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Fakrul Islam Tushar

HIGHLIGHTS

- Led first *in silico* lung screening trial, cutting duration from 10 years to hours and saving ≈$300M.
- Rule-based NLP and weakly supervised AI research saved ≈400 person-years of expert annotation effort.
- Curated a human–AI dataset and led open-access benchmarking of healthcare AI models.
- Developed task-relevant pretraining without extra data, outperformed foundation models (AUC ↑ to 0.90).
- Improved performance by up to +10% proposing anatomy-informed simulation pipeline for data-limited AI.
- Built a consensus labeling pipeline with domain adaptation & VLM checks, saving ≈2.5 years.
- Engineering a conditional diffusion model with a foundation autoencoder for population-scale synthetic data.
- Research cited 350+ times, reflecting broad adoption across medical imaging and AI communities.

EDUCATION

PhD in Electrical and Computer Engineering, **Duke University**, NC, USA — Aug. 2021 – Present

MSc in Medical Imaging (Erasmus Mundus), **University of Girona**, Spain — Sept. 2017 – 2019

BSc in Electrical and Electronics Engineering, **AIUB**, Dhaka, Bangladesh — Jan. 2013 – Feb. 2017

EXPERIENCE

Duke University

ML PhD Research — *Aug. 2021 to Present*

- **AI-Powered Clinical Trial Emulation:** Led the first in silico replication of the NLST, matching clinical outcomes while reducing trial time from 10 years to hours and saving ≈$300M.
  Tushar et al., *Medical Image Analysis* (2025).doi:10.1016/j.media.2025.103636; *RSNA (2024)*; *VITM (2024)*; *SPIE (2024)*; ***Project-page:*** fitushar.github.io/VLST.github.io/.

- **AI–Human Data Curation, Task-Aware Pretraining, and Benchmarking:** Delivered benchmark dataset via human–AI curation; state-of-the-art performance via task-aware pretraining, surpassing foundation models. **Tushar** et al., *arXiv (2024).* arxiv.org/abs/2405.04605; *Radiology: Artificial Intelligence* (2025). doi.org/10.1148/ryai.240248; ***Dataset:*** zenodo.org/records/13799069; ***Code:*** *https://shorturl.at/Xh2uO*.

- **Data-Limited AI:** Anatomy-informed simulated data improves AI performances in low-data settings, ***outperforming state-of-the-art by upto +10%*** in detection, classification and segmentation tasks. **Tushar et al.**, *arXiv* (2025). arxiv.org/abs/2502.21187; ***Code*:**github.com/fitushar/SYN-LUNGS.

- **Consensus-Based Labeling with Domain Adaptation and VLM:** Automated pseudo-labeling for **30k** nodules, saving ≈**2.5 person-years** of expert annotation time, by doing ensemble-based inference, domain adaptation, calibration, and VLM verification. ***Project-page:*** fitushar.github.io/ReFINELung.github.io/

- **Anatomy-Controlled and LLM-Prompted CT Synthesis (on-going):** Developing a family of generative models to simulate population-scale CT datasets for lung cancer research. Utilizing 100K CTs and 40K+ 3D nodules, the pipeline integrates (1) annatomy-controllable synthesis via ControlNet, (2) LLM-guided text-conditioned generation, and (3) patient feature–driven synthesis (age, size, pathology).

Duke University Medical Center

Radiology AI Research Associate — *Oct. 2019 to Feb. 2021*

- **NLP:** Automated the processing of 400K radiology texts using rule-based NLP, generating structured labels that ***saved 800k+ expert-hours in manual annotation***, equivalent to 400 person-years of radiologist effort.
- **Weak Supervision:** Developed 3D CNN on 13k+ CT images using 19k+ NLP-extracted case-level disease labels across Body, achieving AUCs up to 0.97 while saving ***10+ person-years of radiologist effort***.
- **Research Impact:** Resulted in first-author publications, open-source releases, and RSNA-News. **Tushar** et al., *Radiology: Artificial Intelligence* (2021). doi.org/10.1148/ryai.210026; D'Anniballe, & **Tushar** et al., *BMC Med Inform Decis Mak* (2022).doi.org/10.1186/s12911-022-01843-4; ***Code:*** https://shorturl.at/M2epv; ***RSNA News:*** www.rsna.org/news/2022/may/Body-CT-To-Classify-Diseases.

