Modeling Multi-Level Factors to Promote Oral Health Equity for Chinese Americans

Qiuyi Zhang[a], Mary E. Northridge[b], Stella Yi[c], Sara S. Metcalf[a]

a) Department of Geography, The State University of New York at Buffalo

b) Department of Epidemiology & Health Promotion, NYU College of Dentistry

c) Department of Population Health, NYU School of Medicine

University at Buffalo

Introduction

Many U.S. racial and ethnic minorities suffer from poor health status and face substantial cultural, social, and economic barriers to obtaining quality health care. The health disparities experienced by racial and ethnic minorities relative to the white majority population are due to many factors, including low socioeconomic status, inadequate access to health care, inferior quality of health care received, forms of discrimination, and language barriers.[1] Trust is also an important dimension of the care experience that plays an important role in health disparities.[2,3] Social networks influence trust and provide social support, which includes the ability to obtain support when in need. This study examines factors at multiple levels (community, outreach site, provider, family, and patient) that contribute to or ameliorate the inequitable access to oral health care and poor oral health outcomes experienced by Chinese Americans in New York City (NYC).[4] A dynamic agent-based model is developed in this study to simulate how social relations and socioeconomic factors shape oral health care access and care-seeking behaviors for these Chinese American communities.

Model Development

Our approach to development of the agent-based model involves iterative articulation of feedback mechanisms, as illustrated in Fig. 1 below for the model as presently implemented (see Fig. 3). These mechanisms express how participation in outreach events at community centers provides a leverage point for promoting oral health access through preventive screening services, referrals to care, and oral health education. Utilization of oral health care by Chinese Americans is modulated by accessibility as well as trust in oral health care providers.

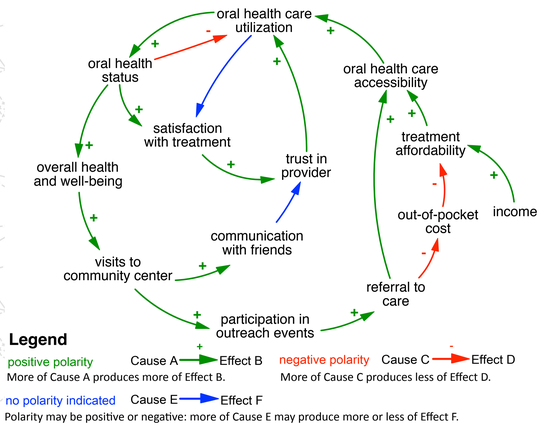


Fig. 1: Causal Map

Several feedback mechanisms in Fig. 1 involve trust in provider as shaped by satisfaction with treatment as well as social influence. Dental care experiences have either positive or negative effects on patient satisfaction.

NYC is home to the largest population of Asian Americans in the United States and a growing population of Chinese Americans. The map in Fig. 2 below shows the population density of Chinese Americans in NYC.

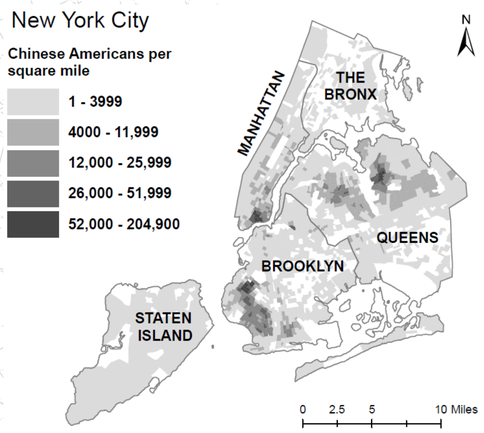


Fig. 2: Chinese Americans in NYC

Multiple Levels of Dynamic Simulation

An agent-based model (ABM) was implemented using AnyLogic software to simulate how individual behaviors and social networks affect oral health equity at multiple levels in a spatially-explicit GIS environment (Fig. 3 below). Development of this model was informed by previous models that sought to address oral health disparities.[3,5,6]

Two types of people are modeled as mobile agents in this study:

1. **Patients** are simulated as agents who have opportunities to meet each other at community centers and interact with neighborhood resources. Agents have an income and racial/ethnic identity. For simplicity, just 2 racial/ethnic groups (Chinese Americans and white Americans) are represented in this model. Chinese Americans are simulated with lower income and smaller activity space than white Americans.
2. Health care **providers** are simulated as agents who may or may not deliver culturally appropriate care to Chinese American patients. Providers are assumed to deliver culturally appropriate care to white American patients. Planned extensions of the model will distinguish between types of providers: community health workers and dental providers.

