Safety

Contents

Required Safety Measures

Fatalities (Number)

Measure at a Glance	
Category: Safety **Subcategory:** Required Safety Measures	

Indicator Overview

Description

This indicator measures the total annual number of persons suffering fatal injuries in a motor vehicle related crash. This measure is used to quantify the overall safety of the United States' surface transportation system and is one of five safety performance measures the Federal Highway Administration has established to assess performance and carry out the Highway Safety Improvement Program: (1 Number of fatalities; (2 rate of fatalities per vehicle miles traveled (VMT); (3 number of serious injuries; (4 rate of serious injuries per VMT; and (5 number of combined non-motorized fatalities and non-motorized serious injuries.

Human and Environmental Drivers

Environmental: Improving intersection design and signaling decreases fatalities; greater road friction decreases fatalities; greater winter road maintenance decreases fatalities; the use of crash cushions and energy-absorbing barriers decreases fatalities; the use of traffic calming road design decreases fatalities. Flashing yellow signals, increased speed limits, and designated bus lanes increase the number of accidents. Most fatal crashes occur on straight and flat roadways or straight and graded roadways compared to curved roadways. Rural roadways have higher fatality rates compared to urban roadways. Larger vehicles reduce risk of fatalities for their occupants but increase the risk of fatalities to occupants of smaller vehicles. Anti-lock braking systems improve braking and stability but induce riskier driving behavior among users which may actually decrease safety. Economic recession decreases fatalities, perhaps due to higher gas prices or less VMT, but fatalities increase once the economy begins to grow again. Drivers ages 16-24 and 75 and older have an increased risk of involvement with a fatal crash. Male drivers have higher fatality rates. Urbanization of the nation decreases fatalities.

Human: Use of seat belts, driving the speed limit, greater awareness and enforcement preventing impaired driving, and increased driving experience all decrease fatalities. Distracted driving (eating, reading, use of cell phone, etc.) increases fatalities.

Application

In the Basin

TRPA uses "Number of Fatalities" as a measurement for the number and rate of fatalities and the safety of Lake Tahoe's transportation system. (TRPA 2014)

External uses

The Federal Highway Administration uses a "Traffic Incident Management" indicator to outline the benefits of increased driver and responder safety which ultimately results in the goal of reduced fatalities (Federal Highway Administration n.d.).

Nevada Department of Transportation presents detailed infographics pertaining to different aspects of fatal crashes, such as whether seatbelts were a factor, cause of crash, etc. (Nevada Department of Transportation 2016a).

Nevada Department of Transportation analyzes the different increases and decreases in the number of traffic-based fatalities in an overview of its performance measures in an effort to reduce fatalities. (Nevada Department of Transportation 2016b).

Florida Department of Transportation's 2060 Transportation Plan Scorecard indicates that there was a nearly 2 percent reduction in fatalities from 2006 to 2011, which was categorized as an at/above target measure. (Florida Department of Transportation n.d.).

Florida Department of Transportation's 2016 Transportation Performance measurement indicates under the safety category through helpful visuals that the fatality rate has significantly slowed since the year 2000. (Florida Department of Transportation 2016a).

Carson Area Metropolitan Planning Organization aligns its goals of reducing fatalities within the transportation system with the goal of the state (this being the "Zero Fatalities" goal presented by NDOT. (Carson Area Metropolitan Planning Organization 2016).

Oregon Metro analyzed that between the years of 2007 and 2009 there were nearly 159 fatalities within the Portland Metro region, incurring high economic costs and decreased perceptions of safety. (Metro 2014).

San Diego Association of Governments sees the value in decreasing fatal accidents due to the cost-effective nature of the crash mitigation (San Diego Association of Governments 2015).

Southern Nevada Regional Transportation Commission outlines four primary strategies within its Access 2040 Plan of which the first is finding ways to improve safety, especially in the wake of fatal injuries (Southern Nevada Regional Transportation Commission 2017).

Santa Cruz County Regional Transportation Commission presents a comparative table between transportation related fatalities in the Santa Cruz region and the entire state of California, demonstrating that overall the number of fatalities within

the area has not changed tremendously over the 10-year period being analyzed (Santa Cruz County Regional Transportation Commission 2014).

San Francisco County Transportation Authority recognizes the need to improve street-space allocation, education, and investments to increase bike, pedestrian, and transit facility safety and reduce the rate of fatalities (San Francisco County Transportation Authority 2013a).

San Francisco County Transportation Authority presents a table that tracks fatalities from traffic related crashes from the year 1999 to 2011, generally noticing a slight decline over the years (San Francisco County Transportation Authority 2013b).

Chicago Metropolitan Agency for Planning indicates that there are over 1,000 fatalities on Illinois roadways each year, emphasizing the need for improved safety measures (Chicago Metropolitan Agency for Planning 2010).

Chicago Metropolitan Agency for Planning indicates that the total number of fatalities has progressively declined from 675 fatalities in 2002 to 419 fatalities in 2012 (Chicago Metropolitan Agency for Planning 2016).

Chicago Metropolitan Agency for Planning uses the "Crash Rate per Capita" measure by severity and mode to understand system safety (Chicago Metropolitan Agency for Planning 2013a)**.**

Washoe Regional Transportation Commission aligns its 2035 Regional Transportation Plan with the Nevada goal to have "Zero Fatalities" throughout the entire transportation system (Washoe Regional Transportation Commission 2013).

The National Park Service produced a series of transportation system objectives and performance measures under which the number of and severity of crashes is analyzed (National Park Service 2017).

