

# A Pipeline for Creating Patient-Centered Radiology Education Material

**Presenter: Timothy Arleo, MD**

Deangelo Harris, MD

Jada Hislop, MD

John Moon, MD

Hanssen Li, MD

Correspondence: Nadja Kadom, MD ([nkadom@emory.edu](mailto:nkadom@emory.edu))

# Background and Project Aim

- The American Medical Association (AMA) and National Institutes of Health (NIH) recommend that patient education material (PEM) are written at a 6<sup>th</sup> – 8<sup>th</sup> grade reading level
- We found that our institution's radiology PEM by far exceed the 8<sup>th</sup> grade reading level, were too long, were poorly designed, and contained some inaccurate information regarding imaging exams at our institution

## Project Aim

To develop a pipeline for creating patient-centered radiology education materials using ChatGPT for efficiency, as well as radiology staff and patient and family advisors (PFA) as subject matter experts.

# Methods



**Document Sourcing:** Existing PEM were collected by two radiology residents



**Editorial Stage:** Two radiology residents and one attending radiologist faculty member combined information from multiple PEM into a single unified document, approximately one page in length



**Language Simplification:** A prompt was created in ChatGPT-4.0 to which each drafted PEM was inputted to simplify language below the 7th grade reading level



**Image Creation:** Simplified images of each examination type were created in Adobe InDesign and added to the PEM



**Subject Matter Expert Review:** Radiology modality directors and divisional faculty reviewed each PEM using the AHRQ Patient Educational Material Assessment Tool (PEMAT) survey. Additional qualitative feedback was used to adjust PEM



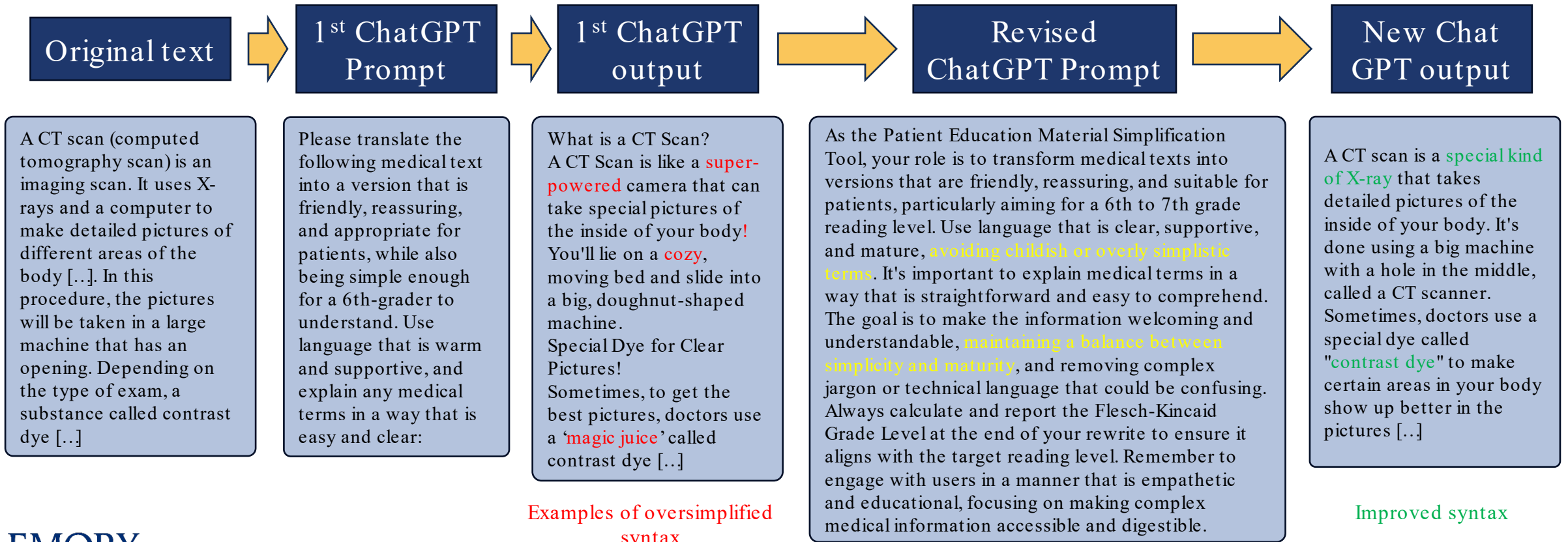
**Patient Ratings:** Patient and family advisors (PFA) volunteers were recruited to assess PEM understandability using a modified version of the AHRQ (PEMAT) survey



