



# FAST AND EFFICIENT SERIAL TUMOR ASSESSMENT WITHOUT THE NEED FOR DICTATION

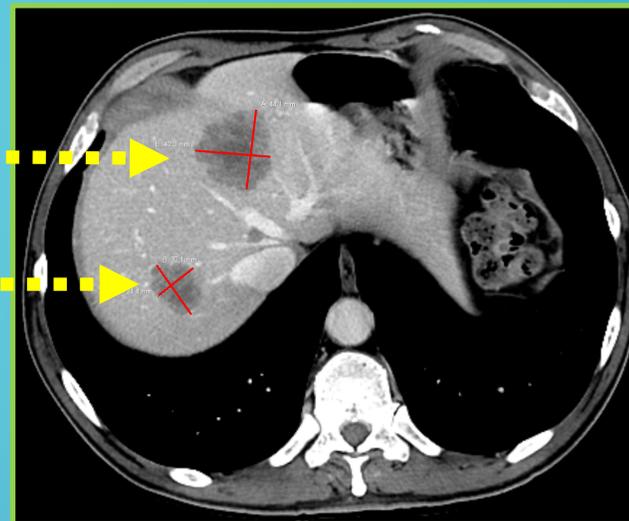
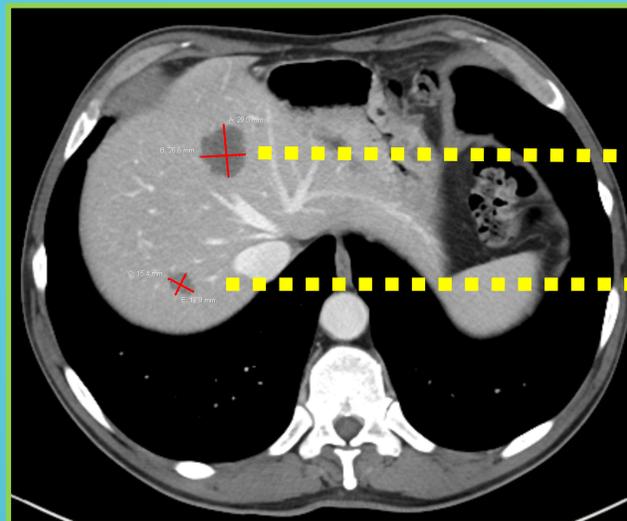
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## PURPOSE:



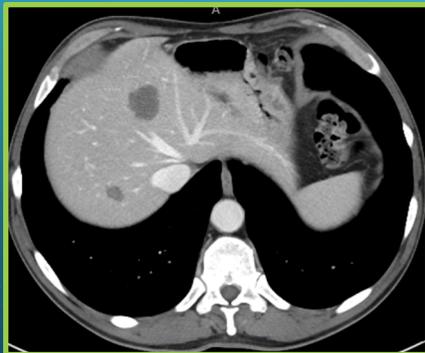
- Serial tumor assessment is tedious and time-consuming when processing multiple exams containing numerous lesions.
- Human and/or transcription error introduced during dictation may result in the reporting of incorrect measurements and/or image locations.
- To improve efficiency and eliminate error, we interfaced an interactive multimedia reporting system to a PACS so that DICOM images and measurements can be transmitted directly into a report without the need for dictation.

# METHODS:

An interactive multimedia reporting system was developed that works as follows:

1. Record key images and dictate descriptions of baseline findings
2. Tag baseline findings with metadata using natural language processing (NLP) referenced to an ontology to define anatomy and pathology
3. Assemble multimedia report with related data linked in timelines for disease response calculations

## Step 1: Record images/voice



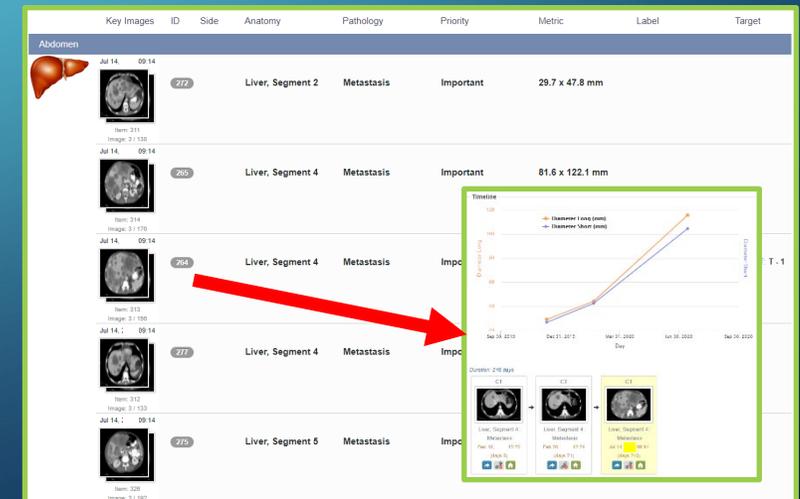
*A metastasis is identified in liver segment 4.*

