

Modeling Social Factors of Oral Health Equity for Older Adults

Sara Metcalf,^a Hua Wang,^a Susan Kum,^a Zhu Jin,^a Peng Wang,^a Michael Widener,^b Carol Kunzel,^c Stephen Marshall,^c and Mary Northridge^{c,d}

^a Departments of Geography, Communication, and Computer Science, The State University of New York at Buffalo

^b Department of Geography, University of Cincinnati

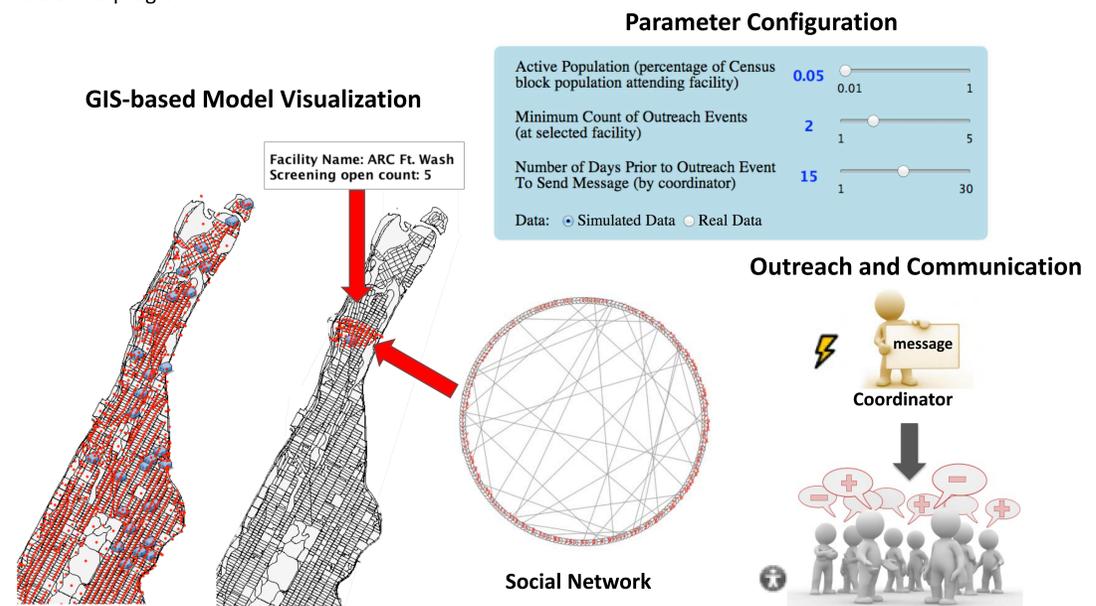
^c College of Dental Medicine and Mailman School of Public Health, Columbia University

^d Department of Epidemiology and Health Promotion, New York University College of Dentistry

Abstract

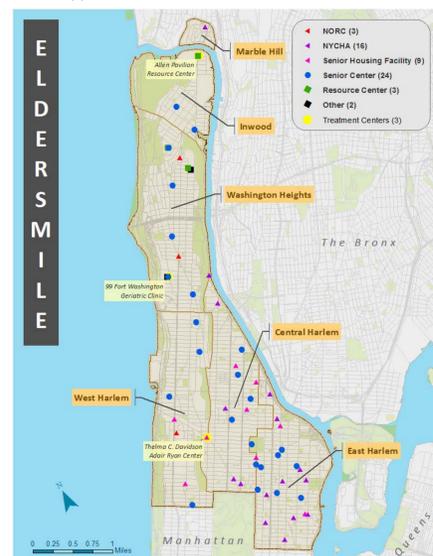
Recognizing oral health equity as a critical indicator of progress toward a more inclusive health care system, this research effort develops simulation models informed by the qualitative and quantitative data collected through the *ElderSmile* community outreach program operated by Columbia University's College of Dental Medicine. Through an iterative process drawing upon group model-building workshops to share expertise among members of our interdisciplinary research team, we have constructed a portfolio of models involving different methods associated with systems science: system dynamics, spatial analysis, agent-based modeling (ABM), social network simulation, and geographic information science (GIS). We have developed a hierarchical ABM that builds upon other models in the portfolio. This process has enabled us to identify performance improvements. Several insights have emerged from this multi-method approach to integrating social and systems science with simulation.

