Envisioning Research in a Whole New World

Transformed by technology:
- Networked
- Standardized
- Data-rich

Leonhard Euler (1707-1783)
- Graph theory: nodes and edges
- Seven Bridges of Königsberg

Stanley Milgram (1933-1984)
Small World Experiment

Science and technology: Networks
- Skitter data capture a macroscopic snapshot of Internet connectivity, with selected backbone ISP colors separated by K. C. Claffy
Mark Granovetter (1943 - )
The Strength of Weak Ties

Arc map showing the worldwide internet traffic by Stephen G. Eick
http://barabasi.com/gallery/g1.php

Albert-Laszlo Barabasi (1967 -)
The New Science of Networks

Growth and Topology of the NLANR Caching Hierarchy
by Bradley Huffaker, Jaeyeon Jung, Duane Wessels at CAIDA/NLANR

Science

and technology:

Standards
Science and technology: Data

New Data-driven Paradigm
- New cyber infrastructure
- New data-driven paradigm of research in which the data generate the hypotheses

Data = Opportunity
- The Omaha System Data Warehouse originally proposed by Dean Delaney is a gold mine of health care quality knowledge
- Clinically relevant questions are being answered on a daily basis
- Students, faculty, and clinicians are partnering in practice-based research
- New metrics and methods are evolving with every study

Omaha System Partnership

Proposed or Current Research
- 12 completed studies with manuscripts published (6), accepted (1), submitted (5)
- 11 studies in progress
- 3 grants awaiting decisions
- 3 studies in development
Funding Acknowledgment

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The Population Health and Systems Cooperative and Champ Software provided seed grant funding for Omaha System Partnership research.

A Health Care Quality Research Agenda

New data sets, methods, models, and metrics are needed in all areas of health care research

We are developing exemplars that can be used with any structured data sets

All studies use data from clinical settings and involve clinical and/or scholarly experts as partners

New Metrics

Problem stabilization
Benchmark attainment
Maternal Risk Index

Stabilization: a proposed interim improvement indicator

Problem stabilization is an intervention pattern for a client problem that is characterized by:

- co-occurring interventions with more than one category during a nurse-client encounter (i.e. teaching, guidance, and counseling; treatments and procedures; case management; and/or surveillance)

followed by surveillance only (for that problem) during a subsequent nurse-client encounter.

Problem Stabilization (mean values across all problems)

<table>
<thead>
<tr>
<th></th>
<th>Adult</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Stabilized</td>
<td>30.1%</td>
<td>20.1%</td>
</tr>
<tr>
<td>Time to Stabilization</td>
<td>158 days</td>
<td>116 days</td>
</tr>
<tr>
<td>Length of Care</td>
<td>286 days</td>
<td>273 days</td>
</tr>
</tbody>
</table>

Survival Analysis (Kaplan-Meier Curves)

Graphing methods for depicting the timing and occurrence of events
**Benchmark Attainment**

improvement process used to discover (and incorporate) best practices into operations

**Concepts and Ratings of the Problem Rating Scale for Outcomes:**

<table>
<thead>
<tr>
<th>Concepts</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: Ability of the client to understand and interpret information</td>
<td>No knowledge</td>
<td>Minimal knowledge</td>
<td>Basic knowledge</td>
<td>Adequate knowledge</td>
<td>Superior knowledge</td>
</tr>
<tr>
<td>Behavior: Repercussions, reactions, or activities of the client</td>
<td>Not appropriate behavior</td>
<td>Rarely appropriate behavior</td>
<td>Inconsistently appropriate behavior</td>
<td>Usually appropriate behavior</td>
<td>Consistently appropriate behavior</td>
</tr>
<tr>
<td>State: Condition of the client in relation to objective and subjective characteristics</td>
<td>Extreme signs/symptoms</td>
<td>Severe signs/symptoms</td>
<td>Moderate signs/symptoms</td>
<td>Minor signs/symptoms</td>
<td>No signs/symptoms</td>
</tr>
</tbody>
</table>

**Benchmarking PHN Outcomes**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Low-risk</th>
<th>High-risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 466</td>
<td>n = 243</td>
<td>n = 243</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>25.6</td>
<td>23.4</td>
</tr>
<tr>
<td>Racial/ethnic minority (n = 244)</td>
<td>12.5%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Unmarried (n = 37)</td>
<td>86.4%</td>
<td>89.9%</td>
</tr>
<tr>
<td>Male (n = 142)</td>
<td>4.3%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Pregnant (n = 190)</td>
<td>16.4%</td>
<td>22.4%</td>
</tr>
<tr>
<td>Mean numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visits</td>
<td>7.7</td>
<td>13.9</td>
</tr>
<tr>
<td>Interventions</td>
<td>23.1</td>
<td>43.4</td>
</tr>
<tr>
<td>Problems</td>
<td>3.8</td>
<td>5.4</td>
</tr>
<tr>
<td>Categories</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>Trends</td>
<td>19.5</td>
<td>37.5</td>
</tr>
</tbody>
</table>

**Benchmarking Outcomes for Mothers with Intellectual Disabilities**

For mothers with ID, the benchmark of 4 was attained by 50% of the sample for 10 of 21 outcomes.

