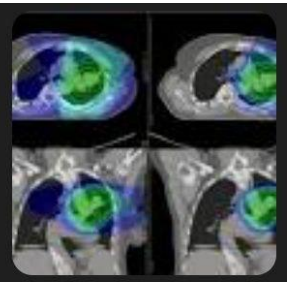
# SynthCT

**MedAI: An efficient approach towards Synthetic CT Scan Generation through MRI**

An AI-driven healthcare solution that improves patient outcomes and reduces the burden on healthcare professionals.

# Let’s Talk Science!

Traditional radiation delivers x-rays, or beams of photons, to the tumor and beyond it. This can damage nearby healthy tissues and can cause significant side effects. By contrast, proton therapy delivers a beam of proton particles that stops at the tumor, so it's less likely to damage nearby healthy tissues.



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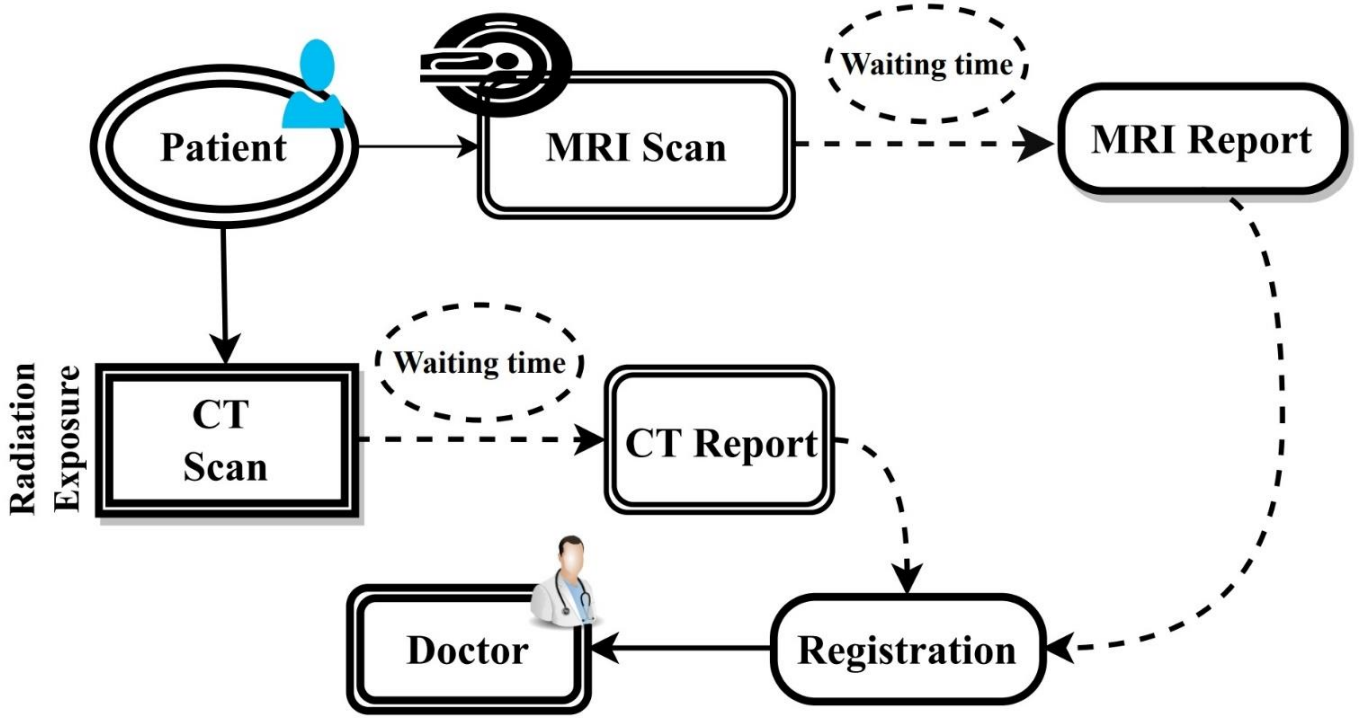
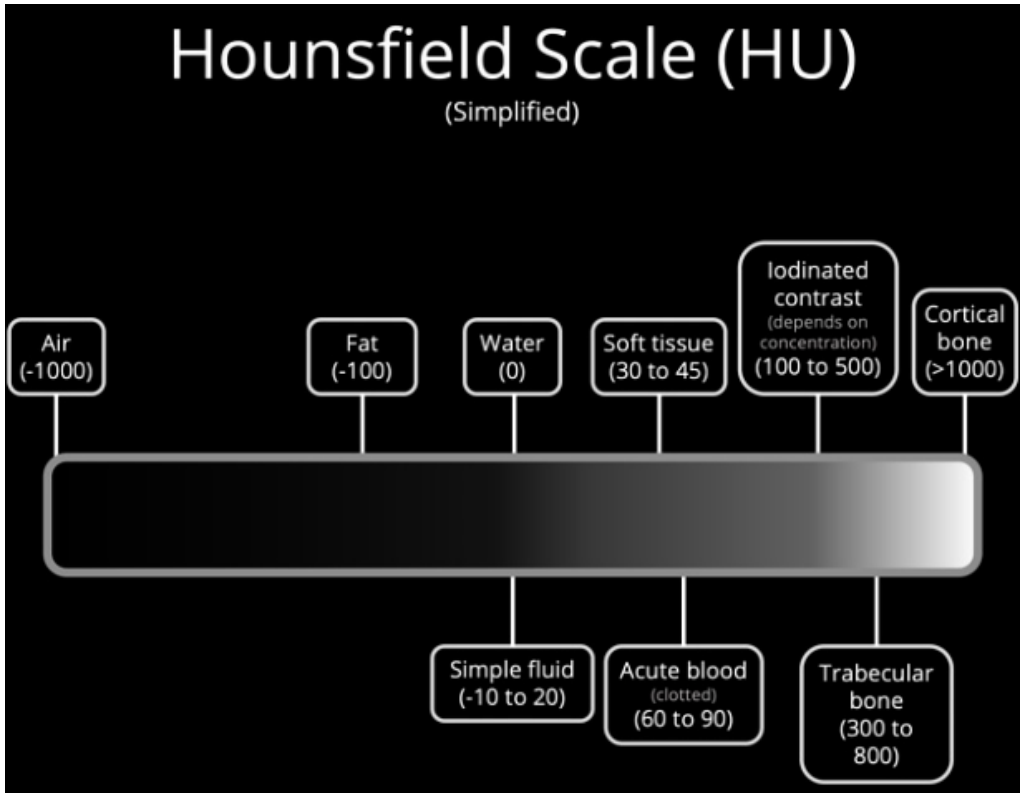
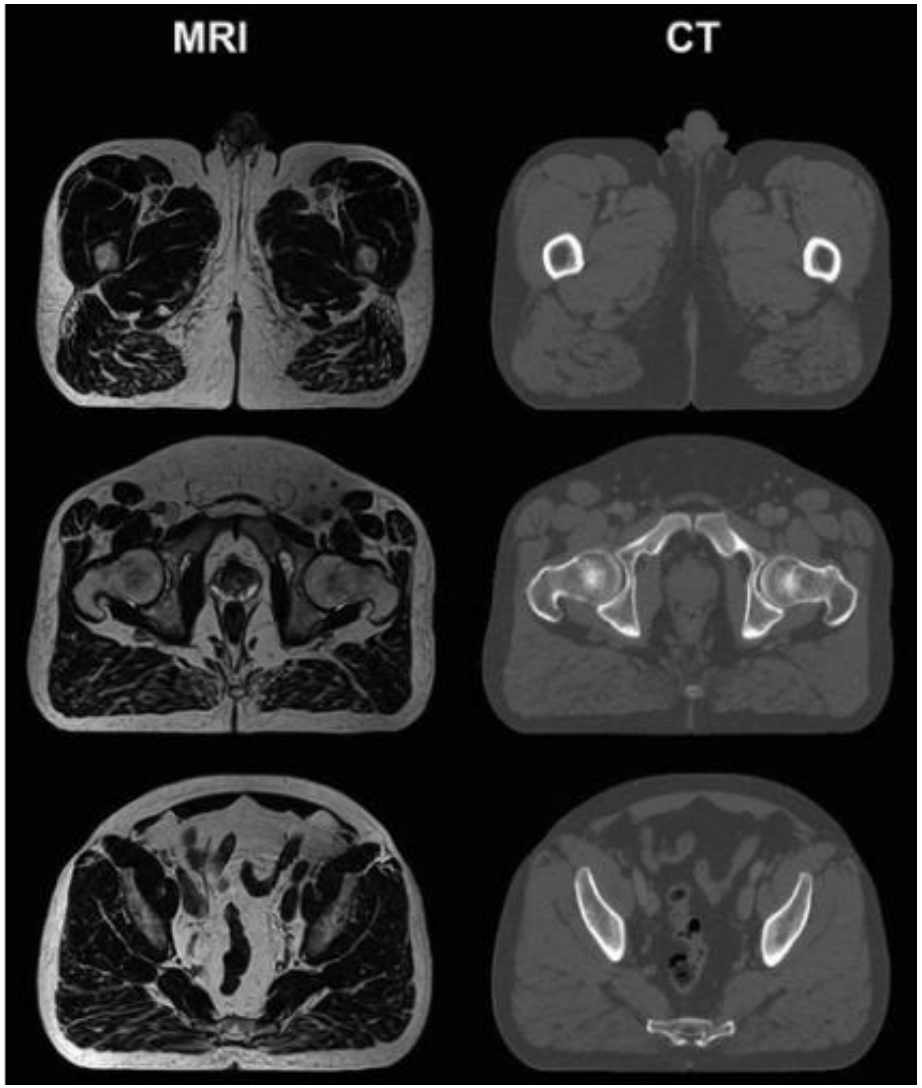



