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If Health Matters

Integrating Public Health Objectives in Transportation Planning

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Abstract

This paper investigates how transport policy and planning practices would change if public health objectives received greater priority. Conventional transport decision-making focuses on some health impacts but overlook others. It gives considerable attention to per-mile vehicle crash risk and pollution emissions, but overlooks the safety and pollution problems that result from increased vehicle mileage, and the negative health impacts resulting from less physically active travel. As a result, transportation agencies tend to undervalue strategies that reduce total vehicle travel and create a more diverse transport system. Various mobility management strategies are described and their impacts on traffic safety, pollution emissions and physical activity are evaluated. This analysis suggests that giving greater priority to health objectives in transport planning would reduce roadway and parking capacity expansion and increase support for mobility management strategies, particularly those that increase walking and cycling.

Introduction

Conventional public decision-making tends to reflect a *reductionist* model, in which individual problems are assigned to a specialized organization with narrowly defined responsibilities.[1] For example, transportation agencies are responsible for solving traffic problems, environmental agencies are responsible for reducing pollution, and health agencies are responsible for public health. This can result in an agency implementing solutions to one problem (which is within their mandate) that exacerbate other problems (which are outside their mandate), and it undervalues solutions that provide modest but multiple benefits.

This paper examines a particular example of this sort of policy disconnect: the lack of coordination between transport and health objectives. It asks, “How would transport policy and planning practices change if transportation agencies considered public health one of their primary responsibilities?”

Many transportation professionals may be offended by this question because they believe that they *are* concerned with public health, as reflected in their efforts to reduce traffic crashes and pollution emissions. However, as this article points out, current transport planning practices tend to overlook some significant health impacts. For transportation agencies to better address public health objectives they will need to expand the range of health impacts they consider, and develop better tools for evaluating how particular policy and planning decisions affect public health.

Transportation Health Impacts

Transport planning decisions impacts public health in several ways, including traffic crash risk, pollution emissions and physical fitness. These are examined below.

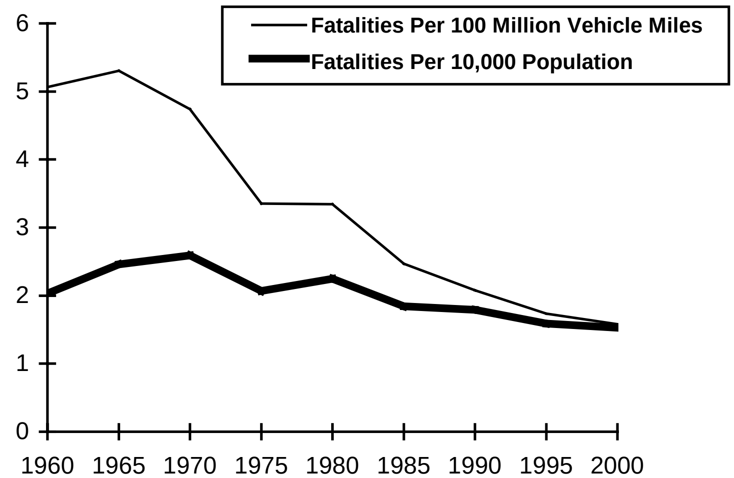
Traffic Crashes

Transport planning gives considerable attention to traffic safety. Many vehicle design features, roadway improvements and traffic safety programs are intended to prevent crashes or protect vehicle occupants when they crash.

Motor vehicle crash risk can be viewed in two different ways, giving two very different conclusions about the nature of traffic safety problems and solutions. Transportation professionals usually measure crash rates per unit of travel (i.e., injuries and fatalities per hundred million vehicle-miles or -kilometers). Measured in this way, U.S. crash rates have declined by more than two thirds over the last four decades, indicating that traffic safety programs have been successful and should be continued to further increase traffic safety.

But per capita vehicle mileage has more than doubled over this period, which has largely offset the decline in per-mile crash rates. When fatalities and injuries are measured *per capita* (e.g., per 10,000 population) as with other public health risks, there has been surprisingly little improvement over this period despite large investments in safer roads and vehicles, increases in the use of crash protection devices, reductions in drunk driving, and improvements in emergency response and trauma care. Taking these factors into account, much greater casualty reductions should have been achieved. For example, the increase in seat belt use over this period, from about 0% in 1960 up to 75% in 2002, by itself should reduce fatalities by about 33%, yet, per capita traffic deaths only declined by about 25%. Figure 1 compares these two different ways of measuring traffic crash risk.

Figure 1 **U.S. Traffic Fatalities**[2]



This figure illustrates traffic fatality trends over four decades. Per mile crash rates declined substantially, but per capita crash rates declined little despite significant traffic safety efforts.

Traffic crashes continue to be the greatest single cause of deaths and disabilities for people in the prime of life. Although the U.S. has one of the lowest traffic fatality rates *per vehicle-mile*, it has one of the highest traffic fatality rates *per capita*. From this perspective, traffic safety continues to be a major problem, current safety efforts are ineffective, and new approaches are needed to really improve road safety.

