Incorporating public health in US long-range metropolitan transportation planning: A review of guidance statements and performance measures

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ABSTRACT

Transportation influences public health primarily through traffic safety, air quality, physical activity, and accessibility. Despite the importance of all four components, only safety and air quality are typically considered during institutionalized transportation planning processes. This paper assesses the integration of public health into transportation planning by focusing on the long-range transportation plans that US metropolitan planning organizations develop. The most recent plans from eighteen large regions were reviewed for health or health components within plan guidance statements and supporting performance measures. Goals and objectives exhibited an incomplete perspective of transportation's effects on health, focusing on safety, air quality, and accessibility. Regional guidance statements reflected national goals and planning requirements, which are rarely framed from a health perspective. Performance measures followed policy guidance except for physical activity. More work is needed to develop health-related performance measures, advance travel modeling and health assessment techniques, and improve public participation and environmental justice efforts. Best practices and study limitations are also discussed. This review informs a stronger and more comprehensive consideration of health concerns within the institutionalized structure of US metropolitan transportation planning.

INTRODUCTION

Public health, the health and wellness of a population, is influenced by transportation in several critical ways: primarily through traffic safety, air quality, physical activity, and accessibility. Traffic collisions can cause minor to severe injuries and fatalities. Emissions produced from the operation of motor vehicles pollute air and lead to adverse health impacts such as asthma and other respiratory illnesses. Walking and bicycling provide physical activity that affords significant health benefits. Transportation systems facilitate access to healthy opportunities like education, employment, food, health care, social services, and recreation. Together, these aspects constitute a holistic view of the connections between transportation and physical health.

Theoretically, health impacts could be analyzed during all aspects of the planning, design, maintenance, and operations of transportation systems. Arguably, incorporating health considerations during the planning stage may have the greatest impact, since overarching planning goals tend to influence the kinds of projects that are implemented. While all four transportation–health dimensions could be examined in transportation planning, only safety and air quality are typically considered; physical activity and accessibility are "emerging" topics (*1*). Even when evaluating transportation impacts to safety and air quality, these dimensions are traditionally not discussed from the perspective of public health.

In the US, transportation planning goals can be articulated by federal, state, regional, and local governments. However, since the enactment of the Intermodal Surface Transportation Efficiency Act of 1991 (*2*), many regulated transportation planning functions and the management of federal transportation funding have operated at the regional level, through metropolitan planning organizations (MPOs).

MPOs have several different roles and requirements. Every four to five years, each MPO must develop a metropolitan, regional, or long-range transportation plan (LRTP) that anticipates investments over the next two decades. In comparison with a transportation improvement program (TIP), which lists specific projects for the next four years, a LRTP identifies future visions, goals, policies, and strategies for longer-term investment. It is at this long-range planning scale that health concerns may best be integrated into transportation planning, especially since many of the health effects of transportation are felt over multiple years or the course of individual lifetimes. As a result, this project focuses on MPO LRTPs in order to investigate one important way in which public health can be incorporated into transportation planning.

Although the structure of a long-range transportation plan is dictated by the MPO, most LRTPs tend to have common key components: guidance statements, current conditions, and lists of fiscally-constrained projects. Several statements guide the development of the plan. A vision statement lays out the plan's overarching purpose. Goal statements describe the region's desired future. Specific objectives, measurable outcomes of the plan or the transportation system, usually accompany goals. Strategies or actions to accomplish the objectives may also be included. Together, these guidance statements are intended to frame the plan, influence the selection of transportation investments, inform project prioritization, and be the statements against which to assess the success of the plan (*3*, *4*, *5*). High-level language is often developed by MPO boards and vetted through public comment. Guidance statements regarding public health may or may not be included.

An emerging area is performance-based planning (*4*, *6*). Many MPOs have begun to incorporate performance measures—quantitative metrics or qualitative assessments—into their LTRPs (*3*, *7*) so that decision-makers can better analyze current conditions, select projects,

assess plan performance, and monitor progress toward plan goals. Hundreds of different performance measures exist in various categories (*6*). Theoretically, performance measures should be developed to fit established objectives, rather than selecting goals to fit the limited scope of what can be measured (*4*, *5*). However, data availability, forecastability, and ability to influence also shape the selection of performance measures (*4*). The Moving Ahead for Progress in the 21st Century Act requires the U.S. Department of Transportation to establish national performance measures in the areas of highway performance, safety, air quality, and freight (*8*). Health-related performance measures may be developed; yet, they can often be difficult to forecast and affect.

In order to measure the performance of the plan and its constituent projects, especially for future scenarios, analytical methods must generate the necessary data (*5*), particularly for quantitative performance measures. Travel demand forecasting models, or travel models, traditionally supply estimates that can be used for performance measurement. A number of innovative practices are advancing the analytical capabilities of travel models, including better recognition of activity-travel linkages and household interactions, more realistic representation of dynamic traffic network conditions, and inclusion of bicycle and pedestrian modes (*9*, *10*). One perspective for travel model development is that analytical capabilities should attempt to address key regional concerns; thus, as much as possible, travel model outputs should support the assessment of plan objectives through performance measurement. For example, adding walk and bicycle modes to travel models (*10*) could inform measures of physical activity.