## Step 2: Tag with metadata

A screenshot of a medical report interface. The report is titled "Abdomen" and shows a liver icon. The main finding is "Liver, Segment 4 Metastasis" with a size of "26.6 x 29 mm". The report is marked as "Important". Below the main finding, there are tabs for "Details", "Info", "History", "External Links", "Ontologies", "Show more", and "Treatments". A "Key Image" section shows a thumbnail of the CT scan. A red dashed arrow points from the "NLP" box to the "Ontologies" tab. A green dashed arrow points from the "NLP" box to the "Show more" tab. A red box labeled "NLP" contains the text "A metastasis is identified in liver segment 4.".

Disease metrics and series/image numbers are transmitted automatically using PACS API.

## Step 3: Assemble multimedia report

A screenshot of a multimedia report interface. The report is titled "Abdomen" and shows a liver icon. The main finding is "Liver, Segment 4 Metastasis" with a size of "81.6 x 122.1 mm". The report is marked as "Important". Below the main finding, there is a "Timeline" section showing a graph of "Disease Response" over time. The graph shows two lines: "Disease Response (mm)" and "Disease Response (mm)". A red arrow points from the "Timeline" section to the "Key Images" section. The "Key Images" section shows a list of images with their IDs, sides, anatomy, pathology, priority, metric, label, and target. The images are: Item 277 (Liver, Segment 2, Metastasis, Important, 29.7 x 47.8 mm), Item 265 (Liver, Segment 4, Metastasis, Important, 81.6 x 122.1 mm), Item 314 (Liver, Segment 4, Metastasis, Impc), Item 313 (Liver, Segment 4, Metastasis, Impc), Item 276 (Liver, Segment 4, Metastasis, Impc), and Item 275 (Liver, Segment 5, Metastasis, Impc).

# METHODS:

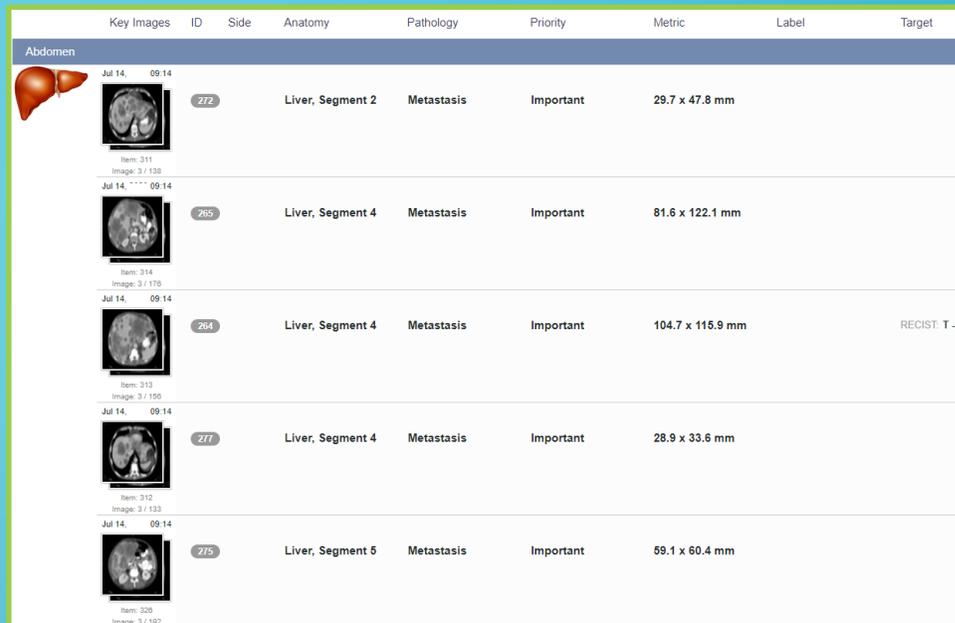
- Originally, radiologists dictated image metrics and series/image numbers that were processed by NLP.
- To improve efficiency and accuracy, a PACS application-programming interface (API) was incorporated to transmit DICOM images and data directly into a report as tumors are measured.
- Reporting system logic recognizes types of metrics, what metrics are associated with which findings, and when metrics are modified.

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PACS API transmits DICOM metadata

# METHODS:

- Each finding in a baseline exam is annotated with metadata describing anatomy and pathology using NLP.