# Existing System

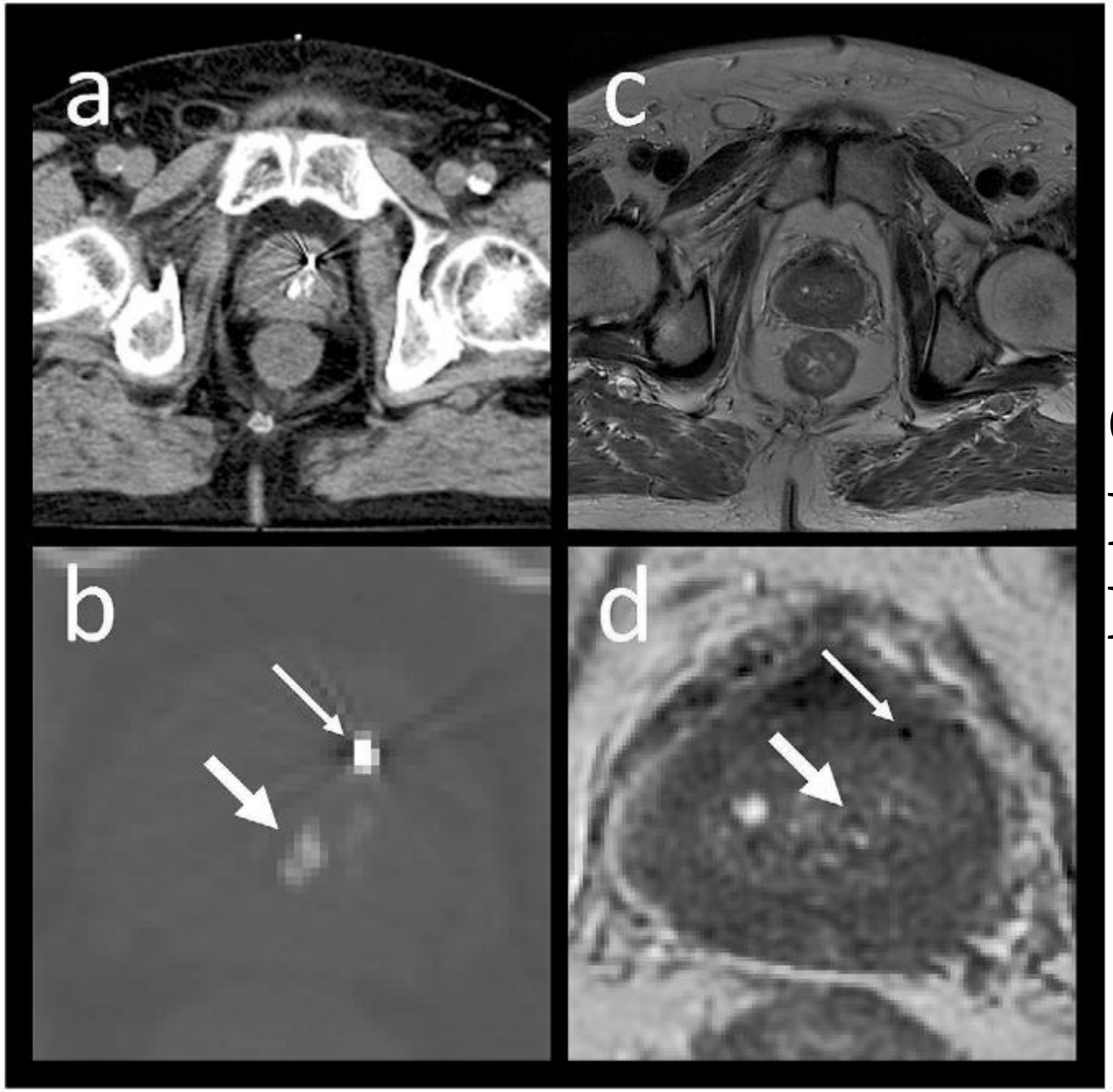
Chemotherapy and radiation therapy are both treatments for cancer – the uncontrolled growth and spread of cells to surrounding tissues. Chemotherapy, or "chemo," uses special drugs to shrink or kill cancer cells. Radiation therapy, or "radiation," kills these cells with high-energy beams such as X-rays or protons. 15-Nov-2022

A proton is a positively charged nuclear particle having mass equal to that of an atom of hydrogen and one unit positive charge. Photon is the smallest particle of light having energy equal to hv.