When road risk is measured using a distance-based rate, increased vehicle mileage is not considered a risk factor and vehicle travel reductions are not considered a safety strategy. From this perspective, an increase in total crashes is not a problem provided that there is a comparable increase in mileage. For example, building grade-separated highways tends to reduce per-mile crash rates and increase total vehicle travel, and reduces crash rates per mile but not per capita.[3] By emphasizing per-mile crash rates, conventional transport planning ignores the potential safety benefits of policies and programs that reduce total vehicle mileage. Transportation professionals consider mobility management (i.e., strategies that change travel behavior and reduce vehicle travel) as a solution to urban traffic congestion and pollution problems, but generally not as a safety strategy.

Vehicle Pollution

A second category of transport-related health impacts involve vehicle pollution emissions.[4] Although tailpipe emissions tend to receive the most attention, pollution is also produced during fuel production and distribution (called "upstream" emissions), vehicle refueling, hot soak (i.e., evaporative emissions that occur after an engine is turned off), and mechanical emissions produced from road dust and wear of brake linings and tires.

Vehicle air pollution is widely recognized as health risk, and vehicle emission reduction programs are often citied as an example of technological success. It is common to hear claims that vehicle emissions have declined by 90% or more over the last few decades, but this is an exaggeration.[5] Although tailpipe emission rates measured by standard tests have declined significantly, actual reductions are smaller.[6] Tests do not reflect real driving conditions, and vehicles produce harmful emissions are not measured in these tests. Increased vehicle mileage has offset much of the reduction in per-mile emissions, so vehicle emissions continue to be a major contributor to air pollution problem.

Many factors affect the human health impacts of vehicle pollutants, including emission rates per vehicle mile, per capita mileage, and exposure (the number of people located in areas where emissions are concentrated). Motor vehicle air pollution probably causes a similar order of magnitude of premature deaths as traffic crashes, although air pollution deaths tend to involve older people, while traffic crashes are more likely to harm people during the prime of life and so cause greater reductions in Potential Years of Life Lost (PYLL) or Disability Adjusted Life Years (DALYs).[7, 8, 9]

Physical Activity and Fitness

The third category of health impacts concerns the effects that transport planning can have on physical activity and fitness. In recent years, public health officials have become increasingly alarmed at the decline of physical fitness among the general population, and resulting increases in diseases associated with a sedentary lifestyle.[10]

There are many ways to be physically active, but many, such as sports or exercising in a gym require special time, money and skill, which discourages most people from participating regularly over their full lifetime. Many experts believe that more active transport (walking, running, cycling and skating) is the most practical and effective way to improve public fitness.[11] One major study concluded, “Regular walking and cycling are the only realistic way that the population as a whole can get the daily half hour of moderate exercise which is the minimum level needed to keep reasonably fit.”[12]

Active transport is declining in most developed countries. In the U.S., walking and cycling transport declined by about 40% between 1977 and 1995, from 9.9% to 6.4% of trips.[13] There appears to be significant latent demand for nonmotorized travel, that is, people would walk and bicycle more frequently if they had suitable facilities and conditions. One survey found that 17% of U.S. adults claim they would sometimes bicycle commute if secure storage and changing facilities were available, 18% would if employers offered financial incentives, and 20% would if they had safer cycling facilities.[14] Table 1 summarizes another public survey indicating high levels of interest in cycling and walking. This suggests that policies that improve walking and cycling conditions and encourage active transportation can increase public health.

Table 1 **Active Transportation Survey Findings[15]**

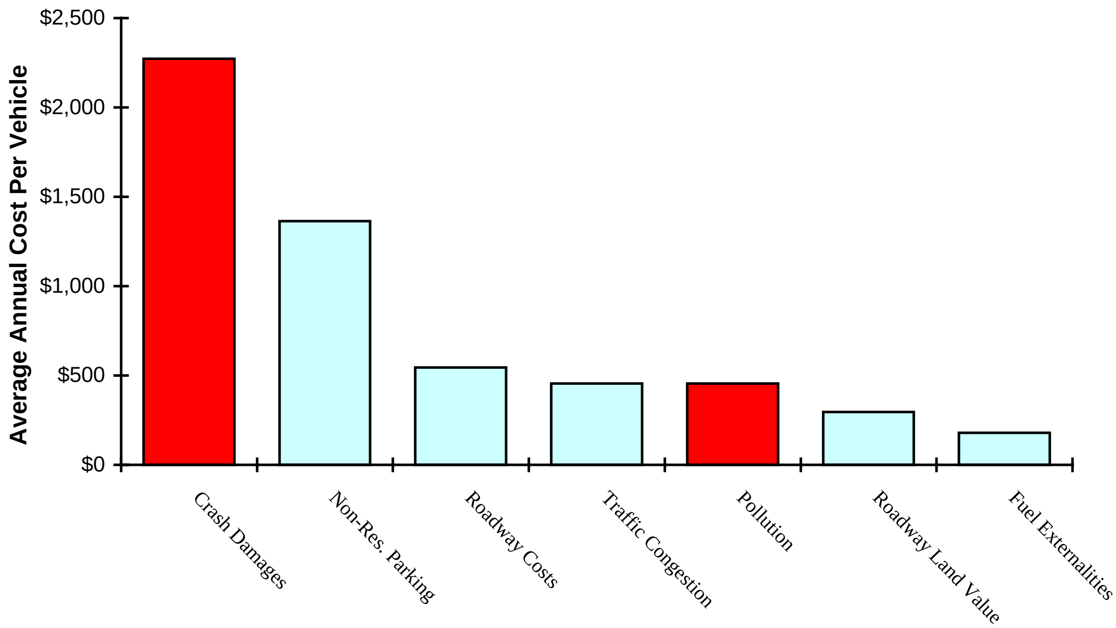
	Cycle	Walk
Currently use this mode for leisure and recreation.	48%	85%
Currently use this mode for transportation.	24%	58%
Would like to use this mode more frequently.	66%	80%
Would cycle to work if there “were a dedicated bike lane which would take me to my workplace in less than 30 minutes at a comfortable pace.”	70%	
Support for additional government spending on bicycling facilities.	82%	