Oregon Department of Transportation analyzes the number of traffic fatalities in its 2014-2015 Approved Key Performance Measures (Oregon Department of Transportation 2015).

Tennessee Department of Transportation created tables detailing the different causes and modes of fatalities from traffic accidents in its 25-year transportation plan (Tennessee Department of Transportation 2016).

Literature or Guidance Documents

No literature or guidance documents identified.

Relationship with Goal

Safety: The goal is a direct measure of the number of vehicle-related fatalities, which is an indicator of the safety of the transportation system.

Variations of the Measure / Alternatives to the measures

Total Annual Number of Fatalities to the Total Annual VMT– The total number of fatal injuries per year related to transportation measured against the total VMT per year.

References

(Atlanta Regional Commission 2015)
(Carson Area Metropolitan Planning Organization 2016)
(Chicago Metropolitan Agency for Planning 2010)
(Chicago Metropolitan Agency for Planning 2013a)
(Chicago Metropolitan Agency for Planning 2016)
(Denver Regional Council of Governments 2016)
(Federal Highway Administration n.d.)
(Florida Department of Transportation 2016b)
(Florida Department of Transportation n.d.)
(Guarino & Champaneri 2010)
(Metro 2014)
(National Park Service 2017)
(Nevada Department of Transportation 2016a)
(Nevada Department of Transportation 2016b)
(Office of the Federal Register 2016)
(Oregon Department of Transportation 2015)
(Oster & Strong 2013)
(Riverside County Transportation Commission 2011)
(San Diego Association of Governments 2015)
(San Francisco County Transportation Authority 2013a)
(San Francisco County Transportation Authority 2013b)
(San Francisco Metropolitan Transportation Commission 2009)
(San Francisco Metropolitan Transportation Commission 2013)
(Santa Cruz County Regional Transportation Commission 2014)
(Southern Nevada Regional Transportation Commission 2017)
(Tennessee Department of Transportation 2016)
(Washoe Regional Transportation Commission 2013)

Rate of Fatalities (per 100 million VMT)

Measure at a Glance

Focus: Safety
Subcategory: Required Safety Measures

Indicator Overview

Description

This indicator measures the annual number of traffic fatalities per 100 million VMT. The measure is intended to effectively evaluate and report on surface transportation safety across the country. It isne of five performance measures the FHWA established to assess performance and carry out the Highway Safety Improvement Program: (1 Number of fatalities; (2 rate of fatalities per VMT; (3 number of serious injuries; (4 rate of serious injuries per VMT; and (5 number of combined non-motorized fatalities and non-motorized serious injuries.

Human and Environmental Drivers

Environmental: Improving intersection design and signaling decreases fatalities; greater road friction decreases fatalities; greater winter road maintenance decreases fatalities; the use of crash cushions and energy-absorbing barriers decreases fatalities; and the use of traffic calming road designs decreases fatalities. Flashing yellow signals, increased speed limits and designated bus lanes increase the number of accidents. Most fatal crashes occur on straight and flat roadways or straight and graded roadways compared to curved roadways. Rural roadways have higher fatality rates compared to urban roadways. Larger vehicles reduce the risk of fatalities for their occupants but increase the risk of fatalities for occupants of smaller vehicles. Anti-lock braking systems improve braking and stability but induce riskier driving behavior among users, which may actually decrease safety. Economic recession decreases fatalities, perhaps due to higher gas prices or reduced VMT, but fatalities increase once the economy begins to grow again. Drivers ages 16-24 and 75 and older have an increased risk of involvement with a fatal crash. Male drivers have higher fatality rates. Urbanization of the nation decreases fatalities.
Human: Use of seat belts, driving the speed limit, greater awareness and enforcement on preventing impaired driving, and increased driving experience all decrease fatalities. Distracted driving (eating, reading, use of cell phone, etc.) increases fatalities.

Application

In the Basin

TRPA uses the "Rate of Fatalities Per 100 Million VMT" as a measurement of fatalities per the amount of driving in the region. This metric helps Tahoe focus on improving areas in the transportation system that have a higher rate of fatalities (Tahoe Regional Planning Agency 2014).

External uses

Oregon Department of Transportation uses the “Traffic Fatalities per 100 Million VMT” measure as a part of its approved key performance measures (Oregon Department of Transportation 2015).
Chicago Metropolitan Association for Planning measures the amount of crashes per 100 million VMT and 100,000 population within its “Crash Rate per Capita and Per VMT” (Chicago Metropolitan Agency for Planning 2013a).
Chicago Metropolitan Association for Planning analyzes safety by determining the level of “Fatalities per 100 Million VMT” in its performance measurement documents (Chicago Metropolitan Agency for Planning 2016).
Southern Nevada Regional Transportation Commission analyzes the “Fatality Rate per 100 Million VMT” to improve safety. (Southern Nevada Regional Transportation Commission 2017).

Literature or Guidance Documents

No Literature or guidance documents identified.

Relationship with Goal

Safety: The goal is direct measure of the number of vehicle related fatalities which is an indicator of the safety of the transportation system.

Variations of the Measure / Alternatives to the measures

Number of Fatalities – The number of transportation related fatalities per year.

