RECOMMENDATIONS FOR CALIFORNIA STATEWIDE GUIDANCE

HIGH INJURY NETWORKS

SEPTEMBER 2021

Recommendations for California Statewide Guidance on High Injury Networks

September 2021

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Thank you to the various jurisdictions that were interviewed and consulted with on the development of this report: Alameda County Transportation Commission (Christopher Marks and Aleida Andrino-Chavez), City of Berkeley (Eric Anderson), City of Daly City (Kevin Fehr and Dana Weissman), City of Fremont (Hans Larsen), City of Santa Barbara (Samuel Furtner), City of Santa Monica (Joseph San Clemente), and City of Sunnyvale (Ralph Garcia), Los Angeles County (Matthew Dubiel and Eric Dunlap).

Introduction and Background

On average, more than 3,700 people are killed and 16,000 are seriously injured[1] in traffic collisions each year in California.[2] These numbers represent children, parents, spouses, relatives, and friends. Collisions are happening in every community in California, from El Centro in Imperial County to San Jose in Santa Clara County. They are happening to people who are driving, and disproportionately, to people who walk and bicycle, and those living in low income and communities of color. There are many reasons that collisions are occurring, but unsafe speed is the top contributing factor of all collisions, accounting for about 26 percent of fatalities in California, as per the National Highway Traffic Safety Administration.[3]

TRAFFIC SPEED SETTING

Current procedures for setting speed limits in California rely on the 85th percentile methodology, an approach developed decades ago for vehicles primarily on rural roads. As its name implies, the 85th percentile speed is the velocity at which 85 percent of vehicles drive at or below on any given road. The 85th percentile methodology assumes that most drivers will drive at a safe and reasonable speed based on the road conditions. It is also based on the idea that speed limits are safest when they conform to the natural speed driven by most drivers and that uniform vehicle speeds increase safety and reduce the risks for collisions.

Traffic engineers calculate the 85th percentile speed for a given roadway during free-flow traffic when conducting an engineering and traffic survey. The survey results are then analyzed, yielding the speed at which 85 percent of the drivers are traveling at or below. The 85th percentile speed does not automatically become the speed limit that is posted for that road. Engineers can apply rounding and adjustment allowances based on a variety of other conditions, resulting in a speed limit that deviates from the 85th percentile speed. However, California law places parameters and limits on these deviations. When using engineering and traffic surveys to post lower speed limits, the maximum amount that a posted speed limit can deviate from the 85th percentile speed is seven miles per hour (mph). Ultimately, the speed at which 85 percent of road users drive at or below exercises a profound influence on the final speed limit that is posted for the road. Given that speed is the leading predictor of whether someone survives a collision, changing speed setting methodologies and allowing agencies more flexibility for lowering speed limits, has significant potential for saving lives.

VISION ZERO, TOWARD ZERO DEATHS, AND SAFE SYSTEM APPROACHES

Vision Zero is a strategy to eliminate all traffic fatalities and serious injuries and has been gaining traction in the U.S. after years of success in Europe. American cities such as Los Angeles, New York City, Portland, San Francisco, and Seattle have all adopted Vision Zero strategies. Vision Zero first started in Sweden in 1997 when the country decided to take a safe system approach to enhancing safety, faulting collisions on overall system design rather the individual failure of the driver. In Sweden, this approach has led to success, with fatalities involving pedestrians decreasing almost 50 percent in the last five years and giving

[1] In 2017, the California Highway Patrol added three additional classifications of injury status based on the Model Minimum Uniform Crash Criteria (MMUCC). Part of these changes involved changing terminology for "severe injury" to "suspected serious injury." To reflect these changes as well as the state's focus on establishing targets for serious injuries, not severe injuries, this document refers to serious injuries instead of severe injuries.

[2] Caltrans. "Safety Performance Management Targets for 2021." *California Department of Transportation*, 2021. https://dot.ca.gov/-/media/dot-media/programs/federal-liaison/documents/2021-spmt-a11y.pdf (Accessed March 15, 2021)

[3] National Highway Traffic Safety Administration. "Traffic Safety Facts: 2018 Data." U.S. Department of Transportation, April 2020. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812932

the country one of the lowest annual rates of road deaths in the world.[4] Vision Zero planning approaches across different jurisdictions often address engineering, education, and establishing safe speed limits. Countermeasures that address the three key elements of the road systems (roads, vehicles, and speed) are encouraged because these three elements typically determine trauma levels in a collision.[5] **TABLE 1** outlines a few strategies of earlier adopters of Vision Zero in the U.S. – specifically, New York City, Washington, DC, and Portland.

Table 1 Strategies for Early Adopters of Vision Zero Strategies

Year Established	NEW YORK CITY 2014	WASHINGTON DC 2014	PORTLAND 2015
Strategies (***bolded text*** *is name of the strategy in the Vision Zero plan)*	Includes **Engineering** strategies like street design, **Education** such as outreach, working with seniors, **Enforcement** though various means like security cameras, and **Legislation** that includes changing default speed limits.	**Education and Enforcement; Engineering and Infrastructure** which includes data analysis of specific locations that require new interventions and safe street designs); and **Data Collection**, which involves a data and information-driven process to inform Vision Zero Strategies	Includes **protecting pedestrians** through signal timing and improving visibility; **reducing speeds citywide; changing street design** including slowing left turns and developing HIN; **creating shared responsibility** through more public education.

Towards Zero Deaths (also known as the Safe System approach) is similar to Vision Zero. It is an approach that is based on the understanding that even one traffic-related fatality is unacceptable. In the U.S., the Toward Zero Deaths National Strategy was launched in 2014, adopting the zero-focused imperative along with a strong commitment to a safety culture. The principles underpinning the approach include:

- People make mistakes that can lead to collisions-- however, no one should die or be seriously injured on the road as a result of these mistakes;
- The human body has a limited physical ability to tolerate collision forces;
- Road safety is a shared responsibility amongst everyone, including those that design, build, operate and use the road system; and
- All parts of the road system must be strengthened in combination to multiply the protective effects and if one part fails, the others will still protect people.

At the center of the system is people, and knowing that people are fragile and will at times make mistakes that can lead to collisions. With that understanding, the road system needs to put layers of protection in the form of safe roads, vehicles, speeds, and people (safe road users) around the fallible and vulnerable human in order to prevent fatalities and serious injuries.

[4] Center for Active Design. "Vision Zero: Learning from Sweden's Successes." *Vision Zero Network,* n.d. https://visionzeronetwork.org/wp-content/uploads/2018/05/What-is-VZ_FINAL.pdf (Accessed March 15, 2021).

[5] Johansson, R. 2009. Vision Zero – *Implementing A Policy For Traffic Safety.* Safety Science 47(6): 826-831. http://www.sciencedirect.com/science/article/pii/S0925753508001859

HIGH INJURY NETWORKS

As more U.S. jurisdictions are adopting Vision Zero, Toward Zero Deaths, and Safe System approaches, they are gathering and analyzing their data to acquire a better understanding of their existing conditions. Specifically, what type of crash is happening? Where is it happening? When is it happening? To whom is it happening? And most importantly, why is it happening? Documenting existing conditions and patterns of collisions is a first step towards developing meaningful community-supported solutions. As a part of this existing conditions analysis, many agencies have developed High Injury Networks (HINs), mapping corridors where people have been killed or seriously injured in traffic collisions.

According to the Vision Zero Network, the City/County of San Francisco was the first jurisdiction to develop an HIN in 2013 when it used data over a five-year period to determine that people were being injured at more than 1,700 intersections, and that six percent of street miles accounted for 60 percent of serious and fatal pedestrian injuries.[6] The City/County of San Francisco officially adopted Vision Zero in 2014, and as part of that effort, staff decided to build onto the pedestrian HIN to research the same data for people bicycling and driving. Staff ultimately combined all layers to create the Vision Zero HIN in 2015. In this, they found that 12 percent of city street miles contributed to 70 percent of fatal and serious injuries among all road users. The assessment was significant in allowing the City/County to identify leading problem areas.

To develop HINs, it is important to understand and identify collision frequencies, collision density and collision rates. HINs by themselves do not assess whether a location or street is dangerous, but rather identify where there is a greater opportunity for serious injury or death at a location.[7] As was the case with the City/County of San Francisco HIN, typically HINs will find that a small percentage of streets account for more than half of serious injuries or fatalities. There are several compelling reasons for developing HINs, including:

- Identifying areas of need;
- Providing agency staff with more information on where they can focus limited resources;
- Providing opportunities to understand how communities of concern or disadvantaged communities[8] are impacted by higher rates of collision and serious injury; and
- Assisting with building greater public and political support.[9]

Although prioritizing corridors may appear to be a straightforward task, there are a number of critical decisions that influence which areas are highlighted on an HIN, including:

- How many years of data should be included?
- Should collisions be analyzed at the intersection or corridor-level?
- Should collisions on local roads be analyzed? Should freeways, unincorporated areas, or expressways be included as well?
- Should the jurisdiction analyze all collisions, collisions resulting in injury, or only collisions resulting in serious injury or death?
- Should all modes of travel be included? Or only those more negatively impacted compared to mode share (e.g., pedestrians and bicyclists)?
- Should collisions be weighted (e.g., collision locations involving children and/or older adults)?

