BIOGRAPHICAL SKETCH

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NAME: Shyam Visweswaran

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 DateMM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| Jawaharlal Institute of Post-Graduate Medical Education and Research (JIPMER), Pondicherry, India | M.B.,B.S. | 12/1987 | Medicine |
| 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 | Biomedical Informatics & Intelligent Systems  |
| University of Pittsburgh, Pittsburgh, PA | Ph.D. | 09/2007 | Biomedical Informatics & 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 artificial intelligence and machine learning to biomedicine with a specific focus on developing intelligent electronic medical record 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 as Director of Clinical Informatics and Director of the Center of Clinical Research Informatics (CCRI). 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.

**B. Positions and Honors**

## Positions and Employment

1989-1991 Resident in Anesthesiology, Department of Anesthesiology, Jawaharlal Institute of Post-Graduate Medical Education and Research, Pondicherry, India

1991-1995 Research and teaching assistant, Department of Physiology and Biophysics, University of Illinois at Urbana-Champaign, Urbana, IL

1996 Internal Medicine Intern, Department of Medicine, St. Luke’s - Roosevelt Medical Center, New York, NY

1997-2000 Resident in Neurology, Department of Neurology, Boston University, Boston, MA

2001-2006 Informatics Fellow, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA

2006-2015 Assistant Professor, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA

2015- Associate Professor, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA

2008- Associate Professor, Intelligent Systems Program (Secondary Appointment), University of Pittsburgh, Pittsburgh, PA

2010- Associate Professor, Clinical and Translational Science Institute (Secondary Appointment), University of Pittsburgh, Pittsburgh, PA

## Other Experience and Professional Memberships

2001- Member, American Medical Informatics Association

2001- Member, American Association for Artificial Intelligence

2018- Member, American Academy of Neurology

2007- Editorial Board Member, International Journal of Medical Engineering and Informatics

2017- Editorial Board Member, Artificial Intelligence in Medicine

2020- Editorial Board Member, Journal of Biomedical Informatics

2005- Ad hoc reviewer for multiple journals, including *Artificial Intelligence in Medicine*, *PLoS ONE*, *PLoS Medicine*, *PLoS Computational Biology*, *Computers in Biology and Medicine*, *Medical Decision Making*, *Science Translational Medicine*, *Journal of Biomedical Informatics*, and *Journal of the American Medical Informatics Association*

2011-2012 NSF Peer Review Committee, Smart Health and Wellbeing Review Panel

2018 NIH, NLM Conflict of Interest and Career Award Review Panel, ZLM1-ZH-C(01), ZLM1 YW-C(01), NIBIB Mentored Career Development (K) Review Panel ZEB1 OSR-E (J1) S

2019 NIH, NLM Conflict of Interest and Career Award Review Panel ZLM1 YW-C (01), NIH, NCATS Biomedical Data Translator: Development

2020 NIH, NLM Special Emphasis Panel ZLM1 YW-C (01), NIH, NIGMS NIH Pathway to Independence Award (K99/R00) Applications ZGM1 TWD-9 (KR)

## Honors

1981-1991 National Science Talent Search Scholarship, Government of India

1995-1996 Excellent Teacher, School of Life Sciences, University of Illinois at Urbana-Champaign, Urbana, IL

2000-2001 Chief Resident, Department of Neurology, Boston University, Boston, MA

2001-2005 National Library of Medicine Post-Doctoral Fellowship

2005 Third place, American Medical Informatics Association (AMIA) Fall Symposium Student Paper Competition, Washington DC

2010 Homer R. Warner Research Award, AMIA Fall Symposium, Washington DC (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)

2012 Distinguished Paper Award, AMIA Joint Summits on Translational Science, San Francisco, CA (for a co-authored paper)

2013 Distinguished Paper Award, AMIA Joint Summits on Translational Science, San Francisco, CA (for a co-authored paper)

2014 Hattie Becich Award for Best Teacher, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA

2015 First place, AMIA Fall Symposium Student Paper Competition, Washington DC (for a last-authored paper)

2017 First place, AMIA Joint Summits Clinical Research Informatics Student Paper Competition, San Francisco, CA (for a co-authored paper)

2019 Featured presentation at the Machine Learning & Artificial Intelligence Application in Translational science: Un-Meeting by the Center for Leading Innovation & Collaboration, Rochester, NY

# C. Contribution to Science

My research is focused on the application of artificial intelligence and machine learning to problems in biomedicine with a specific focus on developing intelligent electronic medical record 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 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
	1. 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. 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
	3. 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
2. **Precision medicine and personalized modeling.** I serve as PD/PI for the *All of Us Pennsylvania* research project that will enroll and collect data and bio specimens for 120,000 individuals for the Precision Medicine Initiative.