References

(Chicago Metropolitan Agency for Planning 2013a)
(Chicago Metropolitan Agency for Planning 2016)
(Guarino & Champaneri 2010)
(Office of the Federal Register 2016)
(Oregon Department of Transportation 2015)
(Oster & Strong 2013)
(Southern Nevada Regional Transportation Commission 2017)

Serious Injuries (Number)

Measure at a Glance

Category: Safety
Subcategory: Required Safety Measures

Indicator Overview

Description

This indicator measures the total annual number of persons suffering serious injuries in a motor vehicle crash. "Serious injury" is defined by U.S. Department of Transportation as "one that includes one or more of the following:
-Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in
significant loss of blood
-Broken or distorted arm or leg
-Crush injuries
-Suspected skull, chest, or abdominal injury other than bruises or minor lacerations
-Second and third degree burns over 10 percent or more of the body
-Unconsciousness when taken from the crash scene
-Paralysis
This measure is used to quantify the overall safety of the United States' surface transportation system and is one of five safety performance measures the FHWA has established to assess performance and carry out the Highway Safety Improvement Program: (1 Number of fatalities; (2 rate of fatalities per VMT; (3 number of serious injuries; (4 rate of serious injuries per VMT; and (5 number of combined non-motorized fatalities and non-motorized serious injuries.

Human and Environmental Drivers

Environmental: Improving intersection design decreases serious injuries; greater road friction decreases serious injuries; greater winter road maintenance (i.e. snow removal) decreases serious injuries; the use of crash cushions/ energy-absorbing barriers decreases serious injuries; the use of traffic calming road design decreases serious injuries; flashing yellow signals, On the other side, increased speed limits and designated bus lanes increase the number of accidents; most fatal crashes occur on straight & flat roadways or straight & graded roadway compared to curved roadways; rural roadways have higher fatality rates compared to urban roadways; larger vehicles reduce risk of serious injuries of its occupants but increase the risk of serious injuries to occupants of smaller cars; ABS improves braking and stability but induces riskier driving behavior among ABS users which may actually decrease safety; Economic recession (may be due to higher gas prices or less VMT) decreases serious injuries, but fatalities increase once the economy begins to grow again; Drivers ages 16-24 and 75 and older have an increased risk of involvement with a fatal crash; Male drivers have higher fatality rate; Urbanization of the nation decreases serious injuries.
Human: Use of seat belts, driving the speed limit, greater awareness and enforcement on preventing impaired driving, and increased driving experience all decrease serious injuries. Distracted driving (eating, reading, use of cell phone, etc.) increases serious injuries.

Application

In the Basin

TRPA uses "Number of Serious Injuries" to calculate the level of safety when engaging in transportation based activities (TRPA 2014)

External uses

Nevada Department of Transportation includes infographics relative to the "Serious Injuries" measure and the source of their cause in their Performance Measures and Management Plan and the 2016 Facts and Figures documents. (Nevada Department of Transportation 2016a) (Nevada Department of Transportation 2016b).
Florida Department of Transportation indicate precise numbers for the "Serious Injuries" measure for the year 2016 for the entire transportation system (Florida Department of Transportation 2016b).
Florida Department of Transportation hopes to "collaborate with Florida's 12 major safety agencies and organizations through engineering, enforcement, education, and emergency management to make progress toward a 5 percent annual reduction in the rate of traffic related (…) serious injuries" (Florida Department of Transportation n.d.).
Carson Area Metropolitan Planning Organization aims to set up the transportation system in a way that will reduce serious injuries within the system (Carson Area Metropolitan Planning Organization 2016).
Oregon Metro presents charts detailing the "Serious Injuries" measure by sub-region in Portland from the year 2007 to 2009 stating that the typical cause of these serious incidents is "excessive speed and aggressive driving". (Metro 2014).
San Diego Association of Governments uses the "Serious Injuries" measure in transportation as a part of the cost-effectiveness criterion for several different transportation systems (San Diego Association of Governments 2015).

Southern Nevada Regional Transportation Commission uses the "Serious Injuries" measure to understand transportation safety in the region (Southern Nevada Regional Transportation Commission 2017).
Santa Cruz County Regional Transportation Commission aims to minimize serious injuries for all modes of transportation within its second system performance goal (Santa Cruz County Regional Transportation Commission 2014).
San Francisco County Transportation Authority brings to light the fact that of the entire pedestrian population, those most susceptible to serious injuries are those with a higher age (San Francisco County Transportation Authority 2013a).
San Francisco County Transportation Authority utilizes crash data from the California Statewide Integrated Traffic Records System and classifies injuries based on severity (San Francisco County Transportation Authority 2013b).
Chicago Metropolitan Agency for Planning assess location and specific infrastructure at the crash site, stating that the number of crashes resulting in serious injury is a byproduct of at-grade crossings associated with a number of highway-rail incidents. (Chicago Metropolitan Agency for Planning 2010).
Chicago Metropolitan Agency for Planning indicates that non-fatal injuries has progressively declined by nearly 30,000 from the year 2002 to 2012 (Chicago Metropolitan Agency for Planning 2016).
Chicago Metropolitan Agency for Planning uses the crash rate per capita by severity and mode to understand system safety (Chicago Metropolitan Agency for Planning 2013b).
Washoe Regional Transportation Commission looks to improve resident safety through integration of data analysis, public education, interdisciplinary collaboration, operations, and design to reduce the number of transportation related injuries (Washoe Regional Transportation Commission 2013).
The National Park Service produced a series of transportation system objectives and performance measures under which the number and severity of accidents (serious injury based or otherwise) declined under the transportation safety goal (National Park Service 2017).

Literature or Guidance Documents

No literature or guidance documents identified.

Relationship with Goal

Safety: The goal is a direct measure of the number of vehicle-related serious injuries which is an indicator of the safety of the transportation system.

Variations of the Measure / Alternatives to the measures

Total Annual Serious Injuries to Total Annual VMT – The number of serious injuries per year related to transportation, measured against the total VMT per year.

