Key Questions:

Accessibility

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Version 1.0

DESIGN FOR HEALTH is a collaboration between the University of Minnesota and Blue Cross and Blue Shield of Minnesota that serves to bridge the gap between the emerging research base on community design and healthy living with the every-day realities of local government planning. This Accessibility Key Question is part of a series with a focus on identifying and interpreting evidence-based research linking public health with planning.

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Overview

A defining characteristic of metropolitan areas is that they provide a variety of activities within a shorter travel time than rural areas. Embedded within this statement are several questions and assumptions. What is the range of different activities (services and facilities) that are important to get to, e.g., health care, employment opportunities, groceries, social networks? How close is close enough? Are non-motorized modes of travel safe and available? Each question has strong bearing on the health and welfare of residents who live in these cities. Healthy cities provide both a variety of services for residents in a community and a variety of means to get to such services.

The concept of accessibility captures the above phenomena. Accessibility measures ask: (a) do people have access to the activities that they need or want to participate in, and (b) how easy is it to get these activities? In contrast to measures of mobility, which focus solely on the means of travel, accessibility adds in a consideration of the characteristics of the traveler and his or her desired destination. Depending on their use, accessibility measures can inform everything from advanced transportation modeling to healthy cities or even quality of life. The late Mel Webber of the University of California, Berkeley, often quipped that the ideal city is “one that maximizes access among its interdependent residents and establishments.” This notion has been widely shared among urban scholars.

Metropolitan Design Center

Lagona Woods Village, CA, Senior Community Bus

Accessibility is measured in a variety of ways. Highly detailed measures weave together both the locations of specific origins and destinations, as well as an estimate or measure of the likelihood that they can be served by different modes. Semi-detailed measures count the number of services within say, a ten-minute drive. Rough measures, may examine whether destinations can even be reached by transit, walking or cycling (e.g., by measuring if transit service exists).

The latter group serves as the baseline for measures of accessibility used in the suite of health-impact assessments provided in the Design for Health Project. If any range of services is not available to different segments of the population because the services are only accessible by car, then they fail to sufficiently advance the goals of healthy communities aiming to reduce auto dependency. Most metropolitan areas have a full array of destinations available for residents (e.g., employment, health care, grocery stores). At issue is the time required to reach these destinations and if they can be reached by means other than the automobile. Only providing for auto access to destinations, even in today’s metropolitan areas, runs counter to many basic tenets of healthy communities, including equity and air quality.

At the same time, however, it is difficult to assume that everyone will walk or bicycle to destinations, especially those far away. Particularly for the elderly, the young or the financially disadvantaged, transit is the mode of transportation that provides such access where walking or cycling is too burdensome. An estimated 23 percent of the U.S. population is under legal driving age (under age 16), 9 percent of the population is over 69 years old, and almost 13 percent of the population is in poverty. But merely making services available is a principle that applies to broader issues than just planning for cycling, walking or transit. It requires thinking about the design of these modes so that they are usable by as many people as possible, regardless of age, ability or circumstance, following tenets of universal design. Such examples include buttons on control panels or traffic signals that can be distinguished by touch; relatively wide doorways, hallways or sidewalks; smooth ground surfaces at entranceways without stairs; and transit service that can easily accommodate wheelchairs (N.C. State University (2004).

In addition to subscribing to principles of universal design, as part of the Design for Health Project, we suggest it is important to consider how viable transit service is to the populations affected by a particular plan or development proposal. Providing for just auto access ultimately leaves many residents longing for other options for mobility and accessibility.

Providing for attractive transit accessibility requires that three tenets be met: first, transit is available; second, the available transit service is of reasonably high quality; and third, transit is provided for different trip purposes.

According to a supplemental questionnaire of the American Housing Survey, just over half of the American population (54.48 percent) reported having public transit available from their home (U.S. Department of Commerce 1996). Thus, almost half of the US population does not even have transit available; transit could not compete for any trips from almost half the households in America. Of those who had transit available, a next step is to assess its relative quality. Again, the American Housing Survey yields useful information; only 28.8 percent of U.S. households reported that they had satisfactory public transportation available (down from 39.39 percent in 1983 and 54.52 percent in 1974, the first year this matter was surveyed). Finally, one must be aware of the different purposes of travel for which transit may be used. In most transit markets, the majority of trips are to and from work. Work trips are consistent in terms of origins, destinations and timing. When less frequent destinations at varied times of day are thrown into the fray, transit loses any semblance of a competitive edge over the auto.

There has been extensive research trying to uncover some of the underlying characteristics for where transit "works" and the associated land-use and travel characteristics. Below, we break down relevant information related to the provision of transit service and the state of the knowledge.

Things for Certain (or Semi-certain)

People's use of transit—and their willingness to walk to transit stops—varies tremendously by socio-economic group, trip purpose, frequency of service and type of service, and the attractiveness of the walking environment to the transit stop. It is well documented, for example, that poorer socio-economic groups have higher rates of bus ridership than other groups.

When it comes to planning for successful transit, however, two factors stand out: (1) the importance of development densities and (2) being sensitive to the walking "catchment" areas for the transit.

The best known and most reliable work on this subject was offered by Pushkarev and Zupan in the late 1970's (Pushkarev and Zupan 1977; Pushkarev and Zupan 1982). Subsequent work (Transit Cooperative Research Program 1995) reinforced many of the thresholds offered by Pushkarev and Zupan and also expanded the nature of some of thresholds to apply to different types of service and to include employment characteristics. Some of the thresholds presented in these reports are reported on the next page.