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.

* 1. **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
	2. 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
	3. 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.
1. **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.
	1. 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
	2. 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.
	3. 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.
2. **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, and 3) PCORI-funded PaTH clinical data research network.
	1. Amin, W, Borromeo, C, Saul, M, Becich, MJ, **Visweswaran, S**. Informatics synergies between PaTH and ACT networks. In: Proceedings of the 2015 Summit on Clinical Research Informatics. 2015 Mar 25; 2015:294-95.
	2. **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 Google Scholar:

https://scholar.google.com/citations?user=i4k8HmEAAAAJ

# D. Additional Information: Research Support

**Ongoing Research Support**

UPMC Enterprises Thirumala, Visweswaran, Batmanghelich (PIs) 06/01/2020 – 05/31/2021

Realtime Evaluation for Adverse Events using Intraoperative Neurophysiological Monitoring (READE IONM)

The goal of this project is to develop a machine learning based system to detect brain ischemia in realtime from continuous intraoperative neurophysiological monitoring.

Role: Co-PI

U24 TR002306 Haendel (PI) 04/01/2020 – 03/31/2021

NIH/NCATS

A National Center for Digital Health Informatics Innovation

The goal of the National COVID Cohort Collaborative (N3C) is to build a national data resource that will turn data into the knowledge that is urgently needed to address the COVID-19 pandemic.

Role: Consultant

U01 TR00262301 Mandl (PI) 07/31/2019 – 06/30/2024

NIH/NCATS

Instrumenting the Delivery System for a Genomic Research Information Commons

The goal of this project is to develop a federated CTSA-wide Genomics Information Commons to enable rapid identification and analysis of representative cohorts.

Role: Co-Investigator

R01 LM012605 Schleyer (PI) 06/01/2018 – 04/30/2021

NIH/NLM

Enhancing Information Retrieval in Electronic Health Records Through Collaborative Filtering

The goal of this project is to implement and evaluate collaborative filtering as a method to improve information retrieval from electronic health records (EHRs) and reduce cognitive overload.

Role: Co-Investigator

R01 CA225773 Primack (PI) 04/01/2018 – 03/31/2022

NIH/NCI

Leveraging Twitter to Monitor Nicotine and Tobacco-Related Cancer Communication

The goal of this project is to develop and apply machine learning to Twitter data to study cancer communication in nicotine and tobacco products.

Role: Co-Investigator

UL1 TR001857-01S1 Reis (PI) 09/23/2016 – 05/31/2021

NIH/NCATS

ACT (Accrual to Clinical Trials) network

This grant provides funding support to establish a clinical data repository network across CTSA sites for enabling cohort identification for accrual of patients to clinical trials.

Role: Co-Investigator / Lead, Data Harmonization Working Group

R35 GM119519 Seymour (PI) 08/02/2016 – 05/31/2021

NIH/NIGMS

Sepsis Endotyping Using Clinical and Biological Data

The goal of this project is to identify sepsis endotypes though careful analysis of rich clinical data combined with biologic signatures.

Role: Co-Investigator

UL1 TR001857 Reis (PI) 07/01/2016 – 05/31/2021

NIH/NCATS

Informatics Core, Clinical and Translational Science Institute

This grant provides funding support for the University of Pittsburgh’s CTSA program, and the Biomedical Informatics Core provides informatics support.

Role: Director, Biomedical Informatics Core

OT2 OD026554 Reis, Visweswaran, Marroquin (PIs) 02/08/2018 – 01/31/2023

NIH

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

This goal of the national All of Us program is to enroll 1M participants and collect their EHR data and bio specimens. The All of Us Pennsylvania program will enroll 120,000 participants for the national program.

Role: PD/PI

R01 LM012095 (NCE) Visweswaran (PI) 09/15/2015 – 06/30/2020

NIH/NLM

Development and Evaluation of a Learning Electronic Medical Record System

The goal of this project is to develop and evaluate intelligent electronic medical record systems (EMRs) that contain adaptive and learning components to provide decision support using the right data, at the right time.

Role: PI (Sole)

**Completed Research Support (Last Three Years)**

R01 GM088224 Hauskrecht, Clermont, Cooper (PIs) 08/15/2014 – 05/31/2019

NIH/NIGMS

Real-Time Detection of Deviations in Clinical Care in ICU Data Streams

The goal of this project is to develop and evaluate a new clinical monitoring and alerting framework that uses electronic medical records and machine learning methods to send alerts concerning clinical decisions in the ICU that are unexpected in given the clinical context and may represent medical errors.

Role: Co-Investigator