TR News: September - October 2015 - Public Health and Transportation: Innovation, Intervention, and Improvements

DETAILS

64 pages | 8.5 x 11 | PAPERBACK
ISBN 978-0-309-44828-4 | DOI 10.17226/23612

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Technical Activities Division; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine

TR NEWS

NUMBER 299 SEPTEMBER–OCTOBER 2015

PUBLIC HEALTH AND TRANSPORTATION

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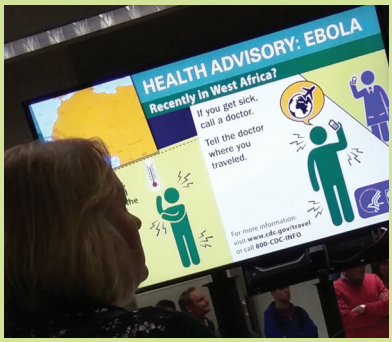

40

COVER: Golden, Colorado, received a commendation for the walkability of its downtown area in 2012. The link between active transportation—walking and bicycling—and health is a growing area of research. (Photo: Toole Design Group)

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

***TR News* is produced by the Transportation Research Board Publications Office**
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TR News (ISSN 0738-6826) is issued bimonthly by the Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001. Internet address: www.TRB.org.

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Subscriptions: North America: 1 year $60; single issue $12. Overseas: 1 year $85; single issue $12 plus shipping. Inquiries or communications concerning new subscriptions, subscription problems, or single-copy sales should be addressed to the Business Office at the address below, or telephone 202-334-3216, fax 202-334-2519. Periodicals postage paid at Washington, D.C.

Postmaster: Send changes of address to *TR News*, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001.

ALSO IN THIS ISSUE:

COMING NEXT ISSUE

TR News reaches a milestone with its 300th issue, and the feature articles present the results of pioneering research. One examines commercial spaceports and the endeavor of building the foundation for a commercial space transportation network; another presents an overview of the first year of research using the vast and valuable databases from the historic Naturalistic Driving Study conducted under the second Strategic Highway Research Program. Also included are the first in a series of articles on research to mitigate transportation's contributions to climate change, insights from a volume in the National Cooperative Highway Research Program's series Strategic Issues Facing Transportation—and more.

INTRODUCTION

Public Health and Transportation

Innovation, Intervention, and Improvements

ED CHRISTOPHER AND ELOISA RAYNAULT

PHOTO: RICHARD MASONER, FLICKR

This special issue of *TR News* addresses the connections between public health and transportation. The Transportation Research Board's (TRB's) Subcommittee on Health and Transportation developed the articles, working with an extensive network of subcommittee friends, public health and transportation professionals, and subject matter experts to highlight and address concerns in a rapidly emerging and evolving subject area.

The worlds of public health and transportation historically have had few opportunities or capabilities for collaboration. Nevertheless, the connections between the two worlds are manifold and are built on a strong, yet still growing, base of evidence encompassing safety, air quality impacts, physical activity, noise pollution, access to the goods and services that support health, and other subjects. The issues are complex and multidisciplinary.

Intersection of Disciplines

In recent years, a palpable shift has taken place, and a flurry of activity is under way at the local, state, regional, national, and international levels. For example, state departments of transportation are adopting health policies, and public health departments are engaging in transportation-related programs. These transportation and public health professionals are finding themselves with relatively new responsibilities at this intersection of disciplines, and the opportunities for connecting with peers and expanding knowledge are multiplying every day.

This issue of *TR News* begins by addressing the big question, why public health and transportation? The articles that follow explore such topics as the use of health impact assessments, promising work in progress at the state and regional levels, mitigating the spread of infectious disease via air travel, the lessons learned for transportation from the Ebola epidemic, and research needs and emerging issues, among others. In addition, members of each of the parent standing committees that established the Joint Subcommittee on Health and Transportation in 2011 have contributed insights about why public health is important to their focus area of transportation research and research applications.

As many of the articles indicate, transportation professionals interested in expanding their world view to include public health sometimes may find that interacting outside of traditional circles is a challenge—new lexicons to learn, new peers to identify and meet, and new and different methodologies to master. To help break down those barriers, this issue has included an annotated list of health-related terms (page 9) and has noted ways to connect with the public health community (page 48).

Enthusiasm for Exchanges

The role of TRB in public health is increasing. In January 2015, the TRB Technical Activities Council approved a new task force to inform the planning, design, and operation of arterials while considering the implications for public health. In April 2015, TRB and the American College of Sports Medicine hosted a conference, Moving Active Transportation to Higher Ground: Opportunities for Accelerating the Assessment of Health Impacts, that focused on quantifying the public health outcomes of active transportation and explored a variety of health metrics, tools, and analyses. The conference convened experts from transportation, planning, public health, and economics and demonstrated the hunger and enthusiasm for information exchanges between the disciplines working at this intersection. The article on page 47 reports highlights and outcomes from the conference.

The contents of this issue intend to place any reader well on the way to understanding the many intersections of public health and transportation and perhaps to getting involved. Thanks are due to the 300-plus friends of the Joint Subcommittee on Health and Transportation for their support in developing this issue of *TR News*. The subcommittee thanks TRB for the opportunity to develop this unique issue, as well as for ongoing support.

Also to be commended are the many authors for their informative and insightful contributions, the subcommittee friends for their dedicated engagement and collaboration throughout the year, and TRB staff Monica Starnes and Katherine Kortum for serving as liaisons. The subcommittee is grateful for the guidance and assistance of its four parent committees and for the helpful insights from members of the *TR News* editorial board in producing this issue.

Finally, anyone whose interest has been sparked in the subject matter is welcome to visit the website of the Joint Subcommittee on Health and Transportation at www.trbhealth.org and to join in discussions through social media.

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Why Public Health and Transportation

Setting the Stage

ANDREW L. DANNENBERG AND IPEK N. SENER

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Transportation is an essential component of a functioning society. Transportation provides access to goods and services, offers opportunities for individual mobility and for better quality of life, and plays an important role in economic development. Because transportation systems and policies can facilitate or discourage healthy behaviors, public health professionals care about transportation. But health is not one of the primary purposes of transportation systems. Why then should transportation professionals care about the impacts of transportation on health?

Public health, as defined by C. E. A. Winslow in 1920, is the "science and art of preventing disease, prolonging life, and promoting health through the organized efforts and informed choices of society, organizations public and private, communities, and individuals" (*1*). Extensive research has documented the impacts of transportation on health in terms of safety, air quality, physical activity, equitable access to opportunities, and noise. Reviewing the ways in which transportation affects health (*2*) reveals the reasons that public health professionals are interested in the decisions made by transportation professionals.

Tracing the Links

Safety

Safety is the most prominent link between transportation and health. Injuries—including motor vehicle–related injuries—are the leading cause of all deaths among children and adults ages 1 to 44 years in the United States (*3*). Motor vehicle–related injuries are the leading cause of injury deaths among children and young adults 5 to 24 years of age and the second leading cause of injury deaths for all ages combined (*4*). According to the World Health Orga-

PHOTO: DAN BURDEN, WALKABLE & LIVABLE COMMUNITIES INSTITUTE

Road improvements that promote safety and walkability along Hamburg, New York's main street include wide sidewalks, curb extensions, well-marked crosswalks, on-street parking, and narrow travel lanes for cars.

nization, more than 1.2 million road traffic deaths occurred in 2010 worldwide (*5*).

In recent decades, transportation engineers and policy makers have implemented numerous successful interventions to reduce transportation-related injuries, including safer vehicles with airbags and rearview cameras, safer roads with improved traveler information systems and pedestrian signalization, and policies such as graduated licensure for teenage drivers and reduced tolerance for driving while intoxicated. Countermeasures to promote safety are particularly important for vulnerable road users such as pedestrians, bicyclists, children, and older adults.

Air Quality

Air quality is the second major link between transportation and health. Motor vehicle emissions are a major contributor to air pollutants such as particulate matter, nitrogen oxides, and carbon monoxide. Air pollution is a major contributor to lung and heart diseases, especially among children, the elderly, and persons with diseases such as asthma, bronchitis, and chronic obstructive pulmonary disease.

Substantial research has documented the adverse impacts of pollutant emissions on public health, leading to transportation policies that promote cleaner air by encouraging alternative-fuel vehicles, replacing older diesel buses, and restricting vehicle idling. For example, a recent study linked improvements in air quality over 13 years with significant positive effects on lung-function growth in children in Los Angeles, California (*6*).

The Clean Air Act of 1970 and the amendments in 1977 and 1990 acknowledged the links between motor vehicles and air pollution and made major contributions to improving air quality in the United States. The U.S. Environmental Protection Agency is responsible for establishing air quality standards and has raised the standards periodically in the past several decades to protect public health.

Physical Activity

Physical activity is the third major link between transportation and health and may be less commonly acknowledged by transportation professionals. People who are physically active tend to live longer and have a lower risk for heart disease, stroke, diabetes, depression, and some cancers (*7*).

Physical inactivity is one of the major contributors to obesity, along with nutrition and genetics. More than one-third of adults in the United States are obese and, as a result, have an elevated risk of heart disease, diabetes, some cancers, hypertension, elevated cholesterol, stroke, gall bladder disease, and osteoarthritis.

PHOTO: SV1AMBO, FLICKR

A highway crash on the M4 Motorway in Sydney, Australia. More than 1.2 million road traffic deaths occurred worldwide in 2010, according to the World Health Organization.

An individual's physical activity depends on personal choices, and transportation system designs can offer major contributions to personal choices by making opportunities for walking and bicycling safe, convenient, and attractive. Active transportation infrastructure, such as well-designed and well-maintained sidewalks, bicycle paths, and street crossings, encourages walking and bicycling. The development of improved public transit systems also provides a cobenefit of encouraging physical activity, because most transit users walk to and from their train or bus trips (*8*).

PHOTO: STEVE REED, DALLAS AREA RAPID TRANSIT

A bicyclist boards a Dallas Area Rapid Transit light rail car. Infrastructure can encourage physical activity as part of travel.

Photo: Dan Burden, Pedestrian and Bicycle Information Center

Accessible facilities allow people with physical disabilities to travel freely.

Equitable Access

A fourth link between transportation and health relates to equitable access to goods and services. A healthy life requires access to jobs, education, healthy food, medical care, recreation, and social interactions, all of which contribute to quality of life. A lack of safe and convenient alternatives to automobile travel disproportionately affects vulnerable populations, such as the poor, the elderly, persons with disabilities, and children, by limiting their access to opportunities and to goods and services.

Improvements to walking and bicycling facilities benefit current and new users, particularly those who are physically and economically disadvantaged, by providing access to essential services and activities (*9*). Increased use of the active travel modes influences the degree of urban accessibility and sustainability.

Noise

Finally, noise can contribute to adverse health effects, including sleep disturbance, hearing loss, and decreased performance. Projects and policies can be designed and implemented to reduce noise related to airports and highways and to mitigate the health impacts of noise on nearby populations. Examples include constructing sound barriers around highways, using road surface materials that produce less noise, and changing airport runway use patterns, flight path locations, and hours of operation.

Mission and Policies

The health impacts of transportation system design are well documented. The U.S. Department of Transportation (DOT) has stated that its mission is to "serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future" (*10*). Although the mission statement does not explicitly include the word "health," it includes several words that directly relate to health:

- *Safe*. The prevention of injuries, which have substantial human and financial costs, is an important component of a well-designed transportation system.
- *Efficient*. By reducing motor vehicle congestion, the provision of safe and convenient transit, walking, and bicycling infrastructures leads to a more efficient transportation system and, as a cobenefit, enhances health by promoting physical activity and reducing air pollution.
- *Accessible*. Transportation enhances the health and quality of life of vulnerable populations, including the young, the elderly, the disabled, and those with low incomes, by providing services that facilitate access to opportunity and to essential goods and services.
- *Quality of life*. A transportation system can enhance quality of life by offering a range of alternatives, so that people can opt out of spending hours in congested traffic daily.

Photo: Molly Dilworth, Flickr

Highway sound barriers help mitigate excessive road noise, a health-related traffic concern.

Transportation professionals can make choices to fulfill this mission to create safe, efficient, and accessible systems, with the cobenefit of promoting public health, whether or not they consider promoting health a part of their job responsibilities.

In 2010, U.S. DOT issued a policy statement strongly supporting the inclusion of pedestrian and bicycling networks as part of transportation programs and facilities. The statement noted:

> The establishment of well-connected walking and bicycling networks is an important component for livable communities, and their design should be a part of federal-aid project developments. Walking and bicycling foster safer, more livable, family-friendly communities; promote physical activity and health; and reduce vehicle emissions and fuel use. (*11*)

PHOTO: DAN BURDEN, PBIC

By reducing the cost of health care in the long term, funds spent on transportation systems that promote public health—for example, bicycling to school—may free up future resources.

Considering Health Impacts

In addition to the goals and implications of the U.S. DOT mission and policy statements, transportation professionals have other reasons for considering the health impacts of their decisions:

1. **Funds spent on transportation systems that promote public health may reduce health care costs in the long term.** Although the savings in health care costs do not become directly available for transportation expenditures, federal and state budget decision makers are constrained by the total pool of available funds—savings in health care costs may become available indirectly for transportation expenditures.

2. **Recent trends suggest that the younger generations are choosing to drive less and to walk, bicycle, and use transit more.** Increased pedestrian activity and bicycle use offer numerous health benefits and have several impacts on the transportation system. These modes of travel reduce the number of short motor vehicle trips, improve congestion and air quality, and—with the appropriate infrastructure and facilities—can discourage the use of personal vehicles.

In one study, 39 percent of teenagers reported that they had delayed obtaining a driver's license because they "could get around without driving" (*12*). Another study indicated "a higher likelihood of workers to walk or bike when commuting by transit, probably due to the resulting access, egress, or transfer walk or bike time during the commute and their inherent lower tendency toward automobile use" (*13*). By acknowledging and responding to these changing preferences, transportation professionals are promoting health as a cobenefit whenever they make planning decisions that include walking, bicycling, and transit infrastructure.

3. **Transportation professionals are becoming increasingly aware of the impacts of climate change on the transportation system and its infrastructure** (*14*). Approximately one-third of the greenhouse gas emissions that contribute to climate change come from the transportation sector, which is the second largest source of carbon dioxide in the United States (*15*). Because mobile sources are the primary cause of air pollution in many urban areas, several governmental initiatives have addressed emissions impacts in long-range planning processes.

Transportation planning decisions to mitigate and adapt to the impacts of emissions and climate change offer the cobenefit of promoting health (*16*). In addition, with the increasing recognition of air quality impacts and the need to improve responses to the federal regulations, transportation professionals have an increased interest in understanding the health impacts of transportation actions. For example, a recent study provided "a well-established, evidence-based foundation for insights into both transportation and human health impacts resulting from the [federal Congestion Mitigation and Air Quality Improvement] program beyond vehicle emissions reductions" (*17*).

4. **Developing a balanced transportation system that includes transit, pedestrian, and bicycling facilities, as well as motor vehicle lanes, is more efficient and cost-effective than spending the majority of a transportation budget on roads for motor vehicles only.** The building or widening of new roads or

Vehicle emissions regulations and long-range sustainability plans are increasing in importance to transportation officials; policy decisions often address health concerns related to air quality.

PHOTO: CAROL VINZANT, FLICKR

Photo: Ipek Sener, TTI

Infrastructure initiatives that promote walking, cycling, and transit find ready support from the public health community.

highways induces demand. Adding 1 mile of pedestrian sidewalk or bicycle lane is substantially less expensive than widening a mile of a roadway for motor vehicles. A well-designed multimodal transportation system provides solutions to many transportation problems, from safety to congestion, and improves heath.

5. **Transportation professionals who choose to promote transit, pedestrian, and bicycling facilities will find powerful and credible voices of support from the public health community.** This support will help in gaining the resources to build health-promoting infrastructure. For example, the federal Centers for Disease Control and Prevention has issued *Recommendations for Improving Health Through Transportation Policy*, identifying policies that would reduce injuries associated with motor vehicle crashes, improve air quality, expand public transportation, promote active transportation, and encourage healthy community design (*18*).

Health-Enhancing Choices

In conclusion, transportation professionals and the general public benefit from the expansion of options that maximize the health-promoting aspects of transportation and mitigate its adverse health impacts. Integrating health-enhancing choices into transportation policy has the potential to save lives and money by preventing chronic diseases, reducing motor vehicle–related injury and deaths, and improving environmental health, while achieving the goals of stimulating economic development and ensuring access to opportunity and to goods and services for all.

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Glossary of Public Health Terms

Most of the definitions below are adapted from the glossary in *Making Healthy Places: Designing and Building for Health, Well-Being, and Sustainability*, edited by A. L. Dannenberg, H. Frumkin, and R. J. Jackson, and published by Island Press, Washington, D.C., in 2011.

Accessible. Easy for persons of all abilities to approach, enter, operate, participate in, and use safely and with dignity; for example, a site, facility, work environment, service, or program may be accessible.

Active living community. A community designed to provide opportunities for people of all ages and abilities to incorporate physical activity into their daily routines.

Active transportation or active travel. Physical activity primarily to move from one destination to another, usually by walking or bicycling.

Aging in place. Remaining and living independently in the same community while growing older and coping with changing needs.

Built environment. Settings designed, created, modified, and maintained by human efforts, such as homes, schools, workplaces, neighborhoods, parks, roadways, and transit systems.

Centers for Disease Control and Prevention (CDC). The federal agency responsible for protecting the health of the U.S. population.

Disability. A dynamic interaction between health conditions and contextual factors, such as community design, age, and legal and social structures, that may or may not lead to limitations of activity and restrictions of participation.

Photo: Patrick Cashin, Metropolitan Transportation Authority

Disability-adjusted life year (DALY). A measure of disease burden; one DALY is one year of healthy life lost because of disability or poor health.

Photo: Lee Cannon, Flickr

Epidemiology. The study of the distribution and determinants of health conditions or events among populations and the application of the findings to control health problems.

Gentrification. A sociocultural phenomenon in which older, declining neighborhoods are renovated, property taxes rise, and lower-income residents are displaced because they can no longer afford the higher costs.

Health. A state of complete physical, mental, and social well-being—not merely the absence of disease or infirmity.

Health disparities. Differences among specific population groups in their burden of adverse health conditions and their access to health protections.

Health impact assessment (HIA). A combination of procedures, methods, and tools that systematically judges the potential effects—sometimes unintended—of a policy, plan, program, or project on the health of a population, as well as the distribution of those effects within the population; an HIA identifies appropriate actions to manage the effects.

Health indicator. A measurable characteristic that describes the health of a population—such as life expectancy, mortality, or disease incidence or prevalence; or that serves as a determinant of health—such as health behaviors, health risk factors, physical environments, or socioeconomic environments.

Health outcome. A change in the health status of a population, group, or individual that is attributable to a policy or program or to a legal or environmental intervention, whether or not the intervention was intended to change health status. Health outcomes are usually assessed through health indicators.

Photo courtesy Toole Design Group

Incidence. The rate of onset of new cases of a disease per unit of time (see *prevalence*).

Injury. Unintentional or intentional damage to a body from acute exposure to a harmful agent.

Intentional injury (violence). Injury caused by a person with intent to do harm, such as homicide, assault, child maltreatment, elder abuse, or suicide.

Unintentional injury. Inadvertent injury from such events as motor vehicle crashes, falls, drowning, or poisoning.

Mental health. A state of well-being in which the individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to the community.

MPH. The most common graduate degree of public health professionals, the Master of Public Health typically includes training in biostatistics, epidemiology, health policy and management, and environmental health.

Obesity (obese). In adults, a body mass index (BMI) of 30 or greater, and in children and adolescents (2 to 19 years old), a BMI at or above the age- and sex-specific 95th percentile on CDC growth charts (see *overweight*). BMI is the ratio of weight (in kilograms) divided by height (in meters) squared.

Overweight. In adults, a BMI between 25 and 29.9, and in children and adolescents (2 to 19 years old), a BMI between the age- and sex-specific 85th and 95th percentiles on CDC growth charts (see *obesity*).

Physical activity. Any bodily movement produced by skeletal muscles that increases energy expenditure above the baseline level.

Prevalence. The proportion of a population suffering from a condition at a given point in time, defined as the number of cases of disease per unit of population (see *incidence*).

Prevention strategies

Primary prevention. Interventions to stop disease or injury from occurring.

Secondary prevention. Interventions to stop or delay the onset of adverse symptoms or effects once a disease has started or an injury is occurring.

Tertiary prevention. Reducing the adverse effects of a disease or providing rehabilitation after an injury to minimize the long-term consequences.

Public health. The science and art of promoting health and preventing disease in populations.

Quality of life. An individual's perceptions of his or her position in life in the context of the culture and value system, and in relation to goals, expectations, standards, and concerns.

Social capital. The interpersonal processes that establish networks, norms, and social trust and that facilitate coordination and cooperation for mutual benefit.

Social determinants of health. Life-enhancing resources, such as a food supply, housing, economic and social relationships, transportation, and health care; distribution of these resources across populations effectively determines the length and quality of life.

Surveillance. The ongoing systematic collection, analysis, and interpretation of data for the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of the data to prevent and control disease and injury.

Sustainability. The ability to meet present needs without compromising the ability of future generations to meet their needs.

Universal design. Design of products and environments to be usable by all without the need for adaptation or specialized design.

Vulnerable population. A group put at risk of adverse health effects by such factors as lack of income, place of residence, health, age, functional or developmental status, ability to communicate effectively, presence of chronic illness or disability, or personal characteristics.

Health Impact Assessment

Considering Health in Transportation Decision Making in the United States

MEGAN L. WIER, MICHAEL SCHWARTZ, AND ANDREW L. DANNENBERG

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The health impact assessment (HIA) has gained interest in the United States in the past decade as a tool for considering the potential health effects of policies, programs, and projects before implementation; the goal is to mitigate the potentially adverse impacts and to leverage the potential health benefits. The practice builds on a strong foundation of HIAs in Europe, Australia, and New Zealand (*1*).