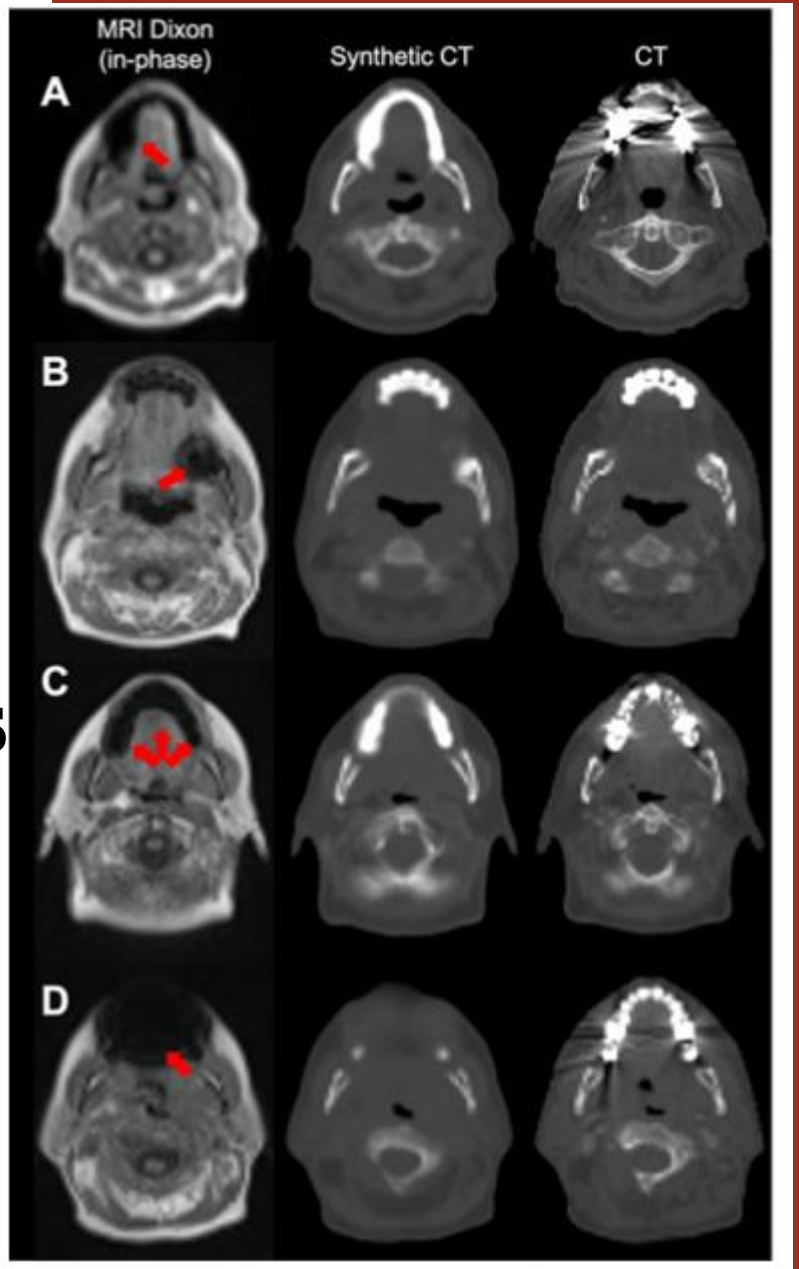



Computed tomography (CT) provides excellent images of high-density tissues such as bone for RTP. It has high geometric accuracy, and provides information on electron density from HU, required to calculate the absorbed dose. CT also provides image data suitable for patient positing during radiotherapy. Unfortunately, CT images have limited soft tissue contrast, while MRI offers outstanding soft tissue contrast, and can therefore contribute to improved target and OAR delineation for RTP in several ways (Chandarana et al., 2018). MRI has been available as a complementary image modality for target and OAR definition since the beginning of the 1990s, and is being increasingly used for RTP (Dirix et al., 2014). Image acquisition using MRI enables oblique slice directions with a multitude of different image contrasts without using any ionizing radiation. MRI is unfortunately not without limitations, and in this chapter potential obstacles to the implementation of MRI images in RTP will be addressed.



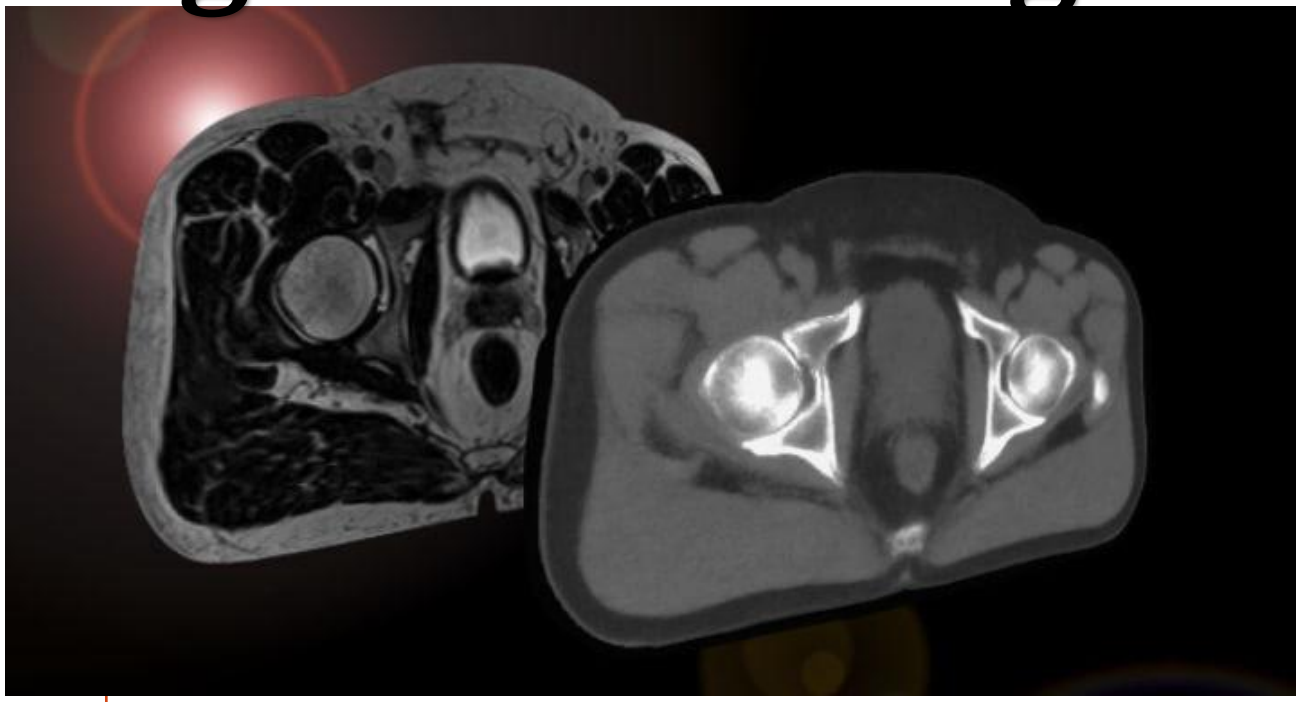

# Gold Fiducial Markers



# SOLUTION DESCRIPTION

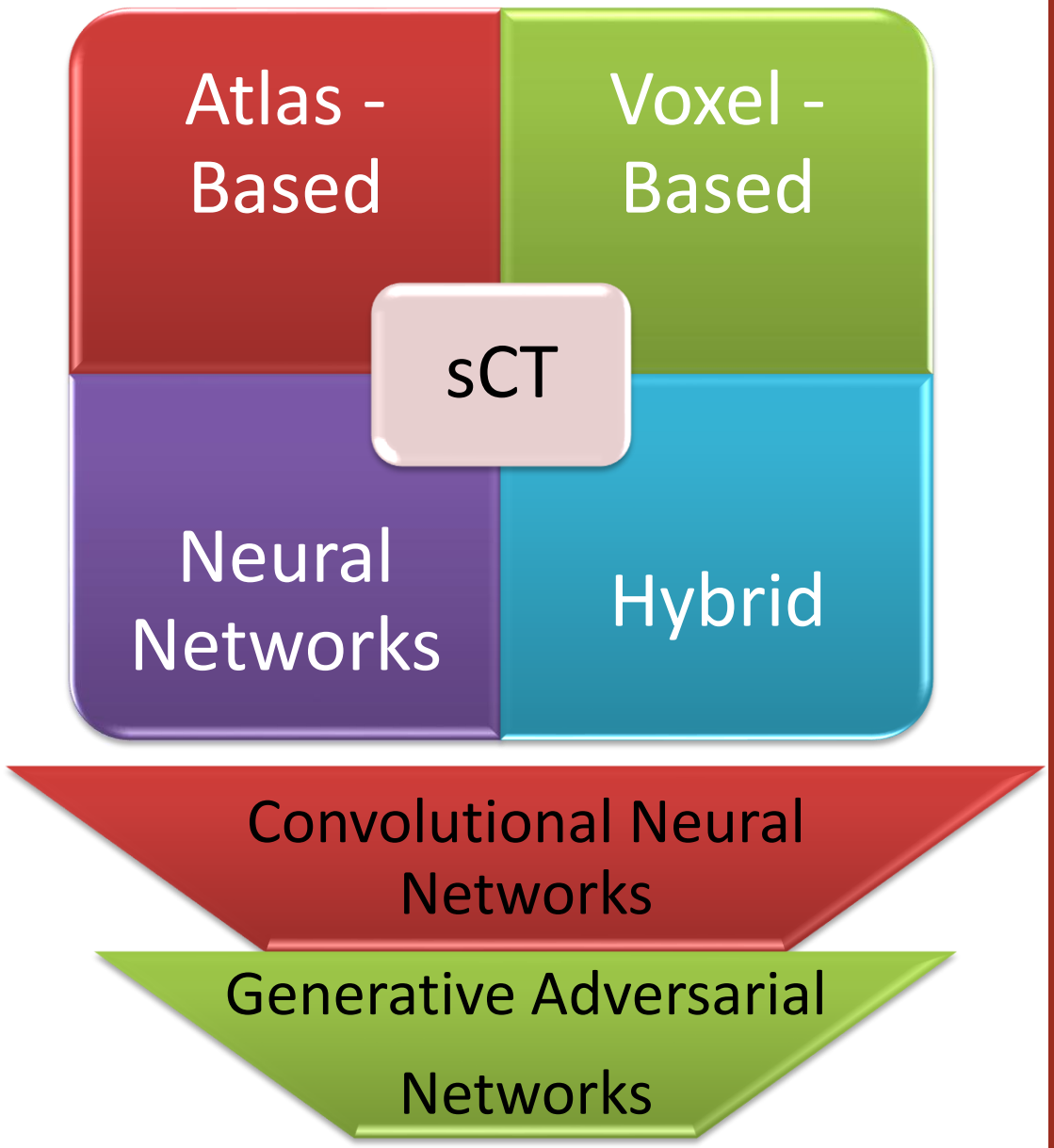
- The existing medical system uses two types of clinical scanning technologies i.e. **MRI & CT Scans** that enable Health professionals to view cross-sections of our interior organs.
- The MRI scan gives out a detailed plot of our human anatomy, and can clearly define the **tumors** in our organs, whereas a CT X-ray machine gives detailed density info of our organs and even exposes patients to a minute amount of radiation.
- The CT Scan process, the Radiation aspect, and there is a crucial step called Registration, where the CT Scans are overlayed with the MRI Scans to Identity & Align the subjected organ cross-section; All these can be avoided, that is where AI comes into play!
- We propose an idea to Synthetically Generate the CT Scan via the MRI Technology that is Harmless and regarded for it's profound detailing; via **CycleGANS**.
- This idea results in; cutting down runtimes, costs, and resource utilization; Most importantly, our approach **cuts down the exposure to Radiation**. Thus, leaning towards a very **efficient way** to utilize the resources we have!