Research questions and hypotheses

By investigating health concerns within MPO long-range transportation plans, this paper attempts to provide insight into some of the following key questions:

- What is the state of the practice regarding the integration of health concerns into MPOs' LRTPs?
- Is health or are its components included in plans' guidance statements?
- Is health or are its components represented in plans' performance measures?
- Is there any connection between the prevalence of health-related guidance statements and health-related performance measures?
    - Is there any connection between physical activity guidance statements, physical activity performance measures, and travel model capabilities for analyzing walking and bicycle?

We anticipate that health will be incompletely represented, with some components—particularly safety and air quality—seen in goals and objectives but fewer included in measures. Regions with strong or comprehensive health-related guidance statements are expected to have more established performance measures. We also may find that regions with physical activity performance measures also have stronger analytical capabilities for modeling walking and bicycling.

BACKGROUND

Focusing on health-related issues in transportation planning is not a new concept; consider traffic safety. Since nearly the beginning of the automobile age, the threats of injuries and fatalities from traffic collisions have driven improvements to vehicle occupant safety. These threats have

also pushed traffic safety to become the motivating objective in street and highway design, for better and for worse (*11*). Road projects have long been promoted on the basis of their potential to reduce traffic collisions, and the Highway Safety Manual (*12*) formalizes the estimation of crash frequencies and severities and the selection of countermeasures. Recent recommendations document how to incorporate safety into regional transportation planning (*13*).

Air quality, while also not a recent concern, has found its way into formal transportation planning processes since the 1970s. Based on the National Environmental Policy Act of 1969 (*14*), a major project that involves federal actions and is likely to have a significant impact to the human environment must develop an Environmental Impact Statement (EIS). An EIS examines impacts to air pollution and quality from transportation-related emissions, among other topics. Since the Clean Air Act Amendments of 1990 (*15*), MPOs in poor air quality (nonattainment or maintenance) areas are required to demonstrate that their LRTPs and TIPs conform to requirements designed to allow states to comply with national ambient air quality standards (*16*). The institutionalized nature of air pollution analysis in transportation planning has led to a strong focus on air quality in LRTPs. With no similar mandate, the physical activity and accessibility components of public health have not been as widely considered in transportation planning goals, policies, and official documents.

Environmental justice (EJ) is another area with federally-mandated regional planning requirements. According to Executive Order 12898, agencies must identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (*17*). Relevant effects include social, economic, and environmental effects (*18*). On its face, EJ appears to suggest that human health should be directly considered within MPO LRTPs and other planning processes. In reality, health concerns are rarely directly addressed within EJ analyses, for several reasons. Region-wide measures of disproportionate impacts typically focus on accessibility, transit service, and economic effects; safety and air quality impacts are considered for specific projects, if at all (*18*, *19*). Even if health effects are examined, data inputs and travel model outputs may be insufficient to analyze impacts by income and especially by racial/ethnic user groups (*20*). Finally, the priorities of EJ and community health advocates often differ from or even conflict with regional transportation goals (*21*, *22*).

Despite these challenges, metropolitan transportation planning practice is beginning to slowly change towards a stronger and more comprehensive examination of health (*23*). Some federal and state funds may now be spent more flexibly and on transportation modes that promote physical activity (*24*, *25*). Many state and local governments have adopted Complete Streets policies that require a consideration of all road users in transportation projects. Health impact assessments are becoming more commonly used to analyze the health effects of significant transportation projects, programs, and policies (*26*). Agencies at different levels are developing active transportation plans (ATPs) to encourage and anticipate future walking/bicycling demand and to coordinate investments to best facilitate meeting that demand. Many ATPs include one or more health-related goals (*27*). Some MPOs are even making their ATPs a component of their LRTPs (*24*, *28*). Others include public-health related goals in their LRTPs (*26*).

Recent research by the Volpe Center has investigated case studies and best practices for how MPOs can consider health in many stages of regional transportation planning (*29*). Through interviews and plan document reviews, the authors investigated work done by leading MPOs for

the Nashville, Sacramento, San Diego, and Seattle metropolitan regions. In each case, they identified:

- motivations for initially expanding traditional planning concerns to include health;
- specific transportation planning process stages at which health was integrated;
- early actions within existing structures that indicated an interest in health; and
- structural changes that resulted in stronger and lasting considerations of health.

The study identified several key themes: (a) forming partnerships with local and state public health organizations; (b) building support for health consideration from MPO boards and the public; (c) developing internal and external capacity for quantitative health assessment; and (d) using an incremental approach to incorporate health concerns without sacrificing other planning functions (*29*). The Volpe Center has also recently completed a companion report looking at health in statewide transportation planning (*30*).