Simulation Scenarios

Using a sample population of 100 patient agents residing in the boroughs of Queens and Brooklyn, this study experimented with four alternative scenarios using the agent-based model:

1. Baseline: No intervention is applied. In the baseline scenario, 20% of providers are culturally competent and respectful of Chinese American patients.

2. With provider training: All health care providers receive training in cultural competency, including provision of materials that are language specific.

3. With preventive screening services: This intervention includes outreach events with preventive screening services at community centers, where participants receive referrals to oral health care.

4. With screening and training: This intervention includes both preventive screening services and provider training to ensure cultural competency.

Aggregate simulation results over a 100 day period for 50 Chinese Americans and 50 white Americans are shown in Fig. 5 (at right) for average trust in provider, average health status, and health disparity. Health disparity was computed using the Gini Coefficient for the distribution of oral health status within and between groups. The results indicate that the combined intervention improved the health status of Chinese Americans and reduced both intra- and inter-group health disparities.

The map in Fig. 3 below illustrates how the agent classes and spatial extent of the model are visualized during simulation for a sample of 50 patients residing in Manhattan, Brooklyn, and Queens. Community centers are shown in green, where patients who participate in preventive screening services may then be referred to care at treatment centers (dental clinics). Social ties between patients are indicated with dotted lines that correspond to the social network matrix depicted in Fig. 4 (at top right).

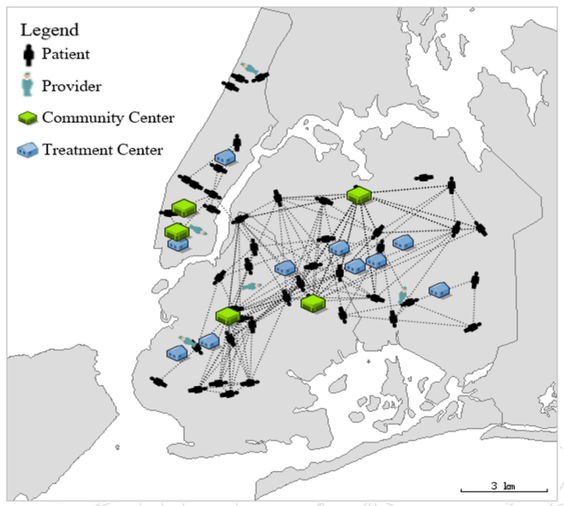


Fig. 3: Agent-Based Simulation

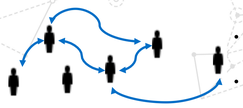
The model captures dynamics at the **interpersonal** level that shape social network structure and trust in health care providers. Communication between friends occurs at community centers and also through virtual communication. The trust dynamics simulated in this model are adapted from previous work by Krueger and colleagues.[3] Extensions of the model will account for the **family** level as a distinct social unit and important leverage point for health promotion.

Chinese American **communities** are modeled as groups of individuals who may exhibit a cohesive social network or be associated with certain neighborhoods, given the geographic diversity indicated by the population density map in Fig. 2 (at bottom left).

Community centers are **sites** of outreach through oral health promotion and preventive screening services. These sites are located as spatial objects in the GIS environment of the agent-based model. Outreach events are held at community centers. Social activities also take place at these sites.

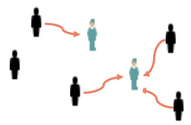
The social network is visualized during simulation in 2 ways: using dotted lines for social ties (Fig. 3 at bottom) and with a matrix (Fig. 4 at far right). The matrix visualization applies the approach used by Esfabhod and colleagues.[2] Shaded cells indicate social ties and darker shades indicate stronger ties (greater familiarity). The social network structure indicates effects of clustering by racial/ethnic identity as well as geography.