References

(Atlanta Regional Commission 2015)
(Carson Area Metropolitan Planning Organization 2016)
(Chicago Metropolitan Agency for Planning 2010)
(Chicago Metropolitan Agency for Planning 2013a)
(Chicago Metropolitan Agency for Planning 2016)
(Denver Regional Council of Governments 2016)
(Federal Highway Administration & National Highway Traffic Safety Administration n.d.)
(Federal Highway Administration n.d.)
(Florida Department of Transportation 2016b)
(Florida Department of Transportation n.d.)
(Guarino & Champaneri 2010)
(Metro 2014)
(National Park Service 2017)
(Nevada Department of Transportation 2016a)
(Nevada Department of Transportation 2016b)
(Office of the Federal Register 2016)
(Oster & Strong 2013)
(Riverside County Transportation Commission 2011)
(San Diego Association of Governments 2015)
(San Francisco County Transportation Authority 2013a)
(San Francisco County Transportation Authority 2013b)
(San Francisco Metropolitan Transportation Commission 2009)
(San Francisco Metropolitan Transportation Commission 2013)

(Santa Cruz County Regional Transportation Commission 2014)
(Southern Nevada Regional Transportation Commission 2017)
(Washoe Regional Transportation Commission 2013)

Rate of Serious Injuries (per 100 million VMT)

Measure at a Glance

Focus: Safety
Subcategory: Required Safety Measures

Indicator Overview

Description

This indicator measures the annual number of traffic fatalities per 100 million VMT. "Serious Injury" is defined by U.S. Department of Transportation as an injury that includes one or more of the following:
-Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in
significant loss of blood
-Broken or distorted arm or leg
-Crush injuries
-Suspected skull, chest, or abdominal injury other than bruises or minor lacerations
-Second and third degree burns over 10 percent or more of the body
-Unconsciousness when taken from the crash scene
-Paralysis
This measure is used to quantify the overall safety of the United States' surface transportation system and is one of five safety performance measures the FHWA has established to assess performance and carry out the Highway Safety Improvement Program: (1 Number of fatalities; (2 rate of fatalities per VMT; (3 number of serious injuries; (4 rate of serious injuries per VMT; and (5; number of combined non-motorized fatalities and non-motorized serious injuries.

Human and Environmental Drivers

Environmental: Improving intersection design/ signaling decreases serious injuries; greater road friction decreases serious injuries; greater winter road maintenance (i.e. snow removal) decreases serious injuries; the use of crash cushions/ energy-absorbing barriers decreases serious injuries; the use of traffic calming road design decreases serious injuries. Most fatal crashes occur on straight & flat roadways or straight & graded roadway compared to curved roadways; rural roadways have higher fatality rates compared to urban roadways; larger vehicles reduce risk of serious injuries of its occupants but increase the risk of serious injuries to occupants of smaller cars; ABS improves braking and stability but induces riskier driving behavior among ABS users which may actually decrease safety; Economic recession (may be due to higher gas prices or less VMT) decreases serious injuries, but fatalities increase once the economy begins to grow again; Drivers ages 16-24 and 75 and older have an increased risk of involvement with a fatal crash; Male drivers have higher fatality rate; Urbanization of the nation decreases serious injuries.
Human: Use of seat belts, driving the speed limit, greater awareness and enforcement on preventing impaired driving, and increased driving experience all decrease serious injuries. Distracted driving (eating, reading, use of cell phone, etc.) increases serious injuries.

Application

In the Basin

TRPA uses “Rate of Serious Injuries per 100 Million VMT” to measure the amount of serious injuries for every 100 million VMT. This metric helps Tahoe understand the number of injuries relative to the amount of miles driven (TRPA 2016 RTP SCS).

External uses

Southern Nevada Regional Transportation Commission includes a metric leveling the “Serious Injury Rate per 100 Million VMT” measure under its Access 2040 Transportation System Indicators in ways to improve safety. The measurement was 5 serious injuries per 100 million VMT. (Southern Nevada Regional Transportation Commission 2017).
Chicago Metropolitan Association for Planning analyzes the “Non-fatal Injuries per 100 Million VMT” measure and noticed a 33 percent decline in non-fatal injuries throughout the 10-year period of 2002 to 2012. (Chicago Metropolitan Agency for Planning 2016).
Chicago Metropolitan Association for Planning uses the “Amount of Crashes per 100 Million VMT” measure within its “Crash Rate per Capita and Per Vehicle Miles Traveled” (Chicago Metropolitan Agency for Planning 2013a).
Oregon Department of Transportation uses the amount of serious injuries per 100 million vehicle miles traveled to set realistic targets for key performance measures. (Oregon Department of Transportation 2017).

Literature or Guidance Documents

No literature or guidance documents identified.

Relationship with Goal

Safety: The goal is direct measure of the number of vehicle related serious injuries which is an indicator of the safety of the transportation system.