The total health costs of inadequate physical activity are far greater than those resulting from traffic crashes. According to a major study by the Harvard University School of Public Health, cardiovascular diseases are the leading causes of premature death and disability in developed countries, causing ten times as many lost years of productive life as road crashes.[8] Even modest reductions in these illnesses could provide even greater overall health benefits than large reductions in traffic crashes. However, it is difficult to determine how a particular transportation policy or planning decision will affect these diseases, since it depends on their ability to increase physical activity by people who are otherwise too sedentary.

Comparing Transportation Objectives

For this analysis it is interesting to compare the value of public health improvements with other transport planning objectives. Figure 2 illustrates the estimated magnitude of various transport costs. It indicates that crash damages are the largest categories of these costs, due to the large number of people killed and injured in the prime of life, and associated property damages.[16] As mentioned earlier, air pollution damages probably cause a similar number of premature deaths, but these generally involve older people and therefore cause smaller reductions in Disability Adjusted Life Years (DALY), and air pollution causes less property damage. The health costs of sedentary transport are even more difficult to quantify, but a plausible guess is that they are at least as great as the costs of air pollution, and may exceed the costs of crash damages.

Figure 2 **Costs of Motor Vehicle Use in the U.S.[17]**



This figure illustrates the estimated magnitude of various transportation costs. Crash damages are one of the largest costs, far greater than traffic congestion or pollution costs.

This has important implications for transport planning. It indicates that a congestion reduction strategy is probably not worthwhile if it causes even a small increase in crashes, pollution emissions or inactive transport. For example, if roadway capacity expansion reduces congestion costs in an area by 10%, but increases total crash costs by 2% by encouraging additional vehicle travel and higher traffic speeds, it is not worthwhile. However, a congestion reduction strategy provides far greater total benefits if it causes even small reductions in crashes and pollution, or small increases in walking and cycling among people who are overly sedentary. For example, a strategy that reduces congestion by 5% provides twice the total benefit to society if it also reduces crashes by 1%.

Planning Practices

Current transport planning tends to focus on a subset of the various health impacts described above. Transportation professionals devote considerable attention to vehicle occupant safety and tailpipe emissions, measured per unit of travel, but give little consideration to the crash and environmental risks associated with increased vehicle mileage, or to the impacts their decisions have on physical activity and fitness.

Although transportation professionals do not intentionally increase vehicle mileage or reduce use of active modes, conventional transport planning practices are biased in various ways that tend to overvalue automobile-oriented improvements and undervalue alternative modes and mobility management strategies.[18] Individually such transport planning decisions usually appear modest and justifiable, but they tend to create automobile-dependent transport systems and land use patterns that significantly increase per capita vehicle travel and reduce active transport.[19]

Current transport planning tends to undercount and undervalue nonmotorized transportation.[20] Travel surveys ignore most walking trips. For example, if a traveler takes 10 minutes to walk to a bus stop, rides on the bus for five minutes, and takes another five minute walk to their destination, this *walk-transit-walk* trip is usually counted simply as a transit trip, even though the nonmotorized links take more time than the motorized link. Similarly, a 5-minute walk from a parking space to a destination is ignored. One researcher estimates that the actual number of nonmotorized trips is six times greater than what conventional surveys indicate.[21]

Current transportation and land use patterns tend to create barriers to walking and cycling.[22] Widening roads, increasing traffic speeds, increasing parking supply and dispersing destinations all tend to make landscapes that are less suitable for nonmotorized transportation. Communities with suitable transportation and land use patterns have much higher levels of walking and cycling.[23, 24, 25]

Are there ways to achieve both transport planning objectives such as reduced congestion, and public health objectives such as reduced per capita crash rates and improved fitness? Yes there are. The general term for these is *Mobility Management* (also called *Transportation Demand Management* or *TDM*), which refers to various strategies that encourage more efficient use of transport resources. Mobility management is the transportation component of Smart Growth and Smart Growth is the land use component of mobility management.[26] Most of these strategies can help achieve a variety of planning objectives such as infrastructure cost savings, consumer choice, community livability and equity. Table 2 lists various mobility management strategies.

