

BIOGRAPHICAL SKETCH

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NAME: Fuchiang (Rich) Tsui

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

POSITION TITLE: Associate Professor of Biomedical Informatics, Intelligent Systems, and Bioengineering

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
Tatung Institute of Technology, Taipei, Taiwan	B.S.	1988	Electrical Engineering
University of Pittsburgh, Pittsburgh, Pennsylvania	M.S.	1993	Electrical Engineering
University of Pittsburgh, Pittsburgh, Pennsylvania	Ph.D.	1996	Electrical Engineering
University of Pittsburgh, Pittsburgh, Pennsylvania	Post. Doc.	1998	Biomedical Informatics
Oracle Education Center, USA	Certificate	1998	Database Management
University of Pittsburgh, Pittsburgh, Pennsylvania		2000	Premedical Study

A. Personal Statement

Dr. Tsui is Associate Professor, Department of Biomedical Informatics at the University of Pittsburgh School of Medicine. He is jointly appointed in Bioengineering, Intelligent Systems Program, and Clinical/Translational Research. He is Director of the Tsui Laboratory.

Dr. Tsui's research interests focus on Bayesian networks, machine learning, natural language processing, signal processing and image/video processing. The applied research applications include predictive modeling, clinical informatics, public health surveillance (biosurveillance), phenotype data science, production systems (integrated into commercial electronic health records system), and learning healthcare systems. He has published more than 100 papers and his publication has been actively cited (Google® scholar *h-index* 40). His research, funded by the RK Mellon Foundation, a local foundation, Coulter Foundation, NCATS, NLM and PCORI, includes clinical phenotyping of readmissions and emergency department infectious disease detection with emphasis on large patient data mining from various patient data types (structured and unstructured). Dr. Tsui's team recently participated in 2016 CEGS N-GRID shared tasks and workshop on challenges in NLP for clinical data, and was ranked top four among 24 international teams for predicting positive valence system severities from processing narrative psychiatric notes; the work was published in the Journal of Biomedical Informatics in 2017.

To provide real-world impact and help advance learning healthcare systems, Dr. Tsui has co-funded several large real-time production systems with Dr. Wagner: the Clinical Event Monitor System (CLEM), the Real-time Outbreak and Disease Surveillance System (RODS), and the National Retail Data Monitor (NRDM). Recently, Dr. Tsui's Bayesian predictive modeling work received distinguished poster awards in 2014 and 2015 American Medical Informatics (AMIA) conferences. He now advises six PhD students. Moreover, he deployed a production system (SHARP) at the Children's Hospital of Pittsburgh of UPMC, providing real-time readmission risk estimate to clinicians; unlike conventional approach, SHARP is uniquely embedded in the Cerner® system to maximize usability and fit into clinicians' workflow.

1. Posada JD, Barda AJ, Shi L, Xue D, Kuan PH, Ryan ND, Tsui FR. [Predictive Modeling for Classification of Positive Valence System Symptom Severity from Initial Psychiatric Evaluation Records](#). J Biomed Inform Published Online First: 2017. doi:10.1016/j.jbi.2017.05.019
2. Ye Y, Wagner MM, Cooper GF, Ferraro JP, Su H, Gesteland PH, Haug PJ, Millett NE, Aronis JM, Nowalk AJ, Ruiz VM, Lopez Pineda A, Shi L, Van Bree R, Ginter T, Tsui F, [A study of the transferability of](#)

[influenza case detection systems between two large healthcare systems](#). PLoS One. 2017 Apr 5;12(4):e0174970. doi: 10.1371/journal.pone.0174970. eCollection 2017. PubMed PMID: 28380048; PubMed Central PMCID: PMC5381795.

- Ferraro JP, Ye Y, Gesteland PH, Haug PJ, Tsui FR, Cooper GF, Van Bree R, Ginter T, Nowalk AJ, Wagner M. [The effects of natural language processing on cross-institutional portability of influenza case detection for disease surveillance](#). Appl Clin Inform. 2017 May 31;8(2):560-580. doi: 10.4338/ACI-2016-12-RA-0211. PubMed PMID: 28561130.
- Lopez Pineda A, Ye Y, Visweswaran S, Cooper GF, Wagner MM, Tsui FR. [Comparison of machine learning classifiers for influenza detection from emergency department free-text reports](#). Journal of biomedical informatics. Sep 16, 2015.

