Methods for Visualizing Omaha System Data

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Introduction

Omaha System

- **Standardized classification** for nursing interventions that consists of three components: problem, intervention, and outcome evaluation
- Omaha System data: **Rich and longitudinal**
Introduction

Why Use Data Visualization?

• Rapid and intuitive pattern detection
  ▪ Human brain interprets graphical data more easily than numbers or text

• Comprehensive and holistic data examination
  ▪ Statistical analysis alone can mask hidden patterns

• Generate research questions in a data-driven way
Methods

Alpha-Numeric Codes for Omaha System

- Simple mechanism for use of Omaha System terminologies **electronically** to facilitate data processing and communication
  - 6-digit alpha numeric code
  - 2-digit prefix
    - PB for Problem
    - SS for Signs and Symptoms
    - CG for Intervention Category
    - TG for Intervention Target
  - Example
    - Income problem, the 1st defined problem in Omaha System
Methods

Relational Database for Omaha System

- Easy to query
- Normalization and relations
  - Less dependency between entities and easy to maintain
- Assured data consistency
- Improved data quality
- Used MySQL Workbench 5
  - Designed a logical model
  - Exported a DDL (Data Definition Language) script to create physical database structure
Methods

Data Migration Strategy

- Migrate data from spreadsheets into the Omaha System Database
- Use SQL statements and Java programs
- Steps
  - Clean data
    - Conduct visual data validation through the original spreadsheet data
  - Extract data
    - Load spreadsheets data into temporary tables
  - Transform & Load data into target tables
    - Convert wide-format to long-format
    - Assure referential integrity and data consistency
  - Validate data
Methods

Dynamic Java-based Web Application

3-Tier Architecture (Client-Middle-Database tier)
MVC (Model-View-Controller) design pattern using Java

Web Application Server (Apache Tomcat 7.0)

Stream Graphs drawn by
• D3
• JavaScript

Interactivity
• Highlights
• Tooltips

HTTP

JDBC

Omaha Database (MySQL 5)
Visualizing Omaha System Data

Stream Graph: by Intervention Category by Nurse

- A type of stacked graph where the baseline is free
- Layer indicates each category-target-problem triplet
- Layer thickness is determined by the frequency of each triplet
- Hue (base color), value (color brightness), and saturation (color deepness) encoded the Omaha System intervention category, intervention target, and problem, respectively
Visualizing Omaha System Data

High Case Management vs. Low Case Management

Pattern differences between public health nurses were detected through visual inspection.
Visualizing Omaha System Data

Stream Graph: by Problem by Patient

- Hue encodes the Omaha System problem
  - Blue: Postpartum; Gray: Pregnancy; Magenta: Family Planning; Purple: Substance Use; Cyan: Abuse; Green: Caretaking/Parenting; Yellow: Mental Health; Orange: Residence; Red: Income

- Value encodes the Omaha System intervention category
  - example
    - surveillance
    - case management
    - teaching, guidance, and counselling

Number of Interventions

Time Period between Patient Admission and Discharge
Visualizing Omaha System Data

Income and parenting problems persist

Most graphs revealed that income and parenting problems persisted over time and interventions for the problems were rarely reduced in frequency.
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**Sunburst Graph**

- A multi-level pie chart
- Hue encodes the Omaha System problem
- The first, second, and third circles from the center indicate patient knowledge, behavior, and status rating for a problem
- Value encodes the Omaha System rating scores
- The rim of the wheel indicates signs and symptoms of a problem and has a hierarchical relationship to the colored problem segment
Visualizing Omaha System Data

Mental Health Signs vs. No Mental Health Signs

The presence of mental health signs and symptom tends to associated with more diagnostic problems and worse patient condition.
Further Studies

Data Visualization as a Data-Driven Research Method

- Review and sort visualized data using online card sorting tool to detect differences
- Generate hypotheses based on visual observations
- Test them statistically
- Evaluate the effectiveness of data visualization
Q & A

THANK YOU