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[6] Ibid.

[7] Southern California Association of Governments. "Regional High Injury Network." SCAG, n.d. https://scag.ca.gov/regional-high-injury-network (Accessed March 20, 2021).

[8] Communities and regions across the state use differing terminology to refer to high need areas including, but not limited to: disadvantaged communities, communities of concern, environmental justice areas, equity priority communities, priority focused communities, etc.

[9] Ferrier, Kathleen. "HIN for the WIN: How Data is Helping Communities Prioritize Vision Zero Strategies and Funding." Vision Zero Network, 2018. https://visionzeronetwork.org/hin-for-the-win/ (Accessed March 25, 2021)

- Should fatalities be weighted more heavily than serious injuries?
- How are collisions in disadvantaged communities taken into consideration (e.g., weighting or an overlay)?

Zero Traffic Fatalities Task Force

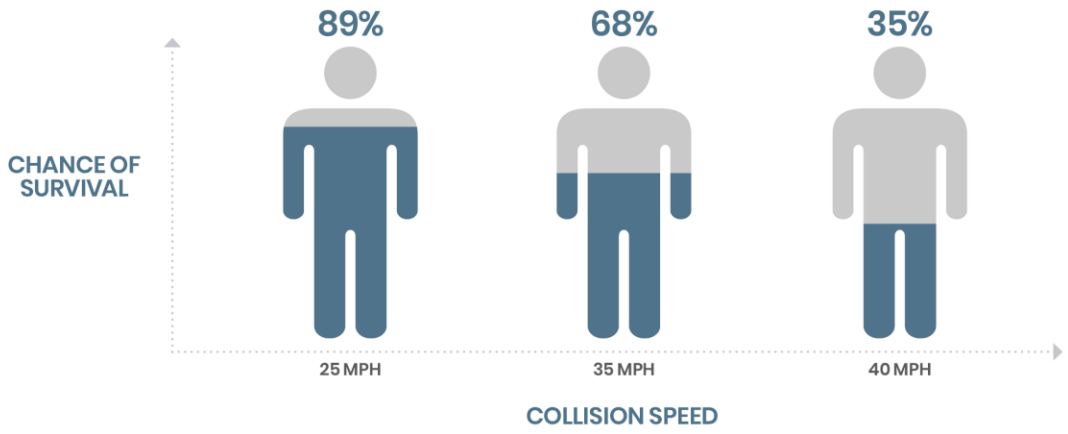
Assembly Bill 2363 (Friedman, Chapter 650, Statutes of 2018) required the Secretary of Transportation to establish and convene a Zero Traffic Fatalities Task Force. The goal of the Task Force was to identify changes in speed setting methodologies and other efforts to reduce traffic-related fatalities and serious injuries. The Task Force was also charged with exploring complementary strategies, such as automated speed enforcement. The California State Transportation Agency (CalSTA) convened the Task Force in three workshops over summer/fall 2019 to seek stakeholder input on recommendations and conducted academic research synthesis. In January 2020, CalSTA released the Zero Traffic Fatalities Task Force – Report of Findings. The report substantiated the relationship between speeding and traffic fatalities and injuries. As noted within the report, speed encourages collision risk in two ways: it increases the likelihood of being involved in a collision and it increases the severity of injuries sustained by all road users in a collision. Speed is a particularly important factor in determining whether vulnerable road users such as bicyclists and pedestrians survive a motor vehicle collision. Figure 1, taken directly from the report, emphasizes the depth of the relationship between survival and collision speed. Recognizing these significant issues, the report included recommendations for changes to speed limit setting that would help California meet its Toward Zero Deaths goals and safety targets.

As described earlier, current procedures for establishing speed limits do not offer agencies with flexibility for setting appropriate speed limits. One option for providing agencies with more flexibility could come through allowing agencies to lower speed limits along established HINs. These HINs would identify specific locations with high collision concentrations and corridor-level segments with a pattern of collision reoccurrence, and they would be able to be stratified by mode. Recognizing this as a potentially viable option for local agency speed setting flexibility, the Task Force report also included recommendations specific to HINs, including:

- Increase the reduction allowance for posted speed limits to allow greater deviations from the 85th percentile speed. Currently, the posted speed may only be reduced by five mph from the nearest five mph increment of the 85th percentile speed. Classes of locations where the posted speed may be reduced further should include:
    - High Injury Networks (HIN). Steps to implement include developing a statewide definition of an HIN. Possible criteria may include:
        - A minimum of three years of the most current collision data;
        - Weighting of fatal and serious injury collisions; and
        - Weighting of collisions that occurred in disadvantaged communities
    - The resultant HIN should identify specific locations with high collision concentrations and identify corridor-level segments;
- Revise the California Manual for Setting Speed Limits to comprehensively cover speed setting methodology and law in easy-to-understand terminology. This update should be guided by a committee of state and local subject matter experts. New material should include guidance on developing a High Injury Network (HIN) and any new methods developed in the future.

Though the report included many recommendations, at the time of its release, it did not include an implementation plan.

Figure 1 Relationship between Vehicle Speed, Collisions, and Fatalities



Strategic Highway Safety Plan – HIN Action Items

In spring 2020, the Southern California Association of Governments (SCAG) proposed actions for inclusion in the Strategic Highway Safety Plan (SHSP) Implementation Plan that would support implementation of the aforementioned HIN recommendations. In fall 2020, the SHSP Executive Leadership and Steering Committees approved the HIN-related actions. More specifically, they approved two actions focusing on establishing a preferred methodology for developing HINs, with specific consideration to more vulnerable road users: bicyclists and pedestrians. In November 2020, SCAG convened a statewide SHSP Bicycle and Pedestrian Challenge Area Team subgroup to focus on implementing these actions. The subgroup included representatives from the following jurisdictions and organizations, many of whom participated in the Zero Traffic Fatalities Task Force: California Department of Public Health, City of Long Beach, City of Los Angeles, City of Oakland, City of Palmdale, City/County of San Francisco, City of San Jose, Federal Highway Administration, Fehr and Peers, Rock Miller (Consultant), San Diego Association of Governments, SCAG, and UC Berkeley SafeTREC. The HIN subgroup met on a monthly basis starting in November 2020 and concluding in June 2021.

Report Purpose

This report provides a summary of the HIN subgroup's work and recommendations. More specifically, this report provides a review of existing California HINs developed at the city, county, and metropolitan planning organization (MPOs) levels of government and provides details on which components were included in each HIN and how they were created. Based on HINs reviewed, this report provides recommendations for statewide guidance on a definition of and methodology for HINs.

Reviewing California's High Injury Networks

To develop recommendations for a definition of HINs and methodology for HINs, the HIN subgroup assembled an inventory largely consisting of California's HINs, with a few notable national examples, based on publicly available HIN methodology documents and any associated safety plans. A total of 23 jurisdictions were initially identified and 20 were considered in the final review as they contained more complete information. The HIN subgroup conducted interviews with a select number of case study

jurisdictions to better understand their HINs. A table of the HIN jurisdictions are listed by population in **TABLE 2**.

Table 2 Jurisdictions included in the HIN Analysis

POPULATION GROUPINGS		
Under 500,000	**500,000 – 999,999**	**1,000,000+**
City of Berkeley	City of Portland	Alameda County (Transportation Commission)
City of Daly City	City of Sacramento	City of Los Angeles
City of Fremont	City/County of San Francisco	City of San Diego
City of Long Beach	City of Seattle	City of San Jose
City of Oakland		Los Angeles County
City of Santa Ana		Portland Metro
City of Santa Barbara		Southern California Association of Governments
City of Santa Monica		
City of Sunnyvale		

Existing High Injury Network Definition

Based on a review of the HIN methodologies collected, the most basic definition of an HIN is a network of designated corridor-level segments where the highest concentrations of collisions occur, typically over the course of the most recent three-to-five-year period of collision data. The HIN represents a defined prioritized subset of the overall transportation network. Many HINs specify the types of collisions incorporated, and the majority are measured by the number of fatalities and serious injuries.

