Masoud Khani

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Ph.D. Candidate, Biomedical & Health Informatics
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University of Wisconsin–Milwaukee
Milwaukee, WI

Computational scientist specializing in medical modeling, simulation, and AI for healthcare applications. Expertise in developing hybrid simulation-ML frameworks, patient-specific digital twins, and explainable AI systems for clinical decision support. Research combines agent-based modeling, discrete-event simulation, transformer architectures, and large language models to address challenges in disease trajectory prediction, risk stratification, and intervention evaluation. Strong record of interdisciplinary collaboration and translating computational methods into clinically actionable tools through stakeholder-centered design and rigorous validation.

EDUCATION

- **Ph.D., Biomedical and Health Informatics** Sep. 2021 – Present (Expected: Aug 2026)
  University of Wisconsin–Milwaukee, Milwaukee, WI
  - Dissertation: Medical modeling, simulation, and AI for clinical decision support
  - Focus: Agent-based models, discrete-event simulation, transformer-based disease trajectory modeling, LLMs in medicine, and explainable AI for healthcare
  - GPA: 3.8/4.0
- **M.S., Computer Science** Jan. 2020 – Aug. 2021
  University of Wisconsin–Milwaukee, Milwaukee, WI
  - Thesis: "Medical Image Segmentation Using Machine Learning" (deep learning for wound image segmentation)
  - GPA: 3.7/4.0
- **B.S., Software Engineering** Sep. 2014 – Jun. 2018
  Tehran Azad University, Tehran, Iran
  - Thesis: "Fall Detection in the Elderly Using Smartphones via Machine Learning Techniques"
  - GPA: 3.5/4.0

RESEARCH INTERESTS

- **Medical Modeling & Simulation:** Agent-based models, discrete-event simulation, hybrid ML-simulation approaches for clinical decision support, intervention evaluation frameworks, and health system optimization. Developing computational frameworks that integrate real-world data for population health applications.
- **Digital Twins for Healthcare:** Patient-specific modeling for personalized medicine, real-time risk stratification using multimodal data (EHR, sensors, imaging), uncertainty quantification in clinical predictions, and dynamic "what-if" scenario analysis for intervention planning.
- **Large Language Models in Medicine:** Clinical text understanding, medical question answering, synthetic data generation, retrieval-augmented generation for evidence-based practice, and comprehensive safety evaluation frameworks. Focus on LLM-enhanced clinical education and simulation platforms.
- **Responsible AI for Healthcare:** Explainability methods (SHAP, LIME, attention mechanisms), fairness assessment across demographics, algorithmic bias mitigation, uncertainty quantification, and stakeholder-centered design with patient and clinician engagement.

RESEARCH FUNDING & AWARDS

- **NIH-funded Research (Team Member)**(2021–Present)
  - *Advancing Healthier Wisconsin Endowment*: Developed AI-driven clinical decision support systems for otolaryngology and geriatric care
  - *CTSI Pilot-BERD Methodological Innovation*: Advanced explainable AI methodologies for clinical prediction models
- **NMDSI Student Scholars Award**, Northwestern Mutual Data Science Institute: $7,500 (Fall 2024–Spring 2025; Summer 2025). Funded LLM-based clinical applications research
- **Chancellor's Graduate Student Awards**: $8,500 total (Jan. 2020; Apr. 2024; Fall 2024). Supported dissertation research on medical modeling and explainable AI
- **Graduate Student Travel Award**: $1,500 (May 2024). Conference presentations on pancreatic cancer mortality
- **Best Reviewer Award**, AMIA Informatics Summit, 2024

PROFESSIONAL RESEARCH EXPERIENCE

- **Engineer I** Milwaukee, WI
  Medical College of Wisconsin — ReyLab (Neurosurgery Research) *Jun. 2025 - Present*
  - Investigate mechanisms of human episodic memory formation and retrieval by developing data acquisition systems that integrate multiscale neural recordings (MRI, intracranial EEG, microwire single-unit/LFP) with cognitive task paradigms in epilepsy patients, enabling analysis of concept cell assemblies and memory-encoding dynamics during clinical monitoring
  - Advance epilepsy diagnosis and treatment through engineering of real-time analysis pipelines for seizure onset zone localization, leveraging single-neuron firing patterns and local field potential biomarkers to inform targeted therapeutic interventions and surgical planning in collaboration with neurosurgeons
  - Lead development of MCWs (MiCroWire sorter), a modular, open-source spike sorting framework engineered for human intracerebral recordings in clinical settings, addressing unique challenges of hospital-based electrophysiology including dynamic noise environments and sparse electrode arrays (first co-author, bioRxiv preprint)
  - Build reproducible computational infrastructure for large-scale neural data analysis (40-core systems, 250TB storage), implementing automated quality control, artifact rejection, and feature extraction workflows that accelerate translational neuroscience research bridging fundamental memory mechanisms with clinical epilepsy applications

