University of Michigan Center for Complexity and Self-management of Chronic Disease

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Overview

The Center for Complexity and Self-management of Chronic Disease (CSCD) conducts translational research on multiple chronic conditions, behaviors to promote health, avoidance and coping of disease, and integration of self-management for optimal living. Chronic illnesses are complex and their trajectories are dynamic due to contextual factors, disease biomedical processes, environmental, and epigenetic factors. Innovative modeling and powerful data analytics are necessary to examine, track, and predict the outcomes of such complex systems, human behaviors, and biomedical observations involved in chronic diseases.

Key Investigators

PIs: Drs. Debra Barton & Ivo Dinov
Executive Committee: Drs. Larson, Titler, Furspan, Saint-Arnault
External Advisory Committee: Drs. Moser, Fan, Resnicow, Piette, Heisler, and Riba
Pilot Project PIs: Drs. Casida, Song, Arslanian-Engoren

Complexity in Studies of Neurodegenerative Disorders

Although there are substantial variations in different neurodegenerative studies, most such studies rely on Big Data that is incongruent, multi-source, and incomplete. Typical processing and analysis protocols involve the following steps: data aggregation, data scrubbing, data fusion (e.g., semantic mapping), exploratory and quantitative data modeling, data analytics, summarization, information synthesis, knowledge management, decision, and action. This workflow illustrates an end-to-end protocol starting with raw data – bits and bytes – (left), information extraction (middle), and ending with knowledge retrieval and appropriate action (right).

Big Data	Information	Knowledge	Action
Raw Observations	Processed Data	Maps, Models	Actionable Decisions
Data Aggregation	Data Fusion	Causal Inference	Treatment Regimens
Data Scrubbing	Summary Stats	Networks, Analytics	Forecasts, Predictions
Semantic-Mapping	Derived Biomarkers	Linkages, Associations	Healthcare Outcomes

CSCD investigators **examine complex heterogeneous data**, and develop protocols for data interrogation & visualization:
o How and why should we "look" at data?
o What data characteristics are important for exploratory data analytics (EDAs)?

We **classify the scientific methods** for data-driven or simulation-driven visualization according to :
o *Data Type*: structured/unstructured, small/large, complete/incomplete, time/space, ASCII/binary, etc.
o *Task type*: based on required interaction between the researcher, the data and the display software
o *Scalability*: to facilitate high-throughput data processing and visualization
o *Dimensionality*: according to the number of data elements or attributes
o *Investigative Need*: specific scientific question or exploratory interest

Data Dashboard

We developed a user-friendly platform for data fusion and graphical query:
o Web-service combining and integrating multi-source socioeconomic and medical datasets
o Big data analytic processing
o Interface for exploratory navigation, manipulation, & visualization
o Adding/removing of visual queries and interactive exploration of multivariate associations
o Powerful HTML5 technology for mobile on-demand analytics

High-Throughput Pipeline Workflow Solutions
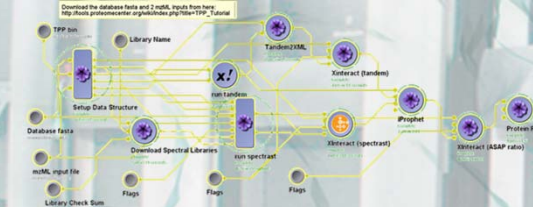
Consulting

CSCD provide consultation on designing translational research studies, addressing novel methodological challenges, scientific visualization, management and processing of Big Healthcare and Biomedical Data.

Choosing appropriate statistical tests for independent observations

		Outcome variables					
		Nominal	Categorical (>2 Categories)	Ordinal	Quantitative Discrete	Quantitative Non-Normal	Quantitative Normal
Predictor Variables	Nominal	χ^2 or Fisher's	χ^2	χ^2 trend or Mann-Whitney	Mann-Whitney	Mann-Whitney or log-rank (a)	Student's t test
	Categorical (>2 categories)	χ^2	χ^2	Kruskal-Wallis (b)	Kruskal-Wallis (b)	Kruskal-Wallis (b)	Analysis of variance (c)
	Ordinal (Ordered categories)	χ^2-trend or Mann-Whitney	(e)	Spearman rank	Spearman rank	Spearman rank	Spearman rank or linear regression (d)
	Quantitative Discrete	Logistic regression	(e)	(e)	Spearman rank	Spearman rank	Spearman rank or linear regression (d)
	Quantitative non-Normal	Logistic regression	(e)	(e)	(e)	Plot data and Pearson or Spearman rank	Plot data and Pearson or Spearman rank and linear regression
	Quantitative Normal	Logistic regression	(e)	(e)	(e)	Linear regression (d)	Pearson and linear regression

Across Time · Across Categories · Multi-Variate · 2 Variables · Multi-Variate · Uni-Variate · Many Factors · 1 Factor

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