B. Positions and Honors

Positions and Employment

1996 - 1998	Postdoctoral Fellow, Center for Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA
1998 - 2000	Research Associate, Center for Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA
2000 - 2006	Research Assistant Professor, Center for Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA
2006 - 2016	Research Assistant Professor, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA
2006 -	Secondary faculty appointment in Intelligent Systems Program, University of Pittsburgh
2014 -	Secondary faculty appointment in Bioengineering, University of Pittsburgh
2015 -	Secondary faculty appointment in Clinical and Translational Research, University of Pittsburgh
2016 -	Associate Professor, Department of Biomedical Informatics, University of Pittsburgh, Pittsburgh, PA

Honors

1997	Nomination for best paper, 1997 Annual Symposium for Computer Applications in Medical Care: The Emergence of 'Internetable' Health Care. Systems That Really Work (October 25-29, 1997, Nashville, Tennessee), American Medical Informatics Association.
1998	Nomination for best paper, 1998 Annual Symposium for Computer Applications in Medical Care: A Paradigm Shift in Health Information Systems: Clinical Infrastructures for the 21st Century (November 7-11, 1998, Orlando, Florida), American Medical Informatics Association.
2002	Nomination for best paper, 2002 Annual Symposium for Computer Applications in Medical Care: Biomedical Informatics: One Discipline (November 9 - 13, 2002, San Antonio, TX), American Medical Informatics Association.
2012	Scientific achievement Award for Outstanding Research Articles in Biosurveillance, 2012 Annual International Society for Disease Surveillance: Expanding Collaborations to Chart a New Course in Public Health Surveillance (December 4-5, 2012, San Diego, California), International Society for Disease Surveillance
2013	Interviewed by Pittsburgh Business Times: Analytic tool helps docs make better calls on discharges (http://www.bizjournals.com/pittsburgh/print-edition/2013/11/22/analytic-tool-helps-docs-make-better.html)
2014	Distinguished poster award, AMIA 2014 Annual Symposium, Nov. 2014, Washington DC.
2015	Distinguished poster award, AMIA 2015 Annual Symposium, Nov. 2015, San Francisco, CA
2016	Innovation award, University of Pittsburgh

C. Contribution to Science

1. **Real-time Rule-based Clinical Event Monitor from Registrations, Laboratory Reports, and Medications**

Dr. Tsui worked with Dr. Michael Wagner, first as a post-doc on the design and deployment of the CLinical Event Monitor (CLEM)^a that receives patient data from registrations, laboratory reports, and medications, and provides clinical alerts to house staff (residents and hospital nosocomial infection control groups) at the University of Pittsburgh Medical Center (UPMC). Fifty more forward-chained

clinical rules were developed in CLEM that became the core rules used in UPMC Cerner CPOE system. We studied the scalability and feasibility of the system and such concept was adopted in electronic health record systems later.^b Dr. Tsui also made impact to clinical practice by first implementing electronic laboratory reporting technology to UPMC, which set as an prototype for automated disease reporting in public health surveillance.^c CLEM is still in operation presently. Dr. Tsui initially started real-time clinical vital sign processing applied to an intensive care unit at UPMC during his PhD study, which allows him to further apply the technology to all his clinical production systems and public health surveillance.^d

- a. Wagner MM, Pankaskie MC, Hogan WR, Tsui F-C, Vries JK. Clinical event monitoring at the University of Pittsburgh. Proc AMIA Annu Fall Symp. 1997:188-92. PMID: PMC2233316.
- b. Tsui F-C, Wagner MM, Wilbright WA. A feasibility study of two methods for end-user configuration of a Clinical Event Monitor. Proc AMIA Symp. 1999: 975-8. PMID: PMC2232807.
- c. Panackal AA, M'ikanatha NM, Tsui F-C, McMahon J, Wagner MM, Dixon BW, Zubieta J, Phelan M, Mirza S, Morgan J, Jernigan D, Pasculle AW, Rankin JT, Hejeh RA, Harrison LH. Automatic electronic laboratory-based reporting of notifiable infectious diseases at a large health system. Emerging Infectious Diseases 8(7):685-691, 2002 Jul. PMID: 12095435
- d. Tsui F-C, Li C.C., Sun M., and Scabassi R.J. Acquiring, Modeling, and Predicting ICP Signals in the Intensive Care Unit. Biomedical Engineering Applications, Basics, and Communications, Vol. 8, No. 6, pp 566-578, 1996.