- **Research Assistant** Milwaukee, WI
  University of Wisconsin–Milwaukee — Biomedical Data and Language Processing Lab *Sep. 2021 - Sep. 2025*
  - Develop AI-driven clinical decision support systems for NIH-funded research, integrating agent-based modeling, discrete-event simulation, and machine learning to evaluate population health interventions, model disease progression pathways, and enable scenario-based clinical planning across multiple therapeutic domains
  - Build LLM-based agentic systems for clinical applications using transformer architectures, synthetic data generation, retrieval-augmented generation (RAG), and prompt engineering to enhance diagnostic accuracy, extract insights from unstructured clinical text, and support evidence-based medical decision-making
  - Design explainable AI frameworks that combine SHAP analysis, attention mechanisms, and natural language generation to translate complex temporal prediction models into clinically interpretable risk pathways, validated through iterative stakeholder engagement with physicians and health system partners

- Engineer scalable data processing infrastructure for large-scale health datasets (7M+ patients) using distributed computing frameworks, enabling longitudinal analysis of clinical outcomes, feature engineering for temporal risk models, and real-time integration with electronic health record systems
- Collaborate across clinical specialties (otolaryngology, cardiology, gastroenterology, neurosurgery, geriatrics) to translate computational methods into peer-reviewed research, contributing to +20 publications through partnerships with academic medical centers and multi-institutional research networks

- **Data Scientist Intern** Milwaukee, WI
  Medical College of Wisconsin — Clinical and Translational Science Institute *Jun. 2023 - Aug. 2023*
  - Reimplemented WaveClus3 spike-sorting algorithm from MATLAB to Python, optimizing computational efficiency and extending functionality for processing large-scale human intracranial recordings from epilepsy patients in clinical research settings
  - Designed novel artifact rejection methods to improve single-neuron detection in hospital-based electrophysiology environments, addressing challenges of electrical interference and non-neural signal contamination unique to clinical recording conditions

- **Project Assistant** Milwaukee, WI
  University of Wisconsin–Milwaukee — Northwestern Mutual Data Science Institute *Jan. 2021 - May 2023*
  - Conducted data-driven program evaluation studies analyzing enrollment patterns, learning outcomes, and engagement metrics to inform strategic development of interdisciplinary data science curricula across engineering, public health, and business domains
  - Built open-source educational framework with 50+ reproducible data science examples demonstrating real-world applications of statistical modeling, machine learning, and computational methods, enabling cross-disciplinary adoption and pedagogical innovation

TEACHING & MENTORING EXPERIENCE

- **Lecturer** Milwaukee, WI
  University of Wisconsin–Milwaukee — College of Health Sciences *Sep. 2024 - Dec. 2025*
  - **Big Data & Healthcare Informatics (Graduate):** Designed and delivered comprehensive curriculum covering distributed computing frameworks (Apache Spark), machine learning for large-scale health data, deep learning architectures, and production AI systems. Developed hands-on lab assignments implementing scalable data pipelines, predictive modeling, and real-world healthcare analytics applications for 60+ graduate students
  - **Introduction to Healthcare Informatics (Graduate):** Taught foundational course spanning health IT ecosystems, stakeholder analysis, clinical decision support systems, medical image processing, AI/ML in healthcare, data standards (HL7, FHIR), evaluation frameworks, and translational informatics. Emphasized interdisciplinary perspectives connecting technology, clinical practice, policy, and patient outcomes

- **Teaching Assistant** Milwaukee, WI
  University of Wisconsin–Milwaukee — Big Data & Healthcare Informatics *Aug. 2023 - Sep. 2024*
  - Led lab sessions on applied healthcare data science, teaching graduate students to implement machine learning pipelines, develop simulation models, and analyze electronic health records using Python-based frameworks and distributed computing tools
  - Contributed to curriculum development by designing assignments, creating coding tutorials, and developing assessment rubrics that emphasized real-world clinical applications of informatics methods, translating complex technical concepts into accessible learning materials