Table 2 **Mobility Management Strategies**[27]

Improve Transport Options	Incentives to Reduce Driving	Parking and Land Use Management	Programs and Policy Reforms
Alternative Work Schedules	Walking And Cycling Encouragement	Bicycle Parking	Access Management
Bicycle Improvements	Commuter Financial Incentives	Car-Free Districts and Pedestrianized Streets	Campus Transport Management
Bike/Transit Integration	Congestion Pricing	Clustered Land Use	Carfree Planning
Carsharing	Distance-Based Pricing	Location Efficient Development	Commute Trip Reduction Programs
Flextime	Fuel Taxes	New Urbanism	Market Reforms
Guaranteed Ride Home	HOV (High Occupant Vehicle) Priority	Parking Management	Context Sensitive Design
Individual Actions for Efficient Transport	Parking Pricing	Parking Solutions	Freight Transport Management
Park & Ride	Pay-As-You-Drive Vehicle Insurance	Parking Evaluation	Least Cost Planning
Pedestrian Improvements	Road Pricing	Shared Parking	Regulatory Reform
Ridesharing	Speed Reductions	Smart Growth	School Transport Management
Shuttle Services	Street Reclaiming	Smart Growth Planning and Policy Reforms	Special Event Management
Small Wheeled Transport	Vehicle Use Restrictions	Transit Oriented Development (TOD)	Mobility Management Marketing
Taxi Service Improvements			Tourist Transport Management
Telework			Transportation Management Associations
Traffic Calming			
Transit Improvements			
Universal Design			

Mobility management includes more than three dozen strategies that improve transportation options, encourage use of efficient modes, and create more accessible land use patterns.

Conventional transportation decision-making does not completely ignore mobility management, but it tends to consider it a last resort for extreme urban traffic problems, to be implemented if conventional engineering solutions are infeasible. Mobility management is not usually considered a safety strategy. When transportation agencies evaluate strategies for achieving objectives such as reducing traffic congestion, parking problems or per-mile crash risk, mobility management strategies do not usually rank very high. Most individual mobility management strategies have modest impacts, typically affecting only a small portion of total vehicle travel. However, their impacts tend to be cumulative and synergetic (total impacts can be greater than the sum of their individual impacts). A comprehensive mobility management program using a complementary set of cost-effective strategies (i.e., strategies that are fully justified for their direct economic and consumer benefits) can often reduce total per capita automobile travel by 20-40% compared with conventional, automobile dependent transportation and land use policies.

Safety and Health Impacts of Mobility Management Strategies

This section describes the safety and health impacts of various mobility management strategies. For more information see specific chapters in the *Online TDM Encyclopedia*.[28]

Vehicle Travel Reduction Incentives

Some mobility management strategies (road and parking pricing, marketing programs, vehicle use restrictions) give motorists incentives to reduce their vehicle mileage. Some studies indicate that given modest incentives and encouragement, many people can reduce their vehicle travel by 10-20%.[29]

A given change in annual mileage tends to cause a proportional change in that vehicle's chance of causing a crash and a proportionally greater change in total crash damages. For example, if you reduce your chances of *causing* a crash by 10% (perhaps by driving more cautiously), your total crash risk declines by about 7%, since other drivers cause about 30% of the crashes you are involved in. If your annual mileage declines by 10%, your chance of causing a crash declines by 10%, and your risk of being in a collision caused by other drivers' mistakes also declines, since you are no longer a crash target for those miles. If all other motorists reduce their mileage by 10%, but you do not, you can expect a 7% reduction in crash risk, since 70% of your crashes involve another vehicle (you are no longer at risk from their mistakes, and they are no longer at risk from your mistakes for the miles not driven). If all motorists reduce mileage by 10% and other factors are held constant, total crash costs should decline by about 17% (10% + 7%). Empirical studies support this conclusion, indicating that each 1.0% vehicle mileage reduction causes a 1.4-1.8% reduction in crashes, although these impacts may vary depending on the type of mileage reduced.[30, 31]

Reductions in per capita vehicle mileage provide air emission reduction benefits, and to the degree that they result in shifts to nonmotorized modes by otherwise sedentary people, they provide fitness benefits.

Pay-As-You-Drive Vehicle Insurance

Pay-As-You-Driver pricing converts vehicle insurance premiums from a fixed cost into a variable cost. It prorates existing premiums by annual mileage, so insurance is priced by the vehicle-mile rather than the vehicle-year. This price structure gives motorists an incentive to reduce their driving, with greater incentives for higher risk categories. For example, a low-risk motorists who currently pays $300 annually for insurance would pay about 2.5¢ per mile, and so is predicted to reduce their mileage an average of 5%, while a higher-risk motorist who currently pays $1,800 for insurance would pay 15¢ per mile, and so might reduce their annual mileage by 20%, since they save far more with each mile reduced. At a result this strategy can provide extra safety benefits. It also reduces pollution emissions and may cause some automobile travel to shift to nonmotorized modes.

