BIOGRAPHICAL SKETCH

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NAME: Visweswaran, Shyam

eRA COMMONS USER NAME (credential, e.g., agency login): vshyam

POSITION TITLE: Professor of Biomedical Informatics, University of Pittsburgh

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Jawaharlal Institute of Post-Graduate Medical Education and Research (JIPMER), Pondicherry, India	M.B.,B.S.	12/1987	Medicine & Surgery
Jawaharlal Institute of Post-Graduate Medical Education and Research (JIPMER), Pondicherry, India		06/1991	Residency in Anesthesiology
University of Illinois at Urbana-Champaign, Urbana, IL	M.S.	06/1996	Physiology and Biophysics
Boston University Medical Center, Boston, MA		06/2000	Residency in Neurology
University of Pittsburgh, Pittsburgh, PA	M.S.	07/2004	Intelligent Systems (AI)
University of Pittsburgh, Pittsburgh, PA	Ph.D.	09/2007	Intelligent Systems (AI)

A. Personal Statement

I am a Professor of Biomedical Informatics with cross appointments in Clinical & Translational Science Institute at the School of Medicine and in the Intelligent Systems Program in the School of Computing and Information. My training is in biomedical informatics, artificial intelligence (AI) and clinical neurology, and my research interests include the application of AI to biomedicine with a specific focus on AI-enabled clinical decision support, race-based clinical algorithms, patient-specific modeling, causal discovery from biomedical data, research-data warehousing, and ontology development. In the Department of Biomedical Informatics, I am the Vice-Chair of Clinical Informatics and the Director of the Center for Clinical Artificial Intelligence (CCAI). I serve as the Director of the Informatics Core for the University of Pittsburgh Clinical and Translational Science Institute (CTSI), as a PD/PI for the *All of Us Pennsylvania* research project that is a component of the Precision Medicine Initiative, and as a PD/PI of the Evolve to Next-Gen Accrual of patients to Clinical Trials (ENACT) network. I also oversee the design and deployment of Neptune, a research data warehouse.

Ongoing projects that I would like to highlight include:

OT2 OD026554
Reis, Visweswaran (PIs), Role: PI
02/08/2018 - 02/29/2024
All of Us Pennsylvania

U24 TR004111
Reis, Visweswaran (PIs), Role: PI
01/08/2022 - 05/31/2027
ENACT: Translating Health Informatics Tools to Research and Clinical Decision Making

My recent key publications include:

1. **Visweswaran S**, Colditz JB, O'Halloran P, Han NR, Taneja SB, Welling J, Chu KH, Sidani JE, Primack BA. Machine learning classifiers for Twitter surveillance of vaping: comparative machine learning study. Journal of Medical Internet Research. 2020; 22(8):e17478. PMID: 32784184; PMCID: PMC7450367.
2. **Visweswaran S**, McLay B, Cappella N, Morris M, Milnes JT, Reis SE, Silverstein JC, Becich MJ. An atomic approach to the design and implementation of a research data warehouse. Journal of the American Medical Informatics Association. 2022 Mar 15;29(4):601-608. PMID: 34613409; PMCID: PMC8922189.
3. Johnson A, Cooper GF, **Visweswaran S**. A novel personalized random forest algorithm for clinical outcome prediction. In: Studies in Health Technology and Informatics. 2022 Jun 6;290:248-252. PMID: 35673011.
4. **Visweswaran S**, Sadhu EM, Morris MM, Samayamuthu MJ. Clinical algorithms with race: an online database. medRxiv. 2023. doi: https://doi.org/10.1101/2023.07.04.23292231. PMID: 37461462; PMCID: PMC10350134.

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2023 - Present	Director, Center for Clinical Artificial Intelligence, University of Pittsburgh
2023 - Present	Professor of Biomedical Informatics, University of Pittsburgh
2023 - Present	Vice Chair of Clinical Informatics, Dept. of Biomedical Informatics, Univ. of Pittsburgh
2018 - Present	NIH Peer Review Committee: CIDH standing member, NLM COI & Career Award, ad hoc
2016 - Present	Director, Informatics Core, Clinical and Translational Science Institute, Univ. of Pittsburgh
2015 - 2023	Associate Professor of Biomedical Informatics, University of Pittsburgh
2011 - 2012	NSF Peer Review Committee: Smart Health and Wellbeing
2006 - 2015	Assistant Professor of Biomedical Informatics, University of Pittsburgh
2001 - 2006	Fellow in Biomedical Informatics, University of Pittsburgh
2001 - Present	Member, American Medical Informatics Association
2001 - Present	Member, American Academy of Neurology
1997 - 2000	Resident in Neurology, Boston University
1996	Internal Medicine Intern, St. Luke's - Roosevelt Medical Center, New York
1991 - 1995	Research Assistant, Physiology and Biophysics, University of Illinois at Urbana-Champaign
1989 - 1991	Resident in Anesthesiology, Jawaharlal Institute of Post-Graduate Medical Education and Research, Pondicherry, India