The two Volpe Center reports demonstrate a wide range of actions and stages in which health concerns can be integrated into metropolitan transportation planning processes. Just because health may not be articulated within an MPO's LRTP does not preclude that agency from making strides to consider health in a range of other activities, from outreach and interagency communication to project evaluation. Yet, the reports note important areas in which to accomplish structural changes that are the focus of this paper: the guidance statements and performance measures contained within MPO plans.

METHOD

We reviewed the long-range transportation plans from several large metropolitan planning organizations for indicators of health concerns. To examine differences in practice across MPOs, eighteen subject MPOs were selected from among the 48 largest MPOs (covering a population greater than one million in 2010). Because of our secondary interest in connecting physical activity guidance statements and performance measures to walk/bicycle travel model capabilities, the eighteen MPOs included six from each of three groups, related to a previous study (*10*): MPOs with tier I models that do not include walking or bicycling; MPOs with tier II models that group walking and bicycling into a single non-motorized mode; and MPOs with tier III models that include both walking and bicycling in the mode choice stage. The most recently-adopted LRTPs for each of these large MPOs were gathered from respective agency websites. Table 1 shows the subject MPOs, information about the LRTPs, and walk/bicycle modeling abilities. The oldest plans dated to 2009, while the newest plans were adopted in 2014; plan horizon years were typically 2035 or 2040.

Once the plan documents were obtained, content analysis (*31*) was performed on the text data using electronic searches for health-related terms. The method was a mix of directed and summative content analyses, in which specific predetermined keywords were used to identify and code passages of interest (*31*). The Volpe Center metropolitan report (*29*) and the LRTP for the Portland MPO (Metro) were used to develop the list of screening and search terms and to pilot the health content analysis. Other analyses of MPO planning documents have used similar search techniques (*3*).

Two areas of the LTRPs were of particular interest: guidance statements and performance measures. The following search terms were used to identify guidance statements: "vision", "goal", "objective", "principle", "policy", "strategy", "recommendation", and "outcome". The

following search terms were used to identify performance measures: “performance”, “measure”, “metric”, “indicator”, “factor”, “standard”, and “target”. Each entire LRTP document was also scanned to ensure that all relevant sections were found.

Once the guidance statements and performance measures from a plan were identified, they were filtered by their concern for public health. The health content analysis was framed around references to public health in general and to the four components of transportation-related health: traffic safety, air quality, physical activity, and accessibility. Statements reflecting a general consideration of health had to include the term “health” and contextually reflect an intention to mean “human”, “population”, or “public” health instead of “environmental” or “economic”. Safety statements had to include one of the terms “safe” or “safety”. Statements about air quality referred to “air quality”, “air pollution”, or “emissions” and not just a concern for “the environment”. Physical activity statements had to include the phrase “physical activity” or mention “health” in relation to walking and bicycling. Accessibility statements typically included the words “access”, “connect”, or “opportunity”. General health performance measures had to be a direct health outcome like obesity rather than a health indicator like physical activity. Other health-related measures were classified by their connection to guidance statements and by context. The inclusion of health-related guidance statements and performance measures into MPO LRTPs is summarized in Table 2 and Figure 1.

RESULTS

Several health guidance statements and performance measures were identified in the review of MPO LRTPs. Table 1 documents the eighteen plans analyzed, while Table 2 summarizes health-related statements and measures. Figure 1 presents the results of Table 2 in graphical form.

1 **TABLE 1 Summary of MPOs and Long-Range Transportation Plans Reviewed**

Region	*Metropolitan planning organization (MPO)*	*2010 pop. (million)*	*Plan year*	*Horizon year*	*Walk/bike models*[a]
Atlanta, GA	Atlanta Regional Commission (ARC)	4.8	2014	2040	III
Baltimore, MD	Baltimore Regional Transportation Board (BRTB)	2.7	2011	2035	
Chicago, IL	Chicago Metropolitan Agency for Planning (CMAP)	8.4	2010	2040	II
Cleveland, OH	Northeast Ohio Areawide Coordinating Agency (NOACA)	2.1	2013	2035	III
Detroit, MI	Southeast Michigan Council of Governments (SEMCOG)	4.7	2013	2040	I
Houston, TX	Houston-Galveston Area Council (H-GAC)	5.9	2010	2035	I
Kansas City, MO	Mid-America Regional Council (MARC)	1.9	2010	2040	I
Memphis, TN	Memphis Urban Area Metropolitan Planning Organization	1.1	2012	2040	II
Miami, FL	Miami-Dade Metropolitan Planning Organization	2.5	2009	2035	II
Milwaukee, WI	Southeastern Wisconsin Regional Planning Commission (SEWRPC)	2.0	2010	2035	II
Nashville, TN	Nashville Area Metropolitan Planning Organization	1.4	2010	2035	I
Orlando, FL	MetroPlan Orlando (METROPLAN)	1.8	2010	2030	I
Pittsburgh, PA	Southwestern Pennsylvania Commission (SPC)	2.6	2011	2040	I
San Antonio, TX	San Antonio–Bexar County Metropolitan Planning Organization	1.8	2009	2035	III
San Francisco, CA	Metropolitan Transportation Commission (MTC)	7.2	2013	2040	III
Seattle, WA	Puget Sound Regional Council (PSRC)	3.7	2014	2040	III
St. Louis, MO	East-West Gateway Council of Governments (EWGCOG)	2.6	2011	2040	III
Washington, DC	National Capital Region Transportation Planning Board (TPB)	5.0	2012	2040	II
Portland, OR[b]	Metro	1.5	2014	2040	III