High Injury Network Core Components

Based on a review of the HIN methodologies collected, there are several core components that many of the jurisdictions had in common. These include:

- Years of data
- Intersection or corridor focused analysis
- Roadway facility types included (e.g., local roads, highways, etc.).
- Consideration of modes (e.g., driver, bicyclist, pedestrian, etc.)
- Weight assignment, such as assigning more weight to collisions involving certain populations (e.g., children, older adults, bicyclists, pedestrians, disadvantaged communities, etc.), or types of injury severity (e.g., fatalities, serious injuries, etc.)
- Normalization (e.g., serious/fatal injuries per mile)
- Overall threshold, which determines a potential cut-off for including a portion of a roadway on the high injury network (e.g., a road segment having a volume of collisions one standard deviation above the average)

YEARS OF DATA USED AND DATA SOURCES

Among the HINs analyzed, the majority of them used three to five years of collision data to determine collision locations with higher frequency. Across the jurisdictions analyzed, the median and average number of years of data considered is four. Using more years of data may capture irrelevant information, and using fewer years of data may result in difficulty drawing the network. In California, the state typically collects and stores collision data, whereas the local jurisdictions collect and store streetline data. While there were a number of data sources used across the individual cities, counties, and MPOs, they mostly centered on a few specific types of data sources: the Statewide Integrated Traffic Records System (SWITRS) from the California Highway Patrol, the Transportation Injury Mapping System (TIMS) from SafeTREC, and individual police departments. It is important to note that TIMS uses SWITRS data, but only SWITRS data that contains location details and can be geolocated. Thus, TIMS data may not perfectly match SWITRS data and may omit certain collisions due to the lack of locational data. Some jurisdictions may choose to download both SWITRS and TIMS data to cross-reference data for accuracy. However, while TIMS is generally regarded as more user-friendly than the SWITRS database, the website notes that "any Caltrans employees and those acting on Caltrans' behalf" shall not rely upon TIMS data, particularly for any engineering decisions.

COLLISION BY INTERSECTION OR CORRIDOR LEVEL

Most HINs analyzed are developed at the corridor level, while some also develop complementary high injury intersections around customized buffered areas. Identifying high injury intersections allows a jurisdiction to apply countermeasures on intersections as well as well as on streets. Jurisdictions of various populations and sizes, such as the Cities of San Francisco, Seattle, and Sunnyvale consider both types of analysis. The City of San Jose recently included an intersections analysis in 2020, after developing a methodology that allowed the City to map the intersections onto road segments. This suggests that internal capacity may be a barrier to completing both types of analysis.

COLLISION BY ROADWAY FACILITIES

Most HINs analyzed include only streets in their HINs and very few jurisdictions incorporate freeways into their HINs. Examples of HINs considering freeways include the Alameda County Transportation Commission, which includes freeway mainlines and ramp terminal intersections, and the City of San Jose, which includes county expressways. Many HINs may have chosen not to incorporate freeways in their network due to the jurisdiction's inability to set speeds on these specific facilities.

COLLISIONS BY MODE

Most HINs incorporate collisions by all modes. This means they include collisions that involve bicyclists, pedestrian, and automobiles. However, some HINs distinguish between the various types of collisions that occur, including auto-auto, auto-bicyclist, and auto-pedestrian, property damage only collisions, and others such as the Cities of Santa Ana and Santa Barbara do not incorporate collision data between automobiles, instead choosing to focus on auto-pedestrian and auto-bicyclist collisions.

COLLISION WEIGHTS

In the creation of an HIN, some jurisdictions included additional weight assignments to specific types of collisions to highlight particular inequities or considerations, which may lead to intentionally emphasizing certain locations over others. For example, an HIN methodology may weight collisions involving children more heavily. This means that if there was data indicating a child was killed or seriously injured by an automobile on a specific segment of a roadway, the collision may be weighted 20 times more than a

collision involving an older adult. This means that the resulting HIN may reflect collisions and their respective locations that otherwise would not have been reflected on the HIN. This ensures locations with high proportions of vulnerable populations (e.g., areas close to schools, older adults, or communities of color) are given the appropriate considerations in drawing the HIN.

The HINs reviewed included weighting for the following types of collisions:

- Fatalities
- Serious injuries
- Minor injuries or complaints of pain
- Young children
- Seniors or older adults
- Equity considerations (e.g., whether the collision took place in a disadvantaged community, however that is defined at the local or regional level).

Most HINs assign weights specific to collisions involving fatalities and serious injuries. **TABLE 3** reflects some of these examples. Additional examples include the City of Long Beach, which did not weight types of collisions differently, but weighted them differently depending on location (e.g., roadway, non-signaled intersection, or signalized intersections). The Alameda County Transportation Commission weighted collisions resulting in fatalities or serious injuries compared to visual injuries or complaints of pain five times more than collisions that did not involve a visual injury or complaint of pain.

While most of the reviewed HINs do not explicitly include weights relating to disadvantaged communities, children, or older adults, due to difficulties of sourcing data or internal capacity, many jurisdictions publish reports mentioning the necessity of developing HINs because of the proximity of these networks to vulnerable populations. For example, reports may indicate a higher proportion of collisions taking place in a community with a large population of Black or Hispanic/Latinx residents, or near a school.

Table 3 Examples of Fatality Weights

Jurisdiction	Weight of Fatalities
City of Daly City	20x a non-fatal collision
City of Los Angeles	1.5x a non-fatal collision
Cities of Oakland, Sacramento, San Francisco, and Sunnyvale	3x a non-fatal collision
Alameda County Transportation Commission and Portland Metro	10x a non-fatal collision

NORMALIZATION

Many jurisdictions normalize collisions by mile or HIN segment length (though some use additional methods such as collision rates or population) to paint a more accurate picture of what is occurring on the streets by reducing the occurrence of outliers. For example, the City/County of San Francisco considered the number of injuries per mile for network eligibility, while the City of Sunnyvale incorporated average weighted collision by roadway length (300 feet).

THRESHOLDS

After determining how to normalize collisions, agencies will typically establish a threshold, which can be defined as a percentage of network which will be categorized as a priority. Having thresholds allows an agency to implement countermeasures on a specific percentage of corridors depending on the availability of funding and other additional factors. Among the HINs analyzed, thresholds vary on how they are established. For example, the City of Fremont uses a percentage threshold for the number of applicable corridors included in the network: its guideline is that its HIN should be comprised of no more than 10 percent of the street network. Other jurisdictions, rather than using a threshold based on the percentage of roadway, use thresholds based on the volume of collisions that take place on a segment. For example, the City of Oakland uses a threshold for a half-mile segment that of one Killed Serious Injury (KSI) collisions and four moderate injury collisions, two KSIs and one moderate injury collision, or seven moderate injury collisions.

In cases where thresholds may create potential roadways and corridors for an HIN that are too short, jurisdictions can make adjustments to ensure HINs are continuous networks, piecing together roadway fragments that have met the threshold for collisions, but were not of sufficient length. Included in **TABLE 4** are examples of how some jurisdictions established their thresholds.

Table 4 Examples of Thresholds Across Jurisdictions

Jurisdiction	Description of thresholds
City of Fremont	The priority street system was created based on no more than 10 percent of the whole street network.
City of Oakland	The threshold corresponds with one KSI and four moderate injury collisions, two KSIs and one moderate injury collision, or seven moderate injury collisions within a half-mile segment.
City of Sacramento	The threshold is set based on a weighted collision score to determine whether a street would be included: roadway segments that meet the HIN threshold, but are less than 500 feet are excluded from the HIN. If gaps less than 2,000 feet on a roadway existed between two longer HIN roadway segments, these areas are included in the HIN.
City of San Diego	The Critical Rate or cut-off point is determined as the average rate plus one standard deviation. All intersections with a collision rate value at or above the Critical Rate are considered High Crash locations.

High Injury Network Case Studies

In identifying case studies, the group considered a variety of jurisdictions across different areas and population sizes. Area and population can influence a jurisdiction's capacity to generate and analyze a large enough dataset to develop an HIN. This report provides case studies of larger cities, smaller cities, and a Metropolitan Planning Organization, a federally mandated and funded transportation policy-making organization (SCAG). Each case study was selected to demonstrate a variety of geographic sizes and populations.

Each case study highlights how the HIN was developed, and how it is currently being used.

CITY OF DALY CITY

Area: 8 square miles | Population: 106,280

The City of Daly City's Vision Zero plan started in 2018 with funding and partnership from the Federal Highway Administration (FHWA). Led by the Public Works department, they met and engaged with numerous external stakeholders including San Mateo County, Caltrans, Silicon Valley Bicycle Coalition, County Health Department, and the County Office of Education, in addition to internal stakeholders like the Planning, Police, Public Works, and City Managers' Office. The Vision Zero Plan built on multiple existing plans and documents including the General Plan, the Bicycle and Pedestrian Master Plan, the Daly City Pedestrian Safety Assessment, and the Systemic Safety Analysis Report, which focused on all traffic collisions, rather than the pedestrian and cyclist collisions that the Vision Zero plan focused on. As part of their data-driven strategy, Daly City created an HIN that sought to identify roads with a high concentration of fatalities and injuries.