**Institutional Branding and Visual Aides:** PEM were sent to the communications and marketing team for institution-specific branding

# Language Simplification: ChatGPT 4.0

- Original documents were iteratively revised using ChatGPT and a small group of subject matter experts (2 radiology residents and 1 radiology attending)
- Observation: ChatGPT was good at simplifying language, but sometimes changed the meaning or simplified too much



# AHRQ PEMAT-P Survey

- Survey from the Agency for Healthcare Research and Quality (AHRQ) for quantitative assessment of understandability and actionability of printed material
- *PFA modified survey*. PEMAT survey language was simplified for improved understanding among PFA volunteers
- Only questions assessing understandability were included, as PEM were not meant to be actionable
- Threshold score of 70%: considered sufficiently understandable
- A summary was not included as each document was not to exceed one page and we felt that subheadings were more useful than a summary

Original PEMAT-P	Modified PEMAT-P
The material makes its purpose completely evident.	The material makes its purpose completely clear.
The material does not include information or content that distracts from its purpose.	The material only includes information or content that relates to its purpose.
The material uses common, everyday language.	The material uses common, everyday language
Medical terms are used only to familiarize audience with the terms. When used, medical terms are defined.	Medical terms are used only to familiarize readers with the terms. When used, medical terms are defined.
The material uses the active voice	The material uses the active voice.
*Numbers appearing in the material are clear and easy to understand.	---
*The material does not expect the user to perform calculations.	---
The material breaks or "chunks" information into short sections.	The material breaks or "chunks" information into short sections.
The material's sections have informative headers.	The material's sections have informative headers.
The material presents information in a logical sequence.	The material presents information in a logical sequence.
*The material provides a summary.	**The material does not have a summary. Should we remove some of the content to add a summary?
---	**The paragraph on "Your next steps" is helpful.
The material uses visual cues (e.g., arrows, boxes, bullets, bold, larger font, highlighting) to draw attention to key points.	The material uses visual cues (e.g., arrows, boxes, bullets, bold, larger font, highlighting) to draw attention to key points.
The material uses visual aids whenever they could make content more easily understood (e.g., illustration of healthy portion size).	The material uses visual aids whenever they could make content more easily understood (eg illustration of healthy portion size)
The material's visual aids reinforce rather than distract from the content.	The material's visual aids are helpful rather than distracting.
The material's visual aids have clear titles or captions.	The material's visual aids have clear titles or captions.
The material uses illustrations and photographs that are clear and uncluttered.	The material uses illustrations and photographs that are clear and uncluttered.
*The material uses simple tables with short and clear row and column headings.	---
---	**We would like to hear any additional comments from you.