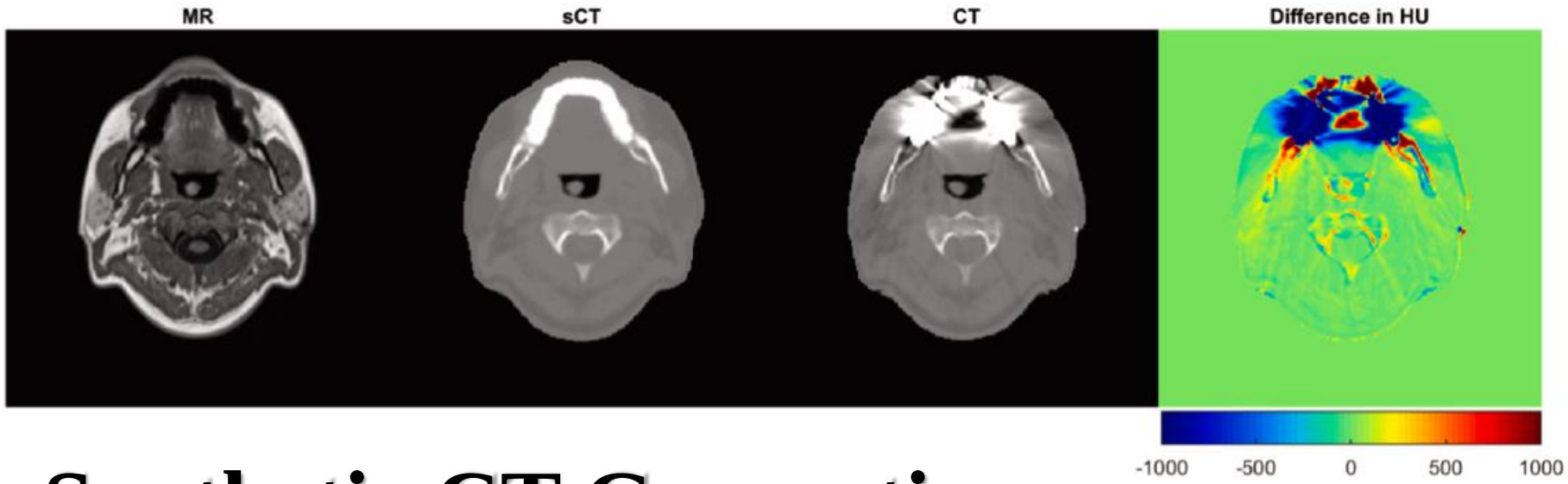
# Registration Stage



Atlas-based methods rely on a reference material consisting of CT images and MRI images. The input MRI image can be matched to the reference image material where deformable registration can be applied to the reference material to create the best fitting CT-representation of the input MRI image (Dowling et al., 2012, Edmund and Nyholm, 2017). Due to limitations of deformable image registration, atypical patients may not be optimally represented in the atlas reference material which could lead to poorer accuracy (Tyagi et al., 2017b).

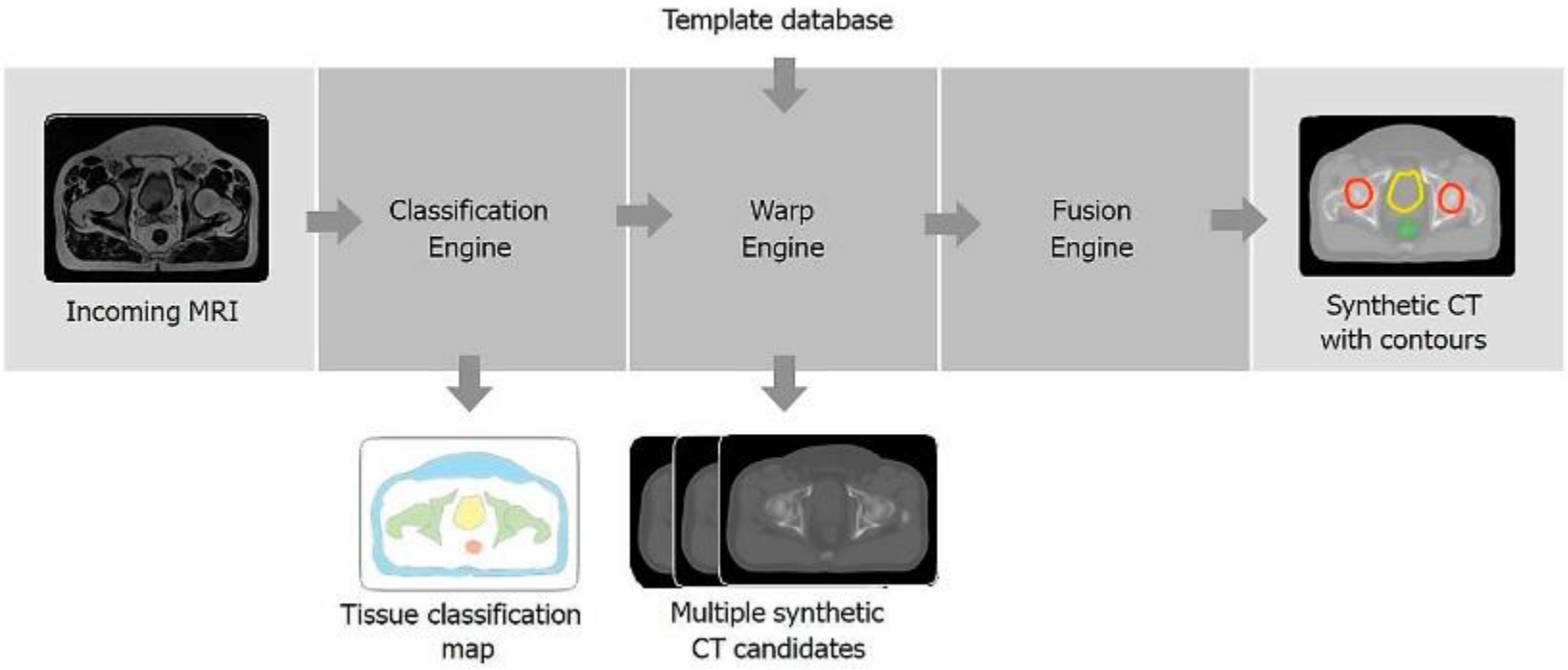
In voxel-based methods, voxel values for different tissues in single, or several types of MRI images are analyzed and used to create models for sCT generation (Korhonen et al., 2014a). sCT generation for patients with atypical anatomy is in general not regarded as problematic using voxel-based methods (Johnstone et al., 2018).