The development of the HIN was created using the roadway network, collision data and GIS software. The collision data was joined spatially to the roadway network, allowing for analysis at the roadway segment

level. Collision densities were developed for each roadway segment, and fatal and serious injuries were weighted as 20 times that of other collisions. These weighted segments were then ranked based on their weight Collision density (collisions per mile), and roadways with the highest weights were added together to identify the roadway segment that contribute to the largest number of collisions.

They included data from 2013–2017 and extracted it from SWITRS. The data analysis includes all collisions within the City, except for collisions taking place on major controlled access Caltrans roadways such as Interstate 280 and Route 1. SWITRS data was supplemented by the Daly City Police Department's collision records, and all non-duplicative collisions with a reported severity level were added to the database.

Daly City also created incorporated elements on the Collision Trends, which evaluated the severity of collisions by mode, location, time, victim demographics, and types of collisions in addition to Emphasis Areas, the five emphasis areas with most prevalent collision characteristics.

The Daly City HIN revealed that 64 percent of all collisions and 83 percent of collisions involving people killed or seriously injured were located along 17 percent of the City's roadway network.

HOW THE HIN IS USED

Most schools and schools and parks in Daly City fall within a quarter mile of the HIN: of Daly City's 50 schools, 45 are within that quarter mile. As a result, relationships were specifically built with San Mateo County Safe Routes to School program to implement infrastructure and programmatic approaches to improving safety for students. It was noted in an interview with the project managers that Daly City did not have a robust Safe Routes to School program and did not conduct walk audits before the HIN, but developing the Vision Zero plan and the Safe Routes to School program around the same time through a complementary process allowed Daly City to focus on which schools to prioritize.

Having the HIN also gave Daly City staff the language to have conversations with external stakeholders on the importance of transportation safety in streetscape and design projects (e.g., in conversations with business owners during a streetscape design project). As a result of the HIN, the City has been able to incorporate striping improvements as part of the annual slurry and overlay projects along the Network. Having the Network and the data has also supported the City in being able to apply for grants along the HIN.

To learn more about the City of Daly City's High Injury Network, visit: www.dalycity.org/936/Vision-Zero-Action-Plan.

City of Fremont

Area: 77 square miles | Population: 241,110

The City of Fremont's Vision Zero Action Plan was approved in 2016, and a High Injury Network (defined by the City as "Safety Priority Streets") was part of the Vision Zero Action Plan effort.

The City of Fremont used three years of data (2013-2015) of collision reports from the Police Department, rather than getting the data from the statewide database (SWITRS): this required building a relationship between Public Works and the Police Department, which benefited the creation of the Safety Priority Streets because it allowed for the timely delivery of necessary data. Using data from the Police Department provided the City with more detail around what happened in a collision.

The City's HIN methodology involved using a outcome-based approach to broadly select the roadway corridor that captured the highest concentration of major collisions, with the street system representing no more than 10 percent of the street network. Using the three years of major collision data that were collected, City staff mapped the KSI (killed and seriously injured) collision locations on a map and

determined the areas with the highest frequency. From there, they determined clusters and corridors to prioritize for safety improvements.

As part of their Safety Priority Streets, their analysis included intersections, local state highways and freeway interchanges though not mainline freeways. Sixty percent of all major collisions and 90 percent of fatalities took place on just 10 percent of streets. The methodology for their analysis included looking at what other Vision Zero cities were doing, including the Cities of San Francisco, San Jose, and Seattle.

HOW THE HIN IS USED

Five years after the creation of the Safety Priority Streets, Fremont reduced the number of fatal and serious injury collisions by 45 percent when compared to a rolling average of major collisions from 2013-2015 and 2018-2020. Most of the Safety Priority Streets were engineered to be "safe and complete streets," with 10 feet travel lanes, buffered bike lanes, enhanced pedestrian crossings (which includes both quick-build and permanent improvements), pedestrian countdown signals, and brighter street lighting. In addition, after these improvements were implemented, speed limits were reassessed and reduced where possible, resulting in over 50 locations lowering their speeds by five mph. The number of radar speed feedback signs were also increased throughout the city from 15 to 45.

To learn more about the City of Fremont's High Injury Network, visit: www.fremont.gov/2594/Fremont-Vision-Zero.

City/County of San Francisco

Area: 47 square miles | Population: 860,000

San Francisco adopted Vision Zero as City policy in 2014, with the goal of zero traffic deaths for all modes, including people in motor vehicles, walking, and bicycling. In support of Vision Zero, the Department of Public Health (SFDPH) created the Vision Zero High Injury Network, a corridor-level analysis that informs transportation injury prevention initiatives and investments to save lives and reduce injury severity, in 2015. The network was subsequently updated in 2017 and is scheduled to be updated again in 2021. The data analysis behind the HIN of San Francisco's Vision Zero plan was performed by the SFDPH in collaboration with the San Francisco Municipal Transportation Agency (SFMTA). San Francisco's Vision Zero approach is highly data driven, but still incorporates professional knowledge at key junctures.

The 2017 Network includes key data enhancements that provide the most comprehensive analysis San Francisco has had to date with respect to the location of serious and fatal injuries, which will help the City be more targeted in Vision Zero investments and identifies some locations previously not on the Network. San Francisco is the first city in the country to use mapped hospital data along with police injury data to analyze spatial patterns of serious and fatal injuries in support of Vision Zero. The updated network has been refocused exclusively on serious and fatal traffic-related injuries from 2013-2015 using a new comprehensive data system that combined police and hospital collision data.

SFDPH in conjunction with the Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG), the only level-one trauma center in San Francisco, completed a comprehensive Transportation-related Injury Surveillance System (TISS) to conduct more accurate, coordinated and timely monitoring of transportation-related injuries and deaths. TISS probabilistically links existing transportation-related injury and fatality data collected by City and County of San Francisco agencies into one comprehensive database. This includes ZSFG, ambulance, Medical Examiner, and police data from SFPD 's Interim Collision Database System, an inhouse software program for collision report data input and management that supports more timely collision reporting.

TISS data captures more traffic injuries than any before. TISS includes Emergency Medical Service (EMS) data from King-American Ambulance Company, American Medical Response, and San Francisco Fire Department Emergency Medical Services Agency, to identify locations of unreported traffic injuries – people treated at the hospital with injuries not reported to SFPD. From 2013-2015, TISS identified 411 serious injuries that were transported by ambulance to the hospital that were not in SFPD records. The new TISS data helps ensure that these serious injuries identified in the hospital dataset are included in analyses to inform injury prevention efforts in support of Vision Zero.

An additional benefit of utilizing TISS linked data is that injury severity can be updated to reflect a more accurate injury outcome as determined by ZSFG medical staff. Police assessment of injury severity is based on an officer's primarily visual assessment of a victim at the scene of the collision while hospital data provides a clinical assessment of a collision victim's injury severity. When possible, the Network update determined injury severity using hospital injury data informed by previously established guidelines including those used by the American College of Surgeons, the National Trauma Data Bank, the California Department of Public Health, and the World Health Organization. A total of 1,494 serious and fatal injuries occurring between 2013-2015 were identified and mapped for the analysis using the TISS dataset.

Using a combination of SFPD, ZSFG and linked collision data, San Francisco's HIN identifies 13 percent of the city's streets where 75 percent of all serious and fatal injuries occur. In addition, 51 percent of the HIN is located within Communities of Concern, which are defined as areas with concentrations of vulnerable residents, including low-income communities, communities of color, seniors, people with disabilities, and residents with limited English proficiency.

In addition, SFDPH collaborated with SFMTA and the San Francisco Police Department (SFPD) to develop a Vision Zero Traffic Fatality Protocol, to ensure consistency in the definition of Vision Zero fatalities across city agencies. Vision Zero traffic fatalities are reported and mapped monthly on the Vision Zero SF website. SFDPH maintains the transbase.sfgov.org webmap, which pairs Vision Zero-related data like the HIN, Statewide Integrated Traffic Records System (SWITRS), and SFPD collision data with relevant datasets covering factors like the built environment, demographics, and institutions.

HOW THE HIN IS USED

San Francisco's HIN helps guide the City's safe streets investments – particularly as it relates to the SFMTA's Quick-Build program. Quick-Build projects can be planned, designed, and constructed faster and cheaper than traditional streetscape projects and are largely located on the HIN.

The HIN is used as a tool to identify priority corridors and areas in greatest need of capital investment. The SFMTA has been successful in obtaining grant funds for traffic signal re-timing amongst other types of projects in part due to having the HIN and its underlying data at its disposal.

The HIN is a valuable equity tool for SFMTA planners. Communities of Concern are overrepresented on the City's HIN – a vital insight for the agency that has been incorporated into recent community-based transportation plans.

To learn more about the City/County of San Francisco's High Injury Network, visit: www.visionzerosf.org.