PUBLICATIONS

2026

[1] **Masoud Khani**, David R. Friedland, Jazzmyne Adams, Michael S. Harris, Qiang Lu, Jake Luo. "User-Centered Explainable AI in Healthcare: A Literature Review." *ACM Computing Surveys*. Under review (submitted Feb 8, 2026)

[2] **Masoud Khani**, David R. Friedland, Michael Widlansky, Michael S. Harris, Jazzmyne Adams, Lei Fan, Hyunkyoung Oh, Qiang Lu, Jake Luo. "Explainable AI reveals temporal risk pathways in fall prediction: extracting clinical insights from multi-horizon machine learning models." *GeroScience*. Feb 2026. DOI: 10.1007/s11357-026-02117-x

[3] Mohammad Assadi Shalmani*, **Masoud Khani***, Amirsajjad Taleban, Zihao Yi, Jennifer T. Fink, Christopher E. Weber, Qiang Lu, Jake Luo. "Sequential pattern transformer (SPT): a generative and interpretable framework for predicting disease trajectories." *Neural Computing and Applications*. Feb 2026. DOI: 10.1007/s00521-025-11695-4

[4] Zihao Yi, **Masoud Khani**, Mohammad Assadi Shalmani, Amirsajjad Taleban, Jennifer T. Fink, Robert F. Frediani, Jake Luo. "From food deserts to nutritional equity: exposing socioeconomic drivers of hypertension." *Journal of Nutritional Science*. Jan 2026. DOI: 10.1017/jns.2025.10067

2025

[4] Jake Luo, **Masoud Khani**, Jazzmyne Adams, Qiang Lu, Kristian O'Connor, and David R. Friedland. "Risk Prediction and Interpretation for Fall Events Using Explainable AI and Large Language Models." *Proceedings of the 2025 9th International Conference on Medical and Health Informatics (ICMHI '25)*, pages 270–277. 2026.

[5] Ali Zolnour, Hossein Azadmaleki, Yasaman Haghbin, Fatemeh Taherinezhad, Mohamad Javad Momeni Nezhad, Sina Rashidi, **Masoud Khani**, AmirSajjad Taleban, Samin Mahdizadeh Sani, Maryam Dadkhah, James M Noble, Suzanne Bakken, Yadollah Yaghoobzadeh, Abdol-Hossein Vahabie, Masoud Rouhizadeh, Maryam Zolnoori. "LLMCARE: early detection of cognitive impairment via transformer models enhanced by LLM-generated synthetic data." *Frontiers in Artificial Intelligence*. Nov 2025. DOI: 10.3389/frai.2025.1669896

[6] Alexander Betancourt*, **Masoud Khani***, Tapasi Brahma, Fernando J. Chaure, Connor Hauder, Sunil Mathew, Ana Sofia Dominguez Zesati, Sean Lew, Kunal Gupta, and Hernan G. Rey. "MCWs (MiCroWire sorter): A New Framework for Automated and Reliable Spike Sorting in Human Intracerebral Recordings." *bioRxiv* 2025.07.09.663285. https://doi.org/10.1101/2025.07.09.663285. Jul 2025.

[7] Phuong H. Bao, David R. Friedland, Jazzmyne A. Adams, Julie K. Freed, **Masoud Khani**, and Jake Luo. "Assessment of Anesthetic Modalities in Otologic Surgery." *Otology & Neurotology Open* 5(3): e075, September 2025. DOI: 10.1097/ONO.0000000000000075

[8] **Masoud Khani**, Mohammad Assadi Shalmani, Amirsajjad Taleban, Susan Tsai, Mochamad Nataliansyah, Mohammed Aldakkak, and Jake Luo. "The Impact of Socioeconomic Factors on Pancreatic Cancer Care Utilization." *PLOS One*, May 7, 2025. DOI: 10.1371/journal.pone.0320518

[9] Beatrice Mumm, David Friedland, Jazzmyne Adams, **Masoud Khani**, Jake Luo, and Kristina Osinski. "Correlation Between Life Stress and Tinnitus Severity." *Otology & Neurotology* 47(2): 221–226, February 2026. DOI: 10.1097/MAO.0000000000004721

[10] Abdullah A. Memon, Mohamed Khalil, Oscar Villarreal Espinosa, Imaad Said, Eric Yang, Jazzmyne A. Adams, David R. Friedland, **Masoud Khani**, Jake Luo, Rachel Kuehn, Anne Frei, Jamie Foeckler, Kenneth