[a] Tier I models do not include walking or bicycling. Tier II models group walking and bicycling into a single non-motorized mode. Tier III models include both walking and bicycling in the mode choice stage.
[b] Portland, OR was used to develop the screening and search terms.

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TABLE 2 Health Concerns in MPO Long-Range Transportation Plans

	Guidance statements					*Performance measures*				
	Public	*Health components*				*Public*	*Health components*			
MPO region	***health***	***Safety***	***Air***	***Activity***	***Access***	***health***	***Safety***	***Air***	***Activity***	***Access***
Atlanta, GA	✓	✓		✓	✓	✓	✓	✓	✓	✓
Baltimore, MD	✓	✓	✓	✓	✓		✓	✓		✓
Chicago, IL	✓	✓			✓					✓
Cleveland, OH	✓	✓			✓	–	–	–	–	–
Detroit, MI		✓		✓	✓		✓	✓		✓
Houston, TX		✓			✓		✓	✓		✓
Kansas City, MO	✓	✓	✓	✓	✓		✓	✓	✓	
Memphis, TN	✓	✓	✓		✓		✓			✓
Miami, FL		✓	✓		✓		✓	✓		✓
Milwaukee, WI		✓	✓		✓	–	–	–	–	–
Nashville, TN	✓	✓	✓	✓	✓	–	–	–	–	–
Orlando, FL		✓	✓		✓		✓	✓		✓
Pittsburgh, PA	✓	✓			✓	–	–	–	–	–
San Antonio, TX		✓	✓		✓	–	–	–	–	–
San Francisco, CA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Seattle, WA	✓	✓	✓	✓	✓	✓		✓	✓	
St. Louis, MO		✓			✓	–	–	–	–	–
Washington, DC		✓	✓		✓	–	–	–	–	–
Portland, OR[a]	✓	✓	✓	✓	✓		✓	✓	✓	✓
Totals	**10**	**18**	**11**	**7**	**18**	**3**	**9**	**9**	**4**	**9**

– Performance measures not included in plan.

[a] Portland, OR was used to develop the screening and search terms; results are not included in totals.

