



## FRED: Framework for Reconstructing Epidemiological Dynamics ID: 4257

Featured Innovators: Don Burke, MD, Mark Roberts, MD MPP, John Grefenstette, PhD, and John Cordier

Traditional forecasting relies on retrospective data and actuarial models to evaluate risk associated with a population or system. Traditional models also lack the ability to factor in behavioral dynamics and geospatially-accurate information. FRED (Framework for Epidemiological Dynamics) is a customizable modeling platform that supports decision making and forecasting based on the dynamic interactions of humans in their daily social interactions. The power and customization capabilities of FRED give non-technical users in healthcare, politics, insurance, and other industries the ability to create more dynamic models and forecasts to better inform their decisions.

### Technology Description

FRED is an agent-based model that can include personal behaviors, social-demographics, local environments, resource allocations, and risk mitigation strategies. The model's flexible, customizable, object-oriented design is built to represent dynamic conditions in a synthetic population that is statistically equivalent to the real population in any given county or state. FRED supports various models of health behavior change to facilitate the study of critical personal health behaviors, such as vaccine acceptance, personal hygiene and spontaneous social distancing. No other agent-based population health models provide the flexibility, modularity, extensibility, and level of geographic and demographic specificity of the FRED synthetic population. In addition, these systems focus on acute infectious disease epidemics, whereas FRED can model general health conditions. Finally, FRED is the only system that can project population demographics into the future.

### Advantages

- Customizable to client need and industry
- Includes interactions among population and the environment and to factor for behavioral dynamics into forecast
- No computer programming required
- Provides a simple workflow environment
- Manages all data produced by simulation and associated metadata

### Applications

- Short-term reserve optimization planning
- Disease progression modeling
- Forecasting health risk in new markets
- Health planning and population health decision making
- Evaluation of risk mitigation strategy and policy
- Planning for population health threats and natural and man-made disasters

### Stage of Development

FRED has over a decade of development and will have a fully functional web-based user interface by November 2017

### IP Status

Invention disclosure was submitted to the Innovation Institute on May 22, 2017.

### Notable Mentions

- Funded by the MIDAS, Bill and Melinda Gates Foundation, and the Robert Wood Johnson Foundation
- Used for disease modeling in partnership with the Department of Homeland Security, multiple Robert Wood Johnson Foundation funded projects including: 100 Resilient Cities, Data Across Sectors for Health
- Adapted to preparedness and planning efforts on the aftermath of Hurricane Sandy, to understand the progression of chronic disease, and to map the opioid epidemic
- Mentioned in *TIME Magazine's* Heroes of Vaccine History in the 20<sup>th</sup> Century issue

## Innovators



### Don Burke, MD

Dean  
 Graduate School of Public Health

Associate Vice Chancellor  
 Global Health  
 University of Pittsburgh

#### Education

MD Harvard Medical School  
 BA Case Western Reserve  
 University

Throughout his professional life, Dr. Burke has studied prevention and control of infectious diseases of global concern, including HIV/AIDS, influenza, dengue, and emerging infectious diseases. He spent six years in Thailand, worked extensively in Cameroon, and conducted field epidemiology and vaccine studies in numerous other developing countries. He has authored or co-authored over 300 peer reviewed academic publications. He currently serves on the Board of Health for Allegheny County and is a Fellow of the American Association for the Advancement of Science, the American Academy of Microbiology, and the American Epidemiological Society. He is also an elected member of the National Academy of Medicine.



### Mark Roberts, MD MPP

Professor and Chair  
 Health Policy Management

Director  
 Public Health Dynamics Lab  
 University of Pittsburgh

#### Education

MD Tufts Medical School  
 MPP Harvard University  
 BA Harvard University

In addition to being a practicing general internist, Dr. Roberts has conducted research in decision analysis and the mathematical modeling of disease for over 25 years. He has expertise in cost effectiveness analysis, mathematical optimization and simulation, and the measurement and inclusion of patient preferences into decision problems. He has used decision analysis to examine clinical, costs, policy and allocation questions in liver transplantation, vaccination strategies, operative interventions, and the use of many medications. In 2014, he received a Lifetime Achievement Award from the Society for Medical Decision Making.



### John Grefenstette, PhD

Professor  
 Health Policy and Management  
 University of Pittsburgh

Senior Scientist  
 Public Health Dynamics Lab  
 University of Pittsburgh

#### Education

PhD University of Pittsburgh  
 MS University of Pittsburgh  
 BS Carnegie Mellon University

Before serving as the founding director of the Public Health Dynamics Lab at Pitt, Dr. Grefenstette was professor and chair of the Department of Bioinformatics and Computational Biology and assistant dean for the School of Computational Sciences at George Mason University. Prior to that he served as head of the machine learning section at the Navy Center for Applied Research in Artificial Intelligence. In 2010, Dr. Grefenstette was honored with the Evolutionary Computation Pioneer Award from the IEEE Computational Intelligence Society.



### John Cordier

MBA / MPH student  
 Graduate School of Public Health  
 Katz Graduate School of Business  
 University of Pittsburgh

#### Education

BS University of Pittsburgh

As entrepreneurial lead for the FRED project, Mr. Cordier leads strategies and coordinates efforts between the Graduate School of Public Health and the Innovation Institute to commercialize FRED.

University of Pittsburgh  
 Innovation Institute

130 Thackeray Ave  
 Pittsburgh, PA 15260

[innovation.pitt.edu](http://innovation.pitt.edu)

### Contact

Jeffrey Depp, JD MBA  
 Technology Licensing Manager  
 412-648-0078  
[jdepp@innovation.pitt.edu](mailto:jdepp@innovation.pitt.edu)