City of San Jose

Area: 181 square miles | Population: 1,027,690

In the City of San Jose, the Department of Transportation conducted an analysis of traffic collision records from a five-year period and identified 14 Priority Safety Corridors (PSCs) as part of its 2015 Vision Zero Action Plan. These corridors are long segments of city streets and county expressways with the highest frequency of fatal and serious injury collisions for people driving, walking, and bicycling. Their research

found that 3 percent of the city's street network experienced a high incidence of serious and fatal injury collisions. Staff updated their data in 2016, adding nine miles of roadways, for an updated group of 17 Priority Safety Corridors (15 City-owned, and two County Expressways) and determined that 3 percent of the street network (totaling 70 centerline miles) was contributing to 33 percent of fatalities and serious injuries in the city. As part of this data research, staff also determined the most dangerous behaviors contributing to the collisions along the Priority Safety Corridors.

San Jose Vision Zero also monitors other best practices coming from other Vision Zero cities. Among new Vision Zero data initiatives as of 2021 that could lead to redrawing the PSC/HIN are 1) trying to create a data sharing agreement with the Valley Transportation Authority (VTA) to include traffic fatalities and injuries that happen in San Jose but on VTA facilities into the City's dataset; and 2) beginning work to emulate San Francisco's linkage of trauma hospital data to police data. However, figuring out the coordination between City DOT, the County's Emergency Medical Service Agency, and the County's three trauma hospitals may take some time.

HOW THE HIN IS USED

City of San Jose staff used data from the Priority Safety Corridors to work with surrounding communities and conduct safety assessments for each of the corridors. Each of the assessments includes recommendations focused on engineering measures to help reduce vehicle speeds, minimize traffic conflicts, and create a safer environment for people walking. Assessments also included recommendations for enforcement and traffic safety education. The identified engineering improvements helped City staff apply for and win more than $25 million in grant funds for several Priority Safety Corridors. These funds were used in addition to City funds for several projects, many of them now in the design phase. In the 2020 Vision Zero Action Plan, the City adopted a new strategy, right before the COVID-19 pandemic started, to make quick build improvements on all 15 of the City-owned PSCs. This created a new Quick Build team in the Department of Transportation in Spring 2020.

To learn more about the City of San Jose's High Injury Network, visit: visionzerosj.org.

Alameda County Transportation Commission

Area: 739 square miles | Population: 1,656,754

The Alameda County Transportation Commission's (Alameda CTC) High Injury Network (referred to as High Injury Corridors) was a core part of its Active Transportation Plan that eventually rolled into the Countywide Transportation Plan. Through this effort, Alameda CTC was able to assist with the development of local bicyclist and pedestrian HIN, with an auto HIN that was kept primarily internal.

For the HIN, Alameda CTC took reported collision data for bicyclists and pedestrians from 2012-2016 from TIMS and SWITRS. They geolocated the collisions using Open Street Map (OSM), which allowed the team to incorporate some roadway characteristics like number of travel lanes, speed limit, bicycle facility presence and type, and functional class into their analysis. Alameda CTC included pedestrian and bicyclist collisions of all severity levels, and confirmed the TIMS data by cross-checking it with the number of fatal and injury collisions from SWITRS data over the same time period.

For the analysis, Alameda CTC included collisions on public streets within unincorporated and incorporated areas of the County, in addition to ramp terminal intersections of freeways (while excluding freeway mainlines). The basic analysis approach included conducting collision analysis with the data to establish countywide patterns, evaluating the frequency and severity of reported collisions with Equivalent Property Damage Only (EPDO) screening and sliding window methodology, which involves creating "windows" of a specific length on GIS that measures the serious injuries and fatalities in that area, before moving the window down the identified corridor to find the performance of the next window. This

allowed them to adjust severity weighting based on conversations with the Commission. Extra care was taken with the sliding window methodology as the length of the "window" impacted the severity score attributed to any particular street section: smaller side streets may appear on the analysis if the window is smaller because it was capturing intersections where major arterials were crossing minor arterials.

EPDO data assigned weighting factors to collisions by severity relative to property damage only (PDO) collisions—fatal and serious injury collisions, for example, were equal to 10 equivalent PDOs, and visual injury or complaint of pain collisions were equal to five equivalent PDOs. EPDO scores were then normalized with walking or bicycling commute mode share from the American Community Survey (by city). The top 20 percent of EPDO scores within each category (high, medium, or low) were selected to be High Injury Corridors.

After specific corridors were identified, Alameda CTC found it important to do some smoothing (connecting the segments together to create longer segments).

HOW THE HIN IS USED

Safety has continued to be an agency priority and the HIN has been a valuable tool to identify projects of countywide significance. Politically, it was also helpful for the agency to articulate where they have priority corridors, the nature of those corridors, and to assist Alameda CTC in prioritizing various infrastructure projects.

City of Los Angeles

Area: 503 square miles | Population: 3.9 million

The City of Los Angeles adopted Vision Zero in 2015 and in 2016 developed its first High Injury Network (HIN) using the five most recent years of collision data available at the time (2009-2013). The City of Los Angeles' road network is over 7,500 miles long and just 6 percent of those streets (almost 500 miles) make up the HIN. Nearly two-thirds of all crashes resulting in deaths and serious injuries for people walking or biking occurred on this network. The HIN was created by overlaying crashes where people walking or biking were killed or severely injured (KSI) and then using visual inspection to create a network that covered streets with a high density of bicycle and pedestrian KSIs. In 2018, the City of Los Angeles updated its HIN using the most recent five years of data (2012-2016) and the same visual inspection process used in 2016. This update added nearly 20 additional miles to the HIN but did not remove earlier identified street segments. These include entirely new corridors, extensions of existing HIN corridors, and street segments that connect two existing HIN corridors.

The Los Angeles Department of Transportation (LADOT) identifies Priority Corridors within the HIN to form the basis of its work plan. LADOT developed the first 40 Priority Corridors in 2016 with community input on the factors that should contribute to prioritization. The three top priorities included Severity, Vulnerability, and Social Equity. To highlight these priorities, LADOT gave additional weight to intersections when a death (versus a severe injury) had occurred, when crashes involved a senior or older adult, or a child, and where the intersection was in a high need community. Based on these priorities, LADOT used these weighted intersection scores to identify Priority Corridors.

LADOT identified a new list of Priority Corridors in 2018 using a different methodology, which focused exclusively on the concentration of KSI crashes per mile. LADOT adapted an algorithm created by the San Francisco Department of Public Health to analyze the most recent five years of collision data (2013-2017) and identified the top 20 corridors on the HIN that met the following criteria: a minimum length of a half-mile and a minimum average of 15 people killed or severely injured per mile (KSI/Mile). LADOT applied this algorithm to the HIN, with previously identified Priority Corridors removed, to identify 20 additional

Priority Corridors. In 2021, LADOT identified another eight Priority Corridors using this methodology and 2015-2019 data.

HOW THE HIN IS USED

The Priority Corridors are the focus of the LADOT Vision Zero work plan. Once identified, LADOT Transportation Engineers make basic upgrades to Priority Corridors using striping, signs, bollards, and signal timing. Next, LADOT Transportation Planners and Engineers in its Vision Zero Division collaborate with communities to identify safety issues and additional appropriate countermeasures such as lane reconfigurations, signals and beacons, curb extensions and pedestrian refuge islands, and other more durable improvements. The HIN also serves as a tool for the Department of City Planning to flag developments for LADOT review that may contribute to or alleviate safety issues.

To learn more about the City of Los Angeles' High Injury Network, visit: ladotlivablestreets.org.

County of Los Angeles

Area: 2654 square miles | Population: 1 million

In August 2020, the Los Angeles County Board of Supervisors adopted the County's Vision Zero Action Plan and directed the departments of Public Health and Public Works to co-lead its Vision Zero initiative. As part of Action Plan development, the County developed an HIN for roadways in the unincorporated County communities maintained by Public Works.

The County of Los Angeles manages nearly 3,300 miles of roads that traverse urban, suburban, rural-mountain, and desert areas. This diversity created a level of complexity in developing a HIN because unincorporated County roadways vary drastically based on terrain and surrounding land uses.

The County of Los Angeles utilized five years (2013-2017) of collision data to inform its Vision Zero Action Plan. Los Angeles County Public Works receives traffic collision reports directly from the local California Highway Patrol (CHP) offices. Staff review the reports and input pertinent information into a traffic collision database maintained by Public Works. During HIN preparation, Public Works manually compared its KSI data with data from TIMS and SWITRS, to ensure parity. Additionally, serious injury records were compared with public case records from the Medical Examiner/Coroner's office to verify any potential changes in a victim's degree of injury.

The County used GIS software to develop its HIN. The County's goals were that the layperson easily understands the methodology and that an HIN segment is calculable without GIS. Therefore, the County felt that identifying KSI collisions over a segment length using a sliding window methodology would be the simplest.