Study Aim: To explore how social factors operating at individual, interpersonal, and community scales influence health-seeking behavior among older adults attending community centers in northern Manhattan. Here, health-seeking behavior (HSB) includes participation in preventive health screenings such as those offered through the *ElderSmile* program.



Problem Context

Amidst demographic changes toward an older and more diverse population as well as policy shifts promoting health care access, this collaborative effort aims to model social factors that facilitate or hinder services to improve oral health equity for the elderly. Because social advantages and disadvantages accrue across the life course, health disparities manifest acutely as well as chronically in terms of missing teeth and other oral health problems experienced by older adults². We therefore identify oral health equity as a critical indicator of progress toward an inclusive health care system. Recent studies^{3,4} have outlined social dimensions of oral health outcomes, supporting our hypothesis that social factors can be leveraged to promote oral health among older adults.



ElderSmile is a community-based program that provides oral health education and prevention services to older adults in northern Manhattan and adjacent communities.¹

3-6 Months before ElderSmile Event

- Contact facility and schedule event
- Send e-mail explaining what to expect on day of ElderSmile event

3-4 Weeks before ElderSmile Event

- Contact facility activities coordinator
- Advertise event (e.g. flyers)
- Reschedule if there is a cancellation

Day of ElderSmile Event

Workshop	
Intake Form	25-30 minutes
Presentation	minutes

Screenings	
Dental	3-5 minutes
Hypertension	3-8 minutes
Diabetes	6-8 minutes
Discussion about eating habits, medications, and health providers	

Referral	
Appointments at community-based dental practices, arrange transportation, and follow up	

Model Design

The model's hierarchical structure enables simulation at the community, interpersonal, and individual scales. Aligning with available data sources, three (3) classes are simulated:

- Community centers (facilities) where *ElderSmile* screenings are held
- Census blocks containing populations of older adults.
- Older adults who live in proximity to facilities.

Using the schedule of *ElderSmile* events, simulated participation is compared with observed participation to calibrate the model at a baseline from which scenarios for social network structure, peer communication dynamics, and program outreach efforts are explored. AnyLogic software (version 6.9) is used for model implementation and experimentation.

Model Assumptions

- To reduce computational demand and to examine health-seeking behavior (HSB) and participation in health screenings in different locations, we run experiments on individual facilities with a proportion of agents that represent potential attendees residing in the Census blocks associated with each facility.
- Agents will attend the facility closest in (Euclidean) distance.
- To capture the impact of outreach, a coordinator (implemented as an event) sends out a message to agents about upcoming *ElderSmile* events.
- To approximate peer communication dynamics, agents evaluate the HSB of other agents in their social network and update their HSB accordingly.

Portfolio Approach

This hierarchical ABM builds upon experience from previous models in our portfolio⁵ and from group model building activities.

Model A-SD: basic diffusion process of oral health care-seeking behavior by communication, "word of mouth"

- Health care-seeking behavior
- Outreach/advertising effect

Model B-SD: effect of wait times and "word of mouth" on participation in screenings

- Communicators
- Program availability
- Treatment decision

Model A-ABM: basic diffusion process of communication through a simulated distance-based small-world social network

- Geography
- Simulated social network

Model C-ABM: availability and utilization of preventive health screening programs

- Hierarchical structure
- US Census block population
- Facility-level operations

Group Model Building

We leverage opportunities to inform the model using group model-building with perspectives from all members of our interdisciplinary research team. We use group model-building to refine our problem definition, construct a shared dynamic hypothesis, discuss model formulation, and develop scenarios for further exploration.