In the United States, many HIAs have focused on transportation-related decisions. A recent review identified 73 transportation-related HIAs conducted in 22 states from 2004 to 2013, for projects from road and bridge redevelopment to public transit to community transportation plans (2).

Definition and Process

According to the National Research Council, an HIA is

> …a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects. (3)

An HIA has many procedural parallels with the environmental impact assessment (EIA). The steps

PHOTO: WASHINGTON STATE DOT

Washington State DOT constructed a temporary work bridge during completion of West Approach Bridge North, which will extend the westbound lanes of SR-520 near Seattle. Public health agencies in Seattle and King County, along with the Puget Sound Clean Air Agency, prepared a health impact assessment (HIA) for the SR-520 project in 2008.

PHOTO: IPEK SENER, TTI

Safety markings and other pedestrian- and bike-friendly elements at St. Pancras Station in London. The World Health Organization's broad definition of health includes such predictors of positive health outcomes as physical activity.

in an HIA typically include screening, scoping, assessment, recommendations, reporting, and monitoring and evaluation, as shown in Table 1, below (*4*).

The preamble to the constitution of the World Health Organization defines health as "a state of complete physical, mental, and social well-being—and not merely the absence of disease or infirmity." Health impacts can include not only disease outcomes, such as asthma, but also established predictors of multiple health outcomes—stress associated with heart disease, for example, or preterm birth—as well as predictors of positive health outcomes, such as physical activity and social support. Democracy, equity, sustainable development, and the ethical use of evidence are among the values that underpin an HIA (*5*).

The depth of an HIA varies in accordance with the time and resources available:

- Rapid or desktop HIAs involve minimal engagement from stakeholders, are often conducted by one or a few practitioners, and lead to final products such as comment letters for environmental impact reports or other projects.
- Comprehensive HIAs are more substantial reports involving significant stakeholder engagement and data analysis.

TABLE 1 Health Impact Assessment Steps

Screening	Determine whether an HIA is feasible, timely, and would add value to the decision-making process.
Scoping	Create a plan for conducting an HIA that defines priority issues, research questions and methods, and participant roles.
Assessment	Assess conditions for a geographic area or population, to understand the baseline conditions. Estimate the potential future health impacts, including the magnitude and direction of the impacts, using quantitative and qualitative research methods and data.
Recommendations	Develop recommendations to improve the project, plan, or policy and to mitigate any negative health impacts.
Reporting	Create written or visual presentations of the HIA results, including reports, Powerpoint presentations, and comment letters. Communicate the results to all involved in the decision-making process, including media outreach and public testimony.
Monitoring and evaluation	Track HIA impacts on the decision-making process and the decision, the implementation of the decision, and the impacts of the decision on health determinants.

NOTE: Adapted from *A Health Impact Assessment Toolkit: A Handbook to Conducting HIA (4).*

◆ Guidance is available on the elements to include in a comprehensive HIA, as well as on the best practices. The website of the Society of Practitioners of Health Impact Assessment, for example, features model HIA reports as a resource (*6*).

Transportation HIAs

The 73 transportation-related HIAs completed in the United States from 2004 to 2013 represent a diverse cross section of projects, plans, and policies (*2*). Projects and plans include bridge replacements, new transit stations, bus rapid transit, bicycle and pedestrian facilities, corridor redevelopment, greenways and walking trails, and port expansions. The policies include road pricing, speed limits, complete streets, and airport procedures.

These projects, plans, and policies were under the consideration of decision-making bodies that included local and state transportation agencies, county and city councils and planning agencies, parks departments, and other state agencies. Twenty-two state agencies were involved; 17 of the HIAs took place in California, 10 in Oregon, and six each in North Carolina and Washington State. The practitioners who conducted the HIAs were diverse, including local and federal public health officials; private and nonprofit consultants, and faculty and students from schools of public health, medicine, the built environment, and architecture.

Health departments conducted some HIAs with limited or no external funding; volunteers conducted others; and yet others received funding from foundations or public health agencies (*2*). Funding to conduct HIAs in the United States has increased in recent years, with funders including the Centers for Disease Control and Prevention, the Active Living Research Program of the Robert Wood Johnson Foundation (RWJF), Blue Cross/Blue Shield of Minnesota, the California Endowment, and the Health Impact Project, a collaboration of RWJF and The Pew Charitable Trusts (see article, page 17).

The 73 transportation-related HIAs examined such topics as physical activity; transportation-related injury; air and water quality; noise; social capital; mobility; mental health; social cohesion; access to goods and services; crime; affordable housing; and discretionary time. Most of the HIAs included the direction of an effect on health, such as an increase in physical activity—but usually not the magnitude; some HIAs, however, include quantitative data and analysis. Decision makers and the public learned about the HIA findings through reports released to the media and posted on websites, in formal public testimony, and in comments integrated into EIA reports (*2*).

HIAs and EIAs

HIAs are related to EIAs, and some EIAs have integrated the consideration of health impacts. In other cases, HIAs conducted separately from the EIA were submitted for consideration during the formal comment period for the draft EIA.

A legal review of the use of HIAs in nonhealth sectors found that the National Environmental Policy Act and equivalent state laws support HIAs in many U.S. jurisdictions (*7*); several case studies have illustrated the incorporation of an HIA into the EIA process (*3, 8*). The review also found that laws in approximately one-fifth of the jurisdictions studied—including states, localities, and tribal nations—required or facilitated HIAs for transportation policies or programs (*7*). For example, the Massachusetts Healthy Transportation Compact of 2009 requires HIAs for transportation projects (*9*), although the specific guidance is still in development.

Stakeholders and Vulnerable Populations

One core value of the HIA is equity, establishing "conditions that allow all to reach their full potential, eliminating inequities on the basis of race, income, ability, geography, age, gender, immigration status, and sexual orientation, among others" (*10*). Guidance is available on applying an HIA to support equitable decision making and to reduce health inequities (*10*), defined as "disparities in health outcomes that emanate from unjust and unfair differences in social, economic, environmental, and political conditions" (*11*).

Several transportation-related HIAs have specifically addressed decisions of concern to vulnerable populations. Steps include conducting the HIA in partnership with community stakeholders,

PHOTO: DAVID GRUMMEY, FLICKR

A walking tour in Tempe, Arizona, examines the future site of the Tempe Streetcar project, the subject of an HIA in 2012.

quantifying the impacts on vulnerable communities, and employing culturally appropriate communication materials to engage communities in applying the findings and recommendations (*10*).

Stakeholder engagement is another important component of the HIA process, supporting core HIA values (*5*); best practice guidance is available (*12*). Stakeholder participation can help to identify important issues, provide context for findings and recommendations, create support for implementation, and shape communications. Potential stakeholders include transportation agencies, community-based organizations, residents, businesses, and elected officials. Constraints on time and resource may limit stakeholder engagement in an HIA, but various strategies can ensure some degree of involvement (*12*).

Partnering on an HIA

Collaboration between transportation and public health professionals in the conduct of an HIA is important in ensuring that decision makers consider the findings and recommendations (*2*). As a case in point, an HIA for a potential road pricing policy in San Francisco, conducted with coordination between the San Francisco Department of Public Health and the San Francisco County Transportation Authority, offers some technical and practical insights (*13*).

Traffic congestion in the Rincon Hill neighborhood of San Francisco, California. The San Francisco Department of Public Health and the San Francisco County Transportation Authority collaborated on an HIA for potential road pricing.

PHOTO: MARYMACTAVISH, FLICKR

◆ **Political and technical sensitivities.** HIAs often address sensitive public topics. Close coordination and strong, ongoing communication therefore are essential, especially for new collaborations, to ensure that each agency has the most current information. Representatives from both public agencies should be present at HIA meetings with outside stakeholders to maintain a distinction between the transportation decision under consideration and the HIA and to ensure that the appropriate expertise is present to address questions.

◆ **Differences in agency culture, practices, and authority**. Transportation and public health agencies have different cultures, sensitivities, and accountabilities that inform the focus and content of their work. An HIA presents an opportunity to build bridges between the cultures through cross-participation in agency meetings to increase trust and transparency. An HIA often has a larger political context; interagency meetings can support a shared understanding of the issues.

◆ **Studies have different timelines and demands.** The transportation plan, project, or study that is the focus of an HIA may have its own deadlines and constraints. This can generate stress for both the transportation agency and for the public health agency, which needs the transportation study outputs for the HIA. Strategies to reduce this tension include regularly scheduled communication, ensuring time for interagency collaboration in the HIA budget and work plan, anticipating the challenges and preparing contingencies as a part of the HIA work plan, and setting the level and scope of the analysis in accordance with the transportation agency's timeline for deliverables. An HIA that involves a complex quantitative analysis of transportation agency data should budget time for the data analysis and for the critical review of methods and findings from the quantitative modeling.

◆ **Differences in language and terminology.** Transportation and public health agencies often use different vocabularies; for example, what a public health professional calls walking and biking may be referred to as nonmotorized transportation in an environmental review document. Multiple documents summarizing HIA findings therefore may be necessary for different audiences—for example, for a public summary in contrast with a technical report for practitioners—although the messages and terminology should be consistent. Transportation planning staff can offer perspectives to help HIA

Photo: Volker Neumann, San Francisco Bicycle Coalition

Members of the San Francisco Municipal Transportation Agency (SFMTA) Livable Streets team. The Vision Zero initiative, adopted by SFMTA and the San Francisco Board of Supervisors, aims to eliminate all traffic deaths by 2024.

practitioners ensure that key findings are clearly stated and highlighted (see the Glossary of Public Health Terms, page 9).

Collaborating on an HIA can strengthen transportation and public health partnerships in support of health-informed decision making. The two San Francisco agencies learned valuable lessons from the HIA process that have guided interdisciplinary collaborations on other local initiatives, such as bus rapid transit projects and San Francisco's citywide Vision Zero initiative.[1] The lessons included the following:

- Determine the synergies between departmental objectives and larger goals at the outset,
- Identify the added value of collaboration on specific initiatives,
- Determine whether an HIA is the most appropriate tool for analysis of the health effects of the project or policy,
- Align the analysis time frames with the desired outcomes, and
- Jointly seek funding resources (2).

Effects of HIAs

Several studies have examined the influences of HIAs on decision making and other outcomes. The review of transportation-related HIAs identified cases that specifically contributed to decisions (2). For example, the HIA for the Atlanta Beltline transit, parks, and trails redevelopment project led to the addition of public health professionals on the advisory committees and helped raise funds for the project.

[1] For more information: VisionZeroSF.org.

In a detailed review of 23 U.S. HIAs in various sectors including transportation, investigators found that HIAs helped shape decision making, influenced changes beyond the initial decision, strengthened relationships across sectors, helped decision makers and stakeholders see the overlooked health connections, and gave communities a stronger voice in decisions that affect them (*14*). According to the study, factors that may increase HIA success include "care in choosing a project or policy to be examined; selecting an appropriate team to conduct the HIA; engaging stakeholders and decision makers throughout the process; crafting clear, actionable recommendations; delivering timely, compelling messages to appropriate audiences; and using multiple dissemination methods."

The report identified challenges to successful HIAs, such as "underestimating the level of effort required, political changes during the conduct of the HIA, accessing relevant local data, engaging vulnerable populations, and following up on recommendations" (*14*).

Health in All Policies

An HIA is one way to advance a broader interest in incorporating health considerations into decision making. Health in all policies (HiAP) is a concept that is gaining popularity. HiAP is defined as "a collaborative approach to improving the health of all people by incorporating health considerations into decision making across sectors and policy areas." HiAP comprises five key elements: "promoting health and equity, supporting intersectoral collaboration, creating cobenefits for multiple partners, engaging stakeholders, and creating structural or

Photo: LADOT Bike Blog

In 2015 the city of Los Angeles, California, installed parking-protected bike lanes on Reseda Boulevard in Northridge under the Great Streets initiative; Mayor Eric Garcetti cited health as a primary benefit of the projects.

process change" (*15*).

The HIA is a tool that can support HiAP. Other approaches to increasing the consideration of health and equity include developing clear goals and performance metrics in planning, policy, or funding and establishing formal, intersectoral bodies to advance health considerations in nonhealth sectors. Fundamental to HIAs and HiAP is collaboration between public health and transportation agency staff—this continues to be a direction with great promise for initiatives in the United States.

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The Health Impact Project

Fostering Safer, Healthier Communities

BETHANY ROGERSON

The Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts, is a national initiative to promote health impact assessments (HIAs). Since the project's launch in 2009, the use of HIAs has grown rapidly, from 54 that year to more than 345 completed or under way nationwide as of March 2015. A recent evaluation found that organizations and government agencies across the United States are applying the findings from HIAs to craft policies that foster safer, healthier communities.

Transportation planners were early pioneers of the approach, and the sector has continued to expand use. Transportation projects such as roads, highways, public transit, and pedestrian and bicycle accommodations can affect a range of factors related to health, including air quality, the opportunity to exercise or walk to school safely, and access to healthy foods, employment, and education. Public health research shows that well-planned projects offer a prime opportunity to improve health.

The Health Impact Project works to promote the use of HIAs in transportation planning and policy making through the following actions:

◆ **Funding HIAs.** The project has provided support for nearly 100 HIAs that have informed a variety of state and local decisions, including regional transportation and sustainability plans and light rail extensions.

◆ **Supporting targeted projects that integrate health into transportation planning.** An example is the Massachusetts Healthy Transportation Compact, a legislative initiative that has established HIAs as part of a routine process to "determine the effect of transportation projects on public health and vulnerable populations." The initiative's pilot HIA was completed in 2013.

PHOTO: PEW CHARITABLE TRUSTS

The National Health Impact Assessment Meeting in Washington, D.C., in June 2015, convened decision makers and program leaders to examine the role of HIAs in policy and planning decisions.

◆ **Building the infrastructure, systems, and funding mechanisms to integrate health into transportation policy and planning decisions at the state, local, and tribal levels.** For example, with funds from the Health Impact Project, the Oregon state health and transportation departments are developing a tool that applies Cambridge University's Integrated Transport and Health Impact Modeling instrument to develop strategies to reduce vehicle miles traveled and improve health.

◆ **Tracking the use of HIAs** across the country in transportation and other sectors with an interactive online map.

◆ **Convening the National Health Impact Assessment Meeting**, which attracted approximately 500 practitioners, policy makers, and representatives from community-based organizations in a variety of sectors.

◆ **Supporting and conducting HIA workshops and training** for professionals in the health and transportation sectors.

◆ **Developing guidance** for a variety of audiences on how to incorporate health considerations and implement HIAs in other sectors, including planning, housing, and disaster recovery.

Building on these successes, the Health Impact Project continues to look for new ways to encourage dialogue and collaboration across the public health and transportation sectors. Through funding opportunities and strategic partnerships, the project will focus on ensuring that health is a valued and routine consideration in decision making. The project will continue to draw from completed HIAs to identify promising practices for practically and affordably integrating health goals into transportation decisions.

IMAGE: PEW CHARITABLE TRUSTS

An interactive online map shows HIAs across the country including those conducted independently and those funded by the Health Impact Project.

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Measuring the Health Benefits of Walking and Bicycling

Nashville Area Metropolitan Planning Organization Applies the Findings

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The Nashville Area Metropolitan Planning Organization (MPO) has experienced success in incorporating health benefits into the transportation planning process through policy, funding, projects, research, and forecasting. The MPO's mission is to provide access and mobility for the 1.6 million people who live and work in Middle Tennessee—and at the same time to have a positive impact on public and environmental health.

As the federally designated regional transportation planning agency for the seven counties in and around Nashville, Tennessee, the MPO facilitates strategic planning for a multimodal transportation system. The MPO also serves as a forum for collaboration among local communities and state leaders to apportion federal funds for transportation projects and programs.

The Nashville Area MPO was among the first to recognize the interplay of transportation and public health, including transportation's potential to increase physical activity while providing access to destinations—such as employment, housing, food stores, and health care—and improving the general quality of life.

Transportation and Health

In the past 10 years, the increasing rates of childhood and adult obesity have drawn national attention to health in the United States. Obesity is related to several diseases, including cancers, diabetes, and heart disease. The two primary contributors to obesity and to health status in general are how much individuals eat and how much they move. Of the trips taken in urban areas, 50 percent are 3 miles or less; walking and bicycling provide options that are often faster and less expensive than driving but also extend opportunities for physical activity.

Transportation-related physical activity often occurs in small increments—for example, a 10-minute walk to a bus stop and a midmorning walk to buy a cup of coffee. These small trips provide opportunities for physical activity, even if partici-

PHOTO: GRANT WICKES, FLICKR

Nashville, Tennessee, has the most traffic congestion of any U.S. city of its size.

Photo: Adams Carroll, Flickr

Bicycle parking on 5th Avenue of the Arts in downtown Nashville.

pants do not consider the trips exercise. National polls show that people want transportation options that include walking, bicycling, and transit.

The Nashville region faces several transportation and health problems. Nashville is the most traffic-congested U.S. city with 1 to 3 million residents; commuters experience 47 hours of annual traffic delay. In addition, Tennessee ranks 49th among states in level of physical activity—58 percent of adults fail to meet the guidelines for aerobic physical activity, and more than 68 percent of adults in the state are either overweight or obese.

Shifting Policy and Funding

The Nashville Area MPO recognized the potential to address these problems by shifting the transportation policy focus to public transit, walking, and bicycling. Surveys showed that public interest already was strong in expanding public transit, in increasing the active transportation options of walking and bicycling, and in preserving roadways and adding sidewalks, bikeways, and transit instead of building new roads. A 2010 MPO attitudinal survey of 1,100 randomly selected households identified these preferences, and a survey in 2014 confirmed the results.

The MPO devised a scoring and selection system for transportation projects; 60 percent of the criteria quantified ways that a roadway project could increase opportunities for active transportation, improve air quality, reduce crashes, and increase physical activity. The MPO then programmed 70 percent of its largest revenue source—funding from the Surface Transportation Program (STP)—to support complete streets projects, which safely accommodate all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities.

The MPO reserved 15 percent of STP funding for a newly created Active Transportation Program (ATP) for bicycle- and pedestrian-specific infrastructure and programs. In comparison, transportation budgets nationwide spend approximately 1 to 2 percent of funding on walking and bicycling facilities. By designating 15 percent, the Nashville Area MPO made a significant commitment to walking and

Photo: Rex Hammock, Flickr

"The Gulch," or 11th Avenue South in Nashville, underwent a complete streets makeover in June 2015.

bicycling projects in addition to the sidewalks and bikeways to be built as part of the complete streets projects.

Transit projects received 10 percent of the STP funds, and technology such as electronic signs and pedestrian signals received 5 percent. The MPO believes that innovations in transportation technology can improve transportation efficiency without having to build more roadways.

With the policy changes in the MPO's 2035 Regional Transportation Plan, almost 70 percent of roadway projects included active transportation elements such as sidewalks and bikeways. In the previous 2030 plan, approximately 2 percent of roadway projects included these elements. Beyond roadway projects, the newly funded ATP has awarded $13.6 million for active transportation infrastructure and education projects.

Prioritizing with Equity

In prioritizing transportation projects that have a potential for improving health, the MPO wanted to concentrate on greenways, bikeways, and sidewalks in areas with high rates of health disparities and chronic diseases. This type of health data, however, often is not available for areas smaller than a county, such as a neighborhood or a street.

The MPO therefore consulted U.S. Census data as a proxy and identified areas with higher-than-average concentrations of low income, poverty, and adults over age 65. Overlaying these three groups allowed the MPO to focus on areas with populations recommended ways to mitigate the effects of alcohol-related behaviors, such as a safe ride program to curb driving under the influence of alcohol and to provide transportation options for employees. The report noted that "during off-peak hours, safe ride buses can be used to help residents who do not own cars access needed services such as grocery stores, recreational facilities, and health care providers." The study postulated that increases in liquor excise taxes could pay for the services.

Integrating Health and Transportation in the Rural Context

DON KOSTELEC

Rural areas have higher highway fatality rates and offer fewer opportunities for complete active transportation networks than urban areas do. Three examples highlight ways that rural jurisdictions are addressing these topics and integrating health and transportation initiatives.

◆ In Haywood County, North Carolina, a bicycle plan defined investments that were likely to yield the highest positive impact on community health. The plan applied data on the body mass index (BMI) of students in nine schools and on changes in BMI; these data were combined with Census data to pinpoint investments in the geographic areas with the poorest health conditions.

◆ Buncombe County, North Carolina, integrated a health impact assessment (HIA) into a greenway plan and applied data from the State Center for Health Statistics (SCHS) to identify the locations most in need of project investment. SCHS compiled 13 datasets from the Census, the American Community Survey, and health records. The HIA overlaid these data to identify facilities for greenways in census tracts with the highest prevalence of poor health conditions.

◆ The Kansas Health Institute evaluated the health impacts of casino development in southeast Kansas and noted that "choices about transportation, education, and taxation are not made in what is typically thought of as the 'health sector,' and yet each has a profound influence on well-being and balancing a variety of scientific, policy, and economic considerations."

The study included discussion of the impacts of traffic—for example, on safety, with the additional vehicle trips likely to increase the number of injuries from crashes. The report

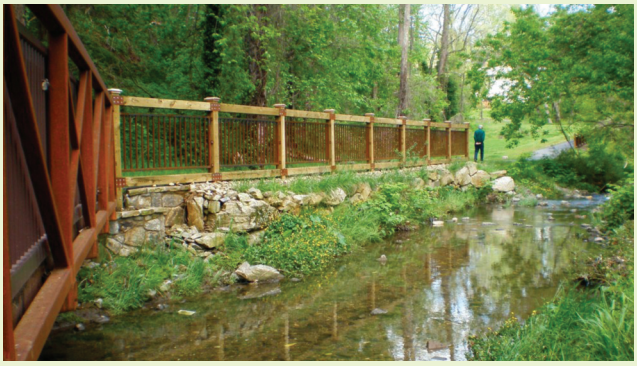

PHOTO: MELINDA STUART

Reed Creek Greenway in Asheville, North Carolina; the city is developing a comprehensive greenway system.

As these examples show, the rural context is diverse. Because the datasets and resources for rural communities are limited, contextual approaches are needed to integrate health and transportation.

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likely to have higher rates of health disparities, more chronic disease, and less car ownership.

