

BIOGRAPHICAL SKETCH

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NAME: Visweswaran, Shyam

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

POSITION TITLE: Associate Professor of Biomedical Informatics

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
University of Pittsburgh, Pittsburgh, PA	Ph.D.	09/2007	Intelligent Systems

A. Personal Statement

I am an Associate 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 informatics, artificial intelligence and clinical neurology, and my research interests include the application of machine learning to biomedicine with a specific focus on developing intelligent electronic medical record and clinical decision support systems, precision medicine and personalized modeling, data mining and causal discovery from biomedical data, and research data warehousing. In the Department of Biomedical Informatics, I serve and as the Director of the Center of Clinical Research Informatics (CCRI) and as the Director of the Center of Clinical Machine Learning (CCML). 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 the Data Harmonization lead for the Accrual of patients to Clinical Trials (ACT) network. I also direct the development and implementation of a research data warehouse called Neptune.

Key publications relevant include:

1. **Visweswaran S**, McLay B, Cappella N, Morris M, Milnes JT, Reis SE, Silverstein JC and **Becich MJ**. An atomic approach to the design and implementation of a research data warehouse. medRxiv, 2021, doi: 10.1101/2021.05.05.21256679.

2. 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; 28(3): 427-443. PMID: 32805036 PMCID: PMC7454687
3. Seymour CW, Kennedy J, Wang S, Chang C-CH, Elliot CF, Xu Z, Berry S, Clermont G, Cooper G, Gomez H, Huang DT, Kellum JA, Mi Q, Opal SM, Talisa V, Poll T, **Visweswaran S**, Vodovotz Y, Weiss JC, Yealy DM, Yende S, Angus DC. Derivation, validation, and potential treatment implications of novel clinical phenotypes for sepsis. *JAMA*. 2019 May 28;321(20):2003-17. PMID: 31104070 PMCID: PMC6537818
4. **Visweswaran S**, Cooper GF. Learning instance-specific predictive models. *Journal of Machine Learning Research*. 2010 Dec 1; 11:3369–3405. PMID: 25045325 PMCID: PMC4102007

Ongoing and recently completed projects relevant to the proposal that I would like to highlight include:

U24 TR002306

Haendel, Chute (PIs)

07/21/20 – 07/20/22

CD2H - National COVID Cohort Collaborative (N3C) Supplement

OT2 OD026554

Reis, Visweswaran, Marroquin (PIs)

02/08/18 – 01/31/23

All of Us Pennsylvania - Precision Approach to healthCARE enrollment Site (PA CARES)

UL1 TR001857

Reis (PI), Visweswaran (Informatics Core Director)

07/12/16 – 5/31/26

University of Pittsburgh Clinical and Translational Science Institute

U01 TR00262301

Mandl (PI)

07/31/2019 – 06/30/2024

Instrumenting the Delivery System for a Genomic Research Information Commons

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2020 - Present	Director, Center for Clinical Machine Learning (CCML), University of Pittsburgh
2018 - Present	NIH Peer Review Committee: NLM COI & Career Award, ad hoc reviewer
2016 - Present	Director, Center for Clinical Research Informatics (CCRI), University of Pittsburgh
2016 - Present	Director, Informatics Core, Clinical and Translational Science Institute, Univ. of Pittsburgh
2015 - Present	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

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 co-authored paper)
2015 First place, AMIA Fall Symposium Student Paper Competition, Washington DC (for a last-authored paper)
2014 Hattie Becich Award for Best Teacher, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA
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, American Medical Informatics Association (AMIA) Fall Symposium Student Paper Competition, Washington DC
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 is focused on the application of machine learning to problems in biomedicine with a specific focus on developing intelligent electronic medical record and clinical decision support systems, precision medicine and personalized modeling, data mining and causal discovery from biomedical data, and research data warehousing.

1. Learning electronic medical record system and intelligent computerized clinical decision support.

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

- a. 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
- b. 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
- c. 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
- d. 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)

2. **Precision medicine and personalized modeling.** In predictive modeling in medicine, the typical paradigm consists of learning a single model from a database of individuals. Such a model is called a population-wide model because it is intended to be applied to an entire population of future individuals. In contrast, my work focusses on personalized modeling where models are tailored to the characteristics of the individual at hand and are optimized to perform well for a specific individual. Personalized 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, personalized models can identify features such as genomic factors that are specific for an individual thus enabling precision medicine.

- a. All of Us Research Program Investigators*. The “All of Us” Research Program. *New England Journal of Medicine*. 2019 Aug 15;381(7):668-76. PMID: 31412182 *Listed as one of All of Us Principal Investigators.
- b. Seymour CW, Kennedy J, Wang S, Chang C-CH, Elliot CF, Xu Z, Berry S, Clermont G, Cooper G, Gomez H, Huang DT, Kellum JA, Mi Q, Opal SM, Talisa V, Poll T, **Visweswaran S**, Vodovotz Y, Weiss JC, Yealy DM, Yende S, Angus DC. Derivation, validation, and potential treatment implications of novel clinical phenotypes for sepsis. *JAMA*. 2019 May 28;321(20):2003-17. PMID: 31104070 PMCID: PMC6537818
- 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. **Visweswaran S**, Cooper GF. Learning instance-specific predictive models. *Journal of Machine Learning Research*. 2010 Dec 1; 11:3369–3405. PMID: 25045325 PMCID: PMC4102007

3. **Causal discovery from biomedical data.** Large amounts of molecular data (e.g., genomic) in combination with clinical data, will lead to increased understanding of the biology of human health and disease, improved prediction of disease and effect of therapy, and ultimately the realization of precision medicine. My work focuses on developing statistical machine learning methods for causal discovery from EMR data, molecular data, or both.

- a. 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.
- b. 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.
- c. 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
- d. 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

4. **Research data warehousing.** Several local, regional and national efforts are ongoing that are creating clinical data repositories for reuse of EMR data for 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 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. **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. *medRxiv*, 2021, doi: 10.1101/2021.05.05.21256679.
- 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. doi:10.1093/jamiaopen/ooab036
- c. 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; 28(3): 427-443. PMID: 32805036 PMCID: PMC7454687

- d. **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

Complete List of Published Work in MyBibliography (from over 110 publications):

<https://www.ncbi.nlm.nih.gov/myncbi/browse/collection/49584579/>