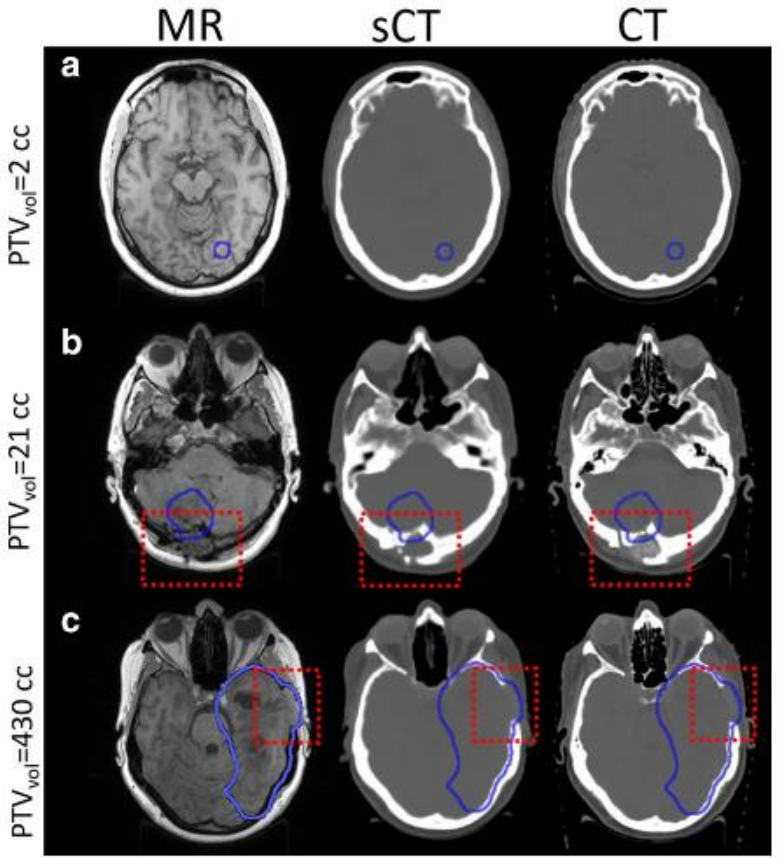





# Atlas & Voxel Based

# Synthetic CT Generation



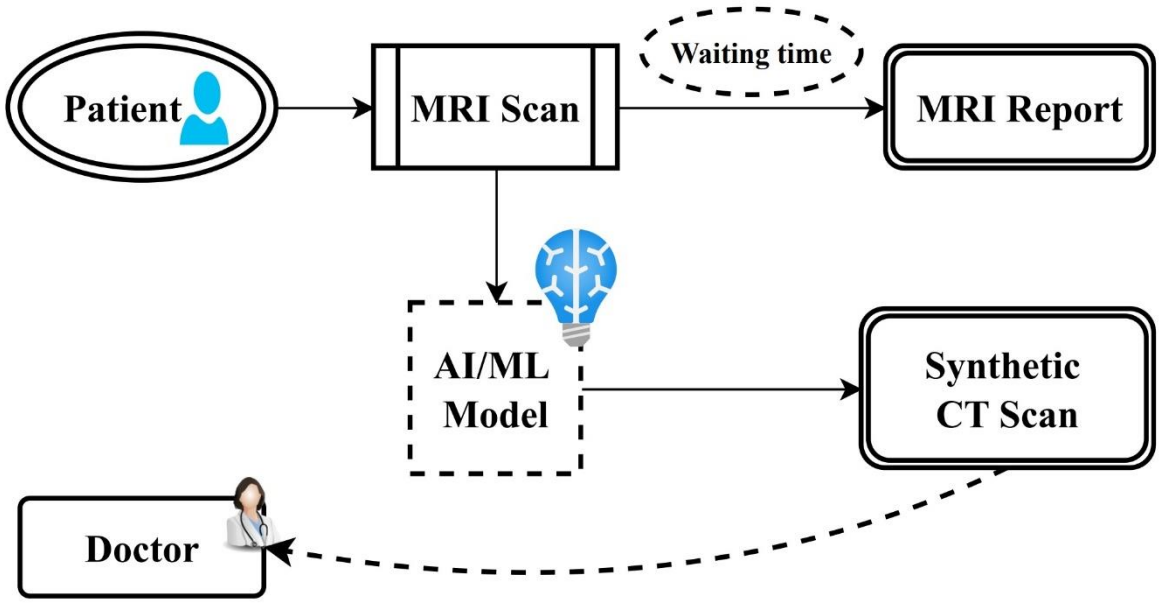
# VALUE PROPOSITION AND MARKET AND AUDIENCE

Our Approach would be beneficial as in the following

- ❑ Cutting down the CT Scan and Registration process results in Streamlining the treatment fast & efficiently
- ❑ Reduces the treatment cost of patients.
- ❑ Saves patients from the ill effects of exposure to radiation.
- ❑ Reduces the resource loads & consumption on the CT scanners at the hospitals.
- ❑ Reduces the timeline of treatment.
- ❑ Results in efficient energy consumption.