Providing opportunities for travel that incorporate physical activity not only addresses transportation options for people who depend on transit, walking, and bicycling but also provides opportunities for physical activity for everyone, including people with chronic diseases. Most chronic diseases have a high rate of positive response to physical activity, which may help to decrease or cure instances of disease.

Additional Research

To obtain more detailed information about health disparities and chronic disease at the subcounty level, the MPO conducted the Middle Tennessee Transportation and Health Study (MTTHS) to measure transportation behaviors and health attributes; the study encompassed 6,000 households and more than 11,000 individuals. Health questions included height, weight, general diet, and health quality and estimated the time spent in physical activity and sitting.

The MTTHS yielded significant data about the transportation and health attributes of households throughout the MPO region. The data generated a new map of high health impact areas in the region.

Common demographic attributes were analyzed for respondents with a high body mass index, low quality of health, poor diet, and low physical activity. The results showed that people who were classified as low income, unemployed, over age 65, or who did not own a car tended to have poorer health.

These four attributes were mapped, and areas with three or all of the four attributes were designated as priority locations for walking and bicycling facilities. The Health Priority Areas map enables MPO staff to prioritize transportation projects with potential positive health benefits in those areas.

Predicting Health Outcomes

The MTTHS data also were used to calibrate the Integrated Transport and Health Impact Modeling (ITHIM) tool, which estimates the population-level health impacts of increased physical activity, reduced air pollution, and altered transportation collision patterns. The tool creates population-level goals for physical activity related to transportation trips and determines the effects on diseases and deaths.

The MPO chose three transportation-related scenarios for the physical activity of walking and bicycling: 6 minutes a day, 10 minutes a day, and 150 minutes a week per person. According to the ITHIM projections of the changes in physical activity, air quality, and collisions, the 10-minutes-a-day scenario for all members of the population would yield an 11 percent reduction in population-level cardiovascular disease and an 11 percent reduction in diabetes, among other health benefits; the health care cost savings would amount to $200 million annually.

In contrast, the MPO allocates approximately $300 million a year in transportation projects. Monetizing the health savings has helped to illustrate the potential positive fiscal impacts on health care from transportation investments that provide opportunities for increased physical activity.

The Nashville Area MPO continues to integrate health into the transportation planning process by changing policies and project funding, as well as by allocating funds for active transportation research and modeling.

Photo: Adams Carroll, Flickr

A midblock crossing on Belmont Boulevard increases the visibility of pedestrians and cyclists, making it easier for residents to use nonmotorized modes of travel.

Active transportation features in 70 percent of roadway projects in the Nashville Metropolitan Planning Organization's 2035 Regional Transportation Plan.

Photo: lrinqwelski, Flickr

Incorporating Health into a Metropolitan Planning Organization's Technical Process

Innovative Approaches for San Francisco Bay Area Projects

SEAN CO

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Transportation planning and public health are intrinsically linked. In the 1960s, the U.S. Congress and the Public Health Service, the primary division of what is now the Department of Health and Human Services, recognized the public health benefit of reducing emissions, which led to the 1963 Clean Air Act and later to amendments for regulating mobile sources of emissions. These regulations still drive much of the work in transportation planning.

In recent years, understanding has increased about the link between physical inactivity and diseases. Americans suffer from a variety of adverse health outcomes attributable to a level of physical activity below the minimum of 30 minutes of daily exercise recommended by the Centers for Disease Control and Prevention. Public health officials understand that the built environment provides people with the opportunity to walk or ride a bike every day, and transportation planners are recognizing their role in determining public health outcomes. On September 8, 2015, U.S. Surgeon General Vivek Murthy released a call to action for Americans to increase levels of walking.

The San Francisco Bay Area Metropolitan Transportation Commission (MTC) developed performance metrics for its 2040 Regional Transportation Plan (RTP), known as Plan Bay Area. In addition to traditional transportation metrics, the plan included a goal to measure the effects of physical activity and transportation and established a performance target of a 70 percent increase in the number of minutes that people walked or biked for transportation.

The RTP relied on a performance-based planning approach to assess the projects and the planning scenarios. The process applied a benefit–cost analysis to identify measurable outcomes for policy decisions in Plan Bay Area.

Cost Savings and Physical Activity

To determine the level of active transportation stimulated by a specific project, the number of minutes

PHOTO: RICHARD MASONER, FLICKR

Performance metrics of Plan Bay Area transportation projects revealed that slower bus travel times correlated with increases in walking and bicycling; when transit services improved operating speeds, active transportation decreased.

PHOTO: TOOLE DESIGN GROUP

Automobiles, bicyclists, and pedestrians in downtown Golden, Colorado. Transportation scenario planning tools such as the Integrated Transport Health Impact Model can offer valuable insight on the health benefits of bicycle, pedestrian, and transit infrastructure.

of walking, biking, and walking-to-transit were calculated from the regional travel model. The model provided the number of walking, biking, and walking-to-transit trips in the region, allowing the calculation of the active transportation minutes per project.

In accordance with evidence from the public health literature, each individual who increased physical activity above the 30-minute threshold as a result of active transportation was expected to generate monetary benefits from reductions in health care costs and in the costs of lost productivity. Monetizing the health care savings was important for a performance-based transportation plan, because the benefits from transportation metrics typically are expressed in dollars—for example, dollars saved from congestion reduction.

Often, however, these benefits only tell part of the story. The cobenefits of active transportation projects are significant and could justify transportation investments in infrastructure for walking or cycling. Nonetheless, these projects often do not compete well in terms of other performance metrics, such as congestion reduction and greenhouse gas reduction.

Project Performance

Projects were ranked from the largest number of active individuals per million dollars of project cost to fewest active individuals per million dollars of project cost (*1*). Several key trends were identified from projects that were the most cost-effective at increasing active transportation. One finding was no surprise: regional programs that target and fund investments for transit-oriented development and bicycle improvements have some of the greatest increases in physical activity per dollar expended.

Projects that were ranked as the least cost-effective in increasing active transportation, or that decreased the number of minutes walked and biked, yielded some interesting observations. For example, when local bus services made improvements to increase low operating speeds, the effect was an unexpected decrease in active transportation. Individuals have a finite time budget for transportation by any mode; therefore, projects that offer travel time savings in comparison to walking and biking can decrease a person's active travel.

Projects that improve already time-competitive modes and attract ridership away from automobile modes may have greater benefits for active transportation—for example, by encouraging access to transit stations via walking or bicycling. As expected, projects that make driving easier, such as road efficiency improvements or road expansions, provided little incentive to increase active transportation. These projects maintain the automobile-dominant infrastructure and do not support other modes that may have positive health cobenefits.

Next Steps

Including public health metrics in a transportation planning framework was an innovative way to consider the health cobenefits from transportation projects. During project prioritization, however, health impacts competed with a range of other performance metrics. Projects that would most benefit health were not always competitive with other projects.

Among the projects analyzed, more than 80 percent of the benefits derived from the monetized value

PHOTO: TOOLE DESIGN GROUP

Transit projects can encourage walking or cycling to stations or stops.

of reduced travel time, typically on freeway projects. The elected officials who serve on MTC reviewed many performance targets and did not necessarily devote particular attention to the health metric. Nevertheless, the method provides the framework for assessing the public health benefits from bicycle, pedestrian, and transit infrastructure and may be useful in the future.

While transportation planners are trying to assess the impacts of transportation on health, epidemiologists are developing more comprehensive tools appropriate for transportation scenario processes. One of these tools is the Integrated Transport Health Impact Model (ITHIM), developed for the United States by the California Department of Public Health. ITHIM examined scenarios for reducing carbon dioxide emissions and identified the associated cobenefits; the scenarios emphasized walking, cycling, and transit use in the Bay Area. The study showed that the physical activity benefits overshadowed any other benefits from the transportation projects (2). A few MPOs in the United States are starting to use the ITHIM tool in scenario planning, and refinements to the model continue to move forward.

These new analytical tools are helping transportation planners quantify health impacts. To create transportation environments that encourage people to walk and bike as part of a healthy lifestyle, elected officials and public agency staff need to embrace the health metrics and to prioritize the results in developing public policy and in making investments.

PHOTO: TOOLE DESIGN GROUP

The model used to develop Plan Bay Area performance metrics monetized the health benefits from increased active transportation.

Quantifying Investments

Public health performance metrics must become indicators not only of the cobenefits but of the intrinsic benefits of transportation projects. Just as transportation officials evaluate projects for congestion relief, they could evaluate projects in terms of the physical activity stimulated. Public health professionals could look at transportation investments as they do other interventions and quantify the level of investment needed to achieve the desired health outcome.

Possible considerations include the following:

- How much investment is needed to achieve an active transportation performance target?
- What are the costs of not meeting the target?
- What is the return on investment for bicycle lanes and sidewalks to help people achieve their physical activity targets?

By answering these and similar questions, transportation and public health professionals can integrate health and transportation to help build environments that will make people happier, safer, and healthier.

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Better Corridors for Healthier Communities

Project Investigates Best Practices

SARA HAMMERSCHMIDT

Every community in the United States aspires to be a great place to live—to be safe, economically and socially strong, with clean air and water and opportunities for recreation. Nearly every community is home to urban and suburban arterials, primarily designed to move automobile traffic around and through the city.

These corridors characteristically consist of multiple traffic lanes, lack infrastructure for pedestrians and bicycles, and feature uses and services geared to and planned for automobiles. These corridors typically are unpleasant, are unsafe for walking or bicycling, and appear indifferent to the surrounding neighborhoods, whose residents should be able to rely on the facilities to meet daily needs and to access transit and jobs, without requiring a car.

PHOTO COURTESY URBAN LAND INSTITUTE

Federal Boulevard in Denver, Colorado, was selected as a demonstration corridor for new transit stops and links to new development.

Most commercial corridors in the United States present untapped opportunities for transformation into safe, healthy, vibrant, mixed-use places with an upgraded infrastructure that moves people on a variety of modes. Through a focus on the health of the people who live, work, and travel along these corridors daily, these community eyesores can be transformed to community assets.

Healthy commercial corridors are holistically healthy, facilitating improvement in the mental, physical, social, environmental, and economic health of a city and its residents. An overarching characteristic of a healthy corridor is that improvements focus on people and their needs and on creating places for people to thrive.

Healthy Corridors Project

With support from the Robert Wood Johnson Foundation and the Colorado Health Foundation, the Urban Land Institute (ULI) is championing a two-year effort to investigate best practices for reinventing underperforming suburban and urban arterials in ways that promote health.

The ULI Healthy Corridors project operates on a national and a local level. Nationally, a working group of leading experts in land use, development, planning, health, community engagement, and design oversees the project and provides input and advice on the work in each project or demonstration corridor. Members of the national working group travel to the demonstration corridors for study visits and make recommendations for solving key challenges to the corridor's redevelopment and revitalization. The goal is to foster health for all who use the corridor regularly.

Four ULI District Councils—in Boise, Idaho; Denver, Colorado; Los Angeles, California; and Nashville, Tennessee—are engaged locally on the project. Each council has identified a problematic corridor for focus, and each demonstration corridor has formed a local leadership group of experts and is engaging other critical stakeholders in workshops that focus on the corridor and on improving the health of the people living along it, through partnerships, collaboration, and on-the-ground changes.

All four corridors have the common characteristics of wide streets, a lack of safe pedestrian and bicycle infrastructure, and strip commercial environments primarily oriented to automobiles. Each corridor is adjacent to lower-income neighborhoods and does not offer services adequate for daily needs. Each corridor has been a subject of study, and action now is needed.

Demonstration Corridors

Each of the four demonstration corridors can become a truly vibrant place within its community:

- Vista Avenue in Boise serves as a gateway between the airport and downtown, and the City of Boise has a larger initiative to reenergize the Vista neighborhood.
- Charlotte Avenue in Nashville links into downtown but could connect better with the plethora of medical services concentrated nearby.
- Van Nuys Boulevard in Los Angeles is known as Mural Mile, and the arts and culture play a major role in the revitalization of the neighborhood.
- In Denver, Federal Boulevard is anticipating new transit stops and new developments that require stronger links.

Although the contexts vary, these four corridors are not unlike others in cities across the country. The local improvements will nurture and inform a new community of practice on effective approaches to creating healthy corridors that improve the lives of those who rely on the connections to services, recreation, transportation, and other daily needs.

For more information, visit uli.org/healthycorridors or e-mail health@uli.org.

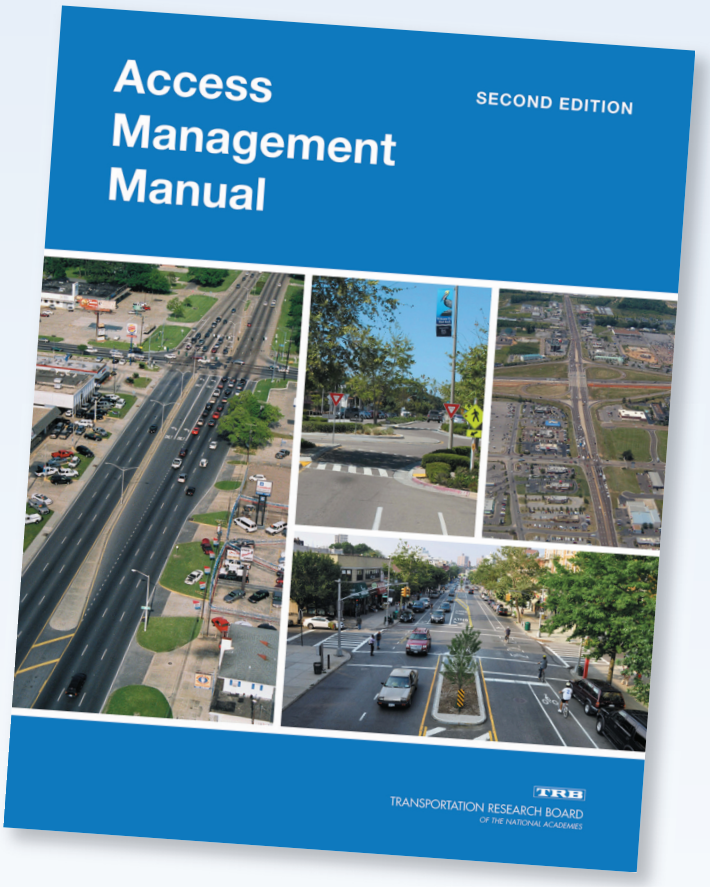
The author is Director of Content, Urban Land Institute, Washington, D.C.

Access Management Manual— New, Updated, and Expanded!

TRB's *Access Management Manual*, second edition, provides a comprehensive, coordinated approach to transportation and community design to enhance mobility, mode choice, and environmental quality. The interdisciplinary guidance addresses access management as a critical part of network and land use planning and pertains to government decision makers at all levels, as well as to pedestrians, bicyclists, and operators of motorized vehicles. The revised and expanded new edition includes the following key updates:

- Network and circulation planning and modal considerations;
- Frameworks and strategies for applications in a variety of contexts;
- Performance measures and monitoring;
- Corridor management planning, alternative funding, and cooperative agreements;
- Network planning, regional policies and programs, interchange areas, auxiliary lane warrants, rights-of-way, and access controls;
- Program development, staffing, training, internal coordination, and roles for transportation agencies; and
- Methods to improve coordination and cooperation between state agencies, local jurisdictions, and private developers—plus sample cooperative agreements.

Most chapters coordinate with sections of a companion volume in preparation, the *Access Management Application Guidelines* (AMAG), which offers additional technical information, design criteria, and practical guidance, along with case examples. The AMAG is scheduled for publication in early 2016 and will be sold separately.



Order your copy of *Access Management Manual*, second edition, today for $120 (TRB affiliates $90) from the TRB Online Bookstore: https://www.mytrb.org/Store/Product.aspx?ID=7507.

For more information, send an e-mail to TRBSales@nas.edu or visit www.trb.org/main/blurbs/171852.aspx.

TRB STANDING COMMITTEE PERSPECTIVES

INTRODUCTION

Coordinating Research on Transportation and Health

Cross-Cutting, Multidisciplinary Approach

ED CHRISTOPHER AND ELOISA RAYNAULT

PHOTO: RISDON PHOTOGRAPHY

Ed Christopher (*left*) briefs a 2014 meeting of the Standing Committee on Urban Transportation Data and Information Systems, one of the parent committees of the Joint Subcommittee on Health and Transportation.

The authors are cochairs of the TRB Joint Subcommittee on Health and Transportation. Christopher is a Community Planner, Federal Highway Administration, Matteson, Illinois. Raynault is a consultant based in Seattle, Washington.

The TRB Joint Subcommittee on Health and Transportation, which developed and organized this special issue of *TR News*, conducted a survey of more than 175 TRB standing committees in November 2012 and found that 61 had a direct interest in public health (*1*). Although many standing committees and sections have expressed interest in adopting the joint subcommittee, practical and logistical concerns have set the limit at four parent committees. Perspectives from each of the four standing committees that have established and parented the Joint Subcommittee on Transportation and Health follow:

- Urban Data and Information Systems (ABJ30),
- Traveler Behavior and Values (ADB10),
- Transportation and Sustainability (ADD40), and
- Environmental Justice in Transportation (ADD50).

The public health interests of the four committees clearly reveal that public health and transportation is a remarkably cross-cutting and multidisciplinary topic that spans the human, natural, and—perhaps most importantly—the built environment.

The joint subcommittee's survey produced some interesting results. The topic of health and transportation may readily relate to such issues as air pollution, safety, physical activity, and access to goods and services. The survey results, however, expanded the list to include mental health, communicable diseases, policy analyses, visualizing and mining data, project selection, and much more. Considering the broad scope for public health concerns in transportation, the topic clearly deserves further exploration and examination by the TRB community. The task is large but can be lightened by the concerted, coordinated work of many hands.

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Health & Transportation Subcommittee TRB

TRB STANDING COMMITTEE PERSPECTIVES

Urban Data and Information Systems

Inventories, Sample Surveys, and Baselines to Inform Policies

NANCY McGUCKIN

The author is a Travel Behavior Analyst, South Pasadena, California.

Including public health indicators in transportation policy has gained interest in the past few years. Urban transportation planners and policy makers want vibrant, walkable communities that offer options for safe and active travel. Transportation systems that encourage walking and bicycling can help people increase daily levels of physical activity, which in turn has many positive associations, including improved academic performance in children (*1*), greater opportunity for community engagement by elderly shut-ins, and better access to resources for vulnerable or disadvantaged members of the community.

The planning of public space and infrastructure at the local level influences active travel. For example, people who take transit daily walk more than people who do not.[1] Designing active travel into urban planning is a public health tool—transportation systems that plan for safe and accessible walking and biking can influence whole populations to be more active. If more people can be encouraged to walk and bike as part of their daily activity, then the positive benefits may mitigate some of the trends of concern to health professionals, such as the growing rates of obesity and heart disease.

PHOTO: CHRIS METKA, PBIC

The Safe Routes to School program promotes active transportation for children.

Health-inspired planning intersects with livability, sustainability, air quality, and safety—and uses many of the same types of data and metrics. A recent study estimated that a combination of public transit improvements, efficient road pricing, and transit-oriented development would reduce regional vehicle miles traveled by 19 percent, would increase walking by 13 percent and biking by 19 percent, and would provide substantial economic, health, and safety benefits (*2*).

Health-promoting policies include complete streets, Safe Routes to School, and multimodal level-of-service analysis. Smart growth policies, accessible

PHOTO: MICHIGAN MUNICIPAL LEAGUE/MML.ORG, FLICKR

Residents visit the Vantage Point Farmers Market on the St. Clair River in Port Huron, Michigan. Well-designed infrastructure and transportation systems can bring together community members of all ages and abilities.

[1] According to the 2009 National Household Travel Survey, people who take transit on their travel day report 20 percent more walk trips in the preceding week compared with people who do not take transit.

design, and transit-oriented development promote active travel. Coordinating these programs and plans is part of the challenge for urban planning that incorporates health goals.

Understanding the impact of land use and the built environment on health and activity levels in a community is key. Transportation infrastructure is a critical aspect of the built environment—but having places to go within walking distance also is critical. The presence of sidewalks, bike lanes, bike trails, and transit, in addition to the accessibility of trip generators such as employers, shopping centers, and recreational facilities, can influence the public's choice to use vehicles or healthier alternatives, such as walking and biking, for daily travel.

Data for Active Transportation

Conducting an Inventory

The first step in establishing a data system for understanding active travel is to conduct an inventory of the facilities and programs related to physically active travel options, such as transit, walking and bicycling, as well as access to parks and recreational opportunities. A complete inventory would include the type and mileage of sidewalks, paths, and trails; the crosswalks and intersection treatments; and other design attributes that support walking and bicycling in the community.

The inventory can identify gaps and barriers to be corrected to enhance and complete the connectivity of the network. These baseline data are important for identifying current conditions and for developing goals and performance measures for incorporating health indicators into mobility plans.

Sample Surveys

The next logical step is to gather information about the amount and type of current active travel—if possible, by specific population groups, such as children, workers, and older people. Regular counts of pedestrian activity on links or at intersections are critical for design and safety planning.

For population estimates—valuable in developing health indicators—sample surveys of household travel are necessary and can be combined with small area census data to help identify geographic areas or special groups of interest. For example, planning focused on active groups may identify families with young children, newer immigrants, and younger nondrivers.[2] The surveys can gather data valuable for understanding active people and the purpose, trip length, destinations, and timing of their activities. In measuring active travel, planners should include activities often not considered trips, such as walking the dog. Surveys also can identify the characteristics of the most sedentary groups and the perceived barriers to incerased activity.

PHOTO: DAN BURDEN, PBIC

The American Community Survey does not include the elderly or children; other survey methods are needed to gain a comprehensive picture of household travel.

Common indicators for measuring the level of active travel can be calculated from most household travel surveys:

- Daily minutes and miles of activity per capita;
- The portion of the population—by meaningful groups, if possible—that achieves various levels of activity—such as 10, 20, or 30 minutes or more of active travel per day;
- The percent of children within 2 miles of school who walk or bike; and
- The percent of adults who report no active travel at all—that is, who are sedentary.