Social Network



- Community centers are spaces of social activity
- Social ties form or strengthen with social activity
- Social ties break or weaken without social activity
- Shared racial/ethnic identity increases the chance of a tie

Trust in Provider



- Shaped by opportunities for oral health care and treatment
- Positive experiences with providers build trust
- Negative experiences with providers erode trust
- Patient trust in a health care provider is socially influenced

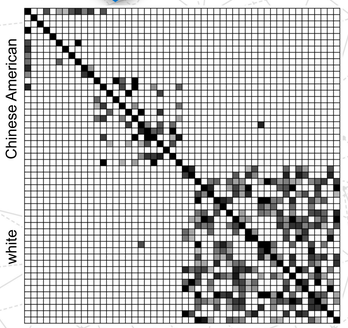


Fig. 4: Social Network Matrix[2]

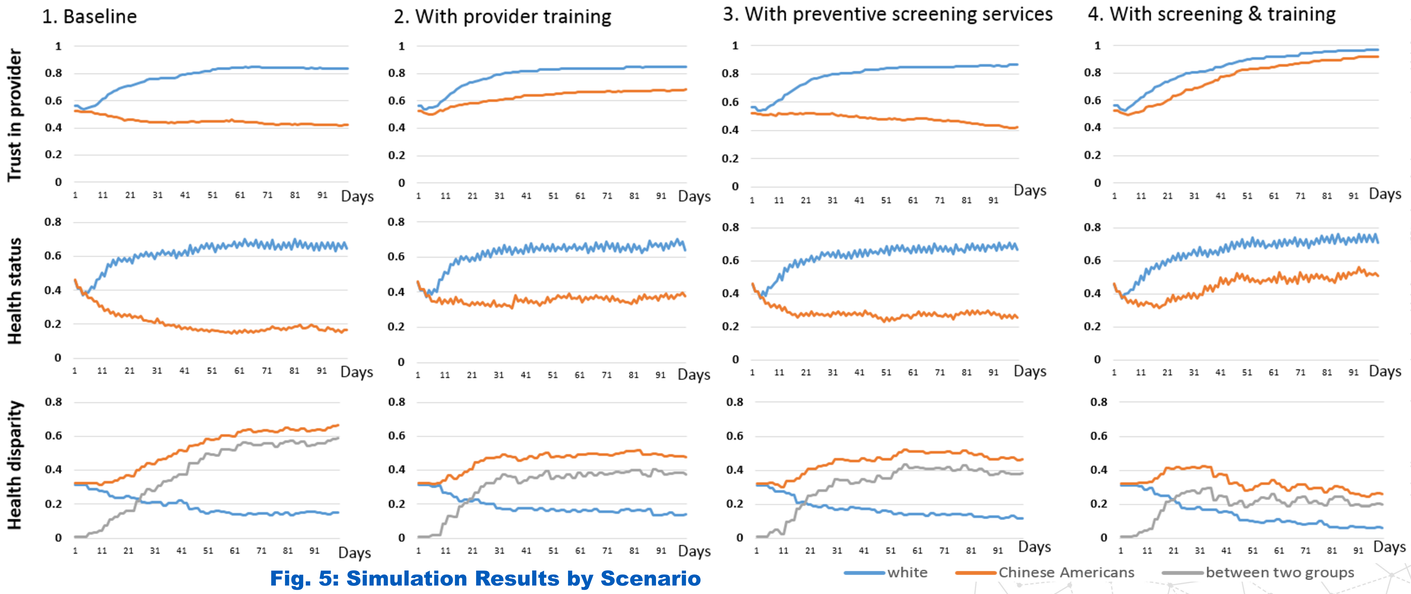


Fig. 5: Simulation Results by Scenario

Conclusions

- Social factors have both positive and negative impacts on patient trust in providers that in turn create health disparities.
- Training community health workers to deliver culturally sensitive oral health promotion and oral health care guidance may lead to greater acceptability of oral health care by Chinese Americans and thereby improve their oral health care access and outcomes.
- Outreach events at community centers provide opportunities for Chinese Americans to be screened by oral health care providers and receive referrals for both preventive and restorative oral health care services.
- Further model development will incorporate a richer conception of oral health equity for Chinese Americans that centers on oral health education and access to care. We are collecting input from team members and community partners to guide model development for our new project.[4]
- Findings from the agent-based model will aid in priority setting and resource allocation by oral health practitioners and policymakers.

Acknowledgments

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