Visual Analytics for Cancer Nutrition Website Data

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Client: Dr. Jean Reading, Department of Family and Community Medicine, UI Health

1. Project Description

This project aims to develop an interactive visualization system for data that will be generated from a personalized nutrition website for cancer patients being developed at Department of Family and Community Medicine UI Health. The website uses AI to recommend recipes tailored to each patient's medical condition, dietary needs, and treatment plan, supporting more personalized approaches to nutrition during cancer care. The visualization platform will help researchers and clinicians explore how patients engage with AI-generated recipes, how dietary patterns evolve during treatment, and how these trends relate to key health metrics such as blood pressure, glucose, and weight. Interactive dashboards will also display insights on recipe trends, engagement behavior, cost and accessibility, and demographic differences. Since the website has not yet been deployed, we will use similar sample datasets provided by the client along with selected publicly available health and nutrition data to simulate how the visualization system will operate once real data becomes available.

2. Project Significance

This project combines health data science and visualization to make cancer related nutrition data understandable and actionable. The visualization system will highlight how interactive dashboards can support both clinicians and researchers in studying how patients engage with personalized diets, and how these choices affect their health over time.

The main Visual Data Science contributions include:

- Designing data abstractions that connect recipe information, patient health metrics, and website engagement data.
- Creating interactive visualization tools for discovering patterns and comparing results across different patient groups.
- Developing customized D3.js based visuals that go beyond static tools like Tableau, enabling linking, filtering, and time based exploration.
- Evaluating how effectively the dashboard supports both patient focused insights and clinical research, ensuring it helps users and researchers understand how dietary impacts on health outcomes.

This project aims to demonstrate how visual analytics can reveal relationships between diet, patient behavior, and health indicators, providing a practical and intuitive tool for cancer nutrition research.

3. Requirements Analysis

I. Humans

The main users of this project are clinicians, dietitians, and researchers at Department of Family and Community Medicine UI Health who study and support cancer patient nutrition. Other users may include data scientists and developers working on the nutrition website. Most of these users come from medical or research backgrounds and may not have much experience with technical data tools. Because of this, the visualization system should be easy to use and understand, with a simple and clear design that helps users quickly explore the data, find patterns, and make sense of the results.

II. Tasks

The visualization system will help researchers and clinicians explore and answer key questions about how cancer patients interact with the personalized nutrition website and how their food choices relate to health outcomes. Some of the main questions include:

- Which types of recipes or cuisines are most often chosen by patients?
- How do patients' recipe preferences change during different stages of treatment?
- What are the most common nutritional patterns among patients (such as high protein, low sugar, or plant-based diets)?
- How often do patients visit the website and use the recipe generation tool?
- Are certain recipes or cuisines more popular among specific age groups or genders?
- How do factors like recipe cost or preparation time influence patient choices?
- Do patients who follow healthier recipe recommendations show improvements in health metrics such as blood pressure, glucose, or weight?
- How do engagement levels (frequency of website use) relate to changes in overall health outcomes?
- Can we identify any patterns that suggest which recipes or diets are most effective for particular cancer types or treatment phases?

- Are there noticeable trends or outliers in how different patient groups respond to dietary recommendations?

III. Data

Since the personalized nutrition website has not yet been deployed, real patient data is not yet available. For this project, the client has provided sample data that reflects what the real data will look like once the site is live. The sample includes recipe details, nutritional values, demographic information, and example health metrics.

To make the system realistic, public datasets such as **BRFSS**, **NHANES**, and **AICR** will also be referenced. These contain information about diet, health indicators, and cancer-related factors similar to what the website will collect. Together, these datasets will be used to create and test interactive visualizations that show relationships between diet patterns, health outcomes, and patient characteristics.

IV. Flow

The system will load pre-processed sample and public data into a web-based dashboard. Users can explore recipe trends, nutritional values, and health metrics through interactive charts built with D3. They can filter data by patient groups, time, or recipe type to see how diet patterns relate to changes in health indicators. All visual components will be linked, allowing smooth exploration from overall trends to detailed insights.

V. Nonfunctional Requirements

The system must be easy to use for non-technical users, with an intuitive and clean interface that supports clear visual exploration. It should handle moderate-sized datasets efficiently, ensuring quick loading and smooth interaction. Data privacy is essential, especially when dealing with patient-related information, so the system will only use de-identified data. The visualizations should be responsive and accessible across different web browsers. The code will be modular and well-documented to support future updates when real patient data becomes available.

VI. Probes

Existing visualization tools like Tableau can display charts and dashboards for exploring nutrition and health data, but they have limited flexibility for combining recipe, engagement, and medical data in one system. This project goes beyond Tableau by using D3.js to create fully customized, interactive visualizations that link dietary patterns with health outcomes. Features like real-time filtering, brushing, and linking will allow users to explore trends across time and patient groups. The design will also allow easy integration with the personalized nutrition website once it is deployed, making the system both flexible and scalable for future research.

4. Work Plan

Week	Task
1	Finalize requirements analysis and confirm data sources with the client.
2	Clean and preprocess sample and public datasets; design initial dashboard layout.
3	Create visualization mockups and prepare alpha prototype using D3.js.
4	Develop alpha version with recipe and health metric visualizations; gather feedback.
5	Add interactivity (filtering, linking, time-series views) and connect multiple data views.
6	Refine design and usability; conduct testing and update documentation.
7	Perform final testing, prepare presentation, and complete final report and demo.

The project will use standard web development tools such as HTML, CSS, JavaScript, and D3.js for visualization. Data will be cleaned and processed using Python. Sample data from the client and public datasets (NHANES, BRFSS, AICR) will be used for testing. The system will be developed and tested on regular computers with internet access and modern web browsers.

5. Bios/CVs

Name: Santhosh Reddy
Department: Computer Science, University of Illinois Chicago
Capacity: As a graduate student, Santhosh will lead the design and development of the visualization system. With experience in JavaScript, D3.js, data visualization, and health-related analytics, he will focus on building the interactive dashboards, implementing visual encodings, and ensuring the usability of the system for both researchers and clinicians.

Name: Dr. Jean Miki Reading
Department: Visiting Assistant Professor, Department of Family and Community Medicine,UIC
Capacity: Dr. Reading is a social and behavioral scientist specializing in cancer prevention, digital health, diet, and physical activity. Her research merges behavioral science with technology to create and optimize interventions that support healthier lifestyles in diverse populations. She is currently developing digital nutrition and lifestyle tools and has been recognized with the Hanover Grant Academy award for her work in research and grantsmanship.