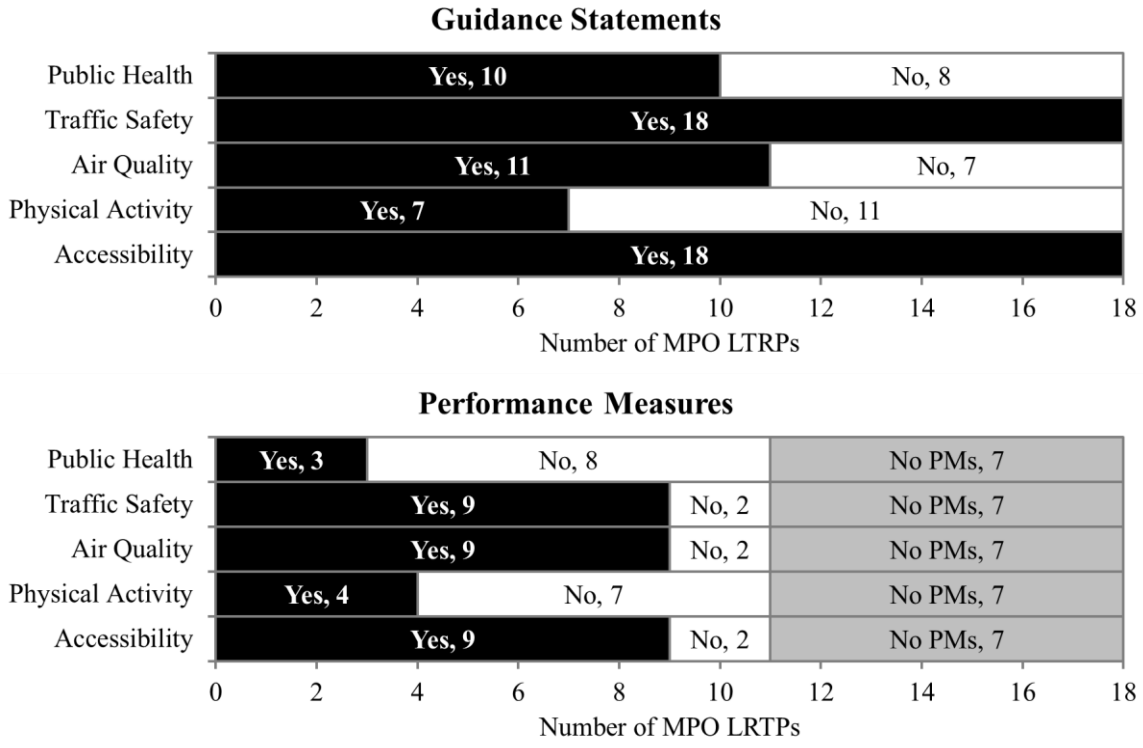

Figure 1 (a) Health-related guidance statements; b) Health-related performance measures.

Health within guidance statements

General public health

Only ten MPOs had plans that specifically referenced "public health" or "human health" in their guidance statements. ("Ecological", "environmental", "fiscal", and "economic" health language appeared more frequently.) (Statements referring to "quality of life" did not qualify.) Some plans noted the "health of people" almost in passing within larger, more encompassing goals like "livability." Health was sometimes linked to other goals like environmental improvement and economic vitality. More often, health was one of a handful of plan goals. However, when "health" was an elaborated goal, plans tended to incompletely represent health, often focusing only on physical activity and air quality (e.g., Nashville, Memphis). Only the Portland and San Francisco plans' health goal were nearly as broad as possible, encompassing safety, air quality, and physical activity elements; e.g.,

> *Goal: Enhance Human Health. Multi-modal transportation infrastructure and services provide safe, comfortable and convenient options that support active living and physical activity, and minimize transportation-related pollution that negatively impacts human health* (Portland).

Traffic safety

All MPO plans included a safety goal or objective. Sometimes "improving safety" was a small part of broader language. More often, guidance statements emphasized the need to provide safety for all modes and road users (e.g., Detroit). San Antonio's plan's inclusive guidance promoted a "transportation system where everyone is able to walk, ride, drive or wheel in a safe…manner". Specific strategies to achieve safety goals, when identified, tended to be comprehensive. Baltimore's plan noted the need to reduce injuries and fatalities, develop safety-focused plans, improve high-crash locations, collect and analyze safety data, and improve emergency response. Regional plans also included other guidance, including suggestions for: street and intersection design improvements (Washington), especially at transit and intermodal locations (Miami); enhanced enforcement (Washington); more driver education (St. Louis); policies like Complete Streets (Memphis); programs like Safe Routes to School (Miami); and upgraded communications in emergency medical care (St. Louis).

Air quality

Eleven MPO plans specifically called out air quality in policy guidance. Air quality references often fell within a broader "environmental" goal or were framed as an impetus for congestion reduction (Memphis). One plan emphasized a need to conform to state and federal air quality requirements (Milwaukee). Other plans did acknowledge the inherent human health benefits of reducing transportation-related emissions and pollution (Kansas City, Baltimore, San Francisco, Portland). Some laid out specific strategies to accomplish air quality goals, including technological improvements (Washington), financial incentives (Washington), transit and bicycle/pedestrian facilities to offset SOV growth (Washington, San Antonio), and a clean air action plan (Kansas City).

Physical activity

The plans of seven MPOs included policies to increase physical activity. Vague plan language referring to walking and bicycling was included: e.g., "improving…personal health by facilitating walking [and] biking" (Detroit). Most statements noted a need to promote communities and transportation systems that supported "healthy lifestyles" and "active living". A few plans specifically mentioned "physical activity" through bicycle and pedestrian and other multimodal options (Kansas City, Baltimore, Portland). Physical activity was more often an objective of the plan, rather than a goal.

Accessibility

Accessibility was the most frequent health component in guidance statements and was found in all eighteen plans. At the same time, it was often the vaguest and only tangentially-related to public health. Accessibility statements were tied up with concepts of mobility, connectivity, and economic development. Some plans promoted access to unspecified "resources" or "desired destinations". Most emphasized access to jobs and "regional activity centers", with specific improvement strategies such as jobs-housing balance (Memphis, Kansas City), job creation (St. Louis), and reverse commutes (St. Louis). Other specified destinations included services—educational institutions, libraries, restaurants, government and social agencies—and amenities—airports, museums, entertainment venues, arts and cultural facilities, and natural areas. Occasionally, policy guidance noted access to health-specific realms, including recreational opportunities (Detroit), health care facilities (Kansas City), and healthy food (Chicago).

