Modeling Social Factors of Oral Health Equity for Older Adults

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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. Throughout 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 program.

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:

1. Community centers (facilities) where ElderSmile screenings are held
2. Census blocks containing populations of older adults.
3. 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 portfolio 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 B-ABM: availability and utilization of preventive health screening programs
- Hierarchical structure
- US Census block population
- Facility-level operations

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.

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References