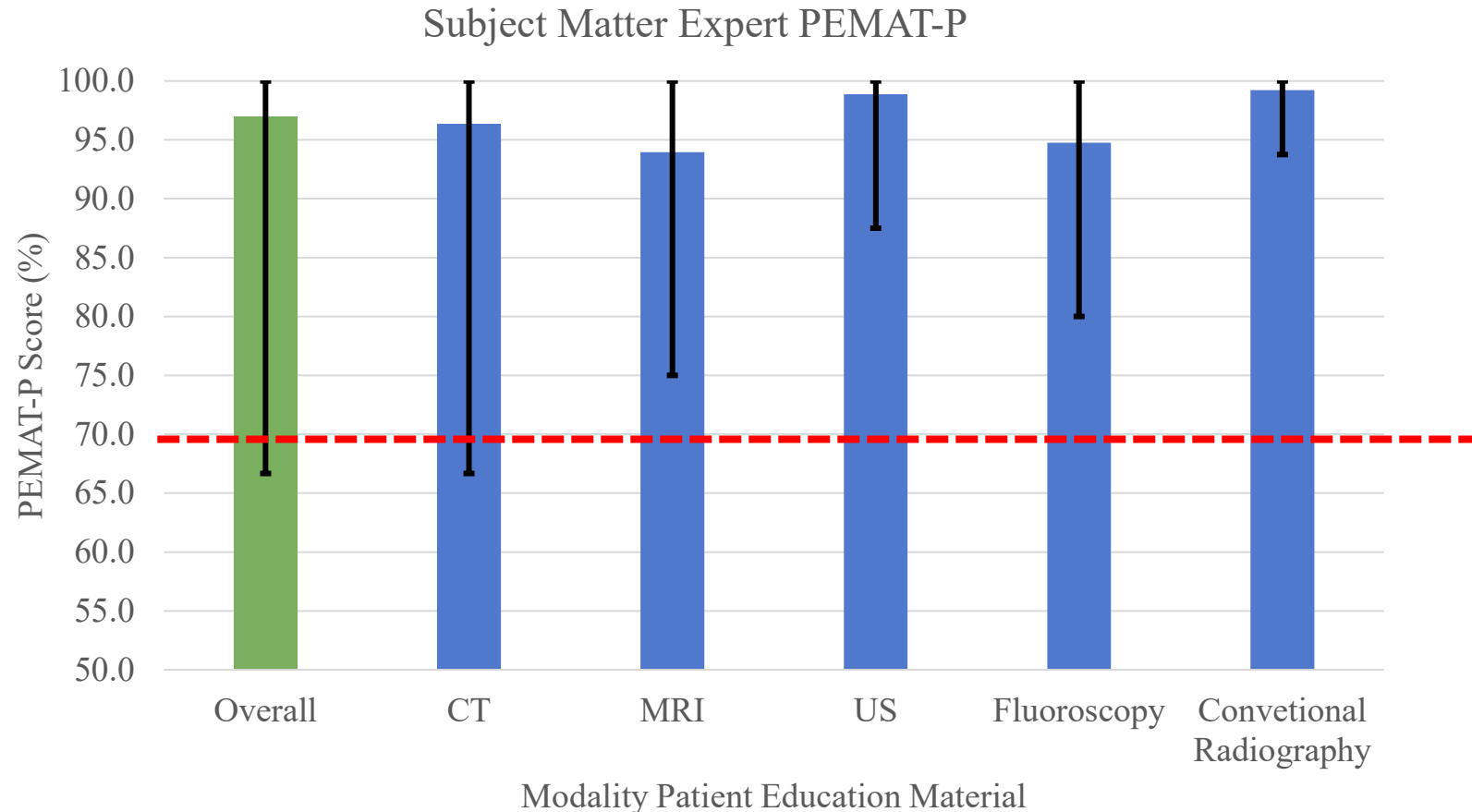
\*Not applicable to PEM

Yellow highlights indicate modified question syntax

\*\*Additional questions not used for PEMAT-P scoring

# Results: Subject Matter Expert PEMAT-P

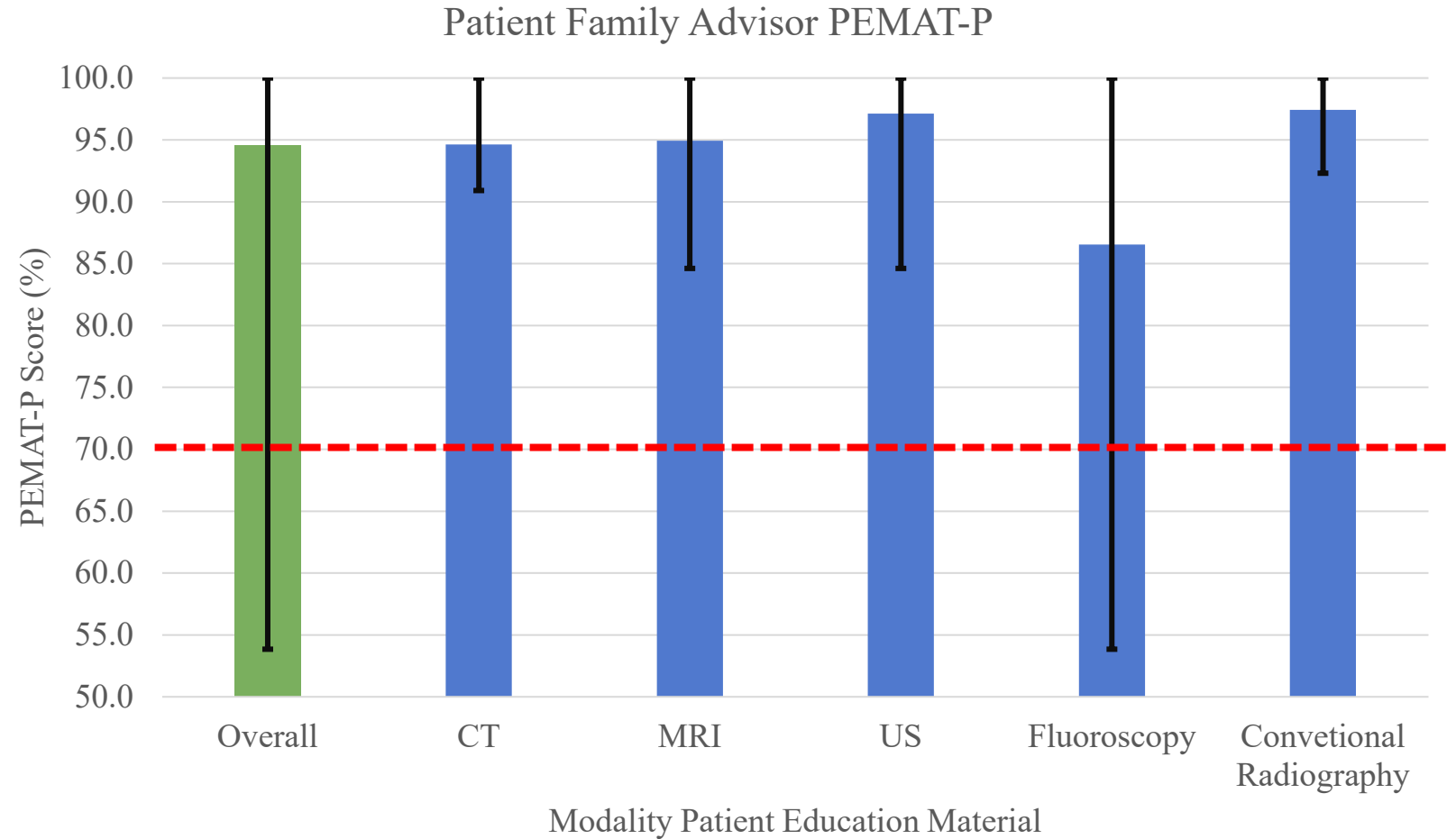
- 64 modality directors and divisional faculty provided feedback: 16 for CT, 13 for MRI, 22 for US, 5 for fluoroscopy, 8 for conventional radiography
- 63/64 (98%) respondents rated understandability of the new documents over 70% (threshold score)
- 39/64 (61%) subject matter experts provided additional qualitative feedback



Average Subject Matter Expert PEMAT-P scores per PEM document. Error bars indicate the maximum and minimum scores.  
Red line: PEMAT-P threshold score.

# Results: PFA PEMAT-P

- 40 PFA recruited, 26 responded (65% response rate)
- PFA per document: 6/8 (75%) CT, 5/8 (63%) MRI, 8/8 (100%) US, 4/8 (50%) fluoroscopy, 3/8 (38%) conventional radiography
- 25/26 (96%) respondents rated over 70% (threshold score)



Average PFA PEMAT-P scores. Error bars indicate the maximum and minimum scores. Red line: PEMAT-P threshold score.