Mode Shifting

Many mobility management strategies cause travelers to shift from driving to another mode, either by making alternative modes more attractive or by discouraging automobile use. This can have a variety of safety impacts. Table 3 shows estimated fatality rates of different transport modes. This only reflects the direct risk to the individual traveler who uses that mode, but does not include risks to others, or impacts of changes in total vehicle travel. Modes such as walking and cycling *bear* relatively high risks, but *impose* little risk on other road users, and when people shift from automobile travel to other modes they often reduce their total mileage (for example, people may choose between walking to a local store or driving across town to a supermarket), and so reduce risk exposure. The safety impacts of shifts to specific modes are discussed below.

Table 3 **Fatalities per 100 Million Passengers in Britain**[32]

	Per Trip	Per Hour	Per Km
Motorbike	100	300	9.7
Air	55	15	0.03
Water	25	12	0.6
Pedalcycle	12	60	4.3
Foot	5.1	20	5.3
Car	4.5	15	0.4
Van	2.7	6.6	0.2
Rail	2.7	4.8	0.1
Bus	0.3	0.1	0.04

This table compares crash rates of common travel modes.

Transit

Travel shifts from automobile to transit tend to reduce total crash costs. Transit vehicle passengers have about one-tenth the crash fatality rates of automobile occupants, and shifts to transit reduce total vehicle traffic, reducing risks to other road users. In the U.S., urban transit has a relatively high total fatality rate (including both occupants and other road users) per passenger-mile due to low load factors (passengers per vehicle-mile), but mobility management strategies that increase transit load factors have small marginal crash risk, and so reduce crash rates.

Transit can be a catalyst for more accessible land use patterns that reduce per capita automobile travel and increase walking.[33] Per capita traffic fatalities tend to be lower and per-capita walking trips tend to be higher in transit-oriented urban areas than in automobile-oriented cities.[34] Most transit trips involve walking or cycling links, to get to a transit stop and to travel from a transit stop to the ultimate destination. Transit oriented communities require good walking conditions. As a result, mobility management strategies that encourage transit use are likely to increase active transportation.

Ridesharing

Ridesharing refers to carpooling and vanpooling. Ridesharing reduces overall crash risk by reducing total vehicle mileage. Two people who carpool rather than drive alone bear about the same level of internal risk, but reduce risk to others by using one vehicle rather than two. It may result in somewhat safer driving, for example, because drivers may be more cautious when they have passengers, carpools may tend to rely more on their more skilled motorist or safer vehicle, and because vanpool operators are sometimes required to take special safety tests. Some High Occupant Vehicle lanes have relatively high crash rates due to awkward merging conditions, and vanpools may have a relatively high rollover rate which may increase crash severity under some conditions, but there is currently insufficient data to quantify these factors, and design changes are being implemented to reduce these risks. Ridesharing reduces air pollution emissions and may cause small increases in walking (for example, commuters who rideshare are more likely to walk for errands during breaks than if they had driven to work).

Nonmotorized Transport

Walking and cycling tend to have relatively high per-mile casualty rates, suggesting that individuals increase their risk of crash injuries and death when they shift from automobile to nonmotorized modes. However, shifting travel to nonmotorized modes may increase safety and health *overall*, because:

- Nonmotorized travel imposes minimal risk to other road users.

- Nonmotorized trips tend to be shorter than motorized trips, so total per capita mileage declines. A local walking trips often substitutes for a longer automobile trip.

- High crash and casualty rates for pedestrians and cyclists result, in part, because people with particular risk factors tend to use these modes, including children, people with disabilities and elderly people. A skilled and responsible adult who shifts from driving to nonmotorized travel is likely to experience less additional risk than average values suggest.

- Nonmotorized travel provides health benefits that can offset crash risk. One study found that bicycle commuters have a 40% lower mortality than people who do not cycle to work, which suggests that the incremental risks of cycling are outweighed by health benefits, at least for experienced adult cyclists riding in a bicycle-friendly community.[35]

- Some mobility management programs include education and marketing components that encourage safety, particularly for cycling. These can reduce per-mile crash rates (experienced cyclists tend to have lower per-mile crash rates than inexperienced, less skilled cyclists), although it is difficult to predict how much effect this has.

Empirical evidence indicates that shifts from driving to nonmotorized modes tends to reduce per capita crashes. Urban regions with high rates of walking and cycling tend to have lower per capita traffic fatalities than more automobile-dependent communities. For example, walking and cycling travel rates are high in the Netherlands, yet the per capita traffic death rate is much lower than in automobile dependent countries.[36]

Shifts from automobile to walking and cycling can provide proportionately large air pollution emission reductions because they usually replaces short, cold start trips for which internal combustion engines have high emission rates. As a result, each 1% of automobile travel shifted to nonmotorized modes decreases motor vehicle air pollution emissions by 2% to 4%.[37] Increased walking and cycling by otherwise sedentary people can provide significant health and fitness benefits.

Mobility Substitutes

Mobility substitutes include telework and delivery services. They tend to reduce vehicle mileage, which reduces crashes, although there may be rebound effects, such as the tendency of telecommuters to make special trips for errands that they would otherwise perform while commuting, and to move farther from their worksite to less accessible, exurban locations. This typically offset about a third of mileage reductions and associated safety benefits.[38] For example, an employee who telecommutes three days a week would reduce commute mileage by 60%, but may drive additional miles for errands, resulting in a 40% net reduction in vehicle mileage and more modest safety benefits. Mobility substitutes that reduce total vehicle travel can provide significant air emission reductions, but they do not necessarily provide direct health and fitness benefits.