Akakpo, Becky Massey, Michael Stadler, Stuart Wong, Heather A. Himburg, Musaddiq J. Awan, Jennifer Bruening, and Joseph Zenga. "Tumoral Skin Invasion Is an Independent Predictor of Rapid Recurrence in Head and Neck Cancer." *Head & Neck* 48(2): 535–542, 2026. DOI: 10.1002/hed.70066

2024

[14] **Masoud Khani**, Jake Luo, Mohammad Assadi Shalmani, Amirsajjad Taleban, Jazzmyne Adams, and David R. Friedland. "Advancing Personalized Healthcare: Leveraging Explainable AI for BPPV Risk Assessment." *Health Information Science and Systems* 13(1), 2025. DOI: 10.1007/s13755-024-00317-3

[15] Mingee Kim, David R. Friedland, Jazzmyne A. Adams, **Masoud Khani**, and Jake Luo. "Increased Healthcare Utilization in Patients with Tinnitus." *International Tinnitus Journal* 28(2): 251–255, 2024. DOI: 10.5935/0946-5448.20240036

2023

[19] Ali Zolnour, Christina E. Eldredge, Anthony Faiola, Yadollah Yaghoobzadeh, **Masoud Khani**, Doreen Foy, Maxim Topaz, Hadi Kharrazi, Kin Wah Fung, Paul Fontelo, Anahita Davoudi, Azade Tabaie, Scott A. Breitinger, Tyler S. Oesterle, Masoud Rouhizadeh, Zahra Zonnor, Hans Moen, Timothy B. Patrick, and Maryam Zolnoori. "A Risk Identification Model for Detection of Patients at Risk of Antidepressant Discontinuation." *Frontiers in Artificial Intelligence* 6:1229609, 2023. DOI: 10.3389/frai.2023.1229609

[20] Ling Tong, **Masoud Khani**, Qiang Lu, Benjamin Taylor, Kristen I. Osinski, Jake Luo. "Association between body-mass index, patient characteristics, and obesity-related comorbidities among COVID-19 patients: A prospective cohort study." *Obesity Research & Clinical Practice*. 2023;17(1):47–57. DOI: 10.1016/j.orcp.2022.12.003

[21] Maie M. Zagloul, Jonathan M. Bock, Joel H. Blumin, David R. Friedland, Jazzmyne A. Adams, Ling Tong, Kristen I. Osinksi, **Masoud Khani**, and Jake Luo. "Evaluation of Social Determinants of Health on Dysphagia Care Pathways at a Tertiary Care Facility." *The Laryngoscope*, 2023. DOI: 10.1002/lary.31040

[22] Ling Tong, **Masoud Khani**, Bradley Taylor, Kristen Osinski, Jazzmyne A. Adams, David R. Friedland, and Jake Luo. "Socioeconomic Disparities for Healthcare Utilization of Senior Adult Falls in Southeast Wisconsin, 2020-2022." *medRxiv* 2023.04.24.23289062. DOI: 10.1101/2023.04.24.23289062. 2023.

[23] Christina N. Feller, Jazzmyne A. Adams, David R. Friedland, **Masoud Khani**, Jake Luo, and David M. Poetker. "Impacts of Socioeconomic Status on Dentoalveolar Trauma." *WMJ* 122(1): 32–37, 2023.

SELECTED CONFERENCE

- **Masoud Khani**, Tapasi Brahma, Alexander Betancourt, Fernando J. Chaure, Connor Hauder, Sunil Mathew, Ana Sofia Dominguez Zesati, Sean Lew, Kunal Gupta, Hernan G. Rey. "A novel spike-sorting pipeline optimized for microwire recordings from humans." *Society for Neuroscience (SfN)*. Nov 2025. [Also presented at Human Single-Neuron Meeting]

- **Masoud Khani**, Amirsajjad Taleban, Jake Luo. "Enhancing Early Intervention: Predicting Pancreatic Cancer Mortality Rates." *AMIA 2024 Clinical Informatics Conference*. May 2024.

- **Masoud Khani**, Ling Tong, Jake Luo. "A Visualization Model for Diagnosing Diabetic Retinopathy Severity and Discovering Plaque Patterns in Retinal Images." *International Conference on AI in Aging and Age-related Diseases*. Oct 2022.