2. Real-time Public Health Surveillance from Emergency Department Visits and Over-the-Counter Sales

In light of the dire need of public health informatics and the threat of bioterrorist attacks in the U.S., Dr. Tsui worked with Dr. Michael Wagner as a Junior faculty member on the design and deployment of the Real-time Outbreak and Disease Surveillance (RODS) system in late 90s and early 2000.^{a-c} RODS received patient chief complaint data from hundreds of emergency departments across multiple states in the U.S. and provided real-time analyses and map display for identifying outbreaks. Dr. Tsui made impact on real-time HL7 data collection, data warehousing, data analytics (such as Wavelet, Recursive Least Square filter) to later national surveillance system design and operation. The RODS system was deployed during 2002 Winter Olympics games at Salt Lake City, Utah, which drew President George W. Bush's visit to the University of Pittsburgh in 2002 for the RODS system.

- a. Tsui F-C, Wagner M.M., Dato V., and Chang J. Value of ICD-9 Coded Chief Complaints for Detection of Epidemics. J Am Med Inform Assoc., 9(6), S41-7, 2002. PMID: PMC419415
- b. Tsui F-C, Espino JU, Wagner MM, Gesteland PH, Ivanov O, Olszweski RT, Liu Z, Zeng X, Chapman WW, Wong W-K, Moore AW. Data, Network, and Application: Technical Description of the Utah RODS Winter Olympic Biosurveillance System. Proc AMIA Symp. 2002:815-9. PMID: PMC2244477.
- c. Tsui F-C, Espino JU, Dato VM, Gesteland PH, Hutman J, Wagner M.M. Technical description of RODS: A real-time public health surveillance system. J Am Med Inform Assoc., 10(5): pp. 399-408, 2003. PMID: PMC212776.
- d. Wagner MM, Robinson M, Tsui F-C, Espino JU, Hogan WR. Design of a national retail data monitor for public health surveillance. J Am Med Inform Assoc., 10(5): pp. 409-418, 2003. PMID: PMC212777.

3. Real-time Probability-based Case Detection from free-text reports using Machine learning algorithms and Natural Language Processing

The current dilemma in case detection, i.e., current detection precision sits at two extreme ends of spectrum: un-precise case detection from chief complaint (available in real-time) and highly precise case detection from confirmed laboratory reports (available days after a patient's visit time). To solve the dilemma, Dr. Tsui started using emergency department electronic discharge reports available hours after a patient's emergency department visit. He and his team employ natural language processing to extract symptoms and signs from emergency department discharge summary free-text reports. His studies allows to advance case detection to reach higher detection accuracy (AUROC > 0.9) from processing discharge summary reports.

- a. Tsui F-C, Espino JU, Wagner MM, et al., Chapter 13 Case detection algorithms. In: Wagner M, Moore A, Aryel R, editors. Handbook of Biosurveillance. New York: Elsevier; 2006.
- b. Tsui F-C, Wagner MM, Cooper GF, Que J, Harkema H, Dowling J, Sriburadej T, Li Q, Espino JU, Voorhees R. Probabilistic case detection for disease surveillance using data in electronic medical records. Online Journal of Public Health Informatics, 2011, Vol 3, No 3. PMID: PMC3615792
- c. Ye Y, Tsui F-C, Wagner M, Espino JU, Li Q, Influenza detection from emergency department reports using natural language processing and Bayesian network classifiers, Journal of American Medical Informatics Association, 21(5): 2014 Sep-Oct, 2014, pp815-23, PMID: 24406261
- d. Lopez Pineda A, Ye Y, Visweswaran S, Cooper GF, Wagner MM, Tsui FR. Comparison of machine learning classifiers for influenza detection from emergency department free-text reports. Journal of biomedical informatics. Sep 16, 2015.

4. Real-time Readmission Prediction and Management from Structured and Unstructured Reports using Machine learning algorithms and Natural Language Processing

Given the dire need of hospitals on raising the quality of patient care and reducing the reimbursement penalty by the Centers of Medicare and Medicaid Services (CMS), Dr. Tsui and his team started working on applying machine learning algorithms and natural language processing to both structured and unstructured patient data to increase the detection accuracy and the width of patient data.^{a-c} In addition to his academic contribution on readmission prediction, his innovative technology was also acknowledged through his recent U.S. Patent publication in March 2015.^d His technology will be implemented in conjunction with Cerner EHR system to provide most direct impact to clinical practice.