Honors

2023 - 2024	Member, NASEM's committee on The Use of Race and Ethnicity in Biomedical Research
2023	Fellow of American College of Medical Informatics (FACMI)
2022	Fellow of the Australasian Institute of Digital Health (FAIDH)
2021	Fellow of the American Medical Informatics Association (FAMIA)
2017	First place, AMIA Joint Summits Clinical Research Informatics Student Paper Competition, San Francisco, CA (for a mentored student – Andrew King)
2015	First place, AMIA Fall Symposium Student Paper Competition, Washington DC (for a

	mentored student – Andrew King)
2014	Hattie Becich Award for Best Teacher, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA
2012	Distinguished Paper Award, AMIA Summit on Translational Bioinformatics, San Francisco, CA (for a co-authored paper)
2013	Distinguished Paper Award, AMIA Summit on Translational Bioinformatics, San Francisco, CA (for a co-authored paper)
2011	Marco Ramoni Distinguished Paper Award, AMIA Joint Summits on Translational Science, San Francisco, CA (for a co-authored paper)
2010	Homer R. Warner Research Award, AMIA Fall Symposium, Washington DC (for a co-authored paper)
2005	Third place, AMIA Fall Symposium Student Paper Competition, Washington DC
2005	Distinguished Paper Award, AMIA Annual Symposium, Washington, DC (for a co-authored paper)
2001 - 2005	National Library of Medicine Post-Doctoral Fellowship
2000 - 2001	Chief Resident, Department of Neurology, Boston University
1981 - 1991	National Science Talent Search Scholarship, Government of India

C. Contributions to Science

My research focuses on the application of AI approaches to biomedical challenges, with a particular emphasis on AI-enabled clinical decision support, race-based clinical algorithms, patient-specific modeling, causal discovery from biomedical data, research-data warehousing, and ontology creation.

1. **AI-enabled clinical decision support.** Electronic health record (EHR) systems are capturing increasing amounts of patient data that can be leveraged by AI and machine learning methods for computerized clinical decision support. My work focuses on developing a learning EHR system to provide decision support using the right data, at the right time. I also work with a team of collaborators in developing and implementing AI and machine learning methods for detecting adverse drug events and for identifying anomalies in clinical management of patients.

    a. King, AJ, Hochheiser, H, **Visweswaran, S**, Clermont, G, Cooper, GF. Eye-tracking for clinical decision support: A method to capture automatically what physicians are viewing in the EMR. In: AMIA Joint Summits Translational Science Proceedings. 2017 Mar 27-30; 2017:512-21. PMID: 28815151; PMCID: PMC5543363. (Awarded First Place in the Student Paper Competition at the AMIA Joint Summits Clinical Research Informatics, 2017)
    b. King AJ, Cooper GF, Clermont G, Hochheiser H, Hauskrecht M, Sittig DF, **Visweswaran S**. Using machine learning to selectively highlight patient information. Journal of Biomedical Informatics. 2019 Oct 29:103327. PMID: 31676461; PMCID: PMC6932869.
    c. King AJ, Cooper GF, Clermont G, Hochheiser H, Hauskrecht M, Sittig DF, **Visweswaran S**. Leveraging eye tracking to prioritize relevant medical record data: Comparative machine learning study. Journal of Medical Internet Research. 2020;22(4):e15876. PMID: 32238342; PMCID: PMC7163414.
    d. Tajgardoon M, Cooper GF, Clermont G, Hochheiser H, Hauskrecht, M, Sittig DF, **Visweswaran S**. Modeling physician variability to prioritize relevant medical record information. JAMIA Open. 2020 Dec 31;3(4):602-610. PMID: 33623894; PMCID: PMC7886572.

