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Modeling Health Impacts of the Transportation Built Environment: Challenges and Opportunities

Editor's Note: NEHA strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, we feature a column from the Environmental Health Services Branch (EHSB) of the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In this column, EHSB and guest authors from across CDC will highlight a variety of concerns, opportunities, challenges, and successes that we all share in environmental public health. EHSB's objective is to strengthen the role of state, local, tribal, and national environmental health programs and professionals to anticipate, identify, and respond to adverse environmental exposures and the consequences of these exposures for human health.

The conclusions in this article are those of the author(s) and do not necessarily represent the views of CDC.

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When most people hear "models," they probably think about people, not transportation. Models—the people version—help predict how clothes will look when we wear them. Models—the transportation version—help predict how our transportation system will function based on current and future infrastructure investments. Neither type of model is entirely accurate; they attempt to predict the future, and the future rarely fully cooperates. Despite this, models can provide useful information for planning and predicting health outcomes.

Environmental health practitioners already utilize model predictions. Prediction of disease risk, such as West Nile virus, may be based on models of vector spread (Harrigan, 2014). The risk of flooding in a given area is predicted based on historical stream-flow records (U.S. Geological Survey, 2008). In transportation, opportunities for environmental health professionals may arise as transportation models expand beyond predicting congestion and air pollution to predicting health impacts of walking and bicycling.

The well-established health benefits of increased physical activity have created much interest in health impacts of the transportation built environment related to walking, bicycling, and public transit (Besser, 2005). Ideally, models could predict changes in health outcomes such as mortality or disease prevalence for a given built environment change, such as a bike path or complete street initiative. This process has two steps: first, predicting changes in travel behavior (e.g., mode shift or total distance walked/bicycled) following an environmental or policy change; second, predicting health outcomes following the change in travel behavior. In practice, the former is currently more difficult than the latter. Each is explained below.

Modeling Travel Behavior

Predicting changes in travel behavior for transportation projects is limited by a lack of high-quality longitudinal data. Current modeling efforts are typically limited to using cross-sectional evidence of associations between built environment characteristics and walking and bicycling. For example, modelers may predict walking volumes after sidewalks are added to a neighborhood based on walking levels in comparable neighborhoods with existing sidewalks. This method is less reliable than information on behavior change after construction. Consider a pedestrian bridge that will link a neighborhood to an employment center. Proper evaluation of changes attributable to the bridge requires three elements. First, preconstruction travel habits of those living and working near the bridge serve as a baseline. Second, travel habits after bridge construction indicate changes potentially attributable to the bridge. Third, comparable measures from residents unaffected by the bridge determine if observed changes are due to general trends versus bridge-specific effects. This type of evaluation design allows transportation projects to be treated as "natural experiments" that provide needed information to modelers.

Environmental health practitioners may play important roles in this evaluation process. Obtaining preconstruction travel data requires quick action while planning transportation projects, which is a key period of involvement for environmental health professionals. Environmental health practitioners may also liaise between engineering and public health groups to foster communication and collaboration on evaluation efforts. Such efforts will prove valuable as they augment the evidence base on behavior and the built environment.

Modeling Health Impacts

Compared to the evidence linking behavior change to changes in the built environment, much better evidence is available linking travel-related exposures to health outcomes. For example, participation in moderate-intensity physical activity (like walking and bicycling) is known to protect against several chronic diseases, including but not limited to coronary artery disease, diabetes, and colon cancer (Physical Activity Guidelines Advisory Committee, 2008). Further, modelers know and can use the dose-response relationship between activity and disease to predict health outcomes.

Perhaps because of the large evidence base for physical activity and health, some health impact models, such as the Health Economic Assessment Tool (World Health Organization, 2014), focus solely on the health effects of increasing population physical activity. Such an approach may oversimplify the potential health consequences of increasing these behaviors by failing to account for changes in ambient air pollution, increased accident rates, sex- and age-specific effects, and underlying disease prevalence. Other models, such as the Integrated Transportation and Health Impact Modeling Tool (Center for Diet and Activity Research, 2014) utilize multiple areas of research to account for these factors but require extensive data for calibration to a specific geographic area and may require special software to handle complex calculations.

Future Directions

Health impact modeling will likely increase in importance as bicycling and walking are accepted as transportation alternatives. Already, air pollution modeling related to transportation projects helps to promote health; other areas of public health interest could follow its lead. One key to continued growth is expanding the evidence base on built-environment-associated behavior change. These data are crucial to creating accurate and cohesive models that estimate both changes in behavior and changes in health outcomes for transportation projects. Additionally, incorporating health impact modeling into larger city and regional transportation models will provide stakeholders and decision makers with important information about the future health of their communities.

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