The HIN segments were manually drawn utilizing GIS, where three or more fatal severe injury collisions occurred within five years over a half-mile road segment. HIN segments were extended if the adjacent road segments met the three or more KSI collisions per half-mile threshold. The length of the segments and KSI collisions along the segments were summed. These segments accounted for 50 percent of the KSI collisions along almost 4 percent (or 125 miles) of the County-maintained roadway network. The County decided to label the roadways on the HIN as "Collision Concentration Corridors" to differentiate the County's network from the City of Los Angeles' and ease potential confusion from community members.

The County determined a priority score for each Collision Concentration Corridor segment by assigning weights for health equity, the severity of injury (fatal and serious injury), and whether pedestrians or bicyclists were involved in the collision. The additional weight for health equity was assigned if the collision occurred in the lowest scoring quartile of the California Healthy Places Index. The priority scores

for the segments were normalized by dividing by the total segment length. The minimum segment length for any location experiencing three or more KSI collision was assumed to be a half-mile.

HOW THE HIN IS USED

The County is prioritizing the top 20 Collision Concentration Corridors identified in its Action Plan to develop and implement traffic safety enhancements and programs. For identified Collision Concentration Corridors outside of the top 20, Vision Zero safety treatments are considered as part of ongoing roadway projects as opportunities become available. The Collision Concentration Corridor list is also used as a catalyst to commence collaboration with other teams at Public Works to create multi-benefit projects. For example, the list is being used to develop projects that incorporate traffic safety enhancements, pavement work, and stormwater capture elements. Further, Los Angeles County Public Health uses the Collision Concentration Corridors to focus media campaigns, bicycle and pedestrian education, and pedestrian planning.

To learn more about the County of Los Angeles' High Injury Network, visit: pw.lacounty.gov/visionzero.

Southern California Association of Governments (SCAG)

In 2018 SCAG developed its first regional HIN, which proved to be challenging. SCAG covers an expansive region that includes six counties, 191 cities, and 19 million people. Transportation safety is a multifaceted issue and the sets of challenges facing any one city or county as well as the solutions for addressing those challenges may be very different. SCAG had several goals for its HIN methodology, including that it:

- Be sensitive to differing county contexts (e.g., allow for additional weighting for other factors);
- Be replicable so that it could be used over time to track changes;
- Be quantifiable so that assessments could be made objectively;
- Focus on collisions resulting in fatalities or serious injuries;
- Consider all modes of travel, but provide the option for reviewing only auto-auto, auto-bicyclist, auto-pedestrian collisions;
- Identify high injury corridors and not only hot spots; and
- Include segments that were normalized by length.

In developing the HIN, SCAG reviewed HIN methodologies for a variety of jurisdictions including Los Angeles, San Francisco, Portland, and Portland Metro. SCAG borrowed elements from their approaches to develop one that could work for the entire region. SCAG incorporated the use of five years of SWITRS data. Only collisions resulting in serious injury or death were considered, which aligned with the region's focus on annual serious injury or fatality targets. SCAG considered all modes of travel, including auto-auto, auto-bicyclist, and auto-pedestrian. The MPO did not weight specific collisions involving certain demographics such as seniors or children. Collisions were analyzed at a corridor-level (one-mile segment lengths, no highways), and the resulting HIN represents a set of county-level HINs representing the regional HIN.

SCAG published a series of documents highlighting the regional HIN, including a Regional HIN storymap, in addition to a series of maps highlighting the HIN jurisdictions in the SCAG region.

HOW THE HIN IS USED

The HIN has been considered in funding proposal evaluations. For example, in past SCAG Sustainable Communities Program funding solicitations, SCAG has evaluated whether a proposed project intersects with the regional HIN. SCAG has also conducted targeted outreach for its funding program based on whether a community includes a portion of the regional HIN. Additionally, the regional HIN has provided

valuable information for its jurisdictions as the Los Angeles County Metropolitan Transportation Authority (LA Metro) has used SCAG's HIN in evaluating and scoring projects for its Measure M Active Transportation Program.

To learn more about SCAG's High Injury Network, visit: scag.ca.gov/regional-high-injury-network.

Discussion

Challenges in Developing HINs

Though many jurisdictions across California have developed HINs, there are a variety of challenges that jurisdictions may experience in their development, including:

- Access to reliable data;
- Lack of robust collision data (e.g., for small jurisdictions);
- Access to software and staff resources;
- Risk and liability concerns; and
- Education and understanding of HINs.

Each of these challenges is described below along with recommendations for how each can be addressed.

ACCESS TO RELIABLE DATA

Jurisdictions may encounter challenges in accessing reliable or timely collision data. For jurisdictions that have their own collision tracking data system, issues arise relating to coordination with local law enforcement or the fire department, and the availability of timely data for use in public works and transportation planning processes. Jurisdictions without a robust collision tracking system may be relying on state data available through SWITRS or TIMS, and may still encounter issues related to data timeliness and completeness. Even those jurisdictions that do have access to timely and complete datasets may experience issues in data reporting and entry errors or collisions without identifiable geographic data, meaning that data must be reviewed and cleaned by local staff in order to develop a dataset ready for HIN development.

As highlighted previously, due to underreporting, bias, or errors in collision reports, collision data may not accurately reflect the roadway safety experiences among vulnerable road user groups. Jurisdictions may also experience reliability issues related to datasets needed for HIN development beyond safety data, including the need for an up to date and clean roadway network dataset. There are a few methods of addressing these concerns. While it may require additional staff time and coordination to obtain and use, additional data, such as hospital records, may be useful to jurisdictions to help supplement collision data. Local law enforcement departments may also provide collision data that is timelier or more complete than data from statewide sources. There may also be open-source roadway network files such as Open Street Map, or additional files that are available from the county or state.

LACK OF ROBUST COLLISION DATA

Even in cases where data may be reliable, many small jurisdictions may encounter the issue of having very few historic collision records to use in their HIN development. While a smaller number of collisions is often positive, it presents issues in developing an HIN based on historic trends and patterns. In cases where a jurisdiction experiences few collisions due to its size, systemic methodologies, which rely on prioritization based on high-risk roadway characteristics or other contextual factors (e.g., professional

judgment from city staff recognizing that a certain intersection may have safety issues), may be appropriate to include in the development of an HIN.

SOFTWARE AND STAFF RESOURCES

Some jurisdictions may lack collision database software for collision record keeping and analysis, or Geographic Information System (GIS) software, which is generally the software through which HIN development is done. In other cases, jurisdictions may not have staff trained on using collision databases or GIS software, or may not have local resources to designate staff to this job function. Finally, the work of analyzing collisions for HIN development and project prioritization is often performed by staff with transportation, planning or public works duties, while collision record reporting is often under the purview of local law enforcement. Decentralization of these roles may present challenges such as poor data infrastructure allowing for the transfer of relevant data, and speaks to the importance of a multidisciplinary approach to roadway safety.

To address these concerns of capacity, staff should look for transportation safety funding opportunities regionally, statewide, and federally to support hiring professionals with expertise to assist in performing this analysis. With the widespread and recent uses of Vision Zero action plans (and consequently High Injury Networks), there are resources for building a case for funding to create an HIN as part of Vision Zero network. As an example, Daly City was able to make use of FHWA funding to complete a Vision Zero plan.

Challenges with decentralization and data coordination can be mitigated if a multidisciplinary team is created at the outset. For example, having a central team comprised of various departments (public health, law enforcement, public works, planning, etc.) can facilitate faster, systemic, and coordinated data sharing actions.

RISK AND LIABILITY CONCERNS

In taking on the task of creating an HIN, local jurisdictions may have risk and liability concerns related to identifying locations with known safety issues and a history of fatal or serious injury collisions. To mitigate these concerns, local staff may want to work with legal staff on concerns of risk and liability, and to determine solutions to mitigate risk. For some project types, collision data and related reports may be protected from discovery and admission in court.

EDUCATION AND UNDERSTANDING OF HINS

While Vision Zero, Toward Zero Deaths, and Safe System approaches may be easily grasped concepts, HINs may present more challenges as they are not as straightforward to explain. Cultivating internal and external understandings of the value of HINs may require effort. Additional education and training may be needed for staff in various departments to help them understand how an HIN can support transportation safety goals, and stakeholders may need greater clarity on how the HINs are constructed and used. Addressing the challenges of background information and knowledge can be as simple as more opportunities for education and creating fact sheets and other informational materials. There are multiple case studies available both earlier in the document and online that illustrate how HINs have been used to further transportation safety goals. Some interviewed jurisdictions have found it challenging to communicate the more technical components of their HINs. In these cases, being intentional and providing more time for targeted outreach paired with presentations and targeted materials may help.

POTENTIAL OVERPOLICING

Some HINs may be concentrated in communities identified by SB 535 as "Disadvantaged Communities," or communities that represent the top 25 percent of highest scoring census tracts in CalEnviroScreen 3.0, along with other areas with high amounts of pollution and low populations. As an example, about 66 percent of SCAG's regional HIN exists in Disadvantaged Communities. While HINs provide jurisdictions with the opportunity to prioritize funding and investment in high need areas, investments such as increased law enforcement may be harmful to communities included in the HIN. Alternatives to law enforcement and other programs that center these communities are important to consider when prioritizing resources.