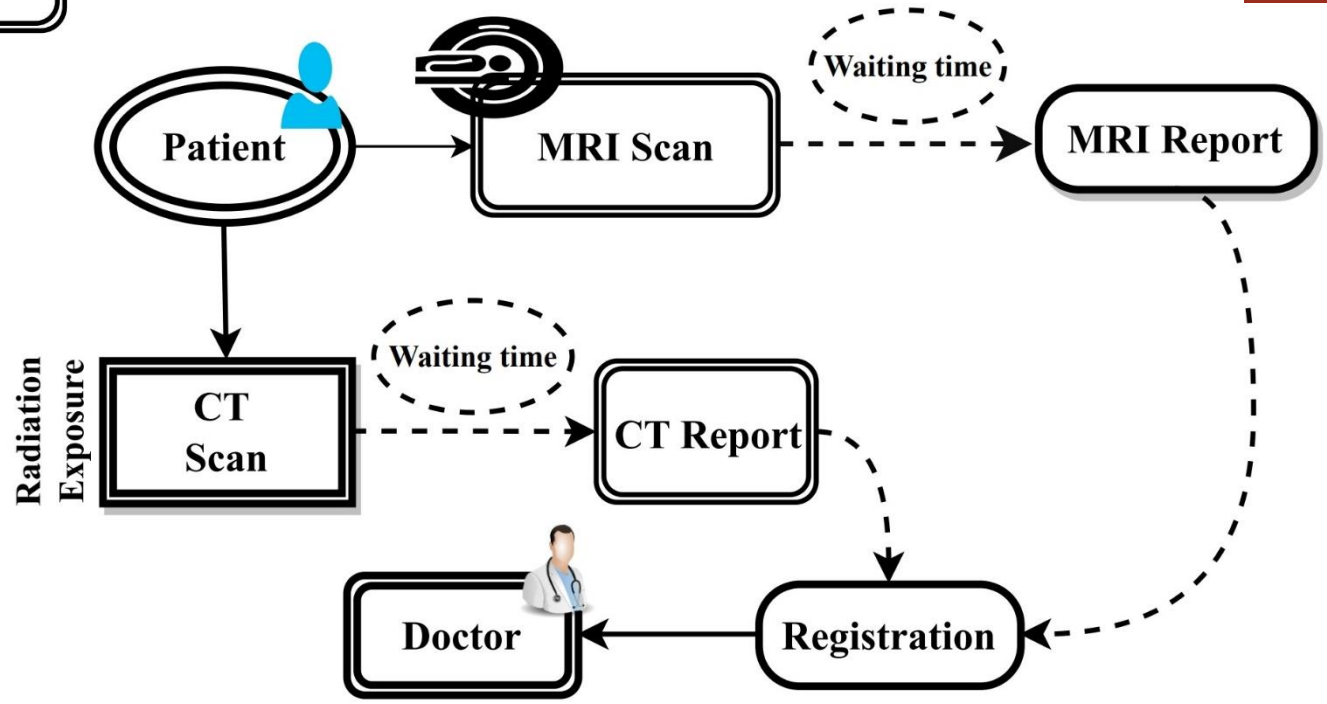
Targeted Audience: **MED Industry**

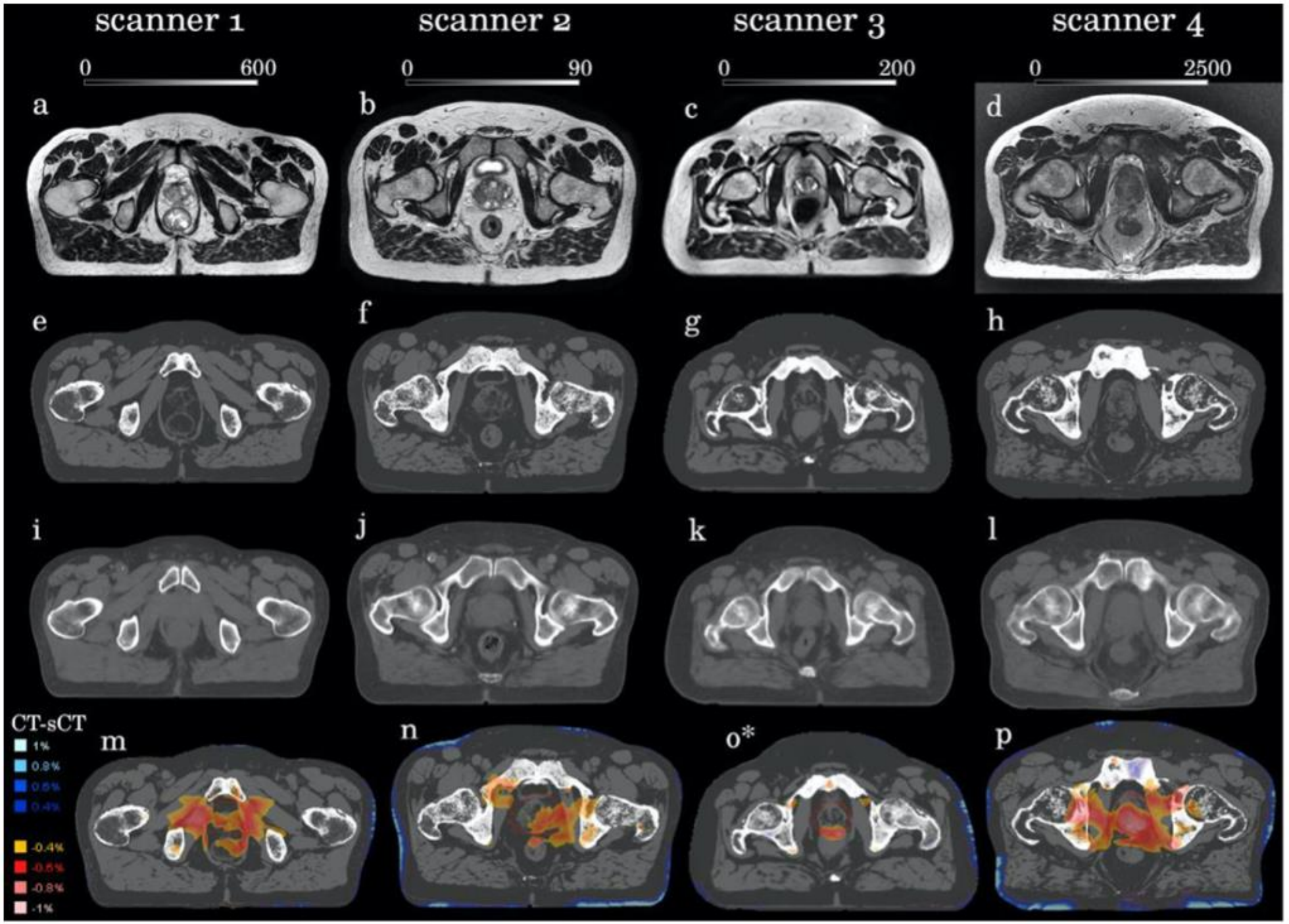
# IMPLEMENTATION




## Proposed System

## Existing System

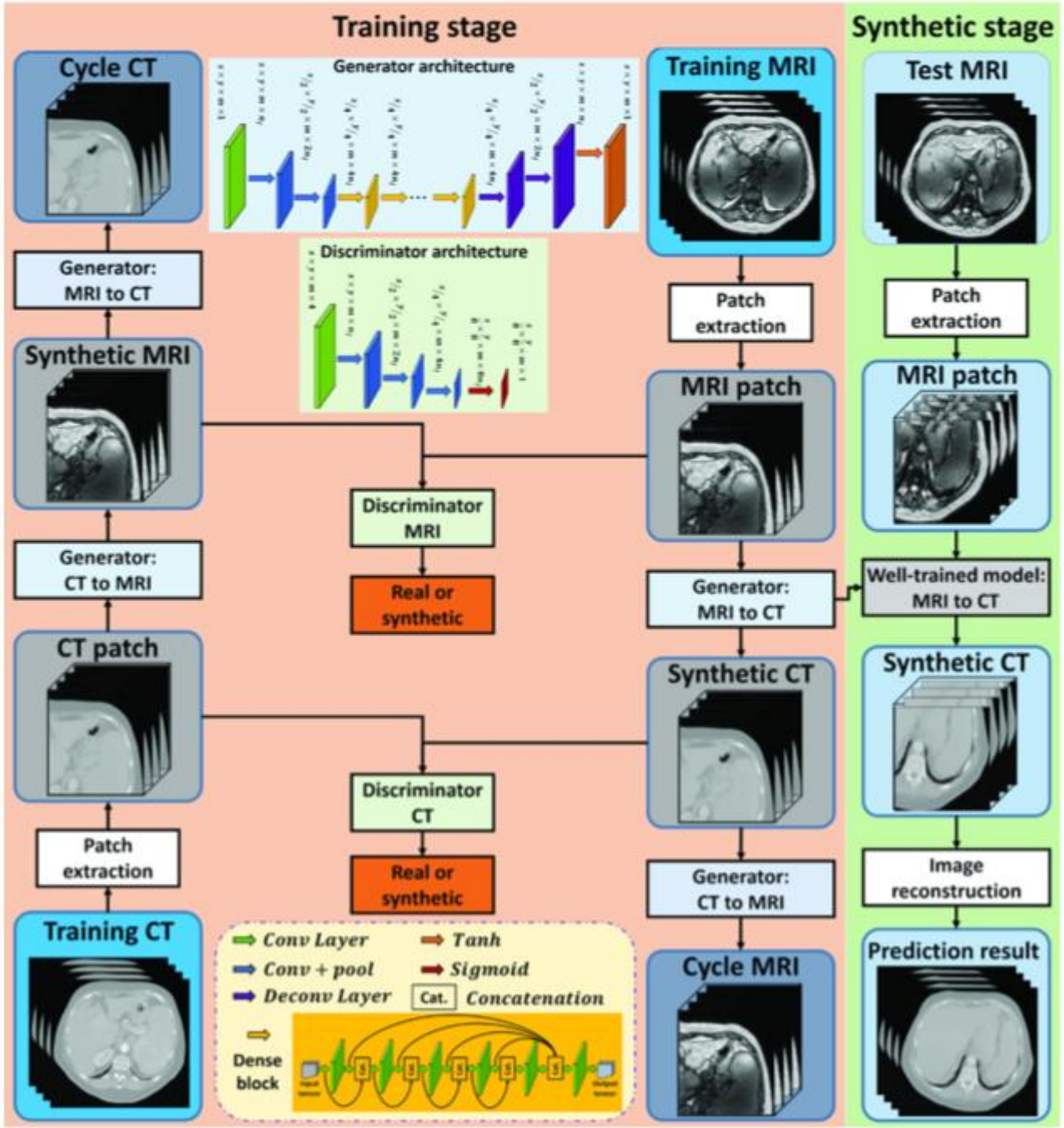


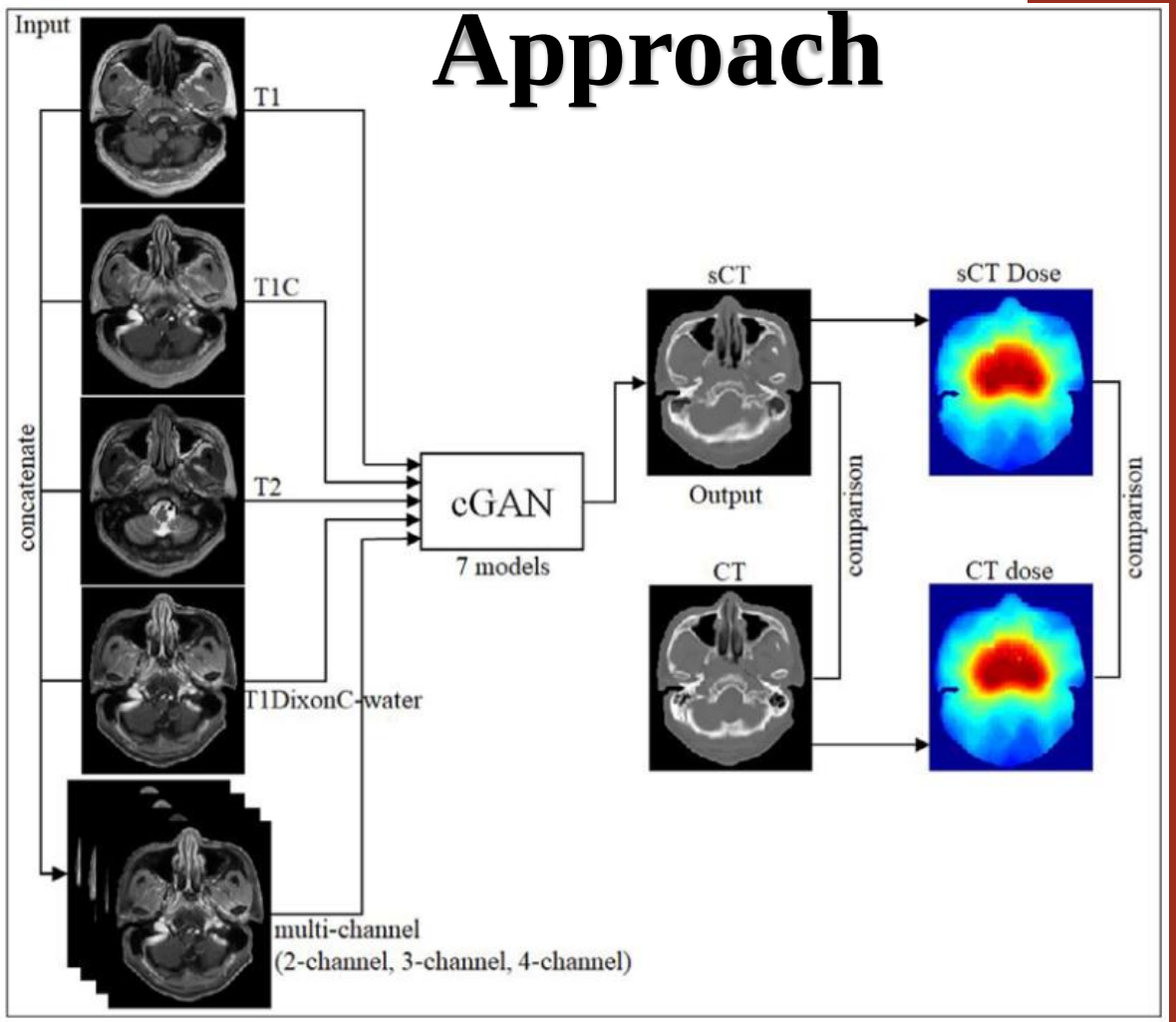



# Atlas & Voxel Based

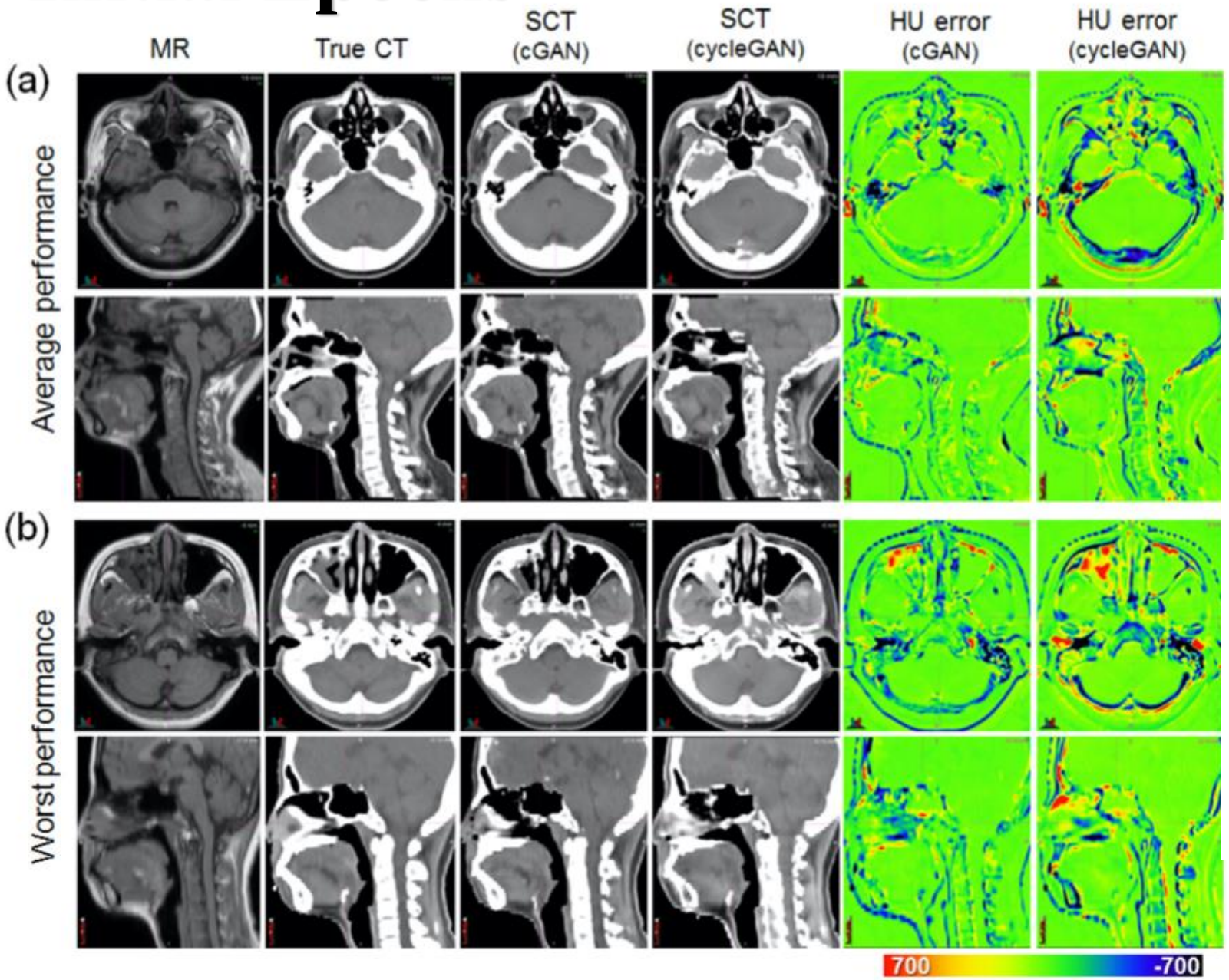
# Significant Difference

# CycleGANs Approach

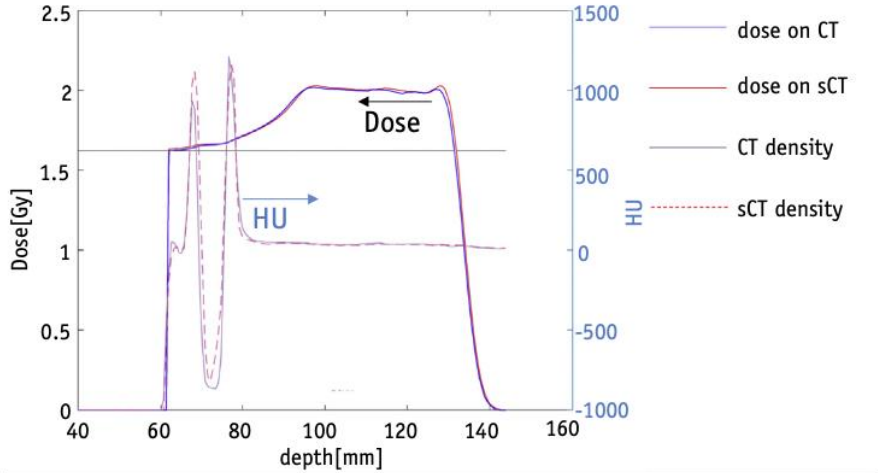