2. **Race-based clinical algorithms.** Inappropriate use of race and ethnicity in clinical algorithms at the point of care may exacerbate health disparities and promote harmful practices of race-based medicine. My work focuses on the effects of including race and ethnicity in clinical prediction models and other clinical decision tools, and in improving the fairness of these models.

a. **Visweswaran S**, Sadhu EM, Morris MM, Samayamuthu MJ. Clinical algorithms with race: an online database. medRxiv. 2023. doi: https://doi.org/10.1101/2023.07.04.23292231. PMID: 37461462; PMCID: PMC10350134.

b. Anderson JW, Shaikh N, **Visweswaran S**. Measuring and reducing racial bias in a pediatric urinary tract infection model. medRxiv. 2023. doi: https://doi.org/10.1101/2023.09.18.23295660.

3. **Patient-specific modeling.** The typical paradigm in predictive modeling in medicine is to learn a single model from a database of individuals. A population-wide model is one that is meant to be applied to an entire population of future individuals. My work, on the other hand, focuses on patient-specific modeling, in which models are personalized to the characteristics of the individual at hand and optimized to perform well for that individual. Patient-specific models are likely to have better predictive performance than the typical population-wide models that are optimized to have good predictive performance on average on all future individuals. Moreover, such models can identify features such as genomic factors that are specific for an individual thus enabling precision medicine.

a. **Visweswaran S**, Cooper GF. Patient-specific models for predicting the outcomes of patients with community acquired pneumonia. In: AMIA Annual Symposium Proceedings. 2005 Oct 22-26; 2005:759-63. PMID: 16779142; PMCID: PMC1560580. (Awarded Third place in the Student Paper Competition at the AMIA Fall Symposium, 2005)

b. **Visweswaran S**, Angus DC, Hsieh M, Weissfeld L, Yealy D, Cooper GF. Learning patient-specific predictive models from clinical data. Journal of Biomedical Informatics. 2010 Oct; 43(5):669-85. PMID: 20450985; PMCID: PMC2933959.

c. **Visweswaran, S**, Ferreira, A, Cooper, GF. Personalized modeling for prediction with decision-path models. PLoS One. 2015 Jun 22;10(6):e0131022 PMID: 26098570; PMCID: PMC4476684.

d. Johnson A, Cooper GF, **Visweswaran S**. A novel personalized random forest algorithm for clinical outcome prediction. In: Studies in Health Technology and Informatics (MedInfo). 2022 Jun 6;290:248-252. PMID: 35673011.

4. **Causal discovery from biomedical data.** Large amounts of molecular data (e.g., genomic data) combined with clinical data will lead to a better understanding of the biology of human health and disease, enhanced disease prediction and treatment effects, and, eventually, the realization of precision medicine. My research focuses on the development of AI and statistical machine learning methods for causal discovery using electronic health record (EHR) data, molecular data, or both.

a. Strobl, EV, **Visweswaran, S**. Markov boundary discovery with ridge regularized linear models. Journal of Causal Inference. 2016 Mar; 4(1):31-48. PMID: 27170915; PMCID: PMC4861166.

b. Strobl EV, **Visweswaran S**, Spirtes PL. Fast causal inference with non-random missingness by test-wise deletion. International Journal of Data Science and Analytics. 2018 Aug; 6(1):47-62. PMID:31321289; PMCID: PMC6638553.

c. Strobl E, Zhang K, **Visweswaran S**. Approximate kernel-based conditional independence tests for fast non-parametric causal discovery. Journal of Causal Inference. 2019 Mar; 4(1):31-48.

d. Strobl EV, Spirtes P, **Visweswaran S**. Estimating and controlling the False Discovery Rate of the PC algorithm using edge-specific p-values. ACM Transactions on Intelligent Systems and Technology. 2019 Oct 10;10(5):46.

5. **Research data warehousing.** Several local, regional, and national initiatives are underway to establish clinical data repositories for the reuse of EHR data in clinical, translational, and informatics research. I lead the development and implementation of a research data warehouse called Neptune. I also lead the efforts for data harmonization, translation to standard terminologies and mapping to standard value sets for several projects that include: 1) NCATS-funded ENACT network (previously Accrual of patients to Clinical Trials (ACT) network), 2) NIH-funded *All of Us Pennsylvania* Research Program, 3) PCORI-funded PaTH clinical data research network, 4) NCATS-funded Genomics Research Information Commons, 5) NCATS-funded National COVID Cohort Collaborative (N3C) and 6) the Consortium for Clinical Characterization of COVID-19 by EHR (4CE).