Travel Time and Route Shifts

Mobility management strategies that shift vehicle travel from peak to off-peak periods, or from congested highways to alternative routes, have mixed safety impacts. Per mile crash rates are lowest on moderately congested roads, and increase with lower and higher congestion levels, but fatalities decline at high levels of congestion, indicating a trade-off between congestion reduction benefits and crash fatalities.[39] Shifting vehicle trips to less congested roadway conditions can reduce crashes, but the crashes that occur tend to be more severe due to higher travel speeds. As a result, the safety impacts of mobility management strategies that shift travel times and routes vary depending on specific circumstances, and are difficult to predict. Shifting travel time or route tends to do little to reduce air pollution emissions or increase health and fitness.

Traffic Speed Reductions

There has been considerable research concerning the effects of traffic speed and speed control strategies have on road safety. Some research indicates that increased speed variance (the range between the highest and lowest speed vehicles) tends to increase crash rates per vehicle-mile, and higher traffic speeds tend to increase crash severity.[40] This suggests that speed control strategies that reduce average traffic speeds and speed variance on highways can reduce crash costs. Traffic calming (roadway design strategies to reduce traffic speeds on a particular roadway) and increased traffic law enforcement tend to increase safety. A meta-analysis of 33 studies concluded that area-wide traffic calming programs reduce injury accidents by about 15%, with the largest reduction is on residential streets (25%), and somewhat smaller reductions on main roads (10%).[41]

Traffic speed reductions have mixed air emission impacts, depending on traffic conditions, driving conditions, vehicle type and which emissions are considered. Speed reductions can improve walking and cycling conditions, and so can improve health and fitness if applied to areas with latent demand for nonmotorized travel.

Land Use Management

Land use patterns can have various traffic safety and health impacts. Higher density, clustered development patterns tend to increase traffic density (vehicles per lane-mile), which tends to increase crash rates per vehicle-mile within the area. However increased density also tends to reduce per capita vehicle mileage (particularly if increased density is implemented as part of an overall Smart Growth program to improve accessibility and encourage use of alternative modes) and tends to reduce crash severity (due to lower traffic speeds). As a result, per capita traffic fatalities tend to be lower in higher density urban areas, and higher in more automobile dependent with dispersed land use patterns. All told, city residents are much safer, even taking into account other risks that increase with urban living, such as pedestrian traffic fatalities and homicides.[42]

Higher density development tends to increase per-mile emission rates (due to increased congestion) and exposure (due to more people located near roadways), but reduced per capita vehicle mileage. This tends to reduce overall pollution emissions.[43] Traditional community design is associated with increased walking and bicycling.[44] This suggests that mobility management strategies which create more accessible land use and more balanced transport systems can increase overall health, although more research is needed to quantify these impacts.[45]

Health Impacts Summary

Table 4 summarizes the safety and public health impacts of various mobility management strategies. Some of these impacts overlap. For example, a vehicle travel reduction strategy often involves some travel shifting from driving to transit or nonmotorized modes.

Table 4 **Mobility Management Safety and Health Impact Summary**

Travel Change	Strategies	Safety	Pollution	Fitness
Vehicle Mileage Reductions	Pricing, marketing, mode shifting and other incentives.	Each 1% mileage reduction reduces crashes 1.2-1.8%.	Proportional reduction in emissions.	May increase walking and cycling
Distance-Based Insurance	PAYD Insurance, Distance-based pricing.	Large potential safety benefits since higher risk drivers have the greatest incentive to reduce their mileage.	10% mileage and emission reduction per participating vehicle.	May increase walking and cycling
Shifts to Transit	Transit Improvements, HOV Priority, Park & Ride	Increases safety due to greater safety for transit passengers and reduced vehicle traffic.	Reduce emissions, particularly if it leverages overall reductions in per capita mileage.	Generally increases walking and cycling.
Shifts to Ridesharing	Ridesharing, HOV Priority	Modest safety benefits.	Emission reductions proportional to mileage reductions.	May encourage some additional walking.
Shifts to Nonmotorized Modes	Walking and Cycling Improvements, Traffic Calming	Increases risk to participants, but reduces risk to other road users.	Reduces emissions.	Large potential benefits.
Mobility Substitutes	Telework, Delivery Services	Increases safety by reducing vehicle mileage, but rebound effects often offset a portion of benefits.	Reduces emissions, but rebound effects often offset a portion of benefits.	No direct benefits.
Time & Route Shifts	Flextime, Congestion Pricing	Mixed. Reducing congestion tends to reduce crashes but increases the severity of crashes that do occur.	Mixed. Reducing congestion tends to reduce some emissions but increases others.	No direct benefits.
Traffic Speed Reductions	Traffic Calming, Speed Enforcement	Significantly increases safety by reducing crash frequency and severity.	Mixed. Reducing speed reduces some emissions but increases others.	Can significantly increase walking and cycling.
Land Use & Transport System Changes	Various land use management and planning reforms	Increases safety by reducing per capita vehicle mileage and traffic speeds.	Increased land use density increases some emissions and exposure, but tends to reduce total emissions.	Can significantly increase walking and cycling.