# Results: Readability levels

- Readability levels for the PEM using Flesch Kincaid Readability Scores (FKRS) met AMA and NIH recommendations (6<sup>th</sup> and 8<sup>th</sup> grade reading levels, respectively)
- *Flesch Kincaid Grade Level (FKGL)*: a score standardized to a U.S. educational system grade level, therefore easily comparable to the AMA and NIH grade reading recommendations
- *Flesch Reading Ease Score (FRES)*: A higher FRES score indicates easier readability. 70.0 grades as, “fairly easy to read”

Modality	Initial document FKGL	Final document FKGL	Final document FRES
Computed Tomography (CT)	4.8	5.8	75.8
Magnetic Resonance Imaging (MRI)	5.9	5.8	75.7
Ultrasound (US)	5.9	6.3	69.1
Fluoroscopy	5.9	5.9	75.4
Conventional Radiography	6.3	6.2	69.3

# Before-After Example

## CT Scan, Adult

A CT scan (computed tomography scan) is an imaging scan. It uses X-rays and a computer to make detailed pictures of different areas inside the body. A CT scan can give more information than a regular X-ray exam. A CT scan provides data about internal organs, soft tissue structures, blood vessels, and bones.



In this procedure, the pictures will be taken in a large machine that has an opening (CT scanner). Depending on the type of exam, a substance called contrast dye may be used to help see the area in the body that is being checked. The contrast may be swallowed, injected through an IV, or in some cases, given by an enema. An enema is when the dye is put into your colon through your anus.

### Tell a health care provider about:

- Any allergies you have.
- All medicines you are taking, including vitamins, herbs, eye drops, creams, and over-the-counter medicines.
- Any bleeding problems you have.
- Any surgeries you have had.
- Any medical conditions you have or recent illnesses.
- Whether you are pregnant or may be pregnant.

### What are the risks?

Your health care provider will talk to you about risks. These may include:

- An allergic reaction to the dye used during the procedure.
- Risk of cancer from too much exposure to radiation from multiple CT scans. This is rare.

### What happens before the procedure?

- Follow instructions from your health care provider about what you may eat and drink. If contrast dye will be used for the CT scan, you may need to stop eating and drinking for a few hours before the procedure.
- Ask your health care provider about:
  - Changing or stopping your regular medicines. These include any diabetes medicines or blood thinners you take.
  - Taking over-the-counter medicines, vitamins, herbs, and supplements.
- Remove any jewelry or metal objects.
- Wear loose, comfortable clothing. You may be asked to change into a hospital gown.

### What happens during the procedure?

- An IV tube may be inserted into one of your veins.
- The contrast dye will be given, if needed.

<https://patientdirect.emory.com/#/services?centerid=24742130>

10/25/24, 8:12 AM

- You will lie on a table.
- Pillows and straps may be used to position you.
- The table you will be lying on will move into the CT scanner.
- You will be able to see, hear, and talk to the person running the machine while you are in it. Follow that person's instructions. You may be asked to hold your breath.
- The CT scanner will move around you to take pictures. **Do not** move while it is scanning. Staying still helps the scanner to get a good image.
- When the best possible pictures have been taken, the machine will be turned off. The table will be moved out of the machine.
- The IV tube will be removed.

The procedure may vary among health care providers and hospitals.

### What can I expect after the procedure?

- It is up to you to get the results of your procedure. Ask your health care provider, or the department that is doing the procedure, when your results will be ready.
- If contrast dye was used you may:
  - Be asked to drink fluids.
  - Feel warm, have a metallic taste in your mouth, or feel the need to urinate, if the dye was given by IV.
  - Have some stomach discomfort if the dye was swallowed or given by enema.

### Where to find more information

- American College of Radiology, & Radiological Society of North America: [www.radiologyinfo.org](http://www.radiologyinfo.org) (<https://www.radiologyinfo.org/en/info/bodyct>)

### Summary

- A CT scan is an imaging scan.
- A CT scan uses X-rays and a computer to make detailed pictures of different areas inside your body.
- Follow instructions from your health care provider about what you may eat and drink.
- Depending on the type of exam, a substance called contrast dye may be used to help see the area of the body being checked.
- You will be able to see, hear, and talk to the person running the machine while you are in it. Follow that person's instructions.