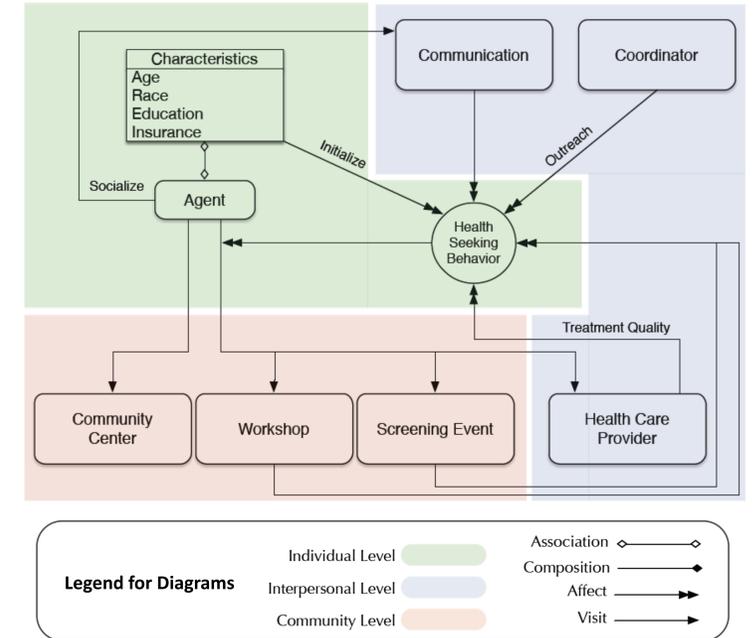
Acknowledgments

This simulation research is supported by the National Institute for Dental and Craniofacial Research (NIDCR) and the Office of Behavioral and Social Sciences Research (OBSSR) of the US National Institutes of Health (grant R01DE023072 titled, "Integrating Social and Systems Science Approaches to Promote Oral Health Equity"). We thank The Fan Fox and Leslie R. Samuels Foundation, Stella and Charles Guttman Foundation, and The Jean & Louis Dreyfus Foundation, Inc. for their financial support of the project, "The *ElderSmile* Dental Network: Delivering Dental Services to the Elderly in Northern Manhattan," which provided major funding for the *ElderSmile* program.

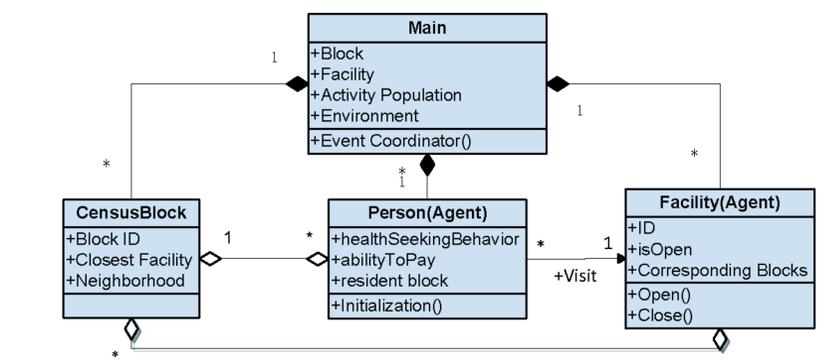
References

- Marshall SE, Cheng B, Northridge ME, Kunzel C, Huang C, Lamster IB. 2013. Integrating Oral and General Health Screening at Senior Centers for Minority Elders. *American Journal of Public Health* 103(6):1022-5.
- Northridge ME, Chakraborty B, Kunzel C, Metcalf SS, Marshall SE, Lamster IB. 2012. What Contributes to Self-rated Oral Health among Community-dwelling Older Adults? Findings from the *ElderSmile* Program. *Journal of Public Health Dentistry* 72(3): 235-245.
- Northridge ME, Ue F, Borrell L, De La Cruz L, Chakraborty B, Bodnar S, Marshall SE, Lamster IB. 2011. Tooth Loss and Dental Caries in Community-dwelling Older Adults in Northern Manhattan. *Gerodontology* 29: e464-e473.
- Widener MJ, Metcalf SS, Northridge ME, Chakraborty B, Marshall SE, Lamster IB. 2012. Exploring the Role of Peer Density in the Self-reported Oral Health Outcomes of Older Adults: A Kernel Density Based Approach. *Health and Place* 18(4): 782-788.
- Metcalf SS, Northridge ME, Widener MJ, Chakraborty B, Marshall SE, Lamster IB. 2013. Modeling Social Dimensions of Oral Health among Older Adults in Urban Environments. *Health Education and Behavior* 40(1S): 63S-73S.

Model Structure



Unified Modeling Language (UML) Diagram



Decision Process for Agents' Health-Seeking Behavior (HSB)

