved

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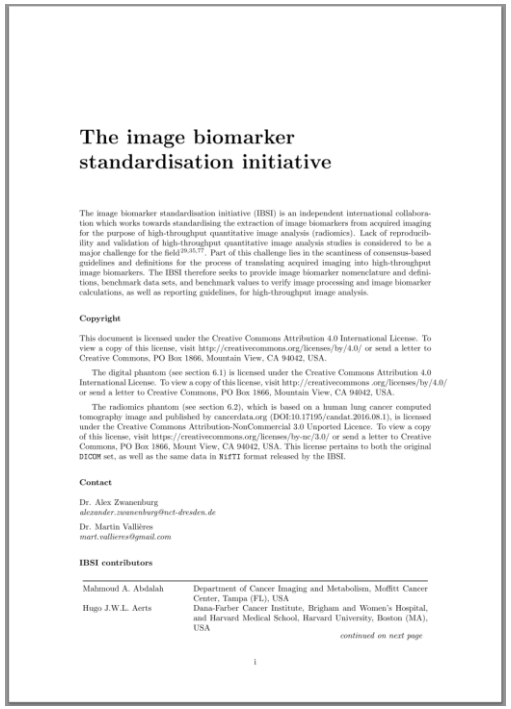
Approach with Mint
Imaging research / Radiomics

Radiomics parameters are based on Image biomarker standardization initiative (IBSI):

- Zwanenburg, A., Leger, S., Vallières, M., & Löck, S., et al. (2016). Image biomarker standardisation initiative - feature definitions. *CoRR, abs/1612.0*. http://arxiv.org/abs/1612.07003



The image biomarker standardisation initiative

The image biomarker standardisation initiative (IBSI) is an independent international collaboration which works towards standardising the extraction of image biomarkers from acquired imaging for the purpose of high-throughput quantitative image analysis (radiomics). Lack of reproducibility and validation of high-throughput quantitative image analysis studies is considered to be a major challenge for the field[20,21]. Part of this challenge lies in the scantiness of consensus-based guidelines and definitions for the process of translating acquired imaging into high-throughput image biomarkers. The IBSI therefore seeks to provide image biomarker nomenclature and definitions, benchmark data sets, and benchmark values to verify image processing and image biomarker calculations, as well as reporting guidelines, for high-throughput image analysis.

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The digital phantom (see section 6.1) is licensed under the Creative Commons Attribution 4.0 International License. To view a copy of this license, visit http://creativecommons.org/licenses/by/4.0/ or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

The radiomics phantom (see section 6.2), which is based on a human lung cancer computed tomography image and published by cancerdata.org (DOI:10.17195/candat.2016.08.1), is licensed under the Creative Commons Attribution-NonCommercial 3.0 Unported Licence. To view a copy of this license, visit https://creativecommons.org/licenses/by-nc/3.0/ or send a letter to Creative Commons, PO Box 1866, Mount View, CA 94042, USA. This license pertains to both the original DICOM set, as well as the same data in NIfTI format released by the IBSI.

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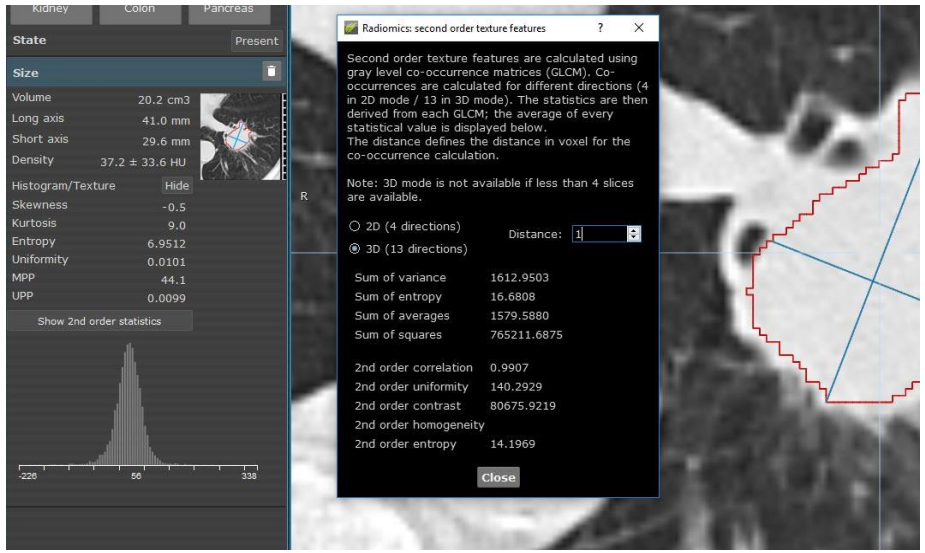