Variations of the Measure / Alternatives to the measures

Total Annual Serious Injuries to Total Annual VMT – The number of serious injuries per year related to transportation, measured against the total VMT per year. Number of Serious Injuries – The amount of serious injuries related to transportation per year.
References
(Chicago Metropolitan Agency for Planning 2013a) (Chicago Metropolitan Agency for Planning 2016) (Federal Highway Administration & National Highway Traffic Safety Administration n.d.) (Federal Highway Administration n.d.) (Guarino & Champaneri 2010) (Office of the Federal Register 2016) (Oregon Department of Transportation 2017) (Oster & Strong 2013) (Southern Nevada Regional Transportation Commission 2017)

Number of Non-Motorized Fatalities and Serious Injuries

Measure at a Glance	
Category: Safety **Subcategory:** Required Safety Measures	

Indicator Overview

Description

This indicator measures the annual combined total number of non-motorized fatalities and non-motorized serious injuries involving a motor vehicle. In these cases, the non-motorized user suffers the serious injury or fatality, not the vehicle user. "Non-motorized" is defined as a pedestrian, bicyclist, or person on a personal conveyance. A "serious injury" is defined by U.S. Department of Transportation as one that includes one or more of the following:

-Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in
significant loss of blood
-Broken or distorted arm or leg
-Crush injuries
-Suspected skull, chest, or abdominal injury other than bruises or minor lacerations
-Second and third degree burns over 10 percent or more of the body
-Unconsciousness when taken from the crash scene
-Paralysis

This measure is used to quantify the overall safety of the United States' surface transportation system and is one of five safety performance measures that the FHWA has established to assess performance and carry out the Highway Safety Improvement Program: (1 Number of fatalities; (2 rate of fatalities per VMT; (3 number of serious injuries; (4 rate of serious injuries per VMT; and (5 number of combined non-motorized fatalities and non-motorized serious injuries.

Human and Environmental Drivers

Environmental: Greater land use density decreases the risk of non-motorized fatalities and serious injuries. Non-motorized crashes are more likely to occur during commuting hours (7 a.m. to 9 a.m., 4 p.m. to 6 p.m.), on weekdays, and in warmer months (May-September).; Non-motorized collision more likely to occur at signalized intersections. Implementing bicycle facilities that are separated from sidewalks reduces the risk of bicycle and motorized collisions because cyclists on sidewalks are less visible to motorists. Wider and straighter road lanes cause drivers to speed more, which increases non-motorized collisions. Improving visibility for all roadway users and the visibility of traffic controls lowers non-motorized collisions. Improving traffic signal timing to accommodate bicyclists and implementing bicycle-only signals and detection decreases non-motorized collisions. Improved signage and pavement markings reduce non-motorized collisions. Implementing contraflow bicycle lanes reduces non-motorist collisions. Routine maintenance of bicycle facilities reduces non-motorized collisions.

Human: Areas with greater use of non-motorized transportation modes experience less non-motorized collisions with vehicles compared to areas with little use, however, greater use of non-motorized modes increases the likelihood that collisions will occur among non-motorized travelers due to greater exposure. Areas with a greater population below the poverty line have an increased risk of non-motorized collisions. People ages 15-19 are more likely to be involved in a non-motorized collision. The number of motorized commuters increases the risk of non-motorized collision. The most common cause of non-motorized collisions is motorists failing to yield to pedestrians and cyclists in crosswalks, sidewalks, and bike lanes and failing to yield while turning. Driving at speeds greater than 30 mph increases the rate of non-motorized injuries and fatalities. Increased use of helmets reduces serious injuries and fatalities among non-motorists. Increasing and improving bicycle law education and enforcement to improve safety and awareness may reduce non-motorized collisions.

Application

In the Basin

TRPA uses “Number of Non-Motorized Fatalities and Serious Injuries” to measure the amount of bicycle and pedestrian fatalities and serious injuries that occur. Monitoring and seeking ways to mitigate these injuries will encourage bicycle and pedestrian transportation utility (TRPA 2014).

External uses

Tennessee Department of Transportation wants to reduce bicycle fatalities by 12.5 percent and pedestrian fatalities by 2.9 percent (Tennessee Department of Transportation 2016).

Oregon Department of Transportation wants to mitigate the number of pedestrian fatalities by improving pedestrian crossings (Oregon Department of Transportation 2015).

Carson Area Metropolitan Planning Organization measures the number of pedestrian and “unprotected occupant” serious injuries and fatalities throughout the developing future (Carson Area Metropolitan Planning Organization 2016).

Southern Nevada Regional Transportation Commission tracking this measure found an increase in the number of bicycle and pedestrian fatalities by 24% in 2014 compared to 2015 and is working to find ways to make non-motorized means of service safer (Southern Nevada Regional Transportation Commission 2017).

Santa Cruz County Regional Transportation Authority presents figures surrounding pedestrian and bicycle injuries in charts from the year 2002 to 2011. They present this information to increase public safety. (Santa Cruz County Regional Transportation Commission 2014).

San Francisco County Transportation Authority is working to realize a a 50 percent decrease in serious pedestrian injuries and pedestrian fatalities (San Francisco County Transportation Authority 2013a).

San Francisco County Transportation Authority uses the 2013 Congestion Management Program to document the potential for fatalities and serious injuries to pedestrians and bicyclists. They do this to encourage public safety. (San Francisco County Transportation Authority 2013b).

Literature or Guidance Documents

No literature or guidance documents identified.

Relationship with Goal

Safety: The goal is a direct measure of the number of surface related serious injuries and fatalities which is an indicator of the safety of the system.

Variations of the Measure / Alternatives to the measures

Variations of this measure include fatalities and serious injuries by bicycling and walking.