Alternatives or Complementary Approaches to HINs

There are certain circumstances when jurisdictions either do not have the amount of data necessary to create an HIN, or they may wish to expand upon the HIN that they have already created. Alternatives to HINs or complementary approaches are described below.

RISK MODEL APPROACH

Highlighted in the Delaware Valley Regional Planning Commission's "Philadelphia Crash Analysis Standards and Recommendations," a risk model approach has been taken in two cities: New York City and Seattle. New York City's attempt to create a risk model is a follow-up to the initial model they wanted to create as a part of their Vision Zero strategy, which they were originally unable to pursue. Risk models allow jurisdictions to proactively predict where collisions are likely to occur, rather than rely on historical collision data to identify priority locations. Risk models require significant investment, with intensive data collection and the development of advanced statistical models. The enormous amount of effort and investment may deter many jurisdictions. However, FHWA provides technical assistance for safety data efforts that could support these jurisdictions.[10]

MANUALLY DRAWING THE NETWORK

The City of Berkeley provides another example for jurisdictions that do not have the amount of data needed to create an HIN. The City engaged in a process where it plotted fatal and serious injury and began drawing lines. Using consensus from staff who had knowledge of individual segments and roadways, the City manually identified hot spots, and considered other segments that had similar roadway design, and were close in proximity to the corridor. The City of Berkeley used this approach because staff had discovered the difficulty in prioritization. While other jurisdictions may choose to prioritize portions of their HIN for safety adjustments based on the number of fatalities or serious injuries that occur, the City of Berkeley found it more effective to prioritize safety projects based on the availability of funding opportunities (e.g., if a segment cut through a particular community that was being prioritized for a particular grant).

SLIDING WINDOW

The sliding window methodology uses overlapping windows for smoothing any errors in collision location reporting.[11] A specific window length is selected (e.g., 0.3 to a half-mile), performance measures are calculated for that window (e.g., the number of fatal or serious injury collisions). The window is moved for

[10] https://safety.fhwa.dot.gov/rsdp/toolbox-home.aspx

[11] More information on the Sliding Window methodology can be found in the "Guidebook on Identification of High Pedestrian Crash Locations", published by the Federal Highway Administration in April 2018.

a given smaller offset (e.g., 0.1 miles) and the analysis is repeated for a shifted window. This method would cause a location to be measured multiple times (e.g., a segment between a 0.4- and half-mile location would be evaluated five times if it was only moved 0.1 times) so inaccurate collision reporting can be mitigated. Windows with the highest values for the segment or facility can be much more easily identified, and this method can be easily automated with GIS or spreadsheet tools.

SYSTEMIC ANALYSIS

As described earlier, in recent years, safe system approaches have become an international roadway safety best practice, and a safe system approach has been adopted as a priority by FHWA and by Caltrans. A key principle of the safe system approach is "safety is proactive." FHWA defines this principle as "proactive tools should be used to identify and mitigate latent risks in the transportation system, rather than waiting for collisions to occur and reacting afterwards." Systemic analysis provides an opportunity to bring this proactive approach to HIN development, a methodology which has generally relied on historic collision data to identify priority roadway segments and intersections. Systemic analysis is based on an entire roadway network, rather than just hot spots, using roadway and contextual characteristics to identify locations with high risk, rather than locations just with a history of fatal or serious injury collisions.

A systemic approach to HIN development helps jurisdictions proactively identify priority locations, and also helps them to overcome some of the shortcomings inherent in collision data. Collisions can go unreported, and collision records can include biased, incorrect, or missing data due to reporting errors or issues of objectivity. For these reasons, collision data may not accurately reflect the roadway safety experiences among vulnerable road users, including people biking and walking, people of color, immigrant communities, or people experiencing homelessness.

- The inclusion of systemic analysis in HIN development could be accomplished in several ways, including:
- The inclusion of roadway segments or intersections in an HIN based on roadway or contextual characteristics, such as high posted speeds or wide lanes;
- The inclusion of roadway segments or intersections in an HIN based on surrogate safety indicators, such as near-miss video detection data or connected vehicle on-board speeding or hard-braking data; or
- The inclusion of roadway segments or intersections in an HIN based on community input identifying near-miss locations, locations of unreported collisions, or other known safety issue locations.

In addition to developing an HIN, Vision Zero jurisdictions often incorporate systemic analysis by identifying "collision profiles" that highlight roadway characteristics or other contextual patterns among serious and fatal collisions. Systemic collision profile development is included in Vision Zero or similar safety plans for Los Angeles, Sacramento, and the Orange County Transportation Authority, among many other California jurisdictions. For example, the City of San Diego used systemic analysis to focus on network-wide sets of intersections with common physical traits such as control type, traffic volumes, or number of lanes, which experienced the highest levels of collisions. The City then analyzed the types of fatal and serious collisions (particularly among pedestrians), and identified counter measures to address the collision types. As a result of this analysis, the City identified both short term and low cost changes as well as long term improvements to address safety systematically. These improvements include considering converting signalized intersections to roundabouts, as they discovered that one of their top three fatal and serious collision types (broadside collisions) could be mitigated with roundabouts.

Statewide Recommendations

Based on the review of California HINs, the statewide subgroup has developed recommendations for a statewide definition of an HIN and the methodology for developing an HIN.

High Injury Network Definition

A High Injury Network is a network of designated corridor-level segments where the highest concentrations of serious injury and/or fatal collisions occur, typically over the course of the most recent three-to-five-year period of collision data. The HIN represents a defined prioritized subset of the overall transportation network.

High Injury Network Methodology

At minimum, a High Injury Network should be developed with the following core component standards:

YEARS OF DATA

An HIN should depend on between three and five years of collision data from a reliable source of data (up to 10 years may be appropriate, depending on the jurisdiction). Collision data may be derived from SWITRS, TIMS, or a jurisdiction's established database.

SHARE OF ROADWAY NETWORK

An HIN should represent a subset of an overall roadway network – typically between 5 percent and 20 percent. Jurisdictions should aim to identify a share less than 50 percent of the total roadway network as the HIN, to support a focused approach for future investments.

LEVEL OF ANALYSIS

An HIN should be focused on corridors that are continuous and have comparable collision patterns or densities—considerations for corridor length can include land use, speed, and intersection spacing.

COLLISION DENSITY

An HIN should have a development threshold that captures a significant number of total KSI collisions – typically more than 40 percent.

ROADWAY FACILITY TYPES

An HIN should consider roadway facilities particularly ones for which they have the authority to establish speeds or conduct enforcement.

EQUITY

An HIN should take into account equity. For example, a jurisdiction could document how much of the proposed HIN falls into communities of concern or disadvantaged communities, or through more heavily weighting collisions occurring in these areas.

CONSIDERATION OF MODES

(e.g., driver, bicyclist, pedestrian, etc.)

An HIN should consider all modes of serious and fatal collisions, including bicyclists and pedestrians.

MAINTENANCE

An HIN should be re-evaluated when speed limits are surveyed/modified, land use characteristics change, data changes or other relevant changes occur.

Jurisdictional Guidance

High Injury Network Development Checklist

For jurisdictions interested in developing their own High Injury Network, they can refer to this checklist below to assess their readiness, and then move into the steps needed to develop one.

1 READINESS ASSESSMENT

To understand your readiness to develop an HIN, consider the following questions:

- Do you have internal resources to develop an HIN?
  - Do you have access to GIS software?
  - Do you have staff with existing GIS skills?
  - If you do not have staff with GIS skills, could any existing staff develop GIS skills, particularly those focused on joining and visualizing?
  - Do you have access to GIS software?
  - If you find that you lack resources, could you apply for a grant to seek support for developing an HIN? Examples of funding sources for safety plans, which could include HINs, include: Caltrans Sustainable Transportation Planning grants and Caltrans Local Road Safety Plans.
    Links: dot.ca.gov/programs/transportation-planning/regional-planning/sustainable-transportation-planning-grants, dot.ca.gov/programs/local-assistance/fed-and-state-programs/highway-safety-improvement-program/local-roadway-safety-plans
- Do you know how to access and review your jurisdiction's safety data?
  - Can you access safety data via SWITRS, TIMS, or another local source (e.g., local police or fire department data)?
  - How much safety data is available and is it a significant amount or is it spotty (i.e., no clear patterns or concentrations)?
- How strong are connections across departments?
  - HINs are often developed in collaboration with multiple departments, such as planning, public health, public works, and police/fire. Understanding the existing relationship between departments can help staff assess the amount of effort that may be needed to establish a foundation for developing an HIN.
- Do you have political or community support?
  - In some jurisdictions, Vision Zero and HIN efforts have been motivated and guided by elected officials or community groups. Seeking feedback from stakeholders as you develop your HIN is critical.