PHOTO: DAN BURDEN, PBIC

Dog walks and other nontrip activities should be included in analyses of active travel.

[2] For a summary of active groups, see Kuzmyak, J. R., and J. Dill. Walking and Bicycling in the United States; The Who, What, Where, and Why, *TR News*, No. 280, May–June 2012, pp. 4–15. http://onlinepubs.trb.org/onlinepubs/trnews/trnews280.pdf.


PHOTO: BETHESDANOW.COM

Bike to Work Day in Bethesda, Maryland, in 2013. The challenges of biking or walking to work regularly—from unpredictable weather to the need to make stops for errands along the way—make the accurate counting of bicycle or pedestrian commuters a challenge.

The biggest concern in using household travel surveys as a source of activity data is that the information is self-reported and may not be reliable. Route information for trips by walking and bicycling also is critical to planning. Wearable GPS and improved smartphone technology to measure location, time, and distance will improve the reliability of survey data for measuring activity levels.

Establishing a Baseline

Estimating the amount and type of active travel in a community is a critical step in establishing a baseline against which to set goals, measure progress, and identify the policies and programs most effective in encouraging people to walk and bike more. But for most metropolitan planning organizations, obtaining estimates of pedestrian and bicyclist activity can be a challenge.

Because of this, many MPOs set baseline activity with available data and use these data in performance measurement. Larger geographic areas, such as counties, may employ data provided regularly by the American Community Survey in performance measures—for example, the percent of workers who usually walk or bike to work.

But for many reasons, even people who walk or bike regularly may not commute to work by walking. For example, the trip to work is the most time-constrained and longest-distance trip of the day for most people, and walking or biking in work clothes or in unfavorable weather may not be comfortable; moreover, incidental stops—for example, to drop children off or to pick up groceries—often are made on the way to or from work.[3]

Table 1 (below) shows the differences in the usual reported commute in the past week and the data on work trips for a randomly assigned day. At the national level, fewer than 80 percent of workers who usually walk to work actually walked to work on their travel day—perhaps these were bad weather days or days with errands built into the commute. When planning for a small zone, therefore, using the U.S. Census journey-to-work data—which report the usual means of commuting in the past week—may overestimate the level of active commuting on a typical day.

But commuting involves approximately 20 percent of workers' daily travel, and the commute data do not include nearly half of the population—those not in the workforce, such as retired persons and children. The American Community Survey is not adequate for estimating the amount of active travel by the population as a whole.

TABLE 1 Workers' Usual and Actual Means of Commuting, 2009 NHTS

Reported Usual Means of Commute	Percent of the Same Workers Who Commuted on Travel Day						
	Drive Alone	Carpool	Transit	Walk	Bike	Other	Total (usual means)
Drive Alone	93.5	5.6	0.1	0.5	0.1	0.4	72.9
Carpool	42.9	54.8	0.6	1.0	0.0	0.7	16.5
Transit	13.0	9.2	69.3	6.6	0.8	1.2	5.5
Walk	6.1	9.3	3.7	80.2	0.2	0.5	2.8
Bike	13.8	3.3	6.0	2.6	73.0	1.4	0.8
Other	66.5	19.3	3.8	4.0	0.3	6.2	1.6
Total (actual means)	77.2	14.4	3.9	3.0	0.7	0.8	100.0

Discovering Barriers

Across the country, the portion of people who report no walking for any reason in the preceding week hovers around one-third of the population. People who report no active travel at all can reveal critical information about the perceived barriers to active travel. In California, sedentary people identified a variety of barriers to walking: no sidewalks or sidewalks in poor condition; no nearby paths or trails; wide or unsafe street crossings; too many cars, traffic too fast, and distracted drivers; and not enough light at night to feel comfortable walking (see Figure 1, page 31).

Public outreach and advocacy activities can encourage the sedentary population groups to engage in walking or biking as part of their daily travel. Policy initiatives such as the Safe Routes to School Program can increase activity in school-aged children and families by assuring the safety of access, and advocacy activities such as Bike-to-Work Day and other campaigns have identified and overcome individual barriers to more active travel.

Transportation planners understand that the built environment has an undeniable impact on the deci-

[3] According to the 2009 NHTS, about one out of four women and one out of six men made an incidental stop during their travel day commute.

sion to walk or bicycle. Building safe and accessible infrastructure can be the most important contribution to healthy communities.

Taking Action

In summary, some basic steps to encourage active transportation in urban areas and to improve the health of the communities include conducting inventories of sidewalks and bike facilities, identifying gaps and committing to connectivity, and gathering data through local surveys—such as regional household travel surveys—to estimate activity levels and determine routes. These data, in turn, can be used to develop baseline measures of activity in various population groups, to set policy and planning targets, and to measure progress toward the goals.

In addition, other initiatives can encourage attention to health and transportation and can inspire ideas for expanding active travel in a community (3):

- Increase incentives for community projects for complete streets and networks of greenways, trails, and multiuse pathways.
- Support the adoption and expansion of safe routes initiatives and other active transportation programs.
- Award incentive funding to planning projects that will have positive effects on active transportation levels and related benefits, such as increased safety, congestion reduction, improved air quality, and community health.
- Create competitive grants or incentives for health impact assessments in planning processes, either as stand-alone requirements or as part of the permitting steps—for example, in transportation and environmental review.
- Prioritize funding to revitalize the economies in small and rural communities that integrate land use, transportation, community design, and economic development in planning for projects that support increased physical activity and improved health outcomes.
- Institute recognition and awards as incentives for planning and for projects that accommodate the desired standards of practice to create or enhance activity-friendly environments and systems.
- Enhance traffic safety in areas where persons are or could be more physically active, such as schools, parks, and recreation areas.
- Improve access to public transportation.
- Identify standards and methods—such as Crime Prevention Through Environmental Design—to enhance personal safety and increase physical activity.

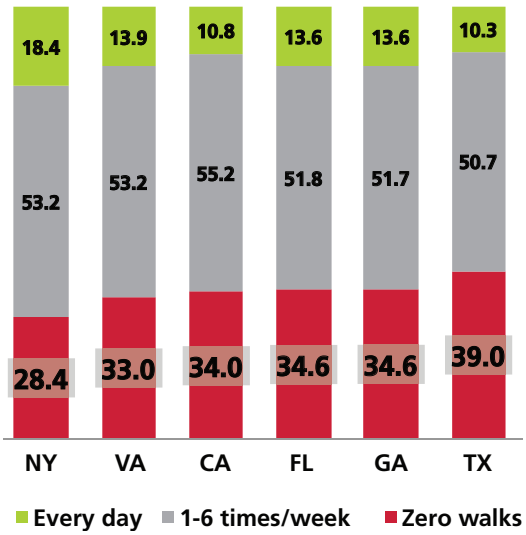

FIGURE 1 Percent of people who reported walks in the preceding week, for selected states, from the 2009 NHTS.

PHOTO: SEATTLE DOT

A bicyclist tests a new bike counter at Fremont Bridge in Seattle, Washington. Collection devices provide another source of data for transportation planners.

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TRB STANDING COMMITTEE PERSPECTIVES

Traveler Behavior and Values

Establishing Associations with Public and Individual Health

KOUROS MOHAMMADIAN

The author is Professor, Department of Civil and Materials Engineering, University of Illinois, Chicago, and Chair of the TRB Standing Committee on Traveler Behavior and Values.

The influence of public health on the livability and well-being of a community has been a subject of interest in many academic fields, including transportation science. Public health has potential associations with a variety of travel-related factors, including travel behavior. Travel behavior in turn can affect public health indirectly by influencing various personal and community-level quality-of-life indicators, such as physical activity or air pollution.

Many aspects of travel behavior—for example, mode choice, route choice, trip generation, trip sequencing, and activity scheduling—are influenced by the built environment, sociodemographic preferences, and network attributes. Figure 1 (page 33) shows these and several other influences, including urban form, land use, the available transportation system, accessibility to transit, quality and frequency of services, and trip purpose and duration. These features have direct influences on travel behavior, and travel behavior directly affects air pollution, physical activity, traffic levels, the comfort and safety of travel, and noise pollution.

PHOTO: WASHINGTON METROPOLITAN AREA TRANSPORTATION AUTHORITY

Travelers disembarking from a Metrobus in Washington, D.C. A variety of factors influence trip sequencing and other travel behavior.

PHOTO: ZACHARY ELGART

A bicycle lane in downtown Washington, D.C. The built environment, sociodemographic factors, transit accessibility, and trip purpose are some of the many factors that influence travel behavior.

In addition, the quality-of-life indicators have some level of association with public health status. For this reason, travel and health specialists alike support consistent, in-depth research on the aspects of travel behavior and the relationship of each aspect to indicators of public and individual health.

Measuring the Magnitude

Despite the association between travel behavior and public and individual health, the magnitude of the impacts is difficult to measure in many cases because of the complexity of the factors involved and the scarcity of reliable data sources (*1, 2*). A key initiative could involve transportation researchers partnering with health-related organizations, such as the Centers for Disease Control and Prevention (CDC), to survey health and travel behavior. The CDC's Behavioral Risk Factor Surveillance System survey,[1] for example, could be expanded to include information about travel.

[1] http://www.cdc.gov/brfss/.

Because of the limitations of available data, many researchers have assessed the impact of transportation-related factors solely on such indicators of health as physical activity and community livability. Nonetheless, transit use is another indicator—long considered a healthy mode of transportation, transit can motivate people to walk more often, increasing their levels of physical activity (3).

Some studies show that travelers with a higher number of automobile-oriented trips engage in fewer daily physical activities and do not frequently walk or bike to destinations (4). Other studies have assumed that the design of livable communities and neighborhoods promotes healthy conditions; most, however, do not identify the extent of the impacts (5).

Livability and Mixed Use

In general, communities that provide residents with safe and secure neighborhoods, clean air, and accessible land use—all of which encourage residents to walk, run, bike, and ride mass transit—are considered livable communities. Similarly, livable communities with mixed-use residential and commercial centers are considered yet more conducive to health because the design promotes walking, exercising, biking, and increased levels of comfortable living and safety.

To establish the associations between travel behavior and health requires further study of the factors displayed in Figure 1, through insightful surveys and the collection of data. The surveys should monitor individuals' short- and long-term health conditions, along with relevant information on travel and on land use.

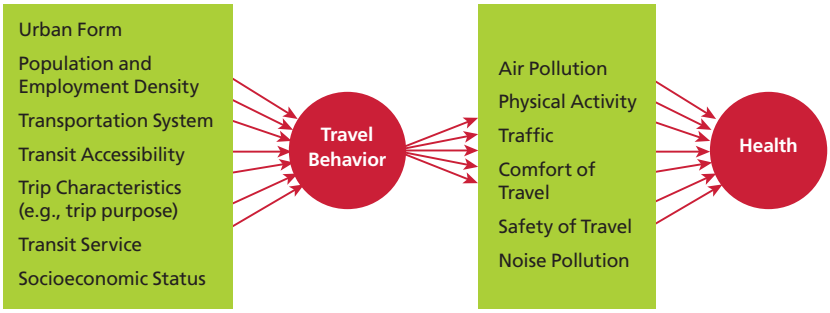

FIGURE 1 Associations between travel behavior and public health.

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PHOTO: DAN BURDEN, PBIC

Mixed-use residential and commercial areas encourage active transportation.

TRB STANDING COMMITTEE PERSPECTIVES

Transportation and Sustainability

Strengthening the Connections with Health

JOHN MacARTHUR AND MICHELLE OSWALD BEILER

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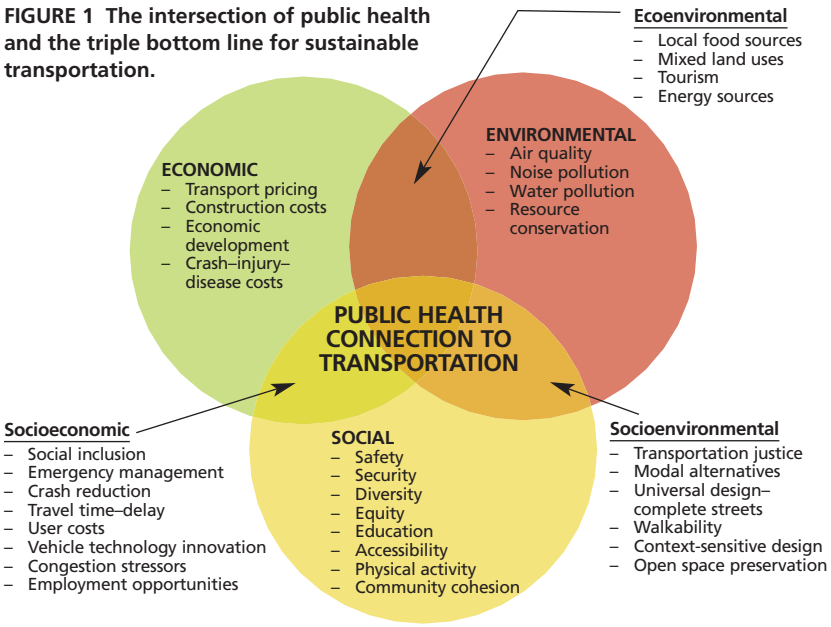
The mission of the TRB Standing Committee on Transportation and Sustainability is to advance the understanding of sustainability and to facilitate the development and implementation of research addressing transportation sustainability. Sustainability entails meeting the needs of current and future generations in terms of economic vitality, social equity, and a healthy environment—also known as the triple bottom line. The committee views sustainability as an overarching, holistic concept applicable for understanding and balancing the triple bottom line.

Promoting public health is a major component in achieving this balance. Moreover, parallels can be drawn between health and sustainability—both are complex and multidimensional concepts that require a holistic approach to balance trade-offs. Researchers and practitioners in the areas of sustainability and public health have many opportunities to collaborate and to learn from each other. Figure 1 (below) highlights some of the direct and indirect influences of transportation on public health in relation to the triple bottom line.

PHOTO: IPEK SENER, TTI

A multimodal roadway in Warsaw, Poland. Transportation sustainability and public health—both complex, multidimensional fields of inquiry—share many areas of research and practice.

FIGURE 1 The intersection of public health and the triple bottom line for sustainable transportation.



Social Sustainability

A recent focus is on the role of social sustainability in transportation equity, environmental justice, and public health. In the past, safety and air emissions were the highlighted health concerns, but the field of transportation now is emphasizing the importance of increased physical activity and expanded access to essential goods and services via nonmotorized modes. In addition, health equity plays a vital role in social sustainability. Understanding and addressing the ways that the social determinants of health affect low-income communities and communities of color is paramount in creating true sustainability.

Several recent reports from the National Cooperative Highway Research Program (*1*), PolicyLink (*2*), and the Volpe National Transportation Systems Center (*3*, *4*) have explored the integration of health considerations into the planning processes of metropolitan planning organizations and state departments of transportation. The findings have elevated the dialogue on health and transportation and have formulated

frameworks to assist in the integration of public health goals into transportation projects. Linking a range of disciplines to strengthen and elevate the role of public health in sustainability concepts and practices can improve the contributions of transportation systems in meeting society's future needs.

Emerging Research

Emerging research efforts are emphasizing social sustainability indicators, rating systems, planning tools, and context-sensitive designs that support public health. Public health–related metrics under development for transportation are focusing on physical activity, air quality, noise exposure, and accessibility for aging populations. These metrics are the foundation for rating systems and planning tools, such as the Sustainable Transportation Analysis and Rating System, or STARS[1]; the Infrastructure Voluntary Evaluation Sustainability Tool, or INVEST[2]; and Green Leadership in Transportation Environmental Sustainability, or GreenLITES.[3] These rating systems provide a framework for integrating health, safety, and social equity goals into the transportation planning process.

Rating systems and planning tools support and encourage the implementation of livability and sustainability goals through context-sensitive design, which is another topic for research and investigation. Planning and design that involve the public can lead to creative and equitable transportation investments.

Research Needs

Research needs include strengthening the connections between transportation and public health by quantifying the direct health benefits from sustainable transportation development—for example, evaluating short- and long-term costs and benefits to achieve multiple goals and outcomes under a sustainability planning framework; understanding the role that efficient and resilient corridors play in emergency management and first responses; quantifying the health benefits of walking and biking, especially for older adults and children; and addressing the impacts on vulnerable populations and their needs when creating more livable, vibrant, and resilient communities.

Another goal is to heighten the importance of health in decision making for transportation investments. As infrastructure systems support changes in urbanization and growth, prioritizing the health effects becomes an urgent need. How would an emphasis on social equity and health, equal to the emphases on the environment and economics, change transportation policy and practice?

In the next few years, the committee's calls for papers will focus on these topics, to strengthen the understanding and connections between public health and sustainable transportation. For more information about the activities of the Standing Committee on Sustainability and Transportation, visit www.trbsustainability.org.

[1] www.transportationcouncil.org/about-stars.
[2] https://www.sustainablehighways.org/.
[3] https://www.dot.ny.gov/programs/greenlites.

Photo: Willem van Bergen, Flickr

New York City's fire lanes run along the middle of the roadway. Well-planned and resilient corridors are vital for effective emergency response.

Photo: San Francisco Bicycle Coalition

Bicycle parking at a playground in San Francisco, California. Research is needed on the health benefits of walking and biking for children, the elderly, and other vulnerable populations.

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Image: Volpe Center

Developed by U.S. DOT's Transportation Planning Capacity Building program, this diagram shows the many topics that comprise a comprehensive approach to health.

TRB STANDING COMMITTEE PERSPECTIVES

Environmental Justice in Transportation

Addressing Adverse Health Effects on Minority and Low-Income Populations

ANNE C. MORRIS AND DAVID KUEHN

The authors are cochairs of the TRB Standing Committee on Environmental Justice in Transportation. Morris is Principal, Anne Morris and Associates, Columbia, South Carolina. Kuehn is Program Manager, Office of Corporate Research, Technology, and Innovation Management, Federal Highway Administration, McLean, Virginia.

The Transportation Research Board (TRB) Standing Committee on Environmental Justice in Transportation is intricately linked and aligned with public health issues. Two of the standing committee's five main research areas specifically address health:

- Research on the distribution of harmful human health or environmental effects of transportation programs, policies, and activities; and
- Research and development of improved methods and techniques for estimating and presenting the distribution of disproportionately high and adverse human health or environmental effects of transportation programs, policies, and activities.

Federal Focus

Executive Order 12898, signed in 1994, has focused federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The order directed federal agencies to develop environmental justice strategies to aid federal agencies in identifying and addressing the disproportionately high adverse effects of programs, policies, and activities on the health and the environment of minority and low-income populations.

The order has promoted nondiscrimination in federal programs that substantially affect human health and the environment and has provided minority and low-income communities with access to public information on matters relating to human health or the environment—as well as the opportunity for public participation in project and policy development and decision making. The Presidential Memorandum that accompanied the order underscored provisions already in U.S. laws intended to ensure that all communities and persons live in a safe and healthy environment.

The Executive Order on Environmental Justice received reinforcement from the subsequent and recently revised U.S. Department of Transportation Order 5610.2(a) and Federal Highway Administration Order 6640.23A. Aligning across various levels of governance, these policies identify and address the effects of a decision or set of activities on specific, affected populations that historically have been disadvantaged.

PHOTO: CLTPATHMAKER

A crossing near an Interstate offers no facilities for safe pedestrian activity. Low-income areas often lack bicycle- and pedestrian-friendly infrastructure.

Shaping the System

These policy directives make clear that the federal government acknowledges the larger body of nondiscrimination laws and identifies protections for low-income and minority populations. These policy inputs and the concrete actions by transportation and community planners, funding agencies, and others at the federal, state, and local levels have shaped the U.S. transportation system.

Although the system has been designed to move

people and goods efficiently, awareness of the impact that transportation systems have on the quality of life and on health is growing across communities. As a result, government and nongovernment agencies are seeking innovative policies and programs that promote health without diminishing the efficient transportation of goods and people.

Transportation policy has many opportunities to expand access to a variety of transportation options, to increase safety, and to integrate choices for improving health. The opportunities have the potential to save lives by preventing chronic diseases, reducing and preventing motor vehicle–related injuries and deaths, and improving environmental health while stimulating economic development and ensuring access for all.

Addressing Shortcomings

Aggressive programs are needed to address shortcomings within underserved communities. Members of these communities do not view walking and riding a bicycle as ways to get exercise, but as the only available mode of transportation to a job, medical care, school, or the store.

Moreover, many underserved communities lack the basic infrastructure for active transportation—paved sidewalks, shared-use paths, and safe roadway crossings. For many, safe pedestrian and bicycling connections to schools, public transportation, and public parks and recreation areas do not exist or may not be safe to use or may lack maintenance. Low-income neighborhoods often do not have street lighting, paved streets, and efficient drainage.

Photo: Stephen Lee Davis, Transportation for America

For many, the use of active transportation is dictated not by a desire for health but by its low cost compared with that of automobile ownership.

Even if the communities have some of these amenities, they may be located next to a busy, multilane, tolled highway; adjacent to a chicken evisceration plant; downwind from a chemical plant; or without food venues or hospital services. The TRB Standing Committee on Environmental Justice is working to stimulate, advise, disseminate, and apply research to address these kinds of public health–related issues and to improve evaluation tools and methodologies; for more information, visit https://sites.google.com/site/trbcommitteeadd50/.

Photo: Dan Burden, PBIC

Safe pedestrian access to schools is not available in all communities.

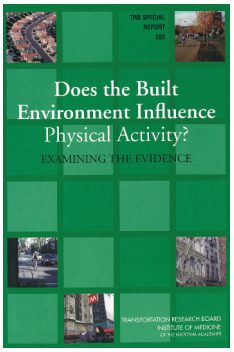
Collaborating in Transportation and Health Research

National Academies Program Units Share Expertise

Special Report 282, *Does the Built Environment Influence Physical Activity? Examining the Evidence*, was developed by TRB and IOM in collaboration at the request of the Robert Wood Johnson Foundation and the Centers for Disease Control and Prevention. For more information, visit www.trb.org/Publications/Blurbs/155343.aspx.