This table summarizes the crash reductions, emission reductions and fitness impacts of various mobility management strategies.

Conclusions

Conventional transportation decision-making tends to use a reductionist approach in which different organizations are responsible for narrowly-defined problems. As a result, they often implement solutions to one problem that exacerbate other problems, and they undervalue strategies that provide modest but multiple benefits.

Transportation agencies tend to focus on traffic improvement objectives such as congestion reductions. However, health impacts are significantly greater in magnitude than congestion costs. Congestion reduction strategies that cause even a small increase in per capita crashes, emissions or physical inactivity are probably harmful to society overall, while congestion reduction strategies that support safety, environment and health objectives can provide far greater total benefits.

Transportation agencies tend to consider some health impacts, but overlook others. They give considerable attention to per-mile crash risk and pollution emissions, but tend to ignore crash risk and pollution emissions from increased vehicle mileage, and negative health impacts from reduced walking and cycling. As a result, transportation agencies tend to overvalue roadway and parking capacity expansion, and undervalue mobility management strategies that reduce vehicle travel and increase transport system diversity.

Many mobility management strategies can help achieve both transport objectives (reduced congestion and parking problems), and public health objectives (improved safety, air quality and fitness). Raising the priority of safety and health objectives in transport planning would reduce emphasis on roadway capacity expansion and increase emphasis on mobility management strategies, particularly those that lead to more walking and cycling. This could provide significant health and safety benefits. Integrating health objectives into transport planning may be one of the most cost-effective ways to improve public health.

References

[1] Litman, T. "Reinventing Transportation; Exploring the Paradigm Shift Needed to Reconcile Sustainability and Transportation Objectives." *Transportation Research Record 1670*, Transportation Research Board (www.trb.org), 1999, pp. 8-12; available at www.vtpi.org.

[2] BTS. *Transportation Safety Data*. Bureau of Transportation Statistics, USDOT (www.bts.gov/programs/btsprod/nts/chp3v.html), 2000.

[3] Noland, Robert. "Traffic Fatalities and Injuries: The Effects of Changes in Infrastructure and Other Trends." Forthcoming in the Journal of Accident Prevention and Analysis. Available at www.cts.cv.ic.ac.uk/staff/wp22-noland.pdf.

[4] Litman, T. "Air Pollution Costs." *Transportation Cost and Benefit Analysis Guidebook*. Victoria Transport Policy Institute (www.vtpi.org/tca), 2002.

[5] DeCicco, J and Delucchi, M. *Transportation, Energy and Environment; How Far Can the Technology Take Us*. American Council for an Energy-Efficient Economy (www.aceee.org), 1997.

[6] BTS. *Mobility and Access, Transportation Statistics Annual Report 1997*. Bureau of Transportation Statistics (www.bts.gov), p. 109-110.

[7] Seethaler, R. *Health Costs Due to Road Traffic-Related Air Pollution; An Assessment Project of Austria, France and Switzerland*, Ministry Conference on Environment and Health, World Health Organization (www.who.dk), June 1999.

[8] Murray, C. *Global Burden of Disease and Injury*. Center for Population and Development Studies, Harvard School of Public Health (www.hsph.harvard.edu/organizations/bdu), 1996.

[9] Litman, T. "Air Pollution." *Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications*. Victoria Transport Policy Institute (www.vtpi.org/tca), 2002.

[10] US Surgeon General. *Physical Activity and Health*. Center for Disease Control and Prevention (www.cdc.gov/nccdphp/sgr/sgr.htm), 1999.

[11] WHO. *Charter on Transport, Environment and Health.* World Health Organization (www.who.dk), 1999.

[12] Physical Activity Task Force. *More People, More Active, More Often*. UK Department of Health (London), 1995.

[13] BTS. *National Personal Transportation Survey* and *National Household Travel Survey*. Bureau of Transportation Statistics (www.bts.gov/nhts), various years.

[14] "A Trend On the Move: Commuting by Bicycle." *Bicycling Magazine*. Rodale Press, April 1991.

[15] Environics. *National Survey on Active Transportation*, Go for Green, (www.goforgreen.ca), 1998.

[16] Miller, T. *The Costs of Highway Crashes*, FHWA (Washington DC), Publ. No. FHWA-RD-055, 1991.

[17] "Transportation Costs." *Online TDM Encyclopedia*. Victoria Transport Policy Institute (www.vtpi.org/mobility management), 2002. Also see Litman, T. *Transportation Cost and Benefit Analysis*, Victoria Transport Policy Institute (www.vtpi.org/tca), 2002.

[18] "Comprehensive Transportation Planning." *Online TDM Encyclopedia*. Victoria Transport Policy Institute (www.vtpi.org/mobility management), 2002.

[19] Litman, T. *Socially Optimal Transport Prices and Markets*. Victoria Transport Policy Institute (www.vtpi.org), 1998.

[20] Litman, T. *Economic Value of Walkability*. Victoria Transport Policy Institute (www.vtpi.org), 2002.