References

(Office of the Federal Register 2016)
(Federal Highway Administration n.d.)
(Federal Highway Administration & National Highway Traffic Safety Administration n.d.)
(Jacobsen 2003)
(Abasahl 2013)
(American Association of State Highway and Transportation Officials n.d.)
(Schmitt 2015)
(Denver Public Works 2016)
(Corvallis Right of Way 2017)
(Nevada Department of Transportation 2016b)
(Nevada Department of Transportation 2016a)
(Florida Department of Transportation n.d.)
(Florida Department of Transportation 2016b)
(Oregon Department of Transportation 2015)
(Tennessee Department of Transportation 2016)
(Carson Area Metropolitan Planning Organization 2016)
(Metro 2014)
(San Francisco Metropolitan Transportation Commission 2013)
(San Francisco Metropolitan Transportation Commission 2009)
(San Diego Association of Governments 2015)
(Southern Nevada Regional Transportation Commission 2017)
(Santa Cruz County Regional Transportation Commission 2014)
(San Francisco County Transportation Authority 2013b)
(San Francisco County Transportation Authority 2013a)

Discretionary Safety Measures

Incident Clearance Time

Measure at a Glance

Category: Safety
Subcategory: Discretionary Safety Measures

Indicator Overview

Description

This indicator measures the time between the first recordable awareness of the incident and the time at which the last responder has left the incident scene. Some agencies quantify this by measuring the percent of major incidents cleared in less than 90 minutes.

Human and Environmental Drivers

Improvements/Increases: Field verification by on-site responders reduces inaccurate incident reports which can improve incident response time. Using electronic loop detectors in combination with closed-circuit television cameras can improve incident detection and verification to improve incident clearance time. Implementing frequent and enhanced roadway reference markers improves incident location reporting accuracy and improves incident clearance time. Enhanced 911 and automated positioning systems improve incident reporting accuracy and reduce dispatcher overload, which improves incident clearance time. Installing motorist aid call boxes along rural interstates and highways with limited cellular service improves incident detection and verification in rural areas and improves incident clearance times.; Automated collision notification systems that are built into new luxury cars and can be installed by after-market suppliers notify a response center of an incident, which improves incident clearance time. Providing incident response agencies with Towing and Recovery Association of America vehicle identification guides ensures responders provide the correct information when requesting a tow truck to improve incident clearance time. Implementing instant tow dispatch procedures with towing personnel notified at the same time as law enforcement improves incident clearance time. zone-based towing contracts with a private towing agency that responds to incidents in a defined geographic area increases incident clearance time. Use of enhanced computer-aided dispatch and automatic vehicle location technologies to accurately locate the incident and quickly route responders to the incident improves incident clearance time. Dual dispatch procedures that have responders approach incidents in both directions on highways and interstates to ensure the fastest route is used improve incident clearance time. Using motorcycle patrols allows greater mobility in congestion which increases incident clearance time. Pre-positioned incident response equipment at areas of high incident frequency can save time and improve incident clearance time. Developing a response vehicle parking plan to increase traffic flow and maneuverability improves incident clearance time. Driver education and awareness of "Move Over" laws improves incident clearance time. Implementing abandoned vehicle removal policies expedites removal of abandoned vehicles from the roadway and improves incident clearance time. Implementing driver removal laws that require drivers in non-injury incidents to move cars to the shoulder improves incident clearance time. Providing service patrols on major freeways improves incident clearance time. Vehicle-mounted push bumpers quickly remove disabled vehicles from roadways and improve incident clearance time. Implementing quick clearance policies improves incident clearance time. Providing towing clearance incentives such as cash bonuses for quick clearance and cash penalties for clearance times over 90 minutes improves incident clearance time. Using expedited crash investigation methods improves incident clearance time.

Application

In the Basin

No current in-basin use.

External uses

Oregon Department of Transportation works on implementing timely programs for the “Incident Response Time” measure preparedness. (Oregon Department of Transportation 2015).

Tennessee Department of Transportation outlines emergency response as a critical factor in their safety vision in order to increase safety within the state. (Tennessee Department of Transportation 2016).

New York State Association of Metropolitan Planning Organizations recognizes and emphasizes the importance of creating the appropriate response program for the safety of transportation systems. They do this in order to increase safety throughout the area. (New York State Association of Metropolitan Planning Organizations 2006).

Literature or Guidance Documents

New York State Association of Metropolitan Planning Organizations outlines an improvement strategy in its Congestion Management Plan with a “toolbox” that identifies a successful incident management program as a key factor for transportation operation and congestion readiness. (New York State Association of Metropolitan Planning Organizations 2006).

Relationship with Goal

Safety: Ensuring a quick incident clearance time reduces the risk that other incidents will occur as a result of congestion from the original incident.
Congestion: Traffic incidents cause congestion and reducing the incident clearance time can also reduce the congestion caused by incidents.

Variations of the Measure / Alternatives to the measures

No variation identified.

References

(Federal Highway Administration 2010)
(Federal Highway Administration n.d.)
(Oregon Department of Transportation 2017)
(Oregon Department of Transportation 2015)
(Tennessee Department of Transportation 2016)
(New York State Association of Metropolitan Planning Organizations 2006)

Public Satisfaction with Transportation Safety

Measure at a Glance	
Category: Safety **Subcategory:** Discretionary Safety Measures	

Indicator Overview

Description

This indicator measures the satisfaction of the general public with the transportation system's safety and means of improvement. This can be measured by taking public polls, surveys, and hosting public forums.

Human and Environmental Drivers

Physical: Designing transportation networks in ways that ensure safety is critical to increasing public satisfaction with transportation safety.

Human: By increasing public satisfaction, a stronger relationship is generated between transportation agencies and the general public.

Application

In the Basin

No current in-basin use.

External uses

Oregon Department of Transportation uses the "Percent of Public Satisfied with Transportation Safety" measure to understand how Oregon residents perceive the safety of the state's transportation system (Oregon Department of Transportation 2017).

Literature or Guidance Documents

Oregon Department of Transportation recommends using the Percent Satisfied with Transportation Safety measure to assess the public's perception of the transportation system's safety (Oregon Department of Transportation 2017).