Facing page:
An interactive infographic based on a 2013 IOM workshop is designed to help decision makers apply a health lens to policy questions (http://resources.iom.edu/PopHealth/Health-Lens.html).

Part of the Institute of Medicine (IOM)—which with TRB is one of seven program units of the National Academies of Sciences, Engineering, and Medicine—the Board on Population Health and Public Health Practice (BPH) focuses on areas and issues affecting public health, from vaccine safety to environmental hazards and more. BPH and IOM have collaborated with TRB on many transportation-related activities:



◆ **Joint activities.** In 2005, a joint TRB–IOM committee produced a consensus report: Special Report 282, *Does the Built Environment Influence Physical Activity? Examining the Evidence*.

◆ **Transportation and land use–related workshops** have included the topics of design, health-focused decision making, and urban revitalization:

– Planners and sustainability experts convened at the Workshop on Bringing Public Health into Urban Revitalization, hosted by the IOM Roundtable on Environmental Health Sciences, Research, and Medicine in 2014. A conference summary will be released soon.

– Applying a Health Lens to Decision Making in Nonhealth Sectors was conducted in 2013 by the IOM Roundtable on Population Health Improvement. Featured speakers included Beth Osborne, then the U.S. Deputy Assistant Secretary of Transportation, and Ned Codd, Director of Project-Oriented Planning at the Massachusetts Department of Transportation. A workshop summary was published in 2014.[1]

– A 2014 paper, "Vitamins for the 21st Century: Valuing Design as a Tool for Prevention," prepared by IOM staff for the 2014 Design + Health summit meeting of the American Institute of Architects, presents research sponsored by the National Academies of Sciences, Engineering, and Medicine on the built environment, including transportation and land use.[2]

◆ **Current and future collaborations.** Staff at BPH currently are working with TRB staff on three projects:

– Planning for the Executive Committee session at the 2016 TRB Annual Meeting on public health and transportation;

– Participating in the TRB Public Health and Transportation Task Force, including preparation of a framing paper; and

– Interacting with TRB staff in the development of a prospectus and statement of task in response to a request from the Federal Transit Administration to help identify data sources and metrics pertinent to the Rides to Wellness program and other transit resources that support travel to health care appointments and services.

[1] http://iom.nationalacademies.org/reports/2014/applying-a-health-lens-to-decision-making-in-non-health-sectors.aspx.
[2] http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aiab104697.pdf.

(*Left to right:*) Nan Humphrey, TRB; Susan Hanson, Clark University; T. Keith Lawton, Metro, Portland, Oregon (retired); and Barbara Ainsworth, San Diego State University, participate in a 2004 meeting of the Committee on Physical Activity, Health, Transportation, and Land Use, which developed the findings and recommendations in Special Report 282.

LOOKING AT POLICIES THROUGH A HEALTH LENS

Good health doesn't start just at the doctor's office. **Where we live, learn, work, and play can influence healthy behaviors.**

While an individual can take steps to change her behavior—for example, to exercise more—it takes individuals and organizations working together to reshape the physical environment, such as through **policies** related to playgrounds and reliable public transit, to help **create healthy, vibrant neighborhoods.**

An Institute of Medicine workshop explored how **different sectors can work together** to advance their own aims **while supporting behaviors intended to lead to better health.**

WHICH POLICIES COULD HELP YOUR COMMUNITY PUT HEALTH ON THE MAP?

SEE HOW POLICIES CAN IMPACT HOW PHYSICALLY ACTIVE WE ARE:

1 TRANSPORTATION

Sidewalks, crosswalks, traffic lights and bike paths can increase kids' physical activity by allowing them to walk or cycle to school. For example, kids that walk or bike to school instead of being driven can get 16 more minutes of physical activity each day.[1]

Policy examples could include: land use planning, "complete streets" (e.g., with sidewalks, crosswalks), transit-oriented development.

2 SCHOOLS

Mandatory physical education classes can increase physical activity by about 23 minutes per day.[1]

Policy examples could include: integration of physical activity across the curriculum, school revitalization, school redesign (e.g., green playgrounds), "joint use agreements" (e.g., of school playgrounds).

3 ENVIRONMENT & PARKS

Being close to parks and walking trails—especially those with nice scenery—can increase people's level of physical activity.[2]

Policy examples could include: urban forestry, trails projects, air quality, water management and quality.

4 NEIGHBORHOODS

Neighborhoods where homes, stores, businesses, and recreational facilities are all close together are associated with increased walking.[2]

Policy examples could include: inclusionary zoning, affordable housing, economic development, mixed use development.

NOTE: This graphic lists statements and policy examples suggested by individual participants in a workshop hosted by the IOM Roundtable on Population Health on September 28, 2013. Statements, recommendations, and opinions expressed—other than those with source information (below)—are those of the individual participants and are not necessarily endorsed or verified by the IOM or the roundtable, and should not be construed as reflecting any group consensus.
SOURCES: [1] IOM. 2013. Educating the student body: Taking physical activity and physical education to school. [2] IOM (Institute of Medicine). 2005. Does the built environment influence physical activity? : Examining the evidence.

INSTITUTE OF MEDICINE
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Halting the Travels of Infectious Disease

Lessons Learned from the Ebola Epidemic

MARK GENDREAU

The author is Vice Chair of Operations, Emergency Services, Lahey Hospital and Medical Center, Burlington, Massachusetts, and Assistant Professor of Emergency Medicine, Tufts School of Medicine, Boston, Massachusetts.

On August 8, 2014, the World Health Organization (WHO) declared the epidemic of West African Ebola viral disease and the potential for international spread a "public health emergency of international concern." This declaration, only the third in WHO history, ignited an international response in accordance with the International Health Regulations treaty that nations have ratified to stem global infectious disease threats.

As of mid-January 2015, more than 21,000 cases of Ebola had been reported, with 8,300 deaths in Guinea, Liberia, and Sierra Leone. Although the epidemic is far from over, significant progress has occurred to break the chain of transmission, resulting from an increased capacity to isolate and treat stricken individuals, the implementation of safe burial practices, aggressive contact tracing, and good communication of the public risk.

Accelerated Contacts

The emergence and spread of the Ebola crisis and the challenges of bringing it under control illustrate the impact that large-scale outbreaks—wherever they may originate—can have on the world community. In the modern era, outbreaks and pandemics spread quickly and are almost impossible to contain because of the ease, speed, and frequency with which people and goods cross borders via shipping and air travel.

In 2014, for example, more than 3.3 billion passengers—equivalent to 42 percent of the world's population—and 50 million metric tons of cargo traveled by air from 41,000 airports along 50,000 routes worldwide. Traveling from one city or region of the world to another within 24 hours is now possible, and this amount of time is shorter than the incubation period for most contagious diseases. A traveler infected with a contagious disease therefore can pass

PHOTO: EMMANUEL TOBEY, UNMI

Two women pass a billboard raising awareness of the 2014 Ebola epidemic in Monrovia, Liberia. The quick spread and high mortality rates of the Ebola virus caused the World Health Organization to declare an international public health emergency. Liberia was pronounced Ebola-free in September 2015.

PHOTO: ASIAN DEVELOPMENT BAN

Travelers at Suvarnabhumi, Thailand's main international airport. The ease and frequency of global travel and shipping pose a challenge for the containment of epidemics.

through the entry and exit screenings at an airport and reach the destination or arrive home days before the symptoms appear.

Response Measures

The Ebola epidemic is remarkable because the virus is very lethal, with mortality as high as 50 to 60 percent, despite the low transmission. This has created a negative psychological impact worldwide and has resulted in measures that many health authorities have criticized as counterproductive—for example, trade bans, entry restrictions, discontinued or modified flights to and from the affected regions, and quarantines on asymptomatic, low-risk aid workers returning home from Ebola hotspots.

These measures led to unintended economic, humanitarian, and public health consequences by slowing the influx of aid workers and supplies and by impeding efforts to control the outbreak at the region of origin. For example, since the start of the Ebola epidemic, annual air travel seat capacity and flight frequencies from the three international airports in West Africa have decreased by 64 percent, and economic growth has halted in the affected nations.

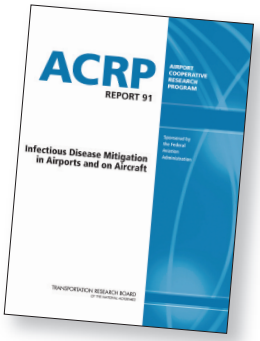
A growing body of evidence from epidemiological modeling studies suggests that discontinuing or restricting commercial flights has little effect on the spread of epidemics or pandemics from novel infectious agents. Moreover, limiting or canceling nonessential internal travel, including restricting or closing mass transit systems and motorways, remains impractical, impossible, and understudied. For example, the United Kingdom's 2007 Pandemic Plan pointed out that a 60 percent reduction in all travel, including commuting to work, would only result in reductions of 5 percent to 10 percent in the national peak incidence for pandemic influenza.

One study showed that imposing a 90 percent restriction on all air travel would delay the peak of a pandemic wave by no more than 1 to 2 weeks; rapidly halting almost all air travel out of an affected area, however, would delay the pandemic wave for several weeks. Although the discontinuation of air travel would buy time for additional preparations, the global economic consequences would be severe and unsustainable.

Many countries have imposed exit and entry screenings on passengers from Ebola hotspots through health questionnaires, visual inspections, and thermal scans for fever. Previous experience with passenger screening at airports during the 2002–2003 epidemic of severe acute respiratory syndrome, or SARS, and during the 2009–2010 influenza H1N1 pandemic, however, demonstrates that these measures are relatively ineffective in identifying infectious individuals and have little value in containing large-scale outbreaks and pandemics.

New Strategies

As with many of the emergent diseases in the past decade, the challenge of the Ebola epidemic in West-



ACRP Report 91 offers guidance for mitigating the spread of disease in airports and on aircraft.

Photo: Martine Perret, UNMEER

A nurse puts on personal protective equipment before entering a secure Ebola treatment unit in Grand Cape Mount, Liberia. A sharp reduction in travel to West Africa in the wake of the epidemic reduced the numbers of aid workers and had other counterproductive consequences.

ern Africa highlights the need for a new strategy to address emerging infectious disease threats of international concern and pandemic potential. The main lesson is to shift from a strategy of containment or reaction to a principally proactive or mitigating approach. This should include strengthening the global surveillance of human and animal diseases in emerging hotspots of infectious diseases, greatly improving the global public health infrastructure, and expanding the capacity for vaccine development and production worldwide.

The transportation industry plays a pivotal role in mitigating the threat of infectious diseases. The International Civil Aviation Organization. in partnership with WHO, the International Air Transport Association, the Airports Council International, and other stakeholders, recently established aviation industry guidelines for operations during outbreaks of a communicable disease, such as pandemic influenza, to minimize the spread by commercial air travel.

The guidelines call for risk communication to the traveling public, the establishment of command and control systems, the consideration of airport screening, and increased preparedness by airports and airlines for handling in-flight illness and for cleaning and disinfecting aircraft. In 2013, the Airport Cooperative Research Program published practical guidance for mitigating the risk of disease spread at airports and aboard aircraft.[1]

The late Joshua Lederberg, a Nobel laureate, wrote: "The microbe that felled one child in a distant continent yesterday can reach yours today, and seed a global pandemic tomorrow." If such lessons are to be heeded, global strategies to enhance the surveillance, prevention, and mitigating capabilities in all nations will be required to face the challenges of novel microbial threats.

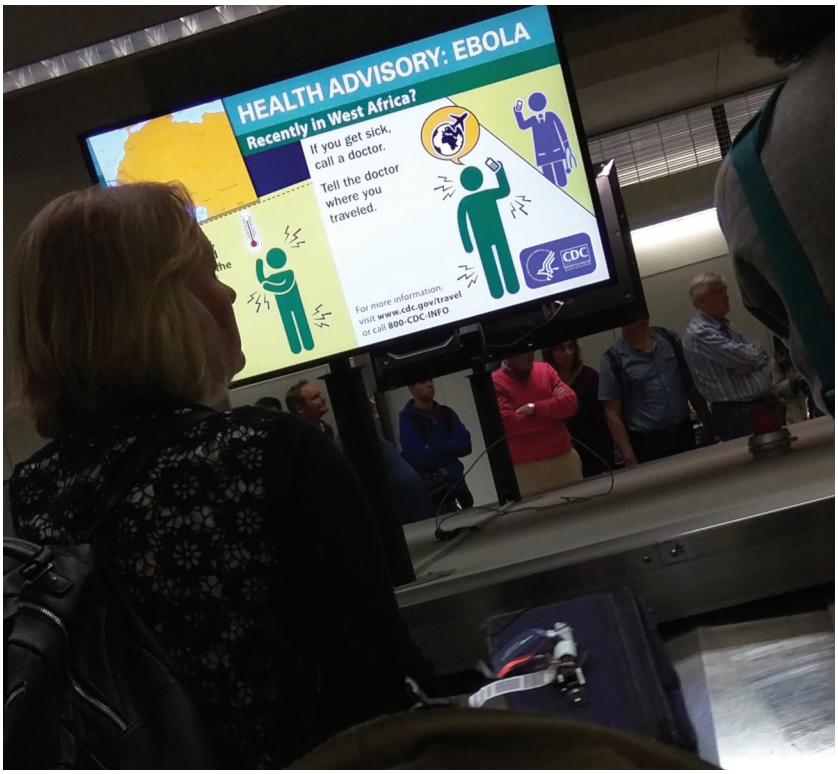


Photo: Cory Doctorow, Flickr

Many countries have implemented disease screenings at airport exit and entry points.

[1] *ACRP Report 91: Infectious Disease Mitigation in Airports and on Aircraft*, www.trb.org/Publications/Blurbs/169466.aspx.

Modeling the Risk of Infectious Disease Spread Through Transport Systems

Emerging Research

LAUREN M. GARDNER

Infectious diseases pose an increasing risk to humans. The growing world population, densely settled urban environments, and highly connected global transport systems together provide the necessary groundwork for a global epidemic.

Before modern transportation networks, natural barriers limited certain diseases to specific geographic regions. Contemporary global transportation systems, however, have connected previously isolated regions, providing a means for pathogens to move around the globe faster and farther than ever before.

PHOTO: ISAAC MAO, FLICKR

Health workers board a plane at Shanghai Pudong International Airport to check for swine flu.

In addition, a rise in the volume of international air travel has increased the likelihood of infections imported by travelers into new regions, and growing urban populations and increased levels of contact have heightened the likelihood of outbreaks within local populations. The 2009 H1N1 pandemic, the H5N1 and H7N9 avian influenzas, SARS or severe acute respiratory syndrome, MERS-CoV or Middle East respiratory syndrome coronavirus, and Ebola, among others, have intensified concerns about possible severe global outbreaks of emerging infectious diseases.

For these reasons, the development of models that can guide public health authorities in implementing real-time containment and control strategies is imperative. Information available from organizations such as the World Health Organization—including case reports, epidemiological and clinical characteristics, and laboratory testing—can assist in disease control and surveillance efforts in real time. Novel methods are needed, however, to exploit these data to provide policy recommendations for controlling outbreaks of infectious diseases.

The development of Gleamviz, the Global Epidemic and Mobility Model,[1] and of VBDair, the vector-borne disease airport importation risk tool,[2] for example, represent steps in addressing the challenges. These tools can be applied at a global level to identify high-risk airports or air travel routes and can aid public health authorities in decisions about implementing passenger surveillance and control strategies.

Analogous models that can quantify the risk of infection through public transport systems at the local level are in demand, and represent an emerging research topic. Further research is needed to strengthen the mathematical modeling of epidemiological risk assessment by developing methodologies that incorporate real-time case reports, mobility data, and multimodal transportation systems into an integrated risk modeling framework.

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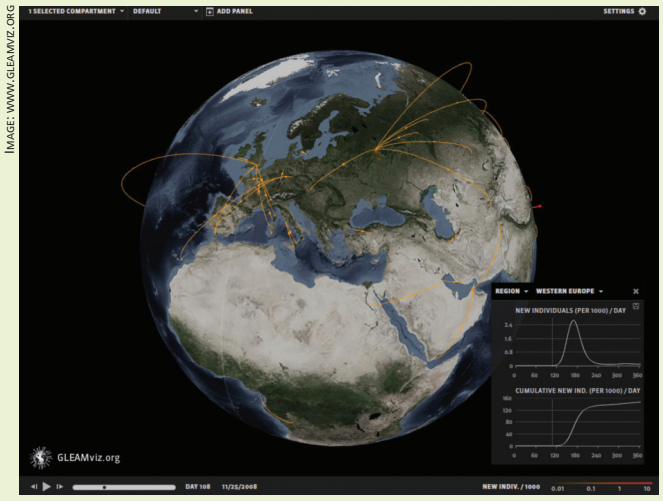


IMAGE: WWW.GLEAMVIZ.ORG

Gleamviz allows users to visualize the spread of the infection on an interactive 3-D globe.

[1] www.gleamviz.org/.

[2] www.vbd-air.com/.

Getting Rid of Unwelcome Transit Riders

IDEA Project Develops Device to Halt Airborne Pathogens

LEE HUSTON AND JON WILLIAMS

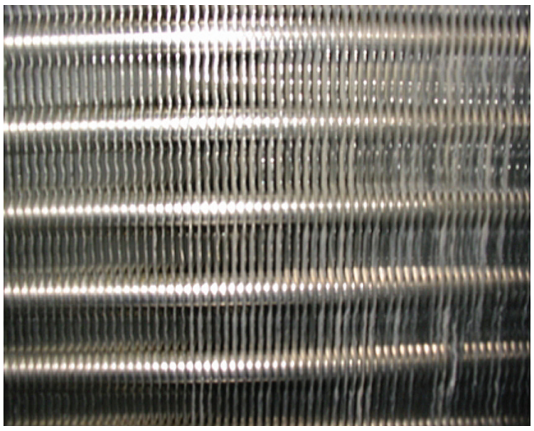
Huston, who died in June 2015, was President of JKA Company, Venice, Florida, and was the inventor of the Breath Safe ultraviolet germicidal irradiation filter for transit vehicles. Williams is Program Director, IDEA and Synthesis Studies, Transportation Research Board, Washington, D.C.

A recent scientific study found that bus ridership is a risk factor for the transmission of tuberculosis (TB). The study stated that "in a shared environment with no mode of air filtration, ... TB droplet nuclei are resistant to gravitational forces and can be sustained in air for up to 9 hours" (*1*). The same study noted that ultraviolet germicidal irradiation (UVGI) can eradicate the airborne pathogens associated with TB.

The Transportation Research Board's Transit IDEA program, which funds high-risk, high-payoff inventions that may not be candidates for usual government research programs, awarded a grant to Lee Huston for the development of an invention to clean viruses, bacteria, and mold from the air in transit buses by harnessing a UVGI device to the vehicle's air conditioning system.[1] The Metropolitan Transit Authority of Houston, Texas, lent 14 in-service buses for a 6-month test of the device, now known as Breath Safe.

PHOTOS COURTESY JON WILLIAMS

Breath Safe, the ultraviolet germicidal irradiation (UVGI) device developed with a grant from TRB's Transit IDEA program, removes pathogens from recirculated bus air; the device also removes the mold that builds up on air conditioner evaporators. An evaporator on a bus before (*above*) and after (*below*) the installation of a UVGI device.



Workings and Benefits

Ninety percent of disease is spread airborne. The average person breathes 10,000 quarts of air per day. When a person infected with a disease sneezes, approximately 4,000 contaminated droplets are released into the air; on a bus, the air conditioning system will receive and recirculate the droplets around the other passengers on board. The ventilation system recirculates the air within a mass transit vehicle five to nine times per hour.

The invention of the UVGI device was the accidental result of a search for air systems that could enhance the interior of a bus. Ultraviolet light offered the advantages of removing odors and of killing the bacteria and germs that are distributed by air conditioning systems.

Ultraviolet light has three light spectra. The first two are used by tanning salons and in hospitals. The third spectrum of 254 nanometers irradiates and kills harmful pathogens. Laboratory tests of the UVGI device on the Houston transit system found a 99 percent reduction in pathogens that cause such diseases as tuberculosis, influenza, pneumonia, and Legionnaires' disease.

[1] Transit IDEA J-04, IDEA 53, http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2262.

Harnessing the UVGI systems to transit bus air conditioning has a collateral benefit—the system cleans the mold that typically builds up on the air conditioner evaporators (see photographs, page 44). Cleaning the mold and debris is expensive and time-consuming for bus transit companies. Using the UVGI can save a company approximately $2,300 in mold-cleaning costs over 2 years—a favorable payback on the investment. Moreover, cleaner air conditioning equipment translates to higher mileage per unit of fuel—an additional savings for the transit operator.

Transit Companies Respond

Transit bus companies have responded to the promises that the UVGI equipment will provide cleaner, healthier air for riders and will lower air conditioner maintenance and fuel costs:

- DART, in Dallas, Texas, which has 468 buses and more expected for delivery this year and in 2016;
- PACE, in Chicago, Illinois, which has placed the UVGI units on 20 compressed natural gas buses and plans to install 71 more units this year;
- Mears Transportation, in Orlando, Florida, which operates 86 buses for Disney World and Disney Cruise Line, as well as 17 trolleys for the International Drive district;
- Fort Worth Transit, Texas, which has 16 buses with the UVGI unit and plans installation on 59 vehicles in the next year; and
- Palm Beach Palm Tran, Florida, which plans to equip 100 buses.

Demonstration buses are undergoing tests in Indianapolis, Indiana; Cleveland, Akron, and Cincinnati, Ohio; Lansing, Grand Rapids, and Flint, Michigan; San Antonio, Texas; and San Diego, California.

Photo: Fort Worth Transportation Authority

Passengers on a bus run by Fort Worth Transportation Authority in Texas, which uses UVGI devices on its buses.

Editor's Note: Lee Huston's family intends to continue the work of producing Breath Safe, including servicing customers and expanding use to additional transit service providers. http://www.jkaco.com/.

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The Transit IDEA program continues to seek out and fund high-risk, high pay-off inventions. Information on how to apply is available at www.trb.org/IDEAProgram/IDEATransit.aspx or contact Jo Allen Gause, Project Manager, 202-334-3826, jagause@nas.edu.