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Table 1: Recommended residential densities for transit service

Service Levels	Residential Density Thresholds (Housing -units per gross acre)
Bus: Minimum service (20 buses/day)	4 dwelling units/gross acre
Bus: Intermediate service (40 buses/day)	7 dwelling units/gross acre
Bus: Frequent service (120 buses/day)	15 dwelling units/gross acre
Light Rail: 5-minute peak headways	9 dwelling units/gross acre (25-100 sq. mile corridor)
Rapid Rail: 5-minute peak headways	12 dwelling units/gross acre (100-150 sq. mile corridor)
Commuter Rail: 20 trains/day	1-2 dwelling units/gross acre (existing track)

*Net acres are often referenced in zoning codes and consider only the area developed for housing or employment. Gross acres are total land areas, which may include streets, parks, water features, and other land not used directly for reisdnetial or empl9oyment-related development.

Table 2: Recommended residential densities and employment center sizes for transit service

Minimum Service Level	Residential Density Thresholds (housing units per gross acre)	Employment Center Thresholds
1 bus/hour	4-6 dwelling units/gross acre	5-8 million sq. ft. commercial/ office space
1 bus/30 minutes	7-8 dwelling units/acre	8-20 million sq. ft. commercial/ office space
Light rail and feeder buses	9 dwelling units/acre	35-50 million sq. ft. commercial/ office space

More specific accounts support some of these thresholds, for example, suggesting that residential densities need to average at least seven dwelling units per gross acre to support viable feeder bus service and an average of fifteen dwelling units per gross acre to support high-frequency bus service (County of Snohomosh 1993). Other research (Frank and Pivo, 1994) found that population densities need to exceed approximately thirteen persons or residents per gross acre before a significant modal shift occurs from single-occupant vehicle (SOV) use to transit use and walking for shopping trips. This analysis suggests that policies that encourage population densities to increase to levels below thirteen persons per acre will have little effect on mode choice. Thirteen persons per acre roughly corresponds to approximately seven to nine dwelling units per gross acre, which is similar to findings from other accounts (Pushkarev and Zupan 1977). Furthermore, King County, Washington's Metro has observed that some bus lines traveling relatively dense corridors in some neighborhoods (more than thirteen dwelling units per gross acre) can support fifteen-minute headways (Kittelson and Associates 2003).

Most of the focus lies on examining residential densities. What happens when the development or plan proposal applies to employment-centered land uses? The above tables suggest some thresholds based on amounts of square feet of office space at a destination. Another way to approach this matter is the number of employees per acre. Again, research based in King County found substantive modal shifts from auto use to transit use and walking with densities between 20 and 75 employees per gross acre and again with more than 125 employees per acre (Frank and Pivo 1994).

The problem with the above numbers, however, is that they are relatively general in nature, drawn from only a select number of locations, and do not control for other factors that may influence the use of transit (e.g., income) or the robustness of the transit service (e.g., the size and strength of a downtown environment).

The second dimension looks at how far people are willing to walk for transit service - a phenomenon with considerable variance depending on the type of service. According to the 1990 National Personal Transportation Survey, the average person is willing to walk about 450 m (1500 feet) to a transit stop. The number of people willing to walk longer distances drops off considerably when distances exceed 500 m (Morris 1996). Examining behavior in Edmonton and Toronto, Canada, analysis found a healthy percentage of transit users were willing to walk as far as 1220 m (4000 feet) from a transit station (Transit Cooperative Research Program 1995); such trips were likely for light rail or commuter rail. A closer examination, looking at half of the population suggests a more reliable threshold to lie between 300 and 600 m (1000 and 2000 feet).

Research exploring this phenomenon from Australia (Ker and Ginn 2003) found considerably longer distances; a substantial number of walkers walked up to 3000 m to a rail station that had frequent connections to the city, though the vast majority of people were willing to walk up to 1200 to 1300 m from the City Station. However, this comparison, while appearing to confirm the existence of a threshold at considerably longer distances (e.g., between 800 m and 1200 m), is flawed, as some zones have fewer employed people than others and areas with more employment will provide bigger draws. When allowance is made for this, by relating the number of walkers to the employment in each zone, the drop-off with distance is even less marked and there is no evidence of a “threshold” distance.

Things up in the air

Many factors serve to create transit-supportive environments. Higher densities lead to better transit service, for example, because of higher demand. An initial transit line often leads to two lines, which then increases to three or more lines and, subsequently, more people using transit for a variety of destinations. Places with higher demand for transit can become competitive with the automobile because, among other things, parking might become expensive or a thriving central business district may serve as a good anchor. More people using the service creates additional demand that may trigger expanded service at a wider array of times throughout the day, which in turn leads to greater demand for development. Which factor is at the core of a successful transit environment? All of them; it is difficult to discern which is most important. Transit use is a network phenomenon and looking only at development densities greatly oversimplifies the issue

Working thresholds for HIA

Given the fact that there is considerable variance in different types of thresholds, a useful place to start is to make opportunities available for transit service, in terms of service location and service time. Density is a critical dimension, though certainly not the only dimension to consider. While specific density thresholds will not apply to every city, type of transit service or destination people want to travel to, available research has honed in on minimum thresholds for intermediate bus transit with one-half mile between bus stops.

Available thresholds suggest at least 4.5 units per gross acre is an absolute minimum residential density for hourly transit service to be feasible. Granted, hourly transit service is a minimal provision, but yields a good place to start. Hourly service corresponds to the minimum level of service (LOS), which is an "E" value for service frequency, as well as the minimum frequency used for determining hours of service LOS (Pushkarev and Zupan 1982).

A second criterion is to ensure that areas around both work and residential environments contain transit stations within 1200 m of all destinations. This threshold helps to attract as wide of a trip-shed as possible and is based on analysis of detailed distance-decay curves of thousands of transit boardings in the Twin Cities (Iacono, Krizek and El-Geneidy 2007); 750 m (2460 feet) is where there was considerable drop-off in walk-to-transit activity.

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