Relationship with Goal

Safety: This measure relates to the safety goal because it measures how safe the public feels using the transportation system.

Resident Quality of Life: This measure helps ensure that residents are satisfied with the transportation system. Ensuring public satisfaction and safety increases overall resident quality of life.

System Connectivity: This measure relates to the system connectivity goal because a disconnected transportation system is not going to fare well with public satisfaction. Public feedback on the transportation system can help determine where and what kind of future improvements should be prioritized such as gap closures.

Variations of the Measure / Alternatives to the measures

No variations identified.

References

(Cunningham & Young 2000)
(Stradling et al. 2007)
(Fellesson & Friman 2012)
(Oregon Department of Transportation 2017)
(Oregon Department of Transportation 2015)

Americans with Disabilities Act (ADA) Planning Measures

Measure at a Glance

Category: Safety
Subcategory: Discretionary Safety Measures

Indicator Overview

Description

"Americans with Disabilities Act (ADA) Planning Measures" are efforts by a planning agency to meet and exceed the needs of disabled individuals. This indicator measures ADA accessibility for all transportation systems to increase inclusivity.

Human and Environmental Drivers

Environmental: Design standards that fiscally, physically, or otherwise visibly focus largely around ADA accessibility will be noted and given appropriate level of priority. Base implementation of ADA applications is important because ADA accessibility works for all residents whereas the lack there of favors those who do not require ADA accessible means, and therefore increases effectiveness of ADA Planning Measures.

Economic: Not allowing projects to begin construction until all ADA planning considerations have been met increases effectiveness of ADA planning measures.

Application

In the Basin

No current in-basin use.

External uses

Carson Area Metropolitan Planning Organization uses the "Number of Transportation Facilities Improved to ADA Standards" measure to understand the mobility and reliability of the transportation system (Carson Area Metropolitan Planning Organization 2016).

Chicago Metropolitan Agency for Planning uses the "Percent of Transit Stations that are ADA Compliant" measure to understand mobility options and challenges for people with disabilities in the region (Chicago Metropolitan Agency for Planning 2013a).

Literature or Guidance Documents

No literature or guidance documents.

Relationship with Goal

Operations: This measure helps ensure that agencies implement and maintain ADA accessible transportation infrastructure and policy.

Resident Quality of Life: This measure increases inclusivity for disabled residents. Integration of ADA accessible facilities such as lifts and ramps at transit stations and in parking spaces and accessibility for those with service animals increases resident quality of life. Increasing implementation of anti-discriminatory transportation plans and policies increases overall resident quality of life.

Variations of the Measure / Alternatives to the measures

Number of Transportation Facilities Improved to ADA Standards – The running count of transportation facilities that have been updated/modified to comply with ADA Standards.

References

(Federal Transit Administration 2015)
(Nevada Department of Transportation n.d.)
(Americans with Disabilities Act National Network 2016)
(Nevada Department of Transportation n.d.)
(Carson Area Metropolitan Planning Organization 2016)
(Chicago Metropolitan Agency for Planning 2010)
(Chicago Metropolitan Agency for Planning 2013a)

Cost of Accidents

Measure at a Glance

Category: Safety
Subcategory: Discretionary Safety Measures

Indicator Overview

Description

This indicator measures the physical, economic, and environmental cost of accidents on the people living in the area. This ultimately results in the use or disuse of parts of the transportation system. For example, if a road is too dangerous to drive, there is a diversion of traffic away from that roadway. Diversion away from one roadway may lead to congestion on a different, safer roadway.

Human and Environmental Drivers

Environmental: Accidents may result in fires that have the potential to damage land and property.
Economic: The cost of construction to ensure road safety increases the total cost of accidents. The cost of repairing damaged roadways increases the total cost of accidents. Increased numbers of accidents mean increased costs for police and fire departments.
Human: Congestion derived from rerouting of individual automobile drivers may decrease safety on alternate routes, increasing the likelihood of accidents on alternate roads.

Application

In the Basin

No current in-basin use.

External uses

California Rural Counties Task Force uses the "Accident Cost" measure to understand costs associated with automobile accidents (California Rural Counties Task Force 2015).

Literature or Guidance Documents

No literature or guidance documents.

Relationship with Goal

Safety: This measure analyzes ways to prevent and recover from accidents.
Wildlife: Damage or fire from an accident may result in the displacement or mortality of wildlife and the destruction of wildlife habitat.
System Preservation: Poor transportation system maintenance is correlated with accidents.

Variations of the Measure / Alternatives to the measures

No variations identified.

References

(Leppanen 1968)
(National Highway Traffic Safety Administration 1990)
(Reynolds 1956)
(California Rural Counties Task Force 2015)

Seismic Safety

Measure at a Glance	
Category: Safety **Subcategory:** Discretionary Safety Measures	

Indicator Overview

Description

This indicator is the measure of a region's safety in relation to earthquakes and other seismic activity. It is important to recognize that seismic activity is a natural geologic occurrence and safety preparation must be handled appropriately. Avoiding fault lines and other areas at high risk of seismic activity helps increase overall safety. This indicator measures the preparedness of the transportation system to handle potential seismic activity with minimal disruption or damage.

Human and Environmental Drivers

Environmental/Human: Improved design standards increase seismic safety by protecting transportation infrastructure and the surrounding environment.