Accessibility was frequently a justification for policy statements supporting public transit (Miami, Atlanta, St. Louis) and walking and bicycling (Nashville, Washington, Atlanta). Many guidance statements also noted unique access needs (e.g., San Francisco) of specific populations, including children, students, older adults, people with disabilities, low-income communities, minority communities, transit-dependent individuals, food desert residents, and other "persons with special accessibility needs" (Washington).

Health-related performance measures

General public health

Only three MPO plans had a direct measure of population health (besides safety). These health performance measures included the regional obesity rate (Atlanta), average body mass index (Seattle), and number of premature deaths due to fine particulates exposure (San Francisco). While other plans' measures were related to general health policies, they were actually health proxies (e.g., walk/bike mode share, physical activity levels) and fit better within one of the following health components. Injury and fatality metrics could be considered direct health metrics; but, as this is standard practice, they were included only in the safety category.

Traffic safety

When performance measures were used, MPO plans typically included safety measures. Most traffic safety performance measures were annual totals and/or average rates of traffic-related crashes, injuries, and/or fatalities. For example, Kansas City's plan had four safety performance measures: the total annual numbers of injuries and fatalities and the annual injury and fatality rates per 100 million vehicle miles traveled. Some plans also segmented measures by mode: walk, bicycle, and motor vehicle (Memphis, Portland). Unique safety performance measures

were: incident response and clearance times (Atlanta, Portland), investment in safety projects (Miami), seat belt usage (Baltimore), and the presence of a Safe Routes to School program (Miami). Atlanta's plan noted the challenge of forecasting crashes and severities (especially fatalities) when evaluating the safety performance of future scenarios.

Air quality

Nine of the MPO plans also contained air quality performance measures. Most air quality measures reflected the total weight of criteria pollutants emitted (usually from transportation sources) in the region, including ozone, particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), and nitrogen oxides (NO_X), sometimes averaged over a three-year period. For example, Baltimore's plan had four air quality measures: the total weights of volatile organic compounds, NO_X, CO, and $PM_{2.5}$ emitted. Other less common air quality performance measures tracked time out of compliance with state and federal air quality standards (Kansas City, Seattle).

Physical activity

Only four MPO plans included physical activity performance measures, and most had tier III walk/bicycle travel models. While some regions intended to track the obesity rate (using data from the Centers for Disease Control), most instead measured the number of walk, bicycle, and walk-to-transit trips (or mode shares) as a proxy for physical activity levels. Only one plan (San Francisco) specifically replaced a prior mode share measure with daily time spent in active transportation because it was more directly related to physical activity. Interestingly, only the Portland and San Francisco plans suggested using the regional travel model to obtain this performance measure; other regions took commute mode shares from US Census data.

Accessibility

As with traffic safety, most MPO plans with measures included accessibility. Many types of accessibility performance measures were associated with the wide range of accessibility guidance statements. Some plans gave undefined metrics, such as "reasonable access", "walking distance", or "served by transit". More common accessibility measures fell into two categories: distance-based and time-based.

Distance-based measures assessed the proportion of residents or jobs located within a certain distance of a type of transportation facility, typically a "walkable" quarter or half mile from transit (or fixed-route/high-capacity transit). For example, Orlando's plan focused on transit access at both the production (home) and attraction (job) ends of trips: percentages of population and employment within one quarter mile of transit service. Other facilities examined included trail access (Portland) and highway access to major activity centers, tourist attractions, and health, recreation, employment, and cultural facilities (Miami).

In contrast, time-based accessibility measures assessed the proportion of the population or employment located within a time threshold of people or jobs; Atlanta's plan included both. Thresholds typically varied by mode: e.g., 30 minutes by highways and 60 minutes by transit (Baltimore). Other regions incorporated innovative accessibility measures into plans, including jobs-housing balance (Orlando), joint housing–transportation affordability (Atlanta, San Francisco), sidewalk extent on urban state-owned roadways (Baltimore), and access to healthy food and to parks (Chicago).

DISCUSSION

As we hypothesized, health is incompletely considered within regional transportation planning. Only one reviewed MPO plan (San Francisco) contained guidance statements and performance measures in all categories of health (including a direct health measure), and even that plan only weakly represented accessibility. Plan guidance statements tended to follow national goals and emphasized safety, air quality, and accessibility more than physical activity. Health-related performance measures were incomplete in some areas like physical activity, but regions with better bicycle and pedestrian modeling abilities tended to have physical activity measures. Significant efforts are needed in the areas of performance measurement, travel modeling and health assessment, and public participation.

The following sections summarize key findings, provide potential strategies for increasing the role of health in transportation planning practice, and discuss study limitations based on the content analysis and review of health in metropolitan long-range transportation plans.

Findings

Plans often reflect an incomplete view of how transportation systems influence public health.
Only five plans referred to all four health components within guidance statements. Even those plans with overarching goals of public health tended to describe "health" in terms of air quality and physical activity. MPO LRTPs have yet to fully adopt a holistic approach to linking transportation and health (*29*).