- a. Lu S, Ye Y, Tsui R, Liu X, and Hwa R, Feature Selection for 30-Day Heart Failure Readmission Prediction Using Clinical Drug Data. NIPS workshop on Machine Learning for Clinical Data Analysis and Healthcare, Dec. 10, 2013.
- b. Draper AJ, Ye Y, Ruiz VM, Patterson C, Urbach A, Palmer F, Wang S, Somboonna M, Tsui FR, Using laboratory data for prediction of 30-day hospital readmission of pediatric seizure patients, American Medical Informatics Association (AMIA) 2014 Annual Symposium, Washington DC, Nov. 2014 (Distinguished Poster Award)
- c. Posada J, Tsui FR. Inpatient 30-day readmission prediction using cTAKES. Science2015-Unleashed; Pittsburgh, PA2015.
- d. Fuchiang (Rich) Tsui, System for hospital adaptive readmission prediction and management (SHARP), US Patent publication number, US 2015/0081328 A1, March 19, 2015

Complete List of Published Work in MyBibliography:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/fuchiang.tsui.1/bibliography/48762736/public/?sort=date&direction=ascending>

D. Research Support

Ongoing Research Support

The Beckwith Foundation Tsui (Co-PI) 06/2017 - 05/2018

Using Electronic Health Records to Identify Patients at Risk for Suicide

The project is to develop predictive models for prediction of patients with risk of suicide during their hospital visits.

Role: Co-PI

The Children's Hospital of Pittsburgh of UPMC Tsui (PI) 01/2017 - 06/2018

C-WIN: Cardiac ICU Warning Index

The project is to develop a smart warning system that predictive morbidity of patients in a pediatric cardiac intensive care unit.

Role: PI (sole)

The Richard King Mellon Foundation Tsui (PI) 08/2016 - 07/2018

Infant Mortality Prediction and Reduction

The project is to develop predictive models for infant mortality prediction in Allegheny County, Pennsylvania based on large cohort clinical, behavioral, and environment data from City of Pittsburgh and UPMC-HS.

Role: PI (sole)

The McCune Foundation Tsui (PI) 05/2015 - 04/2018

System for Hospital Adaptive Readmission Prevention and Reduction (SHARP)

The proposed research is to develop predictive models for three pediatric populations (seizure, asthma, and pneumonia), and to implement SHARP within the Cerner EHR system to maximize the impact to clinical practice.

Role: PI (sole)

Completed Research Support

The Coulter Foundation Tsui (PI) 1/2015 - 12/2016

Readmission technology development for Industrial applications

The project is to develop a pathway to facilitate the industrial applications of the readmission prediction technology. It pushes the proposed technology from the bench side to the bed side.

Role: PI (sole)

1 R01 LM011370-01A1 Wagner (PI) 07/2013 - 06/2016

Probabilistic Disease Surveillance

The purpose of the proposed research is to improve disease surveillance by (1) replacing the current Boolean approach to case detection with a probabilistic approach [case detection system (CDS)], and (2) developing an algorithm for outbreak detection and characterization (OD&C) that uses the probabilistic case data.

Role: Co-I (Director of CDS development)

PCORI Hess (PI) 01/2014 - 06/2016

PaTH towards a Learning Health System for the Mid-Atlantic Region

The purpose of the proposed research is to build a large distributed cohort data repository from four institutions (University of Pittsburgh/UPMC, Penn State, Temple University, and John Hopkins University) that uses standard terminologies and core data elements.

Role: Co-I

First Gear, University of Pittsburgh Tsui (PI) 2/2014 - 1/2015

Hospital Readmission Prediction

The project focuses on the strategy for the industrial application of readmission technology.

Role: PI (sole)

Innovation Works Tsui (PI) 8/2014 - 7/2015

AHRPS

The project focuses on the strategy for the industrial application of readmission technology.

Role: PI (sole)

P01 HK000086 (CDC) Wagner (PI) 09/2009 - 08/2014

University of Pittsburgh Center for Advanced Study of Informatics in Public Health (CASIPH)

The purpose of this project was to establish a center at the University of Pittsburgh that brings together a diverse group of investigators to carry out research focusing on improving the nation's ability to detect and characterize cases of disease and outbreaks of disease as quickly as possible. The research projects will develop a Bayesian case detection system and a Bayesian outbreak detection system.

Role: PI on Research Project 1 (Case Detection System)

1U38HK000063-01 (CDC) Tsui (PI) 10/2008 - 09/2010

PA-OH BiG: Building a Regional Biosurveillance Grid for Pennsylvania and Ohio

The objective of this project is to form a regional biosurveillance grid network, PA-OH BiG, to facilitate collaboration of regional public health surveillance in Pennsylvania (PA) and Ohio (OH). PA-OH BiG will allow participating organizations or members, e.g., public health departments, to form federated (decentralized) data repositories and to share their data with other members.

Role: PI (sole)