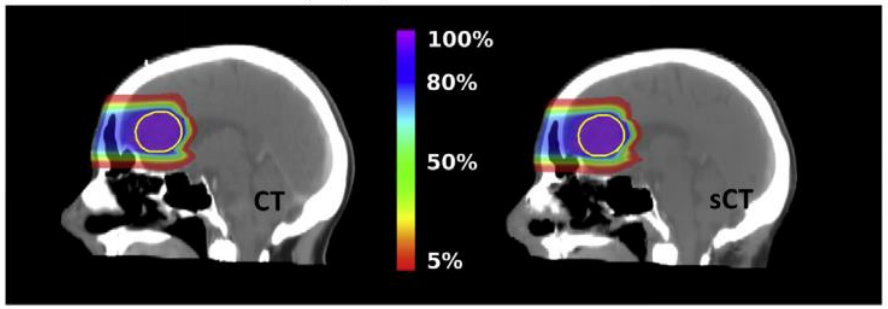



# Initial Epochs

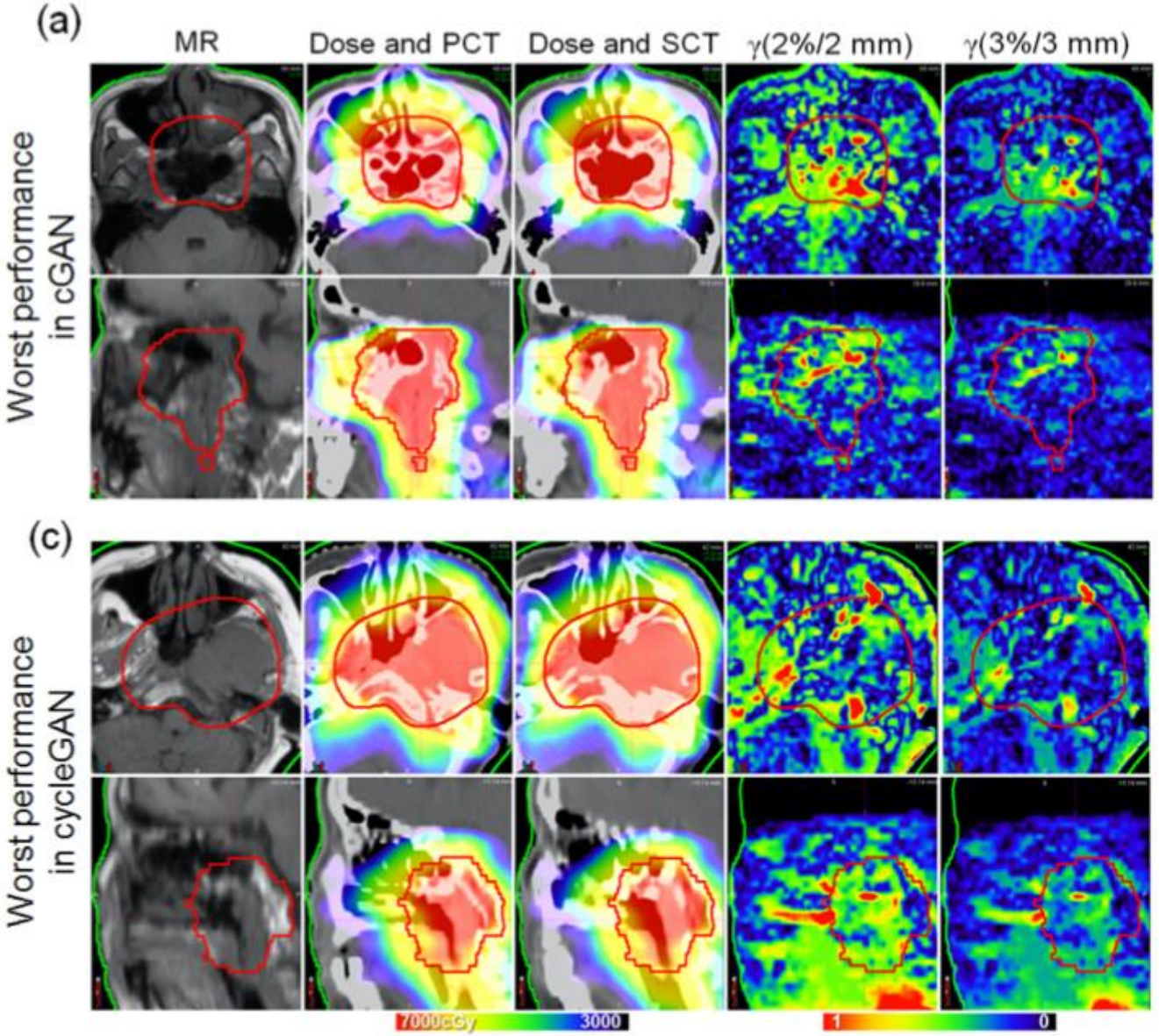


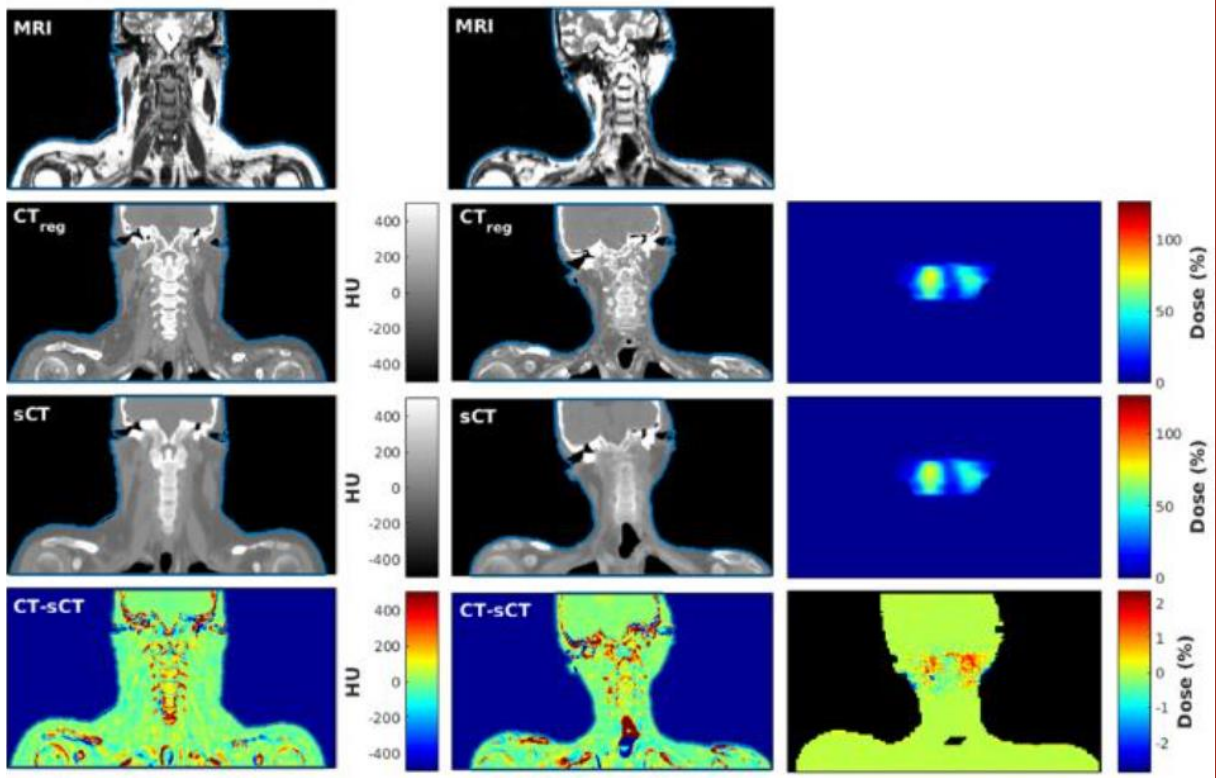

# Trained Model



# State-of-the-Art Accuracy



# FEASIBILITY

- Training an AI model to Synthetically Generating the CT Scan from MRI is much more Cost-effective than obtaining a Clinical CT Scan.
- Running an CT Machine for an Year is Equivalent to 17 HouseHolds Energy Consumption.
- Generating the Synthetic CT Scan might require a Mediocre level GPU.
- Can be Easily integrated into the Existing system.
- Minimal SetUp cost

# CHALLENGES

- Obtaining a Reliable Dataset for training the Model.
- Complexity in Integrating Multiple Dimensions & GenerativeAI.
- Implementing Active Learning to Tone-down unreliable results.

# Thank Ya