Most plans are guided by safety concerns and a desire to increase accessibility.
Nearly all MPO plans had safety and accessibility as important transportation planning goals. Yet, these goals—especially access—were often divorced from a public health perspective. Accessibility was promoted more from the points of view of equity and economic vitality than as a health concern. The consideration of safety and access in isolation reflects the lack of a comprehensive vision of health in transportation planning.

Air quality concerns may be under-represented in this analysis.
Although only slightly more than half of the plans referenced air quality guidance, all MPO plans were likely concerned with air quality. Explicit air quality statements could have been slightly less common because of strong federal requirements for air quality conformity. Perhaps policy-makers—intentionally or unintentionally—discounted air quality concerns when crafting guidance statements precisely because a mandated air quality assessment process already exists for long-range transportation planning. If true, this may suggest that federal planning requirements can skew regional priorities away from important areas like air quality. On the other hand, other regions might not have prioritized air quality if not for the federal mandate.

Regional plan policy foci are guided by national policy language.
During the analysis of health-related and other plan policies, it became clear that regional guidance statements—in the selection of goals and objectives, or at least in their framing—were frequently influenced by national transportation policy guidance. Many plans referenced federal transportation "planning factors" established in SAFETEA-LU (and reaffirmed in MAP-21): economic vitality, safety, security, accessibility/mobility, environmental protection, intermodal

connectivity, operational efficiency, and preservation (*32*). LRTPs goals and objectives often matched these federal priorities or were borrowed almost verbatim. Similarly, MAP-21 established national performance goals in the areas of: safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays (*8*). Only the safety goal is directly related to health.

Performance measurement is generally related to policy guidance.

Based on the analysis of guidance statements and performance measures, it does appear that measures are being related to goals, as expected (*5*). Overall, the frequency of health-related measures matched the relative frequency of health-related statements, although the areas of physical activity and general public health are lacking. In many plans, measures were clearly linked to goals or objectives in a table (Atlanta, Kansas City, San Francisco). It is assumed that performance measures are being developed to fit goals and objectives and not the other way around, although this cannot be determined without a longitudinal analysis of previous plans and more information on the plan development process. With new federal requirements for transportation performance measurement (*8*), the linkage of measures to goals becomes more critical.

Travel model capabilities to forecast walking and bicycling appear to be related to performance measures but not plan guidance statements.

Physical activity is the health component most directly linked to walking and bicycling levels. MPOs with tier III models could estimate walk and bicycle travel throughout their regions, while MPOs with tier II models could do this incompletely (with one "non-motorized" mode) and MPOs with tier I models not at all. Notably, a physical activity performance measure was found in all three plans of tier III MPO with performance measures (Atlanta, San Francisco, Seattle) but only one plan of tier I or II MPOs (Kansas City). This suggests a connection between model capabilities and performance measurement, although the direction of causality cannot be determined. Did the measure provide the impetus for improving the model, or did model improvements allow for the adoption of the measure?

On the other hand, there seemed to be no association between physical activity goals and walk/bicycle modeling: just as many (three) tier I MPO plans included physical activity guidance statements as did tier III MPO plans. As has been found in other studies (*3*), it appears that technical model capabilities lag changes to planning goals. The difficulty of travel models to adapt to new and broadening policy goals constrains analyses of transportation plans' effects in relation to their objectives; this may bias plan development and project prioritization in favor of factors that can be assessed using standard travel model outputs. The disconnects between health-related guidance statements, performance measures, and travel model capabilities, especially in the areas of physical activity and walking/bicycling, become more problematic in an era of performance-based planning.

Potential strategies

What might be the best way to integrate health concerns into MPO LRTPs? Despite no single ideal procedure, best practices do stand out. Public health could be one of several overarching plan goals, with a definition that encompasses safety, air quality, activity, and access aspects. In addition, concepts of traffic safety and accessibility could be reframed to emphasize their

contributions to improving population health: by reducing life-years lost and by affording access to healthy opportunities. More plans could adopt guidance statements relating to increasing physical activity through the transportation system. Education and outreach about the important links between transportation and health might encourage the general public to demand a regional health goal and regional officials to view other goals through a health lens. Community organizations, public health agencies, and academic research institutions are possible sources to help motivate changes (*29*) to regional transportation policy guidance statements.

Significant gains might also be achieved by considering health-related performance measures. Too few plans assessed direct health outcomes, despite the transportation system being a critical contributor to obesity, asthma, respiratory illness, lung cancer, and other diseases. Moving beyond crash, injury, and fatality safety measures, tools such as ITHIM (*33*) could generate health measures like disability-adjusted life years (DALYs) that encompass safety, air quality, and physical activity health impacts. The ITHIM model has already been applied to scenarios in San Francisco's LRTP using regional travel model outputs (*34*). Ongoing travel model improvements to better forecast walking and bicycling (*35, 36*) should offer support for more physical activity performance measures. On the other hand, critics of health outcome measures may contend that it is unrealistic to expect major health improvements from a transportation plan because of the many external factors (e.g., demographics, socioeconomics, education, health care, and food systems) also affecting human health.