a. Haendel MA, Chute CG, Bennett TD, Eichmann DA, Guinney J, Kibbe WA, Payne PRO, Pfaff ER, Robinson PN, Saltz JH, Spratt H, Suver C, Wilbanks J, Wilcox AB, Williams AE, Wu C, Blacketer C, Bradford RL, Cimino JJ, Clark M, Colmenares EW, Francis PA, Gabriel D, Graves A, Hemadri R, Hong SS, Hripscak G, Jiao D, Klann JG, Kostka K, Lee AM, Lehmann HP, Lingrey L, Miller RT, Morris M, Murphy SN, Natarajan K, Palchuk MB, Sheikh U, Solbrig H, **Visweswaran S**, Walden A, Walters KM, Weber GM, Zhang XT, Zhu RL, Amor B, Girvin AT, Manna A, Qureshi N, Kurilla MG, Michael SG, Portilla LM, Rutter JL, Austin CP, Gersing KR, N3C Consortium. The National COVID Cohort Collaborative (N3C): Rationale, design, infrastructure, and deployment. Journal of the American Medical Informatics Association. 2021 Mar 1; 28(3):427-443. PMID: 32805036; PMCID: PMC7454687.
b. Le TT, Gutiérrez-Sacristán A, Son J, Hong C, South AM, Beaulieu-Jones BK, Loh NHW, Luo Y, Moore J, Morris M, Ngiam KY, Patel LP, Samayamuthu MJ, Schriver E, LM Tan ALM, Moore J, Cai T, Omenn GS, Avillach P, Kohane IS, 4CE Consortium, **Visweswaran S***, Mowery DL*, Xia Z*. Multinational characterization of neurological phenotypes in patients hospitalized with COVID-19. Scientific Reports. 2021 Oct 12;11(1):20238. PMID: 34642371; PMCID: PMC8510999. (*senior authors)
c. **Visweswaran S**, McLay B, Cappella N, Morris M, Milnes JT, Reis SE, Silverstein JC, Becich MJ. An atomic approach to the design and implementation of a research data warehouse. Journal of the American Medical Informatics Association. 2022 Mar 15;29(4):601-608. PMID: 34613409; PMCID: PMC8922189.
d. Murphy SN, **Visweswaran S**, Becich MJ, Campion TR, Knosp BM, Melton-Meaux GB, Lenert LA. Research data warehouse best practices: catalyzing national data sharing through informatics innovation. Journal of the American Medical Informatics Association. 2022 Mar 15;29(4):581-584. PMID: 35289371; PMCID: PMC8922176.

6. **Ontology development.** I lead the development of the common data model and i2b2 ontologies and a COVID-19 ontology for the ENACT network (previously ACT network) that links the EHRs of 57 CTSA hubs with >140 million patient records that investigators query in real time for cohort discovery and for research. The ontologies are deployed on the ENACT network, and since they are freely available, they are used beyond the ENACT network, such as the Genomic Information Commons (led by Ken Mandl), the Consortium for Clinical Characterization of COVID-19 by EHR (led by Isaac Kohane) and by institutions not part of the ENACT network.

a. **Visweswaran S**, Becich MJ, D'Itri VS, Sendro ER, MacFadden D, Anderson NR, Allen KA, Ranganathan D, Murphy SN, Morrato EH, Pincus HA, Toto R, Firestein GS, Nadler LM, Reis SE. Accrual to Clinical Trials (ACT): A Clinical and Translational Science Award Consortium network. JAMIA Open. 2018 Oct;1(2):147-152. PMID: 30474072; PMCID: PMC6241502.
b. **Visweswaran S**, Samayamuthu MJ, Morris M, Weber GM, MacFadden D, Trevvett P, Klann JG, Gainer V, Benoit B, Murphy SN, Patel L, Mirkovic N, Borovskiy Y, Johnson RD, Wyatt MC, Wang AY, Follett RW, Chau N, Zhu W, Abajian M, Chuang A, Bahroos N, Reeder P, Xie D, Cai J, Sendro ER, Toto RD, Firestein GS, Nadler LM, Reis SE. Development of a COVID-19 application ontology for the ACT network. JAMIA Open. 2021 Apr 19;4(2):ooab036. PMID: 34113801; PMCID: PMC8083220.

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/shyam.visweswaran.1/bibliography/public/