DECISIONS TO MAKE:

- Will the HIN be developed using internal staff resources or by a consultant?
- Where will you acquire your safety data from? If you have found that the quantity of data is lacking, you may want to pursue an HIN alternative (described more fully in the report).
- Which department and staff will take the lead on HIN work?
- Who will work on cultivating internal and external champions for the HIN?

2 DATA PREPARATION

Once you have conducted a self-assessment for your jurisdiction and decided to move forward with developing an HIN, it is time to consider which datasets you will use.

Where will your data come from? Some suggested sources are listed below.

- **SWITRS/iSWITRS database**
  The Statewide Integrated Traffic Records Systems (SWITRS) takes data gathered from a collision scene. Many jurisdictions use SWITRS to inform their HIN as it includes geocoded information and the severity of injury. Some limitations include SWITRS' slow refresh rate (taking from 8 – 18 months), the removal of helpful contextual data on collisions that may have been included on police reports, and occasionally incorrect data.
- **TIMS database**
  The Transportation Injury Mapping System (TIMS) provides quick, easy and free access to California collision data using the Statewide Integrated Traffic Records System (SWITRS), and has been geocoded to make it easy to map out collisions. TIMs is available, accessible, and not that complicated, and an agency with minimal resources might want to consider using this system.
- **Police or Fire Departments**
  Police or fire departments may have their own methods of collecting data that include greater detail and narrative on the collision (this type of information is typically stripped when sent into SWITRS), and information sharing can be much faster. Limitations of using police or fire data include the number of resources it would take to establish relationships with the department/s if none presently exist, in addition to the accuracy of some demographic data when left to professional judgment and not self-reporting. For example, in a report by the UCLA Lewis Center for Regional Policy Studies,* it is noted that race-based demographic data reported at collisions may be inaccurate as they are reported by the police officer at the collision rather than by the parties or victims themselves.
- **Public Health Departments**
  Some jurisdictions supplement collision data from the police or fire departments and SWITRS datasets with information from their public health department. This is because many injuries initially deemed visible but non-serious may eventually turn serious and even lead to fatalities in the months and time following the collision. Being able to follow the victim in the time after the collision allows for more accurate data reporting. However, the difficulties of using public health data include the number of resources needed to establish a relationship with the department if one was not pre-existing, and the staff knowledge and resources needed to link this dataset with others.

DECISIONS TO MAKE:

- Which datasets will your jurisdiction use?
- Will you combine any of the datasets (e.g., combining public health data and SWITRS data)?
- If completing the HIN internally, do your staff have the capacity and knowledge to manipulate the data?
- What kind of formal data-sharing requirements are needed to acquire data from police, fire, or public health departments?

** Brozen, Madeline and Annaleigh Yahata Ekman. (2020). The Need to Prioritize Black lives in LA's Traffic Safety Efforts. UCLA Lewis Center for Regional Policy Studies. https://www.lewis.ucla.edu/research/black-lives-la-traffic-safety/*

3 CLEAN DATA + CREATE THE HIN

After extracting the data, you can start the process of cleaning the data, and then mapping and creating the HIN while considering the addition of all the core components mentioned starting on page 9 of the main report. This is a multi-step process that will likely take a large amount of staff time.

Cleaning and Quality Assurance

Once the dataset is compiled, it is critically important to clean the data and ensure it is as accurate as possible. Cleaning the data can involve double-checking the SWITRS data against what has been reported in police reports and ensuring collisions occurred in the right location, and additionally ensuring the data is in the right format to be mapped.

Drawing the HIN

There are a variety of methods that one can use to create an HIN.

- **Mapping out the collisions**
  The most important part of the HIN is mapping it. Every jurisdiction will have a method that suits them best, but this process generally starts with collecting serious injury and fatal collisions and mapping them using GIS. However, simply mapping collisions on a map may not tell the full story of what resources may be needed in a particular area. For example, an intersection with a low collision rate may have an inordinate amount of near-misses and may be an anecdotally concerning location, or be located close to a location with vulnerable populations (e.g., near a school with children), or in a community with a high population of people of color. For this reason, it is important to layer on other potential considerations such as:
  - WEIGHT ASSIGNMENT: Many HINs have incorporated additional weighting of certain types of collisions. For example, some jurisdictions more heavily weight collisions involving pedestrians, bicyclists, children, or older adults.
  - NORMALIZATION: Collisions can be normalized by roadway length collision rates, or population, which can provide a more accurate picture of what is occurring on the roads based on differences. Many jurisdictions normalize collisions by mile or HIN segment length, though some use additional methods. Segment lengths may be between 500 feet to quarter mile. In less urban jurisdictions, segment length may be longer.
  - THRESHOLD: Once the collisions are mapped onto the roadway, it is useful to establish only a certain percentage of the affected roadway as the high injury network (such as the highest concentrations of collisions on a subset of the roadway network). Doing so helps staff prioritize which corridors, intersections or areas need work. Setting separate thresholds may be appropriate within one jurisdiction to account for key contextual factors for safety outcomes, such as collision mode, urban and rural contexts, or to account for political boundaries. This approach may be especially useful for larger jurisdictions, such as counties or MPOs.
  - INTERSECTION/CORRIDOR CONSIDERATION: Most HINs are developed at the corridor level, while some also develop complementary high injury intersections around customized buffered areas. Identifying can assist a jurisdiction in applying countermeasures on intersections as well as streets.
  - STREET/FREEWAY CONSIDERATION: One of the benefits of an HIN is providing a jurisdiction with guidance on where on a roadway network improvements should be made. Including freeways in the HIN, where few, if any jurisdictions, have jurisdictional control, may not be the most effective approach.
  - EQUITY: HINs may reveal that traffic collisions disproportionately affect one community over another. Jurisdictions can overlay their collision data with equity-related shapefiles.

DECISIONS TO MAKE:

- How will you clean your data?
- How will you draw your jurisdiction's HIN?
- What kind of weights or other considerations will you add to your HIN?
- What other types of considerations are you able to add based on the quality of your dataset?
- How are you incorporating equity in your HIN?

4 PUBLIC EDUCATION + COMMUNITY ENGAGEMENT

It is important to share information on what has occurred with and the High Injury Network process (and the Vision Zero process, if there is one) with your community during development of the HIN and once it is completed. Some considerations include:

Public Engagement Process

An engagement process should be carefully designed to ensure outreach to all necessary stakeholders. Residents may provide valuable input on locations with near misses and near vulnerable communities and other important pieces of information.

Language and Framing

When creating an engagement process, it is important that you are using the audience-appropriate language to make the HIN creation process, which can be very data-oriented, accessible for the communities that you are trying to reach.

DECISIONS TO MAKE:

- Who and which organizations will be reached out to on the creation of the HIN, and how will feedback be incorporated?
- What materials will you use to educate the community on what the HIN is and how you created it?
- Which organizations and individuals will you reach out to in order to create the HIN, and how will feedback be incorporated?
- Who will lead the outreach efforts? Will the same staff and department who did the work be the best people for outreach?

5 MAINTENANCE + REFRESH

Once the HIN has been created and used by your jurisdiction, it is important to remember that keeping it updated maintains its effectiveness. As recommended above, jurisdictions may consider refreshing their HIN with updated data every three to seven years, and may additionally introduce refinements, including:

Data improvements

Over time, you may reconsider the sourcing of data. You may incorporate additional sources, such as data from public health departments.

Changes in the HIN post-improvements

An HIN may shift based on new traffic patterns, particularly once improvements are made to an HIN corridor or intersection area. Alternatively, streets may drop off the HIN after improvements have been made, even if there have been no improvements made: it then becomes necessary to consider why this happened.

DECISIONS TO MAKE

- Will you use the same methods for extracting data?
- How will you reconcile changes from one HIN to the next?
- How will you streamline processes to ensure maintenance happens regularly?

Additional Resources

To learn more about the City of Los Angeles' High Injury Network:
www.ladotlivablestreets.org/

To learn more about the City/County of San Francisco's High Injury Network:
www.visionzerosf.org/

To learn more about the City of San Diego's safety efforts:
https://www.sandiego.gov/vision-zero/strategic-plan
https://www.sandiego.gov/sites/default/files/systemic-safety-the-data-driven-path-to-vision-zero.pdf

To learn more about the City of San Jose's High Injury Network:
www.visionzerosj.org

To learn more about the City of Daly City's High Injury Network:
www.dalycity.org/936/Vision-Zero-Action-Plan

To learn more about the City of Fremont's High Injury Network:
www.fremont.gov/2594/Fremont-Vision-Zero

To learn more about the County of Los Angeles' High Injury Network:
pw.lacounty.gov/visionzero/

To learn more about SCAG's High Injury Network:
scag.ca.gov/regional-high-injury-network