- Paraj Patel, Omair Iqbal, Divyanshu Mohananey, Saffia Bajwa, **Masoud Khani**, Jake Luo, Daniel J. Stein, Jana G. Hashash, Emad Mansoor, Raymond K. Cross, Gursimran Kochhar, and Preetika Sinh. "Cardiovascular Risk Factors Drive Mortality in Patients with Inflammatory Bowel Disease—A

Propensity-Matched US National Database Study." *The American Journal of Gastroenterology* 120(10): S355–S356, October 2025. DOI: 10.14309/01.ajg.0001134072.68624.46

- Paraj Patel, Omair Iqbal, Divyanshu Mohananey, Saffia Bajwa, **Masoud Khani**, Jake Luo, Daniel J. Stein, Jana G. Hashash, Emad Mansoor, Raymond K. Cross, Gursimran S. Kochhar, and Preetika Sinh. "Increased Risk of Cardiovascular Events in Patients with Inflammatory Bowel Disease Is Primarily Driven by Presence of Cardiovascular Risk Factors and Prior Coronary Artery Disease." *Gastroenterology* 169(1): S-1214–S-1215, May 2025.

- Saffia Bajwa, Paraj Patel, Omair Iqbal, Divyanshu Mohananey, **Masoud Khani**, Jake Luo, Daniel J. Stein, Jana G. Hashash, Emad Mansoor, Raymond K. Cross, and Preetika Sinh. "Inflammatory Bowel Disease Is Associated with Increased Risk of Cardiovascular Events but Not Mortality: Data from a Large US National Database." *The American Journal of Gastroenterology* 119(10S): S760–S761, October 2024.

- Paraj Patel, Omair Iqbal, Divyanshu Mohananey, Saffia Bajwa, **Masoud Khani**, Jake Luo, Daniel J. Stein, Jana G. Hashash, Emad Mansoor, Raymond K. Cross, and Preetika Sinh. "Biologics and JAK Inhibitors Decrease Major Cardiovascular Events (MACE) in IBD Patients: Data from a Large National Cohort." *Gastroenterology* 166(5): S-172, May 2024. DOI: 10.1016/S0016-5085(24)00887-4

- Omair Iqbal, Paraj Patel, Divyanshu Mohananey, Saffia Bajwa, **Masoud Khani**, Jake Luo, Daniel J. Stein, Jana G. Hashash, Emad Mansoor, Raymond K. Cross, and Preetika Sinh. "Anti-TNF Medications but Not JAK Inhibitors Are Associated with Increased Risk of Venous Thromboembolism: Data from a Large National Cohort." *Gastroenterology* 166(5): S-1120, May 2024.

TECHNICAL SKILLS

- **Medical Modeling & Simulation**: Agent-based modeling (ABM), discrete-event simulation (DES), system dynamics, Monte Carlo simulation, digital twin development, stochastic modeling
- **Machine Learning & Deep Learning**: PyTorch, TensorFlow, scikit-learn, Hugging Face Transformers, XGBoost, LightGBM, reinforcement learning, federated learning
- **Large Language Models**: Hugging Face ecosystem, OpenAI API, NVIDIA NeMo, LangChain, fine-tuning (LoRA, QLoRA), retrieval-augmented generation (RAG), prompt engineering
- **Explainable AI**: SHAP, LIME, attention visualization, integrated gradients, counterfactual explanations, uncertainty quantification
- **High-Performance Computing**: Apache Spark, Dask, RAPIDS, Ray, distributed training, HPC cluster management, cloud platforms (AWS, GCP, Azure)
- **Programming & Development**: Python (expert), R, SQL, MATLAB — Git/GitHub, Docker, Jupyter, Linux/Unix
- **Data Engineering**: MySQL, PostgreSQL, MongoDB, ETL pipelines, data preprocessing, feature engineering

SCHOLARLY SERVICE & LEADERSHIP

- **Peer Review Service:** Regular reviewer for leading health informatics and AI journals and conferences
  - *Nature Communications*
  - *JAMA Network Open*
  - *Applied Clinical Informatics*

- *Journal of Medical Internet Research (JMIR)* family (Public Health and Surveillance, JMIRx Med, JMIR AI)
- American Medical Informatics Association (AMIA) Annual Symposium and Informatics Summit (2023–Present)
- American Public Health Association (APHA) Annual Meeting

- **Multi-institutional Collaboration:** Contributed to collaborative research with Columbia University, University of Tehran, University of Florida, and multiple medical centers through data sharing and methodological consultation
- **Research Mentorship:** Mentored 10+ undergraduate and graduate students on research projects involving medical modeling, machine learning, and clinical data analysis. Supervised 5+ students through completion of thesis projects
- **Professional Memberships:** American Medical Informatics Association (AMIA); American Public Health Association (APHA)