Key Images	ID	Side	Anatomy	Pathology	Priority	Metric	Label	Target			
	Item: 211 Image: 3 / 138	Item: 214 Image: 3 / 176	Item: 213 Image: 3 / 150	Item: 212 Image: 3 / 133	Item: 208 Image: 3 / 162	272	Liver, Segment 2	Metastasis	Important	29.7 x 47.8 mm	
						265	Liver, Segment 4	Metastasis	Important	81.6 x 122.1 mm	
						264	Liver, Segment 4	Metastasis	Important	104.7 x 115.9 mm	REGIST: T - 1
						277	Liver, Segment 4	Metastasis	Important	28.9 x 33.6 mm	
						275	Liver, Segment 5	Metastasis	Important	59.1 x 60.4 mm	

Baseline exam annotated by voice dictation and NLP

- Links between serial exams are achieved by the following steps:
  1. Radiologist “activates” a prior annotated finding by clicking on it in edit mode.
  2. Radiologist measures a corresponding “new finding” in the PACS display.
  3. The radiologist presses a speech microphone function button to record the new finding and initiate the transfer of imaging data that is linked to the prior finding.
  4. Metadata from the prior finding is transferred to label the new finding, and automated text is generated to indicate the event.
  5. Repeat for each finding being evaluated.

# Link findings without dictation:

## Step 1: Activate prior finding

Key Images	ID	Side	Anatomy	Pathology	Priority	Metric
	Jul 14, 09:14		Liver, Segment 2	Metastasis	Important	29.7 x 47.8 mm
	217		Liver, Segment 4	Metastasis	Important	28.9 x 33.6 mm
	264		Liver, Segment 4	Metastasis	Important	42.4 x 44.1 mm

Activate prior finding by clicking on it

## Step 2: Measure "new finding"



## Step 3: Press microphone button



## Step 5: Repeat for each finding

Key Images	ID	Side	Anatomy	Pathology	Priority	Metric
	Jul 14, 09:14		Liver, Segment 2	Metastasis	Important	29.7 x 47.8 mm
	217		Liver, Segment 4	Metastasis	Important	28.9 x 33.6 mm

Indicates that a link has been created

## Step 4: Transfer metadata via PACS API

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}
```

# RESULTS:

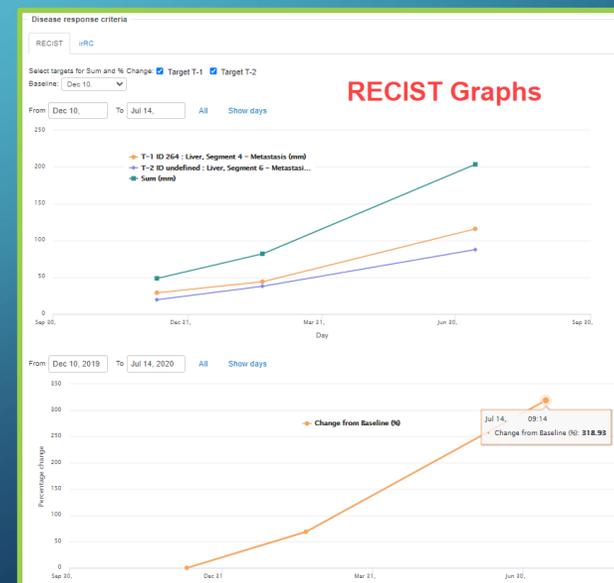
- Unnecessary redundant dictation is eliminated unless a radiologist wants to describe additional details.
- Sans dictation, automated text is generated to describe the event.
- The disease metrics are displayed in graphical timelines.
- Findings designated as Target lesions in the multimedia report are used for disease response calculations (e.g., RECIST, irRC).

The screenshot shows a medical report interface for 'Abdomen'. It features a table with columns: Key Images, ID, Side, Anatomy, Pathology, Priority, Metric, Label, and Target. Two findings are listed:

Key Images	ID	Side	Anatomy	Pathology	Priority	Metric	Label	Target
	272		Liver, Segment 2	Metastasis	Important	29.7 x 47.8 mm		
	264		Liver, Segment 4	Metastasis	Important	104.7 x 115.9 mm		

Below the table, a 'Details' section is visible. A red arrow points to a yellow highlighted text box that reads: 'Metrics only recorded. The liver, segment 4 - metastasis measures 104.7 x 115.9 mm on image 156 of series 3.' The text 'Automated text generation' is written in red above the arrow.

**Metrics only recorded. The liver, segment 4 - metastasis measures 104.7 x 115.9 mm on image 156 of series 3.**



**Disease Response Assessment**

## RESULTS:

- Substantial time-savings (~10 sec/finding) is achieved using the automated process by eliminating unnecessary redundant dictation.
- The time-savings is cumulative depending on the number of findings in a report.
- The system facilitates the capture of more findings per report which can create new disease insights.
- Direct transmission of DICOM data promotes safety by eliminating human and/or transcription errors.

How long does it take to repeatedly dictate?

*There is a 10 x 20 millimeter metastasis in liver segment 6 on image 50 of series 3.*



# CONCLUSIONS:

The use of interactive multimedia reporting with a PACS interface allows for more efficient reporting of serial tumor assessments and eliminates the potential for human and/or transcription errors.