# Computed Tomography (CT)

## Information for your upcoming CT examination

### What is a CT?

A CT scan is a medical imaging test that uses X-rays to take pictures of the inside of your body. It's done using a donut-shaped machine with a tunnel in the middle, called a CT scanner. You may need a special dye made of iodine called "contrast" to make areas in your body show up better in the pictures. This contrast can go through an IV (a small tube in your vein), by drinking it, or through an enema (the contrast is put into your colon from your bottom).

### Before arriving for your CT:

If you are pregnant or think you may be pregnant, speak with your doctor first. It may be possible to delay the CT or do some other type of imaging.

If you're claustrophobic (afraid of tight spaces) or if it's hard for you to lie flat and still for more than 10 minutes, let your doctor know. Your doctor may be able to give you medication to manage anxiety or pain. Before your scan, it's important to talk to your doctor about: Any allergies, your medicines, any prior surgeries, if you have any problems with bleeding, your health history, and any recent illnesses. You might need to stop eating and drinking for a few hours before the test. Also, ask your doctor if you need to change or stop any of your usual medicines or supplements. Wear loose, comfortable clothing.

### After arriving for your CT:

If you are pregnant or think you may be pregnant when you arrive for the CT, let our schedulers and technologists know. We will make sure that it is safe to take the images. You'll change into a hospital gown when you arrive.

### During the CT:

An IV might be put into your vein. You'll lie on a table, and pillows or straps might be used to help you stay in the right position. The table will move into the CT scanner. You can see, hear, and talk to the CT technologist during the scan. Follow their instructions, like when to hold your breath. Stay still while the machine takes pictures. The contrast in your vein can make you feel warm, taste something metallic, or feel like you need to go to the bathroom. All of this is normal. If you drank or had an enema with dye, your stomach might feel a bit uncomfortable.

### How long it takes:

The scan usually takes 15 to 30 minutes. It might vary depending on what part of your body is being scanned and whether we are using the contrast dye.

### After the CT:

If you had the contrast, you might be asked to drink lots of fluids. The CT technologist will not be able to give results right after the exam. Instead, a specialized doctor called a radiologist will review the CT images and send a detailed report to your doctor.

### What are the risks of a CT?

Radiation dose: This is from getting a small amount of radiation during the test, and it is generally safe. Harm to an unborn baby: If there's a chance you might be pregnant, it's crucial to tell the person doing the test.

### Allergic reaction to contrast:

If contrast is used, it is possible to get a reaction to the contrast. If you've had a reaction to this contrast before, it's important to let us know.

### Your next steps:

- After the radiologist reviews your images and makes a report, you can see the report through your MyChart portal. Using MyChart is free, but you have to sign up the first time.
- Remember to keep any follow-up appointments and talk with your healthcare provider about what your test results mean.

Thank you for choosing Emory Healthcare.



Showing a CT examination

Your health and safety are our top priorities. Feel free to share any concerns or questions with us when you arrive. We hope you will have a safe and comfortable experience with us.

If we did well by you, we are happy.

If for any reason we did not, you can resolve any issues here:



[www.emoryhealthcare.org/patients-visitors/patient-and-visitor-resources/patient-relations](http://www.emoryhealthcare.org/patients-visitors/patient-and-visitor-resources/patient-relations)

# Discussion

- Established a pipeline for creating patient centered PEM that are readable and understandable
- Established that the pipeline process is efficient and reproducible
- Utilized ChatGPT-4.0 and Flesch Kincaid Readability Scores as cost-effective and efficient language simplification tools
- The PEMAT-P tool was successfully adapted for use by PFA and feedback from patient and family advisor (PFA) volunteers was critical in validating that our pipeline yielded understandable documents

# Limitations

- Conducted at single institution
- Small PFA sample sizes per PEM
- Intrinsic subjectivity in creation of initial documents limits certain aspects of reproducibility
- Visual aides for PEM were not evaluated for understandability and/ or patient satisfaction
- Communications and graphic design resources vary depending on the institution