Policy: Implementation of a feasible safety policy, that emphasizes emergency routes through the region with connections to fire stations, hospitals, and other critical infrastructure and services, increases seismic safety. Planning for the location of transportation infrastructure in geographic locations and on soils with the least seismic risk increases seismic safety. Requiring transportation infrastructure to be built to the highest seismic standards in areas of the highest risk increases seismic safety.

Application

In the Basin

No current in-basin use.

External uses

San Francisco Metropolitan Transportation Commission uses the "Seismic Safety" measure to understand transportation emergency preparedness in the Bay Area (San Francisco Metropolitan Transportation Commission 2009).

Literature or Guidance Documents

No literature or guidance documents identified.

Relationship with Goal

Safety: This measure analyzes ways to increase public safety during potentially dangerous times of seismic activity.

System Connectivity: A seismically safe transportation system ensures reliable public travel even during times of natural disaster and emergency.

Variations of the Measure / Alternatives to the measures

No variations identified.

References

(California Department of Transportation 2003)
(Higgins 2012)
(Cornell Law n.d.)
("Earthquake Track" n.d.)
(Helmstetter 2005)
(San Francisco Metropolitan Transportation Commission 2009)

Crashes by Mode and by Cause

Measure at a Glance

Category: Safety
Subcategory: Discretionary Safety Measures

Indicator Overview

Description

This indicator is a measure analyzes the cause and mode of transportation accidents. Analyzing the mode and cause of crashes provides important information to improve the transportation system, target driver enforcement and education, and take other steps to prevent future accidents. Automobile collisions are the largest cause of fatal injuries on roadways. That includes collisions with other automobiles and collisions with bicyclists and pedestrians. Automobile collisions with pedestrians have the highest fatality rate.

Human and Environmental Drivers

Policy: Increasing enforcement of safety policies and implementation of safety measures results in fewer incidents. Enforcement actions on-distracted driving decrease the amount of incidents.
Environmental/Physical:.Increased traffic congestion increases the likelihood of crashes. Driving at high speeds can increase the changes of being in a serious traffic crash. Strategies that can reduce the likely hood of being involved in a crash include providing defensive driving education to bus drivers, targeted training and education for drivers who have an above average rate of accidents, equipping buses with heated remote controlled convex mirrors improves driver vision, equipping buses with LED brake and warning lights and additional brake lights reduces rear end accidents. Design strategies that can improve safety include implementing far-side bus stops located directly after intersections in the direction of bus travel; this allows pedestrians to be more visible to drivers and causes less sight obstructions to traffic signals, signs, and pedestrians to reduce transit accidents.

Application

In the Basin

No current in-basin use.

External uses

Mid-Ohio Regional Planning Commission is working to decrease the total number of crashes per million VMT by 15 percent by 2035 (Mid-Ohio Regional Planning Commission 2011).
Mid-Ohio Regional Planning Commission examines the cause of auto crashes and potential ways to prevent similar crashes in the future (Mid-Ohio Regional Planning Commission 2012).

Mid-Ohio Regional Planning Commission examines the location and type of all crashes to determine whether it involved a bicyclist, pedestrian, or transit vehicle (Mid-Ohio Regional Planning Commission 2016).

Tennessee Department of Transportation monitors incidents pertaining to public transit vehicles and safety (Tennessee Department of Transportation 2016).
United States Department of Transportation uses the "Distracted Driving Fatalities and Serious Injuries" measure to understand causes of crashes (United States Department of Transportation 2015).
Nevada Department of Transportation uses the "Reduction of Fatal Crashes" measure to understand safety (Nevada Department of Transportation 2016a).
Florida Department of Transportation uses the "Transportation-Related Roadway Fatalities" measure to understand safety (Florida Department of Transportation n.d.).
Sacramento Area Council of Governments uses the "Percent Reduction in Accident Rates" measure to understand transportation safety in the region (Sacramento Area Council of Governments 2016).
The National Park Service uses the "Accident Rate" measure to understand transportation safety within parks (National Park Service 2017).
Oregon Department of Transportation uses the "Crashes by Cause" measure to understand the causes of transit derailment incidents (Oregon Department of Transportation 2015).

Literature or Guidance Documents

California Rural Counties Task Force recommends estimating resource requirements per performance measure in order to be adequately equipped for potential incidents (California Rural Counties Task Force 2015).

Relationship with Goal

Safety: This measure looks at the causes of transportation fatalities and ways to prevent them.
Operations: This measure can provide valuable information for the management and design of roads for safer means of travel.
Automobile Connectivity: This measure relates to all connectivity goals.

Variations of the Measure / Alternatives to the measures

Crashes, Fatalities, or Serious Injuries by Mode (transit, bicycle, pedestrian, automobile, etc.) and by Cause (alcohol, distracted driving, etc.) – The amount of accidents, their result, and what initiated the accident. Percent Reduction in Accident Rates – The reduction in accidents over time, measured against total VMT.
References
(Salgado & Colombage 1988) (Rojas-Rueda et al. 2011) (Jacobs et al. 2000) (Nevada Department of Transportation 2016a) (Nevada Department of Transportation 2016b) (Florida Department of Transportation 2016a) (Florida Department of Transportation n.d.) (Sacramento Area Council of Governments 2016) (National Park Service 2017) (Transportation Research Board 2001) (Mid-Ohio Regional Planning Commission 2016) (Mid-Ohio Regional Planning Commission 2012) (Mid-Ohio Regional Planning Commission 2011) (Washoe Regional Transportation Commission 2013) (Makowsky & Stratmann 2011) (Lagerlof 1975) (Wilson & Stimpson 2010) (Klauer et al. 2014) (United States Department of Transportation 2015) (Oregon Department of Transportation 2015)

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