Photo: DART

In Texas, 468 Dallas Area Rapid Transit buses are equipped with UVGI devices, with more to come.

TRB Publications Related to Transportation and Public Health

Select Titles, 2010–2015

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A Guide for Public Transportation Pandemic Planning and Response, National Cooperative Highway Research Program (NCHRP) Report 769, 2014; 56 pp. Available at www.trb.org/Main/Blurbs/170529.aspx.

Guidebook for Advancing Collaborative Decision Making at Airports, Airport Cooperative Research Program (ACRP) Report 137, 2015; 78 pp. Available at www.trb.org/Publications/Blurbs/172799.aspx.

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Improving Mobility for Veterans, TCRP Research Results Digest 99, 2011; 99 pp. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rrd_99.pdf.

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Using Pictograms to Make Transit Easier to Navigate for Customers with Communication Barriers, TCRP Web Document 59, 2012; 99 pp. Available at www.trb.org/Main/Blurbs/168841.aspx.

Worker Health and Safety on Offshore Wind Farms, Special Report 310, 2013; 128 pp. Available at www.trb.org/Main/Blurbs/168713.aspx.

Assessing Active Transportation and Health

Conference Highlights Innovative Practices and Research

ROBERT SCHNEIDER, ELOISA RAYNAULT, AND RALPH BUEHLER

Schneider is Assistant Professor, Department of Urban Planning, University of Wisconsin, Milwaukee, and Chair of the TRB Standing Committee on Pedestrians. Raynault is a consultant based in Seattle, Washington, and Cochair of the TRB Joint Subcommittee on Transportation and Health. Buehler is Associate Professor, Urban Affairs and Planning, Virginia Polytechnic Institute and State University, Alexandria, and Chair of the TRB Standing Committee on Bicycle Transportation.

More than 120 people—the maximum capacity—attended the conference, Moving Active Transportation to Higher Ground: Opportunities for Accelerating the Assessment of Health Impacts, in Washington, D.C., on April 13–14. The Transportation Research Board's Standing Committees on Bicycle Transportation and on Pedestrians organized the conference, working with the Joint Subcommittees on Health and Transportation and on Bicycle and Pedestrian Data and in collaboration with the American College of Sports Medicine (ACSM), an association of sports medicine, exercise science, and health and fitness professionals with more than 50,000 members worldwide.

The conference featured presentations by leading practitioners and researchers in urban planning, engineering, public health, health care, and health economics from the United States, Canada, and Europe.[1] Twenty sessions and workshops provided opportunities for those working on the connections between active transportation—walking and cycling—and public health to share emerging research, network with peers across disciplines, and identify research gaps and next steps for practice and research.

[1] Presentations are available on the conference website, www.cvent.com/events/moving-active-transportation-to-higher-ground-opportunities-for-accelerating-the-assessment-of-healt/custom-18-93088f3956b14c00a4032867ccbc3965.aspx.

PHOTO: RALPH BUEHLER

Keynote speakers at the Active Transportation conference were (*left to right*) Bryna Helfer, U.S. DOT; James Sallis, University of California (UC), San Diego; Audrey de Nazelle, Imperial College London; and Susan Handy, UC Davis.

PHOTO: IPEK SENER, TTI

Pedestrians, cyclists, and drivers share a busy road in London. Speakers and attendees from around the globe participated in a TRB conference on active transportation in April.

Challenges from Keynote Speakers

Keynote speakers were Bryna Helfer of the U.S. Department of Transportation; Susan Handy of the University of California, Davis; James Sallis of the University of California, San Diego; and Audrey de Nazelle of Imperial College London. Their presentations highlighted a shift in the focus of transportation planning, from facilitating the movement of cars to pursuing policies that emphasize walking, cycling, and livability. The public health community has supported this shift by emphasizing the importance of increased physical activity through active transportation and the prevention of injuries.

Each of the keynote speakers described opportunities and challenges, such as collecting data that can

- Show the effects of infrastructure improvements and other approaches on active transportation;
- Support evaluations of the effectiveness of active transportation policies, especially in low-income and minority communities;

Jennifer Dill, Portland State University, moderates a session on Advances in Measurement and Analysis.

◆ Lead to reductions in harmful air quality impacts for pedestrians and cyclists in cities with high levels of pollution;

◆ Help overcome decades of car-centric transportation planning and technological changes that have removed physical activity from daily life; and

◆ Engage elected officials and decision makers in promoting active transportation.

Exploring Initiatives

Breakout sessions and poster presentations explored the conference's main themes: policy and planning initiatives to increase active transportation, health impact assessments (HIAs), data collection and data analysis to quantify active transportation, and methods to forecast active transportation and its effects on health. Highlights included the following:

◆ Policy and planning sessions emphasized that active transportation plans support both personal and public health, that the health outcomes of transportation projects should be evaluated, that walkability metrics relate to physical activity levels, and that zoning codes can affect active commuting.

◆ Data collection and analysis sessions highlighted the capability of automated counting technologies to document walking and bicycling patterns by hour, day, and season; a combination of automated and manual methods to establish robust pedestrian and bicycle counting programs; panel surveys to assess the stability of personal active transportation habits over time; online surveys that capture positive and negative experiences while bicycling; parent surveys to document perceived barriers to walking and bicycling to school; online web maps to collect citizen-reported bicycle crash incidents; and automated video image processing to detect conflicts between pedestrians, bicyclists, and automobiles.

◆ Assessment tool sessions featured critical evaluations of the opportunities and constraints of practical methods such as HIAs, the Health Economic Assessment Tool, and Integrated Transportation and Health Impact Modeling.

◆ Forecasting sessions proposed methods to integrate pedestrian trips into regional travel models, estimate pedestrian and bicycle travel at the state level, and use an accessibility measure to help predict walking and bicycling at the neighborhood and corridor levels.

Topics for Research

Attendees gained a greater understanding of the state of the practice but also recognized the need for more research to assess the health impacts of active transportation. The conference raised awareness of research needs, and the closing town hall session suggested many topics, including the following:

◆ What is the optimal geographic scale for analysis? How can research into other locations or across geographic scales—international, national, regional, or local—be leveraged?

◆ How can the travel needs of diverse users be measured and the results applied for better health outcomes?

◆ What terminology is most effective in communicating strategies and solutions that promote health through transportation changes? For example, should a report refer to access or to mobility, to injury prevention or to safety? Effectively targeted language can establish and guide policies based on research findings.

◆ How can data collection be improved to gather information about physical activity not related to transportation that may serve as a proxy for active transportation?

◆ Which variables should be collected consistently for pedestrian and bicycle counts so that the data can be shared easily between agencies and communities?

◆ What are the advantages and disadvantages of

How to Connect with the Public Health Community

Following is a list of several organizations and groups for transportation and planning professionals who want to connect with the public health community:

◆ The National Association of County and City Health Officials, www.naccho.org/, which includes a web page listing local health departments, www.naccho.org/about/lhd/;

◆ The Association of State and Territorial Health Officials, www.astho.org/;

◆ The American Public Health Association, www.apha.org/;

◆ The Centers for Disease Control and Prevention, which maintains a website on transportation-related topics, www.cdc.gov/transportation/;

◆ The American Planning Association's Healthy Communities Interest Group, which addresses a range of issues at the intersection of health and planning, www.planning.org/nationalcenters/health/interestgroup.htm; and

◆ The TRB Health and Transportation Subcommittee, which offers a variety of ways to connect with public health professionals working on transportation issues, including Twitter, @TRBhealth; the Subcommittee's listserve; Facebook; and LinkedIn—learn more at www.trbhealth.org/.

—Eloisa Raynault

implementing household travel surveys to collect pedestrian and bicycle movements with GPS tracking from personal mobile devices?

◆ How can travel demand models become more responsive to policies that may influence walking and bicycling—for example, to land use changes that affect convenience, to infrastructure changes that affect perceived safety, or to pricing changes that affect relative cost?

◆ What is the best way to quantify the value of years of life lost because of physical inactivity?

◆ Can the effects of mode, distance, intensity, and frequency be quantified in terms of mortality, chronic diseases, injuries, fatalities, and quality of life and be incorporated into the context of a local HIA?

◆ Are data sources available to apply or adjust estimates of effects in the context of a local HIA? For example, do travel surveys, factored pedestrian and bicycle counts, and demand model estimates allow the development of locally accurate estimates of mortality, chronic diseases, injuries, fatalities, and quality of life?

◆ What funding opportunities are available or forthcoming to advance the knowledge of the relationship between active transportation and improved health outcomes? What organizations in the public health sector and in the transportation sector are investing in this field?

Milestone Conference

Moving Active Transportation to Higher Ground was a milestone conference, convening academics and practitioners from the transportation and health fields. Sessions generated a high level of energy and discussion—most continued beyond the scheduled end times. A suggestion by Sallis in the opening keynote session that audiences offer a standing ovation after each presentation became an exhilarating tradition throughout both days of the conference, demonstrating participants' appreciation and a commitment to integrate physical activity into daily routines. The levels of energy and success at the conference promise follow-on programs in the next few years.

Moving Active Transportation to Higher Ground: Opportunities for Accelerating the Assessment of Health Impacts

Conference Planning Committee

Ralph Buehler, Virginia Tech, *Chair*
David Bassett, University of Tennessee–Knoxville
Paula Burkert, American College of Sports Medicine
Sean Co, Metropolitan Transportation Commission
Jennifer Dill, Portland State University
Thomas Götschi, University of Zurich
Janet Rankin, Virginia Tech and American College of Sports Medicine
Eloisa Raynault, Consultant
Robert Schneider, University of Wisconsin–Milwaukee
Elizabeth Stolz, Ready4Wellness, LLC
Meghan Winters, Simon Fraser University

Transportation Research Board Staff

Bernardo Kleiner, Transportation Safety Specialist
Mary Kissi, Senior Program Associate
Freda Morgan, Senior Program Associate

Related Conferences and Events

2015

November 6–9, American Society of Landscape Architects Annual Meeting and Expo, Chicago, Illinois
November 11–13, Disrupting Mobility: A Global Summit Investigating Sustainable Futures, Cambridge, Massachusetts
November 13–14, Oklahoma Bike Summit, Stillwater
November 16–18, 8th International Urban Design Conference, Brisbane, Australia

2016

January 10–14, Transportation Research Board 95th Annual Meeting, Washington, D.C.
January 14–16, Vision Zero for Cities Symposium, New York, New York
January 31–February 3, Active Living Research 2016, Clearwater Beach, Florida
April 5–7, Safe Routes to School National Conference, Columbus, Ohio
June 28–July 1, World Congress on Active Aging 2016, Melbourne, Australia

—Eloisa Raynault

Gregory P. Benz

WSP–Parsons Brinckerhoff

For more than 35 years until his semiretirement in June, Gregory Benz worked as a transportation planner and project manager, focusing on public transit services and high-volume pedestrian facilities. As senior vice president and principal project manager and principal professional associate at WSP–Parsons Brinckerhoff (WSP-PB), Benz managed the Purple Line light transit rail project in metropolitan Washington, D.C. He shepherded the project through the alternatives analysis, draft and final environmental impact statements, and engineering and record-of-decision phases—as well as into the procurement process and the public–private partnership.

Benz also served in corporate leadership roles at WSP-PB, including as global director of career development and chair of the Career Development Committee. In these roles, Benz used his project experience to develop learning tools that are used by WSP-PB employees nationally and internationally. He developed training for public- and private-sector professionals and helped create the National Transit Institute's training program for major investment studies; the program has been presented to more than 1,200 participants. WSP acquired Parsons Brinckerhoff in 2014, and since then Benz has helped to integrate the career development, knowledge exchange, and technical excellence programs of the two firms.

"Look for a readily applicable research outcome, engage with the potential audience for your research, and have a dissemination plan."

At WSP-PB, Benz has focused on strategy development, service and operations planning, design, operations and maintenance and capital cost estimating, travel market analysis, and environmental assessment and has contributed to more than 60 multimodal alternatives analyses involving major transportation corridors. He has helped shape projects across nearly all modes, from bike trails to highways to automated people movers to ferries.

Notable projects that are now in operation include three extensions of the Baltimore Central Light Rail Line in Maryland; the Atlanta MARTA North Line in Georgia; the Washington, D.C., Metrorail Blue Line extension; and the first light rail transit line downtown to the Astrodome in Houston, Texas, which was completed in less than a year. As a planner for the Port Authority of New York and New Jersey, Benz was involved in Federal Transit Administration–sponsored analyses for access to John F. Kennedy International Airport. He also served as the project manager for a six-corridor transitional alternatives analysis for Dade County, Florida, and as the program advisory manager for a $3.5 billion transit system capital program in Charlotte, North Carolina.

After graduating with a bachelor's degree in architecture from the University of Notre Dame and a master's degree in urban planning from Princeton University, Benz worked on a passenger station flow simulation model at Princeton. "That started my career-long interest in pedestrian and passenger flow research and in the development and application of analysis and simulation tools," he recalls.

At a TRB committee meeting in the early 1980s, Benz commented on the limitations of current tools for measuring the time needs of pedestrians, along with their physical space needs. This led to collaboration with Jack Fruin to develop the pedestrian time–space concept and apply it to transportation facility design. "TRB has been the catalyst for the development and dissemination of this type of research," Benz observes.

In 1985, he received the inaugural William Barclay Parsons Fellowship for the pedestrian time–space concept, which still is widely cited and has since been applied to many transportation and crowd management situations. For prospective fellows—and all new researchers—Benz recommends choosing manageable research programs and avoiding an excessive focus on data collection. "Look for a readily applicable research outcome, engage with the potential audience for your research, and have a dissemination plan," he comments.

Benz joined TRB's Standing Committee on Intermodal Transfer Facilities in 1980. He served as chair of the committee from 1992 to 1998 and was appointed emeritus member in 2007. He also was a longtime member of the Standing Committees on Pedestrians, on Light Rail Transit, and on Rail Transit Systems. He currently serves on the Task Force on Mastering the Management of Transportation Research and Training Program.

From 2007 to 2014, Benz and Chandra Bhat of the University of Texas cochaired the Standing Committee on Transportation Education and Training. For several years they organized Annual Meeting transportation training workshops, which culminated in the National Transportation Workforce Summit in 2012. "Having committee cochairs not only helps to manage the committee work, but one chair from the academic research field and one from industry research and development helped unite theory and application," Benz notes.

Antony F. Opperman

Virginia Department of Transportation

When he first entered the workforce, Antony F. (Tony) Opperman could not have predicted a career in transportation. As an undergraduate at the College of William and Mary in Williamsburg, Virginia, he studied anthropology and early in his archaeological career focused on Native American and Colonial European topics, centered around the Chesapeake Bay area. "It was not necessarily a trajectory that would have led me automatically into the transportation field," he observes.

In 1982 Opperman joined MAAR Associates, Inc., in Williamsburg, as research associate and branch manager; there, he directed cultural resource studies and represented clients with state and federal regulatory agencies. "A series of fortunate events led me first to be a consultant working on transportation projects and then to being employed by the Virginia Department of Historic Resources (VDHR) reviewing transportation projects," he recalls. At VDHR, Opperman also maintained a statewide archaeological inventory—an aspect of his work that he eventually would revisit, but in a transportation context.

"At Virginia DOT we take our job seriously to achieve a balance between the public values of environmental work, historic preservation, and transportation."

Working in the regulatory field, Opperman experienced firsthand a need to streamline and digitize the vast amounts of paperwork generated and exchanged in environmental and cultural resources data collection and project coordination. In late 1993, he accepted an appointment as cultural resources program manager at the Virginia Department of Transportation (DOT)—a position he has held for the past 22 years.

"Looking back, I could have told myself this all along: if you are working in the environmental, historic preservation, or cultural resources disciplines, oftentimes you can have more positive influence in public works than you ever would as an academic or as a regulator," Opperman comments.

Virginia DOT oversees a wide scope of projects—unlike some state DOTs, the agency administers secondary roads as well as Interstate and primary roads, encompassing nearly 60,000 miles of highway. As a result, historic preservation often is crucial to balancing Virginia's transportation needs and historic preservation interests. The role of a DOT in historic preservation typically goes unheralded, but years of collaboration between Virginia DOT and VDHR have led to a strong cooperative relationship between the two agencies, Opperman notes. "We take our job seriously to achieve a balance between the public values of environmental work, historic preservation, and transportation," he comments.

"Transportation agencies have become appropriately adept at avoiding or minimizing harm to the environment or to historic resources," Opperman notes, adding that such efforts are of mutual benefit to preservation interests and to DOTs: "Frankly, it helps us get projects on the street faster."

Beginning in the early 1990s, when Opperman transitioned from the regulatory side to public works, he spurred a large-scale effort to transform Virginia's historic resource inventory from paper to electronic records and, eventually, to a web-enabled system essential for efficient coordination of transportation projects between Virginia DOT and VDHR. That model influenced the development of an even larger-scale environmental management system that Virginia DOT still uses today and that is recognized as one of the best in the nation. "I'm fortunate to have had the ability to play an important role in these efforts over the last two decades," Opperman comments.

In 1999, then-chair Kate Quinn encouraged Opperman to join the Standing Committee on Historic and Archaeological Preservation in Transportation. His tenure on the committee lasted 15 years and included service as program coordinator, communications coordinator, and committee chair. He cites the work of the committee—applied research that ranges from ways to increase regulatory efficiency, to determining historic significance, to managing and rehabilitating historic bridges—as some of the most satisfying of his career.

Opperman serves as the communications coordinator for the Planning and Environment Group and is a member of the National Cooperative Highway Research Program (NCHRP) Project Panel on Research for the American Association of State Highway and Transportation Officials Standing Committee on the Environment, also known as NCHRP Project 25-25. He helped compose one of several problem statements that led to NCHRP Report 723, *A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing*. He also has written several research needs statements that have been completed as tasks in NCHRP Project 25-25.

"Transportation research really opens your perspective," he comments. "It gives you a national and an international perspective that you won't necessarily get just plugging away at work."

RESEARCH PAYS OFF

Pavement Recycling

An Effective Reuse of Resources

BRIAN K. DIEFENDERFER AND ANN M. OVERTON

The authors are with the Virginia Transportation Research Council, part of the Virginia Department of Transportation, Charlottesville. Diefenderfer is Senior Research Scientist, and Overton is Communications Manager.

High volumes of heavy traffic combine with the elements to exact a substantial toll on the nation's highways. The implementation of findings from research on pavement recycling, however, can increase the service life of roads and can reduce the costs and environmental impacts of paving.

In 2011, the Virginia Department of Transportation (DOT) addressed the deterioration on a 3.7-mile section of Interstate 81 with pavement recycling. The techniques involved a series of processes to reuse the materials from the asphalt pavement during the rehabilitation or reconstruction. The benefits included reductions in the consumption of raw materials, in the greenhouse gas emissions, and in the costs of preservation, maintenance, and rehabilitation (*1*).

Problem

Mostly built in the late 1960s, Interstate 81 in Virginia carries a high percentage of truck traffic—20 to 35 percent. Virginia DOT has maintained the driving surface routinely by patching deteriorated sections and by milling and replacing surface layers. These treatments, however, do not address structural deterioration and, as a result, do not always provide long-term solutions.

Fatigue cracking in the two southbound lanes of Interstate 81 near Staunton had allowed water to seep into the base layers and to weaken the pavement structure. This compromised the original foundation of compacted aggregate and clayey soil, which no longer provided a stable base for the asphalt layers.

In addition, the asphalt layers within the pavement structure had debonded and no longer served as a monolithic structure to support the high volumes of traffic. The right lane was in worse condition than the left lane, because the right lane carries most of the nearly 6,500 trucks that use this stretch of Interstate 81 every day.

Years of surface repairs had addressed only the symptoms of the deterioration and had masked the structural problems. Virginia DOT needed to find a cost-effective rehabilitation strategy to address the causes of the deterioration.

PHOTO: VIRGINIA DOT

Cold in-place recycling on Interstate 81, Virginia.

PHOTO: VIRGINIA DOT

Full-depth reclamation on Interstate 81.

Solution

Virginia DOT reconstructed the deteriorated section of Interstate 81 with three pavement recycling processes:

- Cold in-place recycling,
- Cold central-plant recycling, and
- Full-depth reclamation.

Virginia DOT determined that these techniques would best alleviate the causes of the deterioration, require less construction time, be better for the environment, and prove cost-effective. This became the first Interstate rehabilitation project to use the three pavement-recycling methods together.

Different treatments were applied to the right and left lanes because the location and extent of the deterioration were not the same. In the right lane, the deterioration consisted of debonded asphalt layers and fatigue cracking that extended throughout the bound layers. The deterioration in the left passing lane also included debonded asphalt layers and cracking that originated from within the bound layers and progressed to the surface. As the project began, Virginia DOT initiated a study to document the construction processes and the early pavement performance after construction.

Pavement Recycling

Virginia DOT's contractor completed construction on the right lane using full-depth reclamation and cold central-plant recycling. The full-depth reclamation pulverized, stabilized, and compacted in place the bound layers and a predetermined portion of the unbound materials (see photo, above).

These steps corrected severe structural deficiencies and defects deep within the pavement's substructure. In this project, the full-depth reclamation stabilized materials 12 to 22 inches below the surface. A combination of lime kiln dust and hydraulic cement served as the stabilizing agent.

Cold central-plant recycling processed the asphalt milled from the roadway's top layers at a mobile plant near the project. After the processing (see photo, below), the contractor applied traditional paving practices to place the recycled material in two layers totaling 6 to 8 inches, depending on the location. The layers of recycled material were paved on top of the base materials placed during the full-depth reclamation process. The cold central-plant recycling material used foamed asphalt and hydraulic cement as the recycling agents.

PHOTO: VIRGINIA DOT

Cold central-plant recycling.