[21] Rietveld, P. "Nonmotorized Modes in Transport Systems: A Multimodal Chain Perspective for The Netherlands." *Transportation Research D*, Vo. 5, No. 1, Jan. 2000, pp. 31-36.

[22] Jackson R. J. and Kochtitzky, C. *Creating A Healthy Environment: The Impact of the Built Environment on Public Health*. Sprawl Watch Clearinghouse (www.sprawlwatch.org/health.pdf), 2001.

[23] Ewing R. and Cervero, R. "Travel and the Built Environment – Synthesis." *Transportation Research Record 1780* (www.trb.org), 2002.

[24] Boarnet, M. and Crane, R. "The Influence of Land Use on Travel Behavior: A Specification and Estimation Strategies." *Transportation Research A*, Vol. 35, No. 9 (www.elsevier.com/locate/tra), November 2001, pp. 823-845.

[25] "Land Use Impacts on Transportation." *Online TDM Encyclopedia*. Victoria Transport Policy Institute (www.vtpi.org/mobility management), 2002.

[26] Killingsworth, R. and Lamming, J. "Development and Public Health; Could Our Development Patterns be Affecting Our Personal Health?" *Urban Land*, Urban Land Institute (www.uli.org), July 2001, pp. 12-17.

[27] VTPI. *Online TDM Encyclopedia*. Victoria Transport Policy Institute (www.vtpi.org/mobility management), 2002.

[28] VTPI. *Online TDM Encyclopedia*. Victoria Transport Policy Institute (www.vtpi.org/mobility management), 2002.

[29] *TravelSmart* (www.travelsmart.transport.wa.gov.au), 2001.

[30] Litman, T. *Distance-Based Vehicle Insurance: Feasibility, Costs and Benefits – Comprehensive Technical Report*. Victoria Transport Policy Institute (www.vtpi.org), 2001.

[31] Edlin, A. *Per-Mile Premiums for Auto Insurance*. Dept. of Economics, University of California at Berkeley (http://emlab.berkeley.edu/users/edlin), 1998.

[32] RSPC (Royal Society of the Prevention of Accidents). Cited in "Fasten Your Safety Belts." *The Economist*, 11 January 1997, p. 57.

[33] Project for Public Spaces, *The Role of Transit in Creating Livable Metropolitan Communities*, Transit Cooperative Research Program Report 22, National Academy Press (www.trb.org), 1997.

[34] Page, Y. "A Statistical Model to Compare Road Mortality in OECD Countries." *Accident Analysis and Prevention*, Vol. 33 (www.elsevier.com/locate/aap), 2001, pp. 371-385.

[35] Andersen, Lars Bo, et al. "All-Cause Mortality Associated With Physical Activity During Leisure Time, Work, Sports and Cycling to Work." *Archives of Internal Medicine* Vol. 160, No. 11 (http://archinte.ama-assn.org/issues/v160n11/full/ioi90593.html). June 12, 2000, pp. 1621-1628.

[36] Pucher, J. and Dijkstra, L. "Making Walking and Cycling Safer: Lessons from Europe," *Transportation Quarterly*, Vol. 54, No. 3, Summer 2000; available at www.vtpi.org.

[37] Komanoff, C. and Roelofs, C. *The Environmental Benefits of Bicycling and Walking*. National Bicycling and Walking Study Case Study No. 15, USDOT, January 1993, FHWA-PD-93-015.

[38] Mokhtarian, Patricia L. "A Synthetic Approach to Estimating the Impacts of Telecommuting on Travel." *Urban Studies* (www.engr.ucdavis.edu/~its/telecom), 2000.

[39] Shefer, D. and Rietvald, P. "Congestion and Safety on Highways: Towards an Analytical Model." *Urban Studies*, Vol. 34, No. 4, 1997, pp. 679-692.

[40] Stuster, J. and Coffman, Z. *Synthesis of Safety Research Related to Speed and Speed Limits*. FHWA-RD-98-154 Federal Highway Administration (www.tfhrc.gov/safety/speed/speed.htm and www.tfhrc.gov/safety/speed/speed.htm), 1998.

[41] Elvik, R. "Zero Killed in Traffic – from Vision to Implementation," *Nordic Road & Transport Research*, No. 1, 2001 (www.vti.se/nordic/1-01mapp/toi1.htm), 2001.

[42] Lucy, W. *Danger in Exurbia: Outer Suburbs More Dangerous Than Cities*. University of Virginia (www.virginia.edu), 2002.

[43] Ewing R, Pendall R, and Chen D. *Measuring Sprawl and Its Impacts*. Smart Growth America (www.smartgrowthamerica.org), 2002.

[44] Friedman B, Gordon S, and Peers, J. "Effect of Neotraditional Neighborhood Design on Travel Characteristics," *Transportation Research Record 1466*, 1995, pp. 63-70.

[45] Frank, L. and Engelke, P. *How Land Use and Transportation Systems Impact Public Health*. Active Community Environments, Georgia Institute of Technology and Center for Disease Control (Atlanta; www.cdc.gov/nccdphp/dnpa/aces.htm), 2000.