On the topic of performance monitoring, MAP-21 requires states and MPOs to soon establish targets for nationally-identified performance measures in the areas of highways, safety, air quality, and freight. While safety and air quality may be linked to human health, accessibility and especially physical activity are conspicuously missing. Because many regions take their cues from federal policy, creating a national health planning factor or goal could be a strategy to encourage MPOs to more strongly consider health in transportation planning and promote innovations in metrics and travel model capabilities. At the same time, select regions are already putting human health concerns alongside other goals like congestion reduction, economic development, and environmental protection. Without a federal health performance measure in transportation, it remains to be seen whether MPOs will maintain their existing or adopt new supplementary health-related measures.

Efforts could also be made to improve public participation and better accommodate environmental justice within the transportation planning process. Local community backlash against major projects, particularly roadway expansions in communities of concern—home to higher concentrations of vulnerable or disadvantaged populations—often revolve around inherent conflicts between regional goals like mobility and local issues like health, safety, air quality, and accessibility (*22*). Conflict around EJ concerns could be a symptom of inadequate public participation in the planning processes. As McAndrews and Marcus note, "In a regional transportation-planning context shaped by state and federal policy, as well as regional collaboration, the power to change transportation outcomes is often upstream of local impacts" (*22*). Community members may prioritize broad health and livability goals but are not motivated to participate in a public process (e.g., LRTP development) until the impacts of a specific project can be immediately felt (*37*), contributing to the sense that regional priorities are immutable (*22*). At a grassroots level, outreach efforts to successfully engage citizens in transportation visioning and planning processes are sorely needed; although, there is no guarantee that communities' voices will be heard or their concerns adopted (*38*). In addition, research and efforts to improve EJ analyses tend to focus on identifying low-income and minority population user groups and

defining the terms "equity" and "disproportionate". Significant gaps exist in determining what "adverse human health" effects are most important and how to measure them to satisfy EJ requirements.

Health-related guidance statements and performance measures do not appear in regional transportation plans overnight. Other reports (*29*) go into further detail about the process that results in the development of health-related statements and measures in LRTPs and other transportation planning arenas. In addition, there are other possible metropolitan planning actions to incorporate health concerns, including adopting relevant policies and establishing regional health or bicycle/pedestrian plans, coordinators, and committees (*24*). Such broader efforts require motivation on the part of MPO boards and staff, outreach to public health agencies, communication with other groups and the public, organizational relationship- and capacity-building, and other structural changes that need commitments over time (*29*).

Limitations and future work

This review was not without limitations and challenges. Broadly, the health analysis of LRTPs was the result of our understandings of plan language and relationships, informed by our own experiences and biases. The admitted subjectivity of several steps, especially the identification and classification of guidance statements and performance measures, means that other researchers may come to different conclusions. Accessibility guidance and measures were particularly difficult to assess due to their broad scope. Also, other MPO plans may exhibit innovative practices not documented here. Nevertheless, our analysis was useful in describing current practice.

More fundamentally, our review has relatively narrow implications. The LTRP scan was a cross-sectional look at a limited number of large MPOs. Conducting a census of large- and medium-sized MPOs would yield more definitive conclusions. Following the evolution of plans from one to the next (or the development of a single plan, including public involvement) would be useful for tracking when and how health concerns became an integral part of LRTPs. Unfortunately, MPOs rarely include out-of-date plans on their websites; previously-adopted plans are typically unavailable online or require special agency requests to obtain. Case studies and interviews may be better able to investigate questions of process (*29*).

In addition, this review did not investigate project prioritization nor relate the prevalence of guidance statements and performance measures to specific types of transportation investments (e.g., bicycle and pedestrian project spending) or health outcomes (e.g., obesity or asthma rates). Documenting actual transportation and health outcomes of new planning processes is a critical area for future research, especially in an era of increased reliance on performance measures. Changing plan guidance statements to include health concerns may or may not yield changes in health-related transportation investments. Our analysis also cannot inform why health-related statements and measures were included in LRTPs or whether such inclusion yields health improvements. However, it does provide a survey of the practice of considering health in long-range transportation planning, which may be helpful in the development of future MPO plans.

CONCLUSION

This paper examined the inclusion of public health concerns within long-range transportation plans in eighteen large US metropolitan areas, including the connections between guidance statements and performance measures. It serves as a review and discussion of the state of the practice of health in MPO LRTPs. Other agencies may borrow performance measures presented

and referenced herein, or use health policy guidance statements to inspire MPO boards and the public to adopt, revise, or at least consider regional health goals and objectives. The findings and potential strategies in this paper offer a jumping off point for future improvements to the consideration of health within metropolitan transportation planning.

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