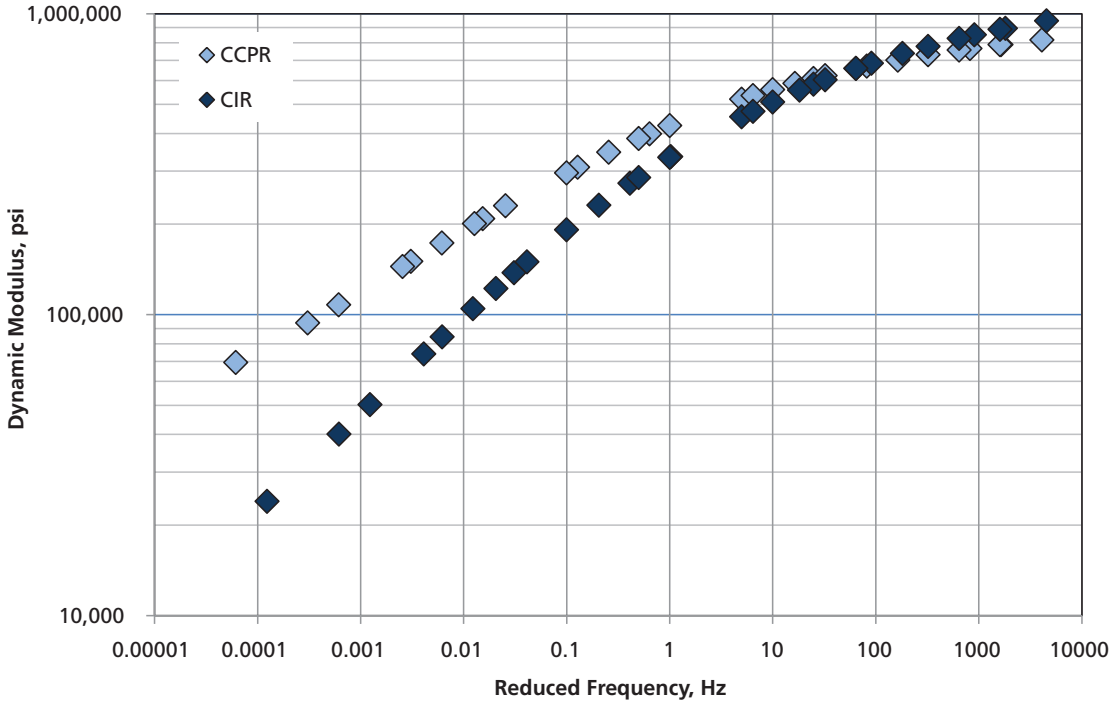

FIGURE 1 Dynamic modulus master curve for cold in-place recycling (CIR) and cold central-plant recycling (CCPR) materials from the Interstate 81 project (reference temperature = 21.1°C).

Because the left lane had less underlying deterioration, cold in-place recycling was specified to rehabilitate only the top layers. In the cold in-place recycling process, a portion of the asphalt pavement layers was pulverized, stabilized, and repaved in place (see photo, page 52). The cold in-place recycling was completed in three days—the contractor milled off the top 2 inches of pavement and recycled the next 5 inches. Foamed asphalt and hydraulic cement were used as recycling agents.

The driving surface of both lanes received a new multicourse asphalt overlay. In the right lane, the asphalt overlay had a thickness of 4 inches for the first 2,150 feet of the project and a thickness of 6 inches for the remainder of the lane, to level the 8-inch and 6-inch sections of material from the cold central-plant recycling. The asphalt overlay for the left lane was 4 inches thick. The thicker asphalt overlay in the right lane was designed for the truck traffic.

Performance Testing

Virginia DOT researchers collected samples of the recycled materials during and after construction and tested the gradation, indirect tensile strength, resilient modulus, dynamic modulus, and rutting resistance with repeated-load permanent deformation.

Results from the indirect tensile strength and resilient modulus testing indicated that the recycled materials from the cold central-plant recycling and the cold in-place recycling processes would perform similarly (2). Dynamic modulus testing revealed that the material from the cold central-plant recycling process was stiffer at higher temperatures, as indicated by the left side of the dynamic modulus master curve shown in Figure 1 (above) (3).

Rut depth and ride quality were measured periodically from five to 34 months after construction, as was the structural capacity, with falling weight deflectometer tests. Throughout the evaluation period, rut depths were less than 0.1 inch, and the ride quality, measured in terms of the International Roughness

Project Explores Properties of Recycled Pavement Materials

More information is needed about the material properties of cold in-place recycling and full-depth reclamation asphalt mixtures, particularly to account for the ways that the stabilized base layers contribute to the performance of the pavement structures. The AASHTOWare Pavement ME Design program, for example, provides little guidance for cold in-place recycling and full-depth reclamation products.

The National Cooperative Highway Research Program (NCHRP) therefore has initiated Project 9-51 to determine the material properties and to propose associated test methods and distress models for predicting the performance of pavement layers prepared with cold in-place recycling and full-depth reclamation materials. The University of Maryland–College Park is conducting the project through a series of laboratory and field experiments, with support from the Virginia Transportation Research Council; Brian Diefenderfer is coprincipal investigator for the project.

For information on NCHRP Project 9-51, visit http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3164, or contact Senior Program Officer Ed Harrigan, eharrigan@nas.edu.

Index, was excellent, according to Virginia DOT criteria, at approximately 45 to 55 inches per mile (*4*). The structural capacity of the pavement increased during the first year after construction; this also had occurred on earlier Virginia DOT recycling projects and may be attributable to the curing of the recycled material (*5*).

Instrumented Load Testing

Instrumenting Interstate 81 during construction was not feasible; therefore, in 2012, Virginia DOT secured three track sections at the National Center for Asphalt Technology (NCAT) in Auburn, Alabama, for trafficking. Data from these sections will help Virginia DOT determine the effects of millions of load passes. The data also will help in developing performance-prediction models to complete the designs with pavement recycling within a mechanistic–empirical framework.

All three NCAT track sections incorporated cold central-plant recycling materials produced with millings from the Interstate 81 project. Full-depth reclamation was incorporated into one of the NCAT track sections by stabilizing the aggregate and subgrade material with hydraulic cement.

The three NCAT sections received 10 million equivalent single-axle loads (ESALs) during the two-year test cycle. In comparison, the Interstate 81 section has received approximately 8 million ESALs since construction in 2011.

Results from the NCAT test sections confirmed that the performance of the recycled design was excellent—no deterioration was observed in any of the three sections after 10 million ESALs. The data further validated the Interstate 81 findings and have allowed Virginia DOT to quantify the pavement's response to the truck loading. Virginia DOT plans to continue the testing at NCAT during the 2015 track cycle and to apply another 10 million ESALs to the recycled sections.

Benefits and Implementation

The Interstate 81 pavement recycling project cost approximately $10 million. Virginia DOT had estimated that an equivalent project using conventional construction practices would have cost approximately $16 million. The pavement recycling and the unique traffic management plan enabled Virginia DOT to reduce costs and to complete the reconstruction work in approximately eight months.

Previous studies have shown that pavement recycling is beneficial in rehabilitating lower-volume roadways (*1*), and agencies' experience had centered on these kinds of roads. This perpetuated the idea that recycling was not suitable for higher-volume highways. Virginia DOT's Interstate 81 and track studies at NCAT have shown that these recycling processes can be successful on roadways with higher truck volumes.

Virginia DOT gained confidence and experience with pavement recycling on Interstate 81 and with the NCAT track studies. As a result, the agency has developed specifications and is pursuing pavement recycling projects.

For more information, contact Brian K. Diefenderfer, Senior Research Scientist, Virginia Department of Transportation, 530 Edgemont Road, Charlottesville, VA 22903; phone: 434-293-1944; e-mail: brian.diefenderfer@vdot.virginia.gov.

Paving the Way with Research

Virginia DOT's I-81 pavement recycling project was selected as one of 16 "high-value research projects" for 2015 by the Research Advisory Committee of the American Association of State Highway and Transportation Officials (AASHTO). The project was a top-10 finalist in 2012 for America's Transportation Awards, sponsored by AASHTO, the American Automobile Association, and the U.S. Chamber of Commerce, and earned the 2012 Recycling Award for Cold In-Place Recycling from the Asphalt Recycling and Reclaiming Association and *Roads & Bridges* magazine.

A video produced by Virginia DOT about the I-81 pavement-recycling project is available at www.youtube.com/watch?v=FF0JQub86E0&list=UU2bzenYbUHlh6S2v6gonuvw.

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EDITOR'S NOTE: Appreciation is expressed to Amir Hanna and G. P. Jayaprakash, Transportation Research Board, for their efforts in developing this article.

Suggestions for Research Pays Off topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (202-334-2956; gjayaprakash@nas.edu).

Webinar Program Broadens Learning Horizons

ELAINE FERRELL

The author is Distance Learning Coordinator, Transportation Research Board, Washington, D.C.

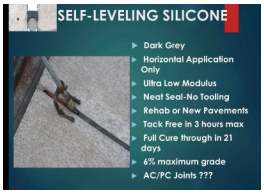
Through its expanding webinar program, the Transportation Research Board (TRB) promotes innovation, disseminates information, and encourages the implementation of research results. With 70 live webinars in 2015, the program—now in its seventh year—recruits experts who broadcast knowledge and research findings to an extensive audience on a balance of topics developed by professionals from all divisions within TRB. Presenters are volunteers—from professional engineers to consultants to academics—who share information about their areas of expertise.

Topics, Credits, and Ratings

The webinar program highlights TRB publications and hot topics: transformational technologies, including connected and automated vehicles and shared-ride services; resiliency, or planning for and recovering from adverse events; and such transportation and public health issues as crash fatalities and injuries and emergency response services.

Webinar participants receive professional credits that count toward professional licensing requirements. So far in 2015, programs have earned a total of 62 Professional Development Hours, 48 Certification Maintenance credits, and 18 American Association of Airport Executives professional credits. Participants use information from the webinars to define and establish research statements and to develop practical applications in their fields.

The TRB webinar program has gained consistently high satisfaction ratings, according to surveys from webinar participants. In 2015, the average session attendance was 370. Popular topics in the 2015 webinar program have included pedestrian and bicycle analytics, roundabouts design, and pavement preservation. Webinars are free of charge for employees of TRB sustaining affiliates and sponsors.



A frequently viewed webinar on concrete crack and joint sealing basics addresses proper preparation and installation techniques.

New Offerings

TRB recently introduced the straight-to-recording program featuring prerecorded lectures by experts in a variety of fields. These lectures are organized by date and content area and are accessible through the TRB Vimeo channel (https://vimeo.com/channels/221095) and via the TRB website (www.trb.org/webinars). The recordings often are serialized, allowing more information about a topic to be communicated. Topics that are highly technical or that appeal to a specialized audience generally are selected for straight-to-recording sessions. Access to these sessions is free of charge, but professional credits are not available. Eleven straight-to-recording sessions are planned for release by November.

TRB plans to increase the offering of webinars and straight-to-recording sessions in 2016, by approximately 20 percent. A committee of experts from all TRB divisions meets in early November to review proposals and select webinar topics.

For more information about the webinar program, contact Elaine Ferrell at EFerrell@nas.edu.

Database Documents Real-Time Research

The Transportation Research Board's Research in Progress (RiP) Database contains more than 12,900 records of current or recently completed transportation research projects from federal, state, and academic organizations,[1] providing an opportunity for organizations to promote their research projects, as well as allowing researchers to identify similar projects and possible avenues of collaboration.

Free of charge, the RiP Database does not require a login to search, view, or export research records. Users can conduct a basic keyword search or can search by title, subject area, project or contract number, project status, type of source agency, location, index term, organization, person, and date. Search results can be displayed in map format, with department of transportation (DOT) or University Transportation Center (UTC) project records plotted by state.

A password-protected area of the RiP website allows authorized users to add, modify, or delete their organization's RiP records. Users from state DOTs, U.S. DOT, or UTCs who are assigned by their organization to manage RiP project records may request login credentials by clicking the "Authorized Users" button on the home page and following the directions below the prompt "Do I Need This Login?"

Users may subscribe to e-mail notifications of new RiP records in specific subject areas, and may print, e-mail, and share search results via Twitter, Facebook, or other social networking tools. In August, TRB conducted a webinar, "Using the New RiP Project Entry Interface," that demonstrated how to enter and update RiP records, locate records for an organization, and submit information on a person or organization. A recording of the webinar is available at www.trb.org/Main/Blurbs/172642.aspx.

[1] rip.trb.org.

TRB 11th International Conference on Low-Volume Roads

G. P. JAYAPRAKASH

The author is Senior Program Officer and Soils, Geology, and Foundations Engineer, TRB.

The worldwide network of low-volume roads poses challenges in planning, design, construction, operation, and maintenance, and in environmental effects and safety. In recent years, as low-volume roads compete with higher-volume urban roads for funding, these challenges have grown.

Nevertheless, low-volume roads constitute the world's largest road network and their socioeconomic role cannot be overstated. Low-volume roads facilitate economic opportunity; connect rural, developing, and underdeveloped areas; and provide access to education, medical facilities, and markets.

PHOTO COURTESY G. P. JAYAPRAKASH

Steven Bloser (*right*), Director of the Center for Dirt and Gravel Road Studies, conducts a field tour. Bloser served as local liaison and was a member of the conference planning committee.

In the early 1970s, the late Eldon J. Yoder of Purdue University initiated TRB activities focusing on low-volume roads; these efforts resulted in the first Low-Volume Roads Conference in 1975. The conference, held every four years, has provided a forum for global information exchange.

TRB's 11th International Conference on Low-Volume Roads, in Pittsburgh, Pennsylvania, July 12–15, 2015, was cosponsored by the University of Belgrade, Pontificia Universidad Catolica de Chile, and the University of Pretoria in South Africa. Other sponsors included the Federal Highway Administration, U.S. Department of Transportation (DOT); the Forest Service, U.S. Department of Agriculture; and the Bureau of Indian Affairs and Fish and Wildlife Service, U.S. Department of the Interior. The Center for Dirt and Gravel Roads Studies, Pennsylvania State University, served as local liaison for the event. Eight U.S. state DOTs also provided support through a pooled fund project, initiated by Vanessa Goetz, Iowa DOT.

Two weeks before the conference, Michael T. Long, chair of the planning committee, passed away. Long played a key role in the conference planning and remained involved in committee activities as he was able; the conference was dedicated to him and to his professional contributions to low-volume roads.

Participants came from 25 countries—with at least one attendee from each continent—and presenters from 17 countries shared their research on low-volume roads. Notable details include the following:

- A delegation represented 10 Indian states that have participated in projects of the Ministry of Rural Development, sponsored by the Government of India.
- A delegation from several African countries shared its experiences on projects supported by the Africa Community Access Programme.
- Female professionals accounted for 15 percent of the 268 delegates in attendance.

The conference also offered several workshops, including the following:

- Manage Safety and Risk on Energy-Impacted Local Roads Now or Testify in Court Later;
- Sustainability in Low-Volume Road Infrastructure Projects: Climatic Issues, Resiliency, Carbon Footprint, and Life Cycle Cost Analysis;
- Socioeconomic Issues Related to Low-Volume Roads; and
- Environmentally Sensitive Maintenance of Low-Volume Roads.

Participants took a field trip to observe projects conducted by the Center for Dirt and Gravel Roads Studies on environmentally sensitive maintenance of low-volume roads. Also included was a postconference field trip to observe the effects of heavy hauling related to unconventional gas extraction on public low-volume roads.

(*continued on next page*)

TRB HIGHLIGHTS

Low-Volume Roads Conference

(continued from page 57)

More than a dozen exhibitors showcased their products and services at the conference.

Hernan Eduardo de Solminihac of Pontificia Universidad Catolica de Chile delivered the keynote address, "Toward Sustainable Management of Low-Volume Roads in Chile: Improvements and Challenges." The Yoder Award for best paper was presented to Paul J. Carlson of Texas A&M Transportation Institute for his paper, "Can Traffic Signs Be Too Bright on Low-Volume Roads?"

The 12th International Conference on Low-Volume Roads will be held in 2019. The date and location will be announced in the TRB E-Newsletter in 2016.

PHOTO COURTESY G. P. JAYAPRAKASH

A panel of representatives from the Iowa, New York, Ohio, Virginia, Louisiana, Illinois, Wyoming, and Pennsylvania Departments of Transportation provides an overview of the management and financing of their states' low-volume roads.

COOPERATIVE RESEARCH PROGRAMS NEWS

Proposed Modifications to Culvert Load Rating Specifications

When load limits are imposed on routes that previously were unrestricted, the choice of a load rating method may affect highway goods movement. For culvert load ratings, engineers use the load and resistance factor rating (LRFR), load factor rating, or allowable stress rating of highway bridges according to the American Association of State Highway and Transportation Officials' (AASHTO's) *Manual for Bridge Evaluation*.

Culvert response to live loads differs from that of bridges, however. Although culvert response should be calibrated based on a single axle or wheel, LRFR generally is calibrated based on bridge response to gross truck weight. As a result, current specifications may be overly conservative or inadequate.

Michael Baker, Jr., Inc., has received a $500,000, 36-month contract [National Cooperative Highway Research Program (NCHRP) Project 15-54, FY 2015] to propose modifications to the culvert load rating specifications in the *AASHTO Manual for Bridge Evaluation* and to revise the *AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications* accordingly.

For more, contact Waseem Dekelbab, TRB, 202-334-1409, wdekelbab@nas.edu.

Proposed Seismic Specifications for Bridge Column Connections

According to the report from NCHRP Domestic Scan 11-02, *Best Practices Regarding Performance of ABC Connections in Bridges Subjected to Multihazard and Extreme Events*, accelerated bridge construction (ABC) techniques have been limited in moderate-to-high seismic regions. The *AASHTO Guide Specifications for LRFD Seismic Bridge Design* prohibits or limits connections that splice longitudinal column reinforcement in plastic hinge regions.

The University of Nevada, Reno, has received a $450,000, 40-month contract (NCHRP Project 12-105, FY 2015) to develop proposed AASHTO displacement-based design and construction specifications for the implementation of ABC column connections in moderate to high seismic regions.

For more, contact Waseem Dekelbab, TRB, 202-334-1409, wdekelbab@nas.edu.

THINKING LONG TERM— Mark McConnell, Mississippi Department of Transportation (*back row, second from right*) and Sue McNeil, University of Delaware (*front row, center*), led a meeting of the AASHTO Highway Subcommittee on Maintenance, July 9–10 at the Beckman Center in Irvine, California. With Amir Hanna, TRB (*front row, third from right*), members reviewed and updated the subcommittee's strategic plan.

NEWS BRIEFS

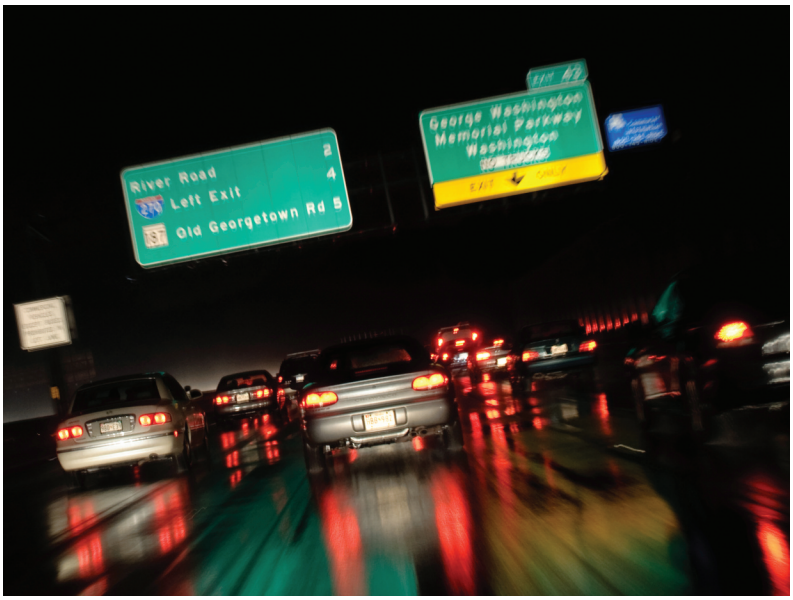


Photo: Michael Galkovsky, Flickr

Cars traveling I-495 in Northern Virginia often are caught in gridlock; the Washington, D.C., area leads the nation in traffic congestion.

Economy Expands—and So Does Gridlock

Traffic congestion has returned to prerecession levels, according to the annual *Urban Mobility Scorecard* produced by INRIX and the Texas A&M Transportation Institute. Annual delay is up to 42 hours—and costs $960—per commuter; travelers wasted 7 billion extra hours and $160 billion in congestion-related costs in 2015.

Washington, D.C., ranked worst for gridlock, with 82 hours of delay per commuter—nearly double the national average. Also in line for the dubious distinction were New York (74 hours) and three California cities: Los Angeles (80 hours), San Francisco (78 hours), and San Jose (67 hours). Americans drove more than 3 trillion miles in 2015, according to the report.

For more information and to see congestion data by city, see http://mobility.tamu.edu/ums/.

Tests Identify Noisy Pavements

Researchers at the Louisiana Transportation Research Center developed a comprehensive experiment to test the noise levels of Joor Road, LA-946, an urban five-lane portland cement concrete roadway in Baton Rouge. The roadway's annual average daily traffic is 13,500—with trucks comprising 7 percent—and the posted speed limit is 55 mph. Since Joor Road opened in 2009, area residents have complained about high noise levels.

In the experiment, researchers randomly selected six PCC slabs—three northbound and three southbound—in the noisy areas, with an additional slab used as a control in a quieter southbound section. Four PCC slabs were tested on a nearby road, recently built under the same specifications. The pass-by method was used to measure sound levels from each of the slabs.

According to the report, sound levels from the Joor Road section indicated excessive noise, at 82 A-weighted decibels (dBA). Onboard sound intensity testing indicated even higher tire–pavement sound levels, at approximately 110 dBA. The Louisiana Department of Transportation and Development's Highway Traffic Noise Policy recommends 66 dBA for residential areas.

Researchers assessed tine depth, tine width, the spacing between tines, and the randomness of spacing between tines. Excessive tine widths and spacing between tines led to higher noise levels, they concluded.

To view the report, visit www.ltrc.lsu.edu/pdf/2015/tar1401TAP.pdf.