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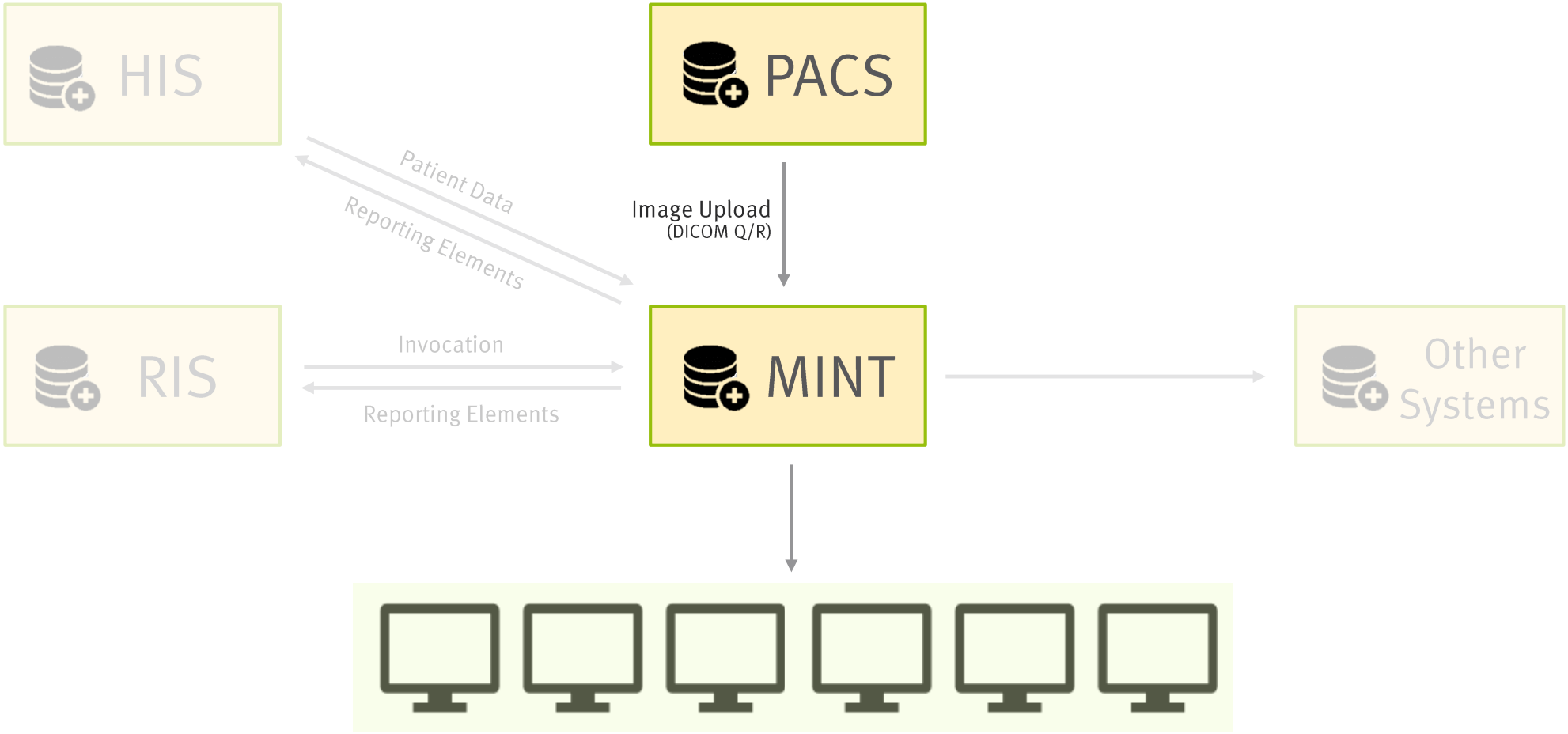
Technical integration
Imaging research / Radiomics



Thank you!

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