For the comparison group, the benchmark of 4 was attained by 50% of the sample for 16 of 21 outcomes.

**Maternal Risk Index**

- Method of assessing and stratifying entities based on the likelihood of occurrence of an event

Maternal Risk = (number of problems) / (average baseline knowledge score)

**New Methods**

- Data mining with structured data
- Overlapping clusters
- Intervention pairs/graphs
- Mining text with structured data
- Semantic equivalence
- Data visualization
Creating intervention clusters using graphing methods with multilevel K-way partitioning

If a triplet $p_1-c_1-t_1$ and $p_2-c_2-t_2$ are associated with first visit of a patient and $p_3-c_3-t_2$ with his second visit. An edge will be added between respective nodes of $p_1-c_1-t_1$ and $p_2-c_2-t_1$, say $e_1$. Also between $p_3-c_3-t_2$ and $p_1-c_1-t_1$ (say $e_2$) and between $p_3-c_3-t_2$ and $p_2-c_2-t_2$ (say $e_3$). But the weight assigned to $e_1$ will be more than that for $e_2$ for this patient. This is because $p_1-c_1-t_1$ and $p_2-c_2-t_2$ occur for the same visit while $p_3-c_3-t_2$ occur for a different visit. The more the separation between the number of visits, the less the weight assigned to an edge between a pair of P-C-T triplet.

Associating Family Home Visiting Interventions and Outcomes for High Risk MCH Clients

Outcome | p  | Intervention cluster
---|---|---
Lower | 0.031 | Monitoring & supporting behavior change
Highest | 0.019 | Monitoring parent mental health and support system
Status | 0.094 | Monitoring & supporting behavior change

Inductive Venn Diagram: Overlapping Intervention Clusters

Associating Interventions and Hospitalization Outcomes for Frail and Non-frail Elderly Home Care Patients
Data Visualization: Learning from Seeing

 Processes that transform large quantities of raw data into graphical representations that exploit the superior visual capability of the human brain to detect patterns and draw inferences.

![Graph showing intervention patterns by baseline status.](image1)

![Graph showing problems by target across time.](image2)

![Before and after implementing standardized care plan.](image3)

Late Breaking News!

**New partners and studies**

**Washington State Children with Special Health Care Needs Program:** Evaluating program outcomes

**Istanbul University:** Description of home care interventions and outcomes in Istanbul, Turkey

**Yi Zhang:** Time-Motion Study tool for inpatient nursing care workflow

**Olmsted County:** 1-2 time visit outcomes in PHN home visiting – do we make a difference?

**Eunice Areba:** Pilot Test of Omaha System documentation in Africa

**Washington State Children with Special Health Care Needs Program**

Principal Investigator: Scott Elsbernd

Purpose: To determine the frequency of problems, interventions and outcomes for children with special health care needs in Washington State (pilot study of initial data)

Partners: State CSHCN Program Staff Barnhart, L., Stock, J.

**Home Care in Istanbul, Turkey**

Co Principal Investigators: Erdogan S., Secginli S., Istanbul University, Florence Nightingale SON

Purpose: To identify the most frequent problems of people receiving home health care services, and to measure clients initial and final knowledge, behavior and status outcomes related to the top identified problems for evaluation the provided care in home care centers.

Anna Pirsch and Karen Monsen co-investigators
Time-Motion Study
Principal Investigator Yi Zhang
Tool development for inpatient nursing observations
Partners in Fairview-University hospital and University of Minnesota Institute for Health Informatics
Potential for translation into Chinese

Public Health Functions of 1-2 time Home Visits
Principal Investigator: Monsen
Purpose is to describe outcomes of clients receiving 1-2 visits
Co-investigators Dubbels, Timm, Johnson, & Areba
Invitation to all public health agencies to participate
Third research project of the Minnesota Omaha System Users Group

Pilot Test of the Omaha System in Kenya, Nigeria, and Tanzania
Principal Investigator: Eunice Areba
Purpose is to determine fit of the Omaha System to describe public health nursing practice in African countries
Pilot test using paper-based data collection in English and Swahili

Your Study Here!
Join the Omaha System Partnership for Knowledge Discovery and Health Care Quality
Contact: mons0122@umn.edu