Virtual Training Posts Real Results for Safety

Pedestrian safety training can help reduce the approximately 40,000 injuries suffered by child pedestrians in the United States each year, according to research from the Southeastern Transportation Research, Innovation, Development, and Education (STRIDE) Center at the University of Florida. Safety training traditionally has been conducted in person at streetside locations, but recent research has tested instruction via virtual reality (VR), which offers the advantages of a safer environment, immersion without injury risk, and the ability to customize.

Researchers at STRIDE tested a mobile VR training system at schools and community centers. The researchers evaluated children's pedestrian safety at baseline, exposed the children to six 15-minute VR training sessions, and reevaluated the subjects' application of pedestrian safety across four performance measures: attention to traffic, delay in entering safe traffic gaps, time to contact with oncoming traffic while crossing, and unsafe crossings.

According to the report, children's attention to traffic and time to contact with oncoming traffic decreased slightly but significantly after the training. Delays in entering traffic decreased slightly, but no substantial changes were recorded in the rate of unsafe crossings. Researchers concluded that training helped children make crossing decisions more confidently and more efficiently, such as choosing tighter traffic gaps that still are safe at an intersection instead of waiting for longer and more obviously safe gaps.

To view the report, visit http://stride.ce.ufl.edu/uploads/docs/STRIDE_final_report_2013-004S_Schwebel.pdf.

Handful of Ports Move Most U.S. Freight

Approximately two dozen metropolitan ports move 85 percent of U.S. imports and exports, according to research from the Metropolitan Policy Program at Brookings. Researchers analyzed international trade at ports of entry using data from 2010, the most recent year available.

Part of a series on metropolitan freight, the report states that in 2014 the United States traded more than $4 trillion in international goods. More than 70 percent of U.S. imports and exports are transported by ships and aircraft; trucks, railroads, and pipelines move the rest. Goods with lower values and higher weights, such as energy and agriculture products, generally travel by ship, while higher-value, lower-weight goods like electronics travel by airplane.

Research shows that all port complexes serve customers in other parts of the country, with only 4 percent of their goods either starting or ending in local markets. Because of commodity specialties and trading partners, even local economies tend to use ports other those nearby.

For more information, visit www.brookings.edu research/reports2/2015/06/metro-freight.

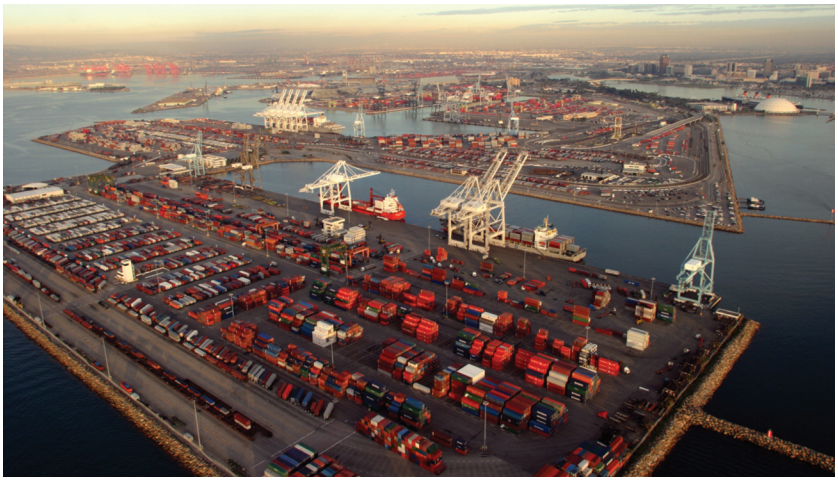


PHOTO COURTESY OF THE PORT OF LONG BEACH

Pier J at the Port of Long Beach, California, part of the busiest port complex in the country. The Los Angeles–Long Beach–Santa Ana port complex moves six percent of the nation's total trade volume, or $417.5 billion per year.

CALENDAR

November

4–5 9th University Transportation Center Spotlight Conference: Connected and Automated Vehicles
Washington, D.C.

5–6 2nd National Roadway Safety Culture Summit
Washington, D.C.

11–15 Disrupting Mobility: A Global Summit Investigating Sustainable Futures*
Cambridge, Massachusetts

15–17 13th APTA–TRB Joint National Light Rail and Streetcars Conference: Transforming Urban Areas
Minneapolis, Minnesota

15–18 15th Pan-American Conference on Soil Mechanics and Geotechnical Engineering*
Buenos Aires, Argentina

December

7–8 National Accelerated Bridge Construction Conference*
Miami, Florida

9–10 Advancing Freight Fluidity Performance Measures Workshop
Washington, D.C.

17–20 3rd Conference of the Transportation Research Group of India*
Kolkata, India

January 2016

10–14 TRB 95th Annual Meeting
Washington, D.C.
For information, visit www.trb.org/AnnualMeeting/Annual Meeting.aspx

21–22 Shifting International Trade Routes Workshop
Tampa, Florida

April

13–16 World Steel Bridge Symposium*
Orlando, Florida

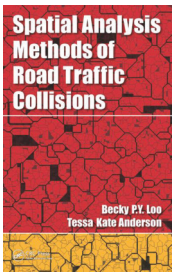
22–28 World Tunnel Congress
San Francisco, California

25–27 International Conference on Winter Maintenance and Surface Transportation Weather
Colorado

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar. For more information, e-mail TRBMeetings@nas.edu.

*TRB is cosponsor of the meeting.

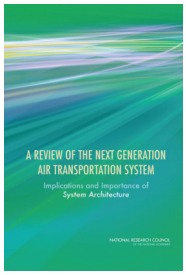
Spatial Analysis Methods of Road Traffic Collisions



Becky P. Y. Loo and Tessa Kate Anderson. CRC Press, 2015; 322 pp.; hardcover, $119.95; e-book, $83.97; 978-14-3987-412-7.

Using geographic information system technology to integrate analysis and visualization of traffic accidents and their causes, the authors propose approaches for comprehensive road safety strategies and outline a range of spatial analysis methodologies and approaches.

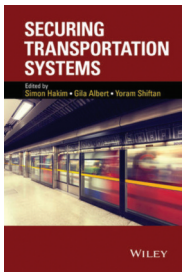
A Review of the Next-Generation Air Transportation System: Implications and Importance of System Architecture



David E. Liddle and Lynette I. Millett (eds.). National Academies Press, 2015; 110 pp.; $42; 978-03-0937-178-0.

A report of the Division on Engineering and Physical Sciences of the National Research Council, this volume offers an overview of the Next-Generation Air Transportation System (NextGen), a highly automated air traffic management system. Also examined are the technical activities—system design and testing, organizational design, and other safety and human-factor aspects—that are necessary to convert to NextGen, as well as an assessment of the risks and costs.

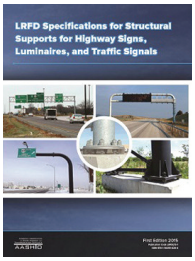
Securing Transportation Systems



Simon Hakim, Gila Albert, and Yoram Shiftan (eds.). Wiley, 2015; 408 pp.; hardcover, $99.95; e-book, $79.99; 978-11-1897-793-4.

Presented in this volume are innovative communication solutions, joint operations centers, technological measures to protect transportation infrastructure, and travel behavior changes in response to terrorism or natural disasters, along with the role of transportation systems in response operations.

Load and Resistance Factor Design (LRFD) Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals



American Association of State Highway and Transportation Officials (AASHTO), 2015; 436 pp.; AASHTO members, $240; nonmembers, $312; 1-56051-628-6.

These specifications incorporate, build on, and supersede the design specifications found in the sixth edition of *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Included in this first edition is current research on LRFD calibration, loads, and resistances, plus new sections on fabrication, construction, and more.

The titles in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS

Characterization of Cementitiously Stabilized Layers for Use in Pavement Design and Analysis
NCHRP Report 789

This report presents performance-related procedures for characterizing cementitiously stabilized layers for use in mechanistic–empirical pavement analysis. Appendixes to the report are available online.

2014; 82 pp.; TRB affiliates, $41; nonaffiliates, $55. Subscriber categories: geotechnology, pavements.

Factors Contributing to Median Encroachments and Cross-Median Crashes
NCHRP Report 790

This investigation of the contributing factors in median-related crashes identifies design treatments and countermeasures that can improve median safety on divided highways.

2014; 92 pp.; TRB affiliates, $43; nonaffiliates, $58. Subscriber categories: design, safety and human factors.

Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM)
NCHRP Report 791

This report provides state departments of transportation staff and other transportation professionals with technical guidance on using the Federal Highway Administration's TNM. Presented are ways to model traffic-generated noise in a range of settings.

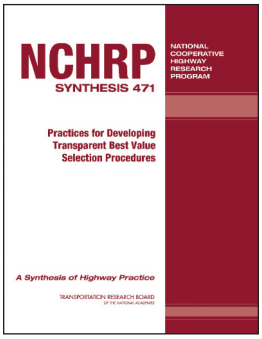
2014; 110 pp.; TRB affiliates, $43; nonaffiliates, $58. Subscriber categories: highways, design, environment.

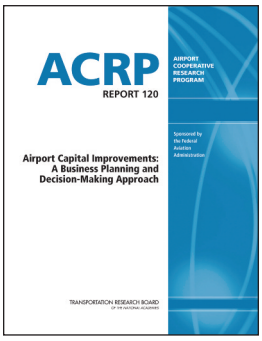
Long-Term Performance and Life-Cycle Costs of Stormwater Best Management Practices
NCHRP Report 792

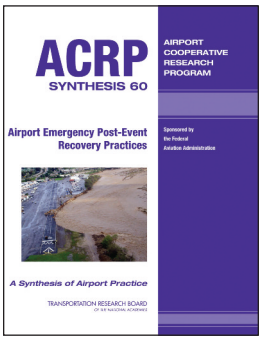
Provided in this report are tools and guidance for transportation agencies on applying best management practices to a stormwater program. An evaluation tool on a CD-ROM accompanies the print version of the report.

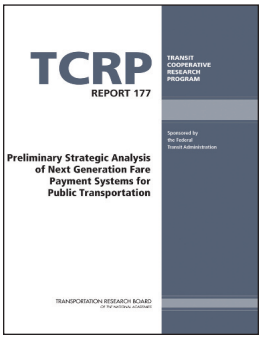
BOOK SHELF

TRB PUBLICATIONS *(continued)*









2014; 164 pp.; TRB affiliates, $58.50; nonaffiliates, $78. Subscriber categories: highways, environment.

Incorporating Transportation Security Awareness into Routine State DOT Operations and Training
NCHRP Report 793

Techniques to integrate all-hazards security awareness concepts and reminders into routine state agency operations are presented in this volume.

2014; 40 pp.; TRB affiliates, $27; nonaffiliates, $36. Subscriber categories: education and training, maintenance and preservation, security and emergencies.

Practices for Developing Transparent Best Value Selection Procedures
NCHRP Synthesis 471

Examined in this volume are best value procurement practices for evaluating schedules, technical merit, management solutions, and past performance, as well as price.

2015; 76 pp.; TRB affiliates, $38.25; nonaffiliates, $51. Subscriber categories: administration and management, construction, highways, maintenance and preservation.

Fiber Additives in Asphalt Mixtures
NCHRP Synthesis 475

This synthesis describes the types of fibers used in asphalt mixtures and examines the fiber properties, testing, methods of application, and laboratory and field performance.

2015; 67 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber categories: highways, materials.

Airport Capital Improvements: A Business Planning and Decision-Making Approach
ACRP Report 120

This guidebook and spreadsheet-based model assists practitioners in estimating the cost of construction projects proposed in an airport's capital improvement plan.

2014; 71 pp.; TRB affiliates, $36; nonaffiliates, $49. Subscriber categories: aviation, construction, economics.

Innovative Revenue Strategies: An Airport Guide
ACRP Report 121

In presenting innovative strategies for airport revenue, this volume reviews customer needs; services, facilities, and equipment; real estate and natural resource development; value capture and other financing opportunities; and improvements to airport businesses.

2015; 304 pp.; TRB affiliates, $64.50; nonaffiliates, $86. Subscriber categories: aviation, economics, planning and forecasting.

Innovative Airport Responses to Threatened and Endangered Species
ACRP Report 122

Approaches are offered for addressing federally listed plant and animal species on or near airport property. Interagency cooperation tools are included on a CD-ROM that accompanies the print version of the report.

2015; 62 pp.; TRB affiliates, $42; nonaffiliates, $56. Subscriber categories: aviation, environment.

A Guidebook for Airport Winter Operations
ACRP Report 123

This report presents ways to prepare for and recover from disruptive weather events as part of an effective winter operations program, along with tips for managing passenger experience.

2015; 139 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber categories: aviation, operations and traffic management, planning and forecasting.

Airport Parking Garage Lighting Solutions
ACRP Report 124

Provided in this report is guidance to help airport industry practitioners select the lighting technologies most appropriate for parking garage conditions.

2015; 76 pp.; TRB affiliates, $41.25; nonaffiliates, $55. Subscriber category: aviation.

Airport Emergency Post-Event Recovery Practices
ACRP Synthesis 60

Explored in this synthesis are ways to improve airport resiliency by planning for the recovery phase of emergency response.

2015; 87 pp.; TRB affiliates, $41.25; nonaffiliates, $55. Subscriber categories: aviation, safety and human factors.

Preliminary Strategic Analysis of Next-Generation Fare Payment Systems for Public Transportation
TCRP Report 177

This report addresses attributes, implementation strategies, and applications of next-generation transit fare payment systems. The state of the practice in emerging fare payment options is presented, with a description of available and anticipated options.

2015; 107 pp.; TRB affiliates, $18.75; nonaffiliates, $25. Subject areas: public transportation, data and information technology, finance.

TRB PUBLICATIONS *(continued)*

Better On-Street Bus Stops
TCRP Synthesis 117

This synthesis explores major issues in addressing on-street bus stops—from the transit agency and customer perspectives—and documents successful approaches and actions to improve on-street bus stops.

2015; 144 pp.; TRB affiliates, $18.75; nonaffiliates, $25. Subject areas: public transportation, operations and traffic management, terminals and facilities.

Improving Freight System Performance in Metropolitan Areas: A Planning Guide
NCFRP Report 33

Potential strategies and practical solutions are outlined for public and private stakeholders to improve freight movement system performance in diverse metropolitan areas. The report includes links to an Initiative Selector tool and to Freight Trip Generation software.

2015; 214 pp.; TRB affiliates, $59.25; nonaffiliates, $79. Subscriber categories: freight transportation, operations and traffic management, planning and forecasting.

Alternative Funding and Financing Mechanisms for Passenger and Freight Rail Projects
NCRRP Report 1

This report identifies alternative funding and financing tools for passenger and freight rail project development, including capital investments, operations, and maintenance. The report summary is available at http://onlinepubs.trb.org/onlinepubs/ncrrp/ncrrp_rpt_001_ReportSummary.pdf.

2015; 195 pp.; TRB affiliates, $32.25; nonaffiliates, $43. Subscriber categories: finance, passenger transportation, railroads.

Guide for Communicating Emergency Response Information for Natural Gas and Hazardous Liquids Pipelines
HMCRP Report 14

Guidance on pipeline emergency response is presented, with additional information available at http://onlinepubs.trb.org/onlinepubs/hmcrp/docs/HM-15_HMCRPReport14_Appendices1-3.pdf.

2015; 43 pp.; TRB affiliates, $33; nonaffiliates, $44. Subscriber categories: pipelines, security and emergencies, terminals and facilities.

Highway Safety Performance 2014
Transportation Research Record 2435

Papers in this volume examine the use of the Monte Carlo simulation for a sensitivity analysis of *Highway Safety Manual* calibration factors, the safety of hybrid main-line toll plazas, safety performance functions for freeways, and other topics.

2014; 81 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber category: safety and human factors.

Highway Design 2014, Volumes 1–2
Transportation Research Record 2436 and 2437

Among the topics presented in these volumes are crossover roundabouts, stopping sight distance and horizontal sight line offsets at horizontal curves, and a safety investigation and guidance for retrofitting approach guardrail transitions.

2014; Vol. 1, 166 pp.; TRB affiliates, $56.25; nonaffiliates, $75. Vol. 2, 88 pp.; TRB affiliates, 45.75; nonaffiliates, $61. Subscriber categories: Vols. 1–2, design; Vol. 1, hydraulics and hydrology; Vol. 2, safety and human factors.

Traffic Signal Systems 2014, Volumes 1–2
Transportation Research Record 2438 and 2439

An empirical analysis of controller event data to select vehicle detector fault triggers, optimal deployment of hybrid alternative power systems at signalized intersections, graphical performance measures for practitioners to triage split failure trouble calls, and coupled linear programming approaches for decentralized control of urban traffic are among the topics presented in these volumes.

2014; Vol. 1, 88 pp.; TRB affiliates, $47.25; nonaffiliates, $63. Vol. 2, 104 pp.; TRB affiliates, $47.25; nonaffiliates, $63. Subscriber categories: operations and traffic management, safety and human factors, pedestrians and bicyclists.

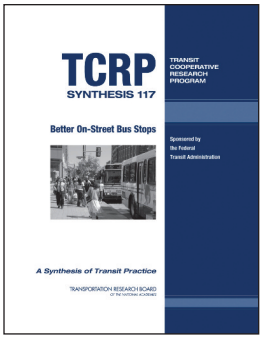
Maintenance Services, Transportation Weather, and Winter Maintenance
Transportation Research Record 2440

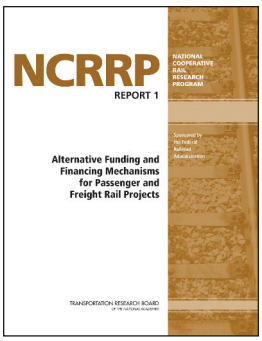
Authors present research on effective lidar deployment by transportation agencies, winter maintenance chemicals, thermal aspects of melting ice with deicer chemicals, and other topics.

2014; 109 pp.; TRB affiliates, $48.75; nonaffiliates, $65. Subscriber categories: maintenance and preservation, operations and traffic management, vehicles and equipment.

Concrete Materials 2014
Transportation Research Record 2441

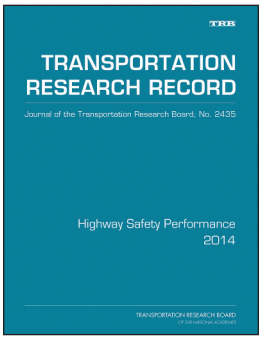
The papers in this volume examine mixture design for minimizing cement content in pavement concrete, a methodology for identifying zero-stress

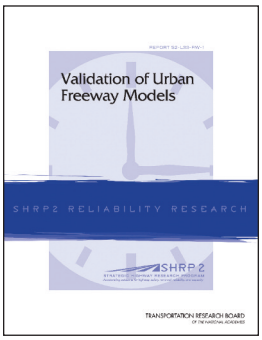




BOOK SHELF

TRB PUBLICATIONS *(continued)*





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time for jointed plain concrete pavements, high-volume fly ash concrete for rigid pavement, and more.

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Urban and Traffic Data Systems 2014, Volumes 1–2

Transportation Research Record 2442 and 2443

Among the topics explored in these volumes are vehicle length measurements and length-based vehicle classifications in congested freeway traffic, a process to determine locations for motorcycle counts, a semiautomated tool for extraction of microlevel traffic data from a videographic survey, an online archive for geospatial transit performance data, and a web-based real-time data collection methodology for transportation operation performance analysis.

2014; Vol. 1, 149 pp.; TRB affiliates, $56.25; nonaffiliates, $75. Vol. 2, 147 pp.; TRB affiliates, $56.25; nonaffiliates, $75. Subscriber categories: Vols. 1 and 2, data and information technology, operations and traffic management; Vol. 2, pedestrians and bicyclists.

Asphalt Materials and Mixtures 2014, Volumes 1–4

Transportation Research Record 2444, 2445, 2446, and 2447

These four volumes address topics including the effects of interaction conditions on the internal network structure of crumb rubber–modified asphalts, a statistical analysis of the influence of mix design parameters on mechanical properties of mixes with reclaimed asphalt pavement, the moisture susceptibility of cold-mix asphalt, reporting results from the Hamburg wheel tracking device, and a numerical–experimental approach to characterize fracture properties of asphalt mixtures at low temperatures.

2014; Vol. 1, 162 pp.; TRB affiliates, $56.25; nonaffiliates, $75. Vol. 2, 112 pp.; TRB affiliates, $48.75; nonaffiliates, $65. Vol. 3, 98 pp.; TRB affiliates, $47.25; nonaffiliates, $63. Vol. 4, 145 pp.; TRB affiliates, $53.25; nonaffiliates, $71. Subscriber categories: materials, pavements.

Railroads 2014

Transportation Research Record 2448

The papers in this volume address deadlock avoidance and detection in railway simulation systems, a three-dimensional train–track–soil model for high-speed rail, ways to detect range-based rail gages and missing rail fasteners, and more.

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Aviation 2014

Transportation Research Record 2449

A statistical analysis of aircraft–bird strikes resulting in engine failure, a simulation study on the impacts of high aviation carbon taxes on tourism, and a human reliability analysis for visual inspection in aviation maintenance by a Bayesian network approach are among the topics presented in this volume.

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Revenue, Finance, Pricing, and Economics

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Validation of Urban Freeway Models

SHRP 2 Report S2-L33-RW-1

This report explores the use of new datasets and statistical performance measures to validate travel time reliability models. Also presented are new application guidelines and enhancements to the models from a second Strategic Highway Research Program (SHRP 2) project on analytic procedures for determining the impacts of reliability mitigation strategies.

2015; 378 pp. Subject areas: highways, operations and traffic management, planning and forecasting. For more information, visit www.trb.org/Publications/Blurbs/171443.aspx.

Technologies to Support the Storage, Retrieval, and Use of 3-D Utility Location Data

SHRP 2 Report S2-R01A-RW-1

Included in this report are strategies, processes, and systems to acquire, store, use, and maintain 3-D utility location data from previous projects and to prevent repeated inventory of utility features on new renewal projects.

2015; 296 pp. Subject areas: construction, data and information technology, highways. For more information, visit www.trb.org/Publications/Blurbs/171927.aspx.

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- Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi. A caption should be supplied for each graphic element.
- Use the units of measurement from the research described and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

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