KEY PUBLICATIONS

- **Tushar** et al., **"Virtual Lung Screening Trial (VLST): An In Silico Study Inspired by the National Lung Screening Trial for Lung Cancer Detection."** *Medical Image Analysis* (2025). doi:10.1016/j.media.2025.103636; ***Project-page:*** fitushar.github.io/VLST.github.io/.
- **Tushar** et al., **"SYN-LUNGS: Towards Simulating Lung Nodules with Anatomy-Informed Digital Twins for AI Training."** *arXiv* (2025). arxiv.org/abs/2502.21187
- Wang, **Tushar** et al., **"The Duke Lung Cancer Screening (DLCS) Dataset: A Reference Dataset of Annotated Low-dose Screening Thoracic CT."** *Radiology: AI* (2025). doi.org/10.1148/ryai.240248; ***Dataset:*** zenodo.org/records/13799069.
- **Tushar** et al., **"AI in Lung Health: Benchmarking Detection and Diagnostic Models Across Multiple CT Scan Datasets."** *arXiv (2024).* arxiv.org/abs/2405.04605; ***Code:*** *https://shorturl.at/Xh2uO*.
- **Tushar** et al., **"Beyond Detection: Bridging the Gap Between Virtual Imaging Trials and Clinical Impact."** in *Proc. Virtual Imaging Trials in Medicine 2024*, p. 202 (2024). ***Poster:*** doi.org/10.13140/RG.2.2.26638.78402; ***Code:*** github.com/fitushar/VLST-Beyond-Detection.
- **Tushar** et al.**"Virtual imaging trials improved the transparency and reliability of AI systems in COVID-19 imaging"** *arXiv* (2023). arxiv.org/abs/2308.09730. Under-review; ***Project-page:*** fitushar.github.io/ReviCOVID.github.io/; ***Code:*** gitlab.oit.duke.edu/cvit-public/cvit_revicovid19.
- D'Anniballe, & **Tushar** et al. **"Multi-Label Annotation of Text Reports from CT Using Deep Learning."** *BMC Med Inform Decis Mak* (2022). doi.org/10.1186/s12911-022-01843-4; ***Code:*** github.com/fitushar/multi-label-annotation-text-reports-body-CT.
- **Tushar** et al., **"Classification of Multiple Diseases on Body CT Scans Using Weakly Supervised Deep Learning."** *Radiology: Artificial Intelligence* (2021). doi.org/10.1148/ryai.210026; ***Code:*** github.com/fitushar/multi-label-weakly-supervised-classification-of-body-ct.

ADDITIONAL PUBLICATIONS AND PRESENTATIONS

- Wang, **Tushar** et al.,**"Concordance-Based Predictive Uncertainty (CPU)-Index: Proof-of-Concept with Application Towards Improved Specificity of Lung Cancers on Low Dose Screening CT."** *Artificial Intelligence in Medicine (2025).* doi.org/10.1016/j.artmed.2024.103055.
- Dahal, Ghojoghnejad, Vancoillie, Ghosh, Bhandari, Kim, Ho, **Tushar** et al. **XCAT 3.0: A Comprehensive Library of Personalized Digital Twins Derived from CT Scans**. *Medical Image Analysis* (2025). doi.org/10.1016/j.media.2025.103636.
- **Tushar** et al., **"Virtual NLST: Towards Replicating National Lung Screening Trial."** *Medical Imaging 2024: Physics of Medical Imaging, SPIE* (2024). doi.org/10.1117/12.2613010
- **Tushar** et al., **"Virtual Human Twins in Lung Health: A Comprehensive In Silico Screening Approach."** *RSNA Annual Meeting*, Scientific Poster #T5A-SPPH-2, Chicago, IL (2024). **Presentation:** github.com/fitushar /VLST.github.io/blob/master/static/pdfs/RSNA-2024-VLST.pdf
- Wang, **Tushar** et al., **"Radiomic-Demographic Data Fusion and Diagnostic Uncertainty Quantification Lead to Improved Specificity of Lung Cancers on Low Dose Screening CT."** *66th Annual Meeting & Exhibition, AAPM* (2024).
- Garcia-Alcsoer, Michael E., Tushar, Fakrul Islam, et al. **"Multidisease Classification of CT Reports Using Traditional Natural Language Processing and a Lightweight Foundation Model."** *Medical Imaging 2025: Imaging Informatics, SPIE (2025).* doi.org/10.1117/12.3047690.
- **Tushar** et al., **"Virtual vs. Reality: External Validation of COVID-19 Classifiers Using XCAT Phantoms for Chest CT."** *Medical Imaging 2022 : CAD, SPIE* (2022). https://doi.org/10.1117/12.2613010.
- **Tushar** et al., **"Quality or Quantity: Toward a Unified Approach for Multi-Organ Segmentation in Body CT."** *Medical Imaging 2022: Physics of Medical Imaging. SPIE* (2022). doi.org/10.1117/12.2613101.
- **Tushar** et al., **"Co-Occurring Diseases Heavily Influence Performance of Weakly Supervised Models for Chest CT."** *Medical Imaging 2022: Computer-Aided Diagnosis, SPIE* (2022). doi.org/10.1117/12.2612700.
- Hasan, M. K., Dahal, L., **Tushar** et al.**"DSNet: Automatic Dermoscopic Skin Lesion Segmentation."** *Computers in Biology and Medicine* (2020). doi.org/10.1016/j.compbiomed.2020.103738.

- Saha & **Tushar** et al., **"Weakly supervised 3D classification of chest CT using aggregated multi-resolution deep segmentation features."** *Medical Imaging 2020: CAD, SPIE* (2020). doi.org/10.1117/12.2550857.
- **Tushar** et al., **"Brain tissue segmentation using neuronet with different pre-processing techniques."** *8th ICIEV and 3rd icIVPR, IEEE* (2019). doi:10.1109/ICIEV.2019.8858515.

SKILLS

- **ML & AI** - PyTorch, MONAI, TensorFlow, Scikit-learn, OpenCV, Pandas.
- **Containerization Tools** - Docker, Singularity.
- **Programming Languages** - Python, MATLAB.
- **Workflow Tools** - Git, Linux shell scripting.

KEY OPEN-SOURCE CODES

- ***In-Silico* Trial Resources:** *https://fitushar.github.io/VLST.github.io/*.
- **AI in Lung Health Benchmarking:** *https://shorturl.at/Xh2uO*.
- **Weak Supervision & Rule-Based Algorithms for Radiology text:** *https://github.com/fitushar/multi-label-weakly-supervised-classification-of-body-ct*.
- **COVID-19 Classifier Diversity Study:** *https://gitlab.oit.duke.edu/cvit-public/cvit_revicovid19*.
- **Basic Medical Imaging Pre-Processing:** *https://github.com/fitushar/3D-Medical-Imaging-Preprocessing-All-you-need*.

KEY OPEN-SOURCE DATASETS & ANNOTATIONS

- **The Duke Lung Cancer Screening (DLCS) Dataset:** *https://doi.org/10.5281/zenodo.13799069*
- **National Lungs Screening Trial 3D annotation:** *https://zenodo.org/records/15320923*.
- **U-10: United-10 COVID-19 CT Dataset** *https://zenodo.org/records/14064172*.

INVITED TALKS

- **Unlocking the Power of AI & *In-Silico* Trials in Chest Radiology**, Invited Speaker, CVIT Research Forum, Duke University, June 2024. *Talk: https://cvit.duke.edu/forum/june-21-2024-unlocking-the-power-of-ai-in-silico-trials-in-chest-radiology/*

TEACHING EXPERIENCE

- **Teaching Assistant, Duke University (Spring 2025):** Graduate-level course **Introduction to Machine Learning (ECE 580)**. Responsibilities included developing assignments and solutions, and holding office hours to support student learning.
- **Teaching Assistant, Duke University (Spring 2023):** Graduate-level course **Human-Centered Computing (ECE/COMPSCI 653)**. Responsibilities included conducting consulting hours to provide personalized student guidance and grading assignments and exams.
- **Thesis Mentor, Duke University:** Co-Supervised 4 Master's theses relating AI and medical imaging.

AWARDS

- **Best Poster Presentation Award**, at 1st International Summit of Virtual Imaging Trials in Medicine 2024.
- **Best Poster Award**, All Pratt Poster Competition 2022, Pratt School of Engineering, Duke University.
- **Erasmus Mundus Joint Master Scholarship (€42,000)**, Covering full tuition fees and monthly stipend.
- **Master Thesis Grant ($5,000)**, from Duke University Medical Center.
- **Academic Honour "Cum Laude"**, for Academic Excellence at AIUB's 17th Convocation.
- **Dean's Award**, for undergraduate final year project (2nd place out of 180 projects for academic year 2016).
- **Merit Scholarship ($4,500)**, from AIUB to complete the undergraduate degree.

REFERENCES

- **Joseph Y. Lo**, Professor and Vice Chair for Research of Radiology, Duke University; joseph.lo@duke.edu
- **Ehsan Samei**, Professor of Radiology, Physics, BME, and ECE, Duke University; esi.samei@duke.edu