Low-Cost Pedestrian Safety Zones:

An Eight-Step Handbook

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Dunlap and Associates, Inc.

THE UNIVERSITY OF NORTH CAROLINA HIGHWAY SAFETY RESEARCH CENTER

CERS Center for Education and Research in safety

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16. Abstract City transportation staff are always seeking ways to make our communities safer for people walking. They look for new ideas in a variety of areas—engineering, enforcement, legislation, training, and public education to support a culture of road safety. Countermeasures may be chosen for implementation at sites that have experienced high numbers of crashes, at locations with features that are associated with high crash risk, or systemically throughout a jurisdiction. Many pedestrian safety strategies, such as constructing sidewalks or installing pedestrian signals, are time-consuming and/or expensive to implement. This can make it difficult for them to be widely and quickly implemented, which is unacceptable in places with urgent safety needs. The availability of a lower-cost and quicker-to-implement approach to selecting and implementing pedestrian countermeasures offers a valuable additional tool and allows practitioners to address the pedestrian safety problem in smaller "bites," focused in areas with great potential to have impact on pedestrian crashes. As such it can more quickly offer solutions in traditionally underserved areas. That is exactly the concept of the low-cost pedestrian safety zone.		
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Introduction

City transportation staff are always seeking ways to make our communities safer for people walking. They look for new ideas in a variety of areas—engineering, enforcement, legislation, training, and public education to support a culture of road safety. Countermeasures may be chosen for implementation at sites that have experienced high numbers of crashes, at locations with features that are associated with high crash risk, or systemically throughout a jurisdiction. Many pedestrian safety strategies, such as constructing sidewalks or installing pedestrian signals, are time-consuming and/or expensive to implement. This can make it difficult for them to be widely and quickly implemented, which is unacceptable in places with urgent safety needs.

The availability of a lower-cost and quicker-to-implement approach to selecting and implementing pedestrian countermeasures offers a valuable additional tool and allows practitioners to address the pedestrian safety problem in smaller "bites," focused in areas with great potential to have impact on pedestrian crashes. As such it can more quickly offer solutions in traditionally underserved areas. That is exactly the concept of the low-cost pedestrian safety zone. It involves selecting a combination of low-cost and quick-to-implement approaches and applying them in places or "zones" with a known problem or safety risk. To do this, it is necessary to identify small land areas (or zones) where these improvements will reach a large number of pedestrians whose risk of a particular type of crash is to be reduced. Geographic information system (GIS) platforms and spatial analysis tools for pedestrian crash analyses offer efficient ways to identify these high-crash (or high-risk) zones for use in further analysis and for taking corrective action. While the definition of "low cost" can vary widely, in the context of pedestrian zones, rapid implementation is critical so the cost should be within an agency's existing resources. Because city budgets vary, eligible countermeasures range from $1,000 to $50,000 with a typical expense of $10,000 to $15,000 or less.

Pedestrian Zone Benefits

- Combining engineering changes with other strategies creates a Safe System approach.
- Identifying and treating zones that are smaller than the whole city but share common risk factors/characteristics is an effective way to move toward a more systemic, risk-based approach.
- Using zones allows a community to integrate valuable context into proposed interventions, such as areas that share cultural or sociodemographic similarities.
- Treating a zone is a more efficient use of resources than targeting individual segments/intersections and treating them one at a time.

In response to growing concerns around road safety, especially rising deaths among bicyclists and pedestrians, the U.S. Department of Transportation (2022) adopted a Safe System approach to guide its investments in road safety. This paradigm shift is an acknowledgement of the complex, highly interactive systems that influence road safety outcomes. With a focus on preventing deaths and injuries, the Safe System approach places emphasis on making system-wide improvements that address factors that have an outsized impact on crash outcomes, such as motor vehicle speed, separation of road users, and the inherent vulnerability of humans involved in crashes. The approach to understanding and solving problems within established zones, those areas that share

unique characteristics and risk profiles, allows transportation agencies to deploy systemic treatments to solve identified problems using this Safe System framework (Goughnour et al., 2021).

While the Safe System context is recent, the pedestrian zone approach is not new. For several years, transportation professionals have used maps of crashes in order to conduct site reviews and apply improvements where they are needed most. Evaluations of pedestrian zone implementations have found reductions in crashes and injuries for pedestrians (Venkatramen et al., 2021). This handbook is based on a research study ("The Zone Study") that developed and successfully applied the safety zone process to pedestrian crashes involving older adults in Phoenix and Chicago (Blomberg & Cleven, 1998). Examples from that study are used to illustrate important parts of the process.

Intended for transportation professionals, this handbook outlines the process of developing and using low-cost zones and explains how this approach can be used as part of a system safety plan to increase the efficiency and effectiveness of pedestrian safety programs. The companion Countermeasure Selection Resource report (Dunlap and Associates, Inc., UNC Highway Safety Research Center, & Center for Education and Research in Safety, 2023b) lists potential low-cost countermeasure approaches compatible with a zone application.

What Are Pedestrian Safety Zones?

The zone process provides a method to apply pedestrian safety improvements in a cost-effective manner in one or more manageable subsets of a jurisdiction that contain a concentration of a pedestrian problem or risk characteristic of interest. Specifically, it involves defining a relatively small geographic area in which a relatively large proportion of the crash problem or risk factors are present.

When thinking jurisdiction-wide, the aim is to achieve the highest possible efficiency ratio, which is expressed as the percentage of the problem addressed to the percentage of the total land area covered by the defined zones. For example, if zones are defined based on child pedestrian crashes in "City A" and the

zones cover 40 percent of all child crashes in 10 percent of the city's total land area, the result would be an efficiency ratio of 4. A ratio of 3 to 1 or more is a good target that suggests that the zone process will yield a meaningful benefit. In some cases, a ratio much greater than 3 may result. In the Zone Study, the zone identification process resulted in an efficiency ratio of over 10 in Phoenix. For places that have identified a high injury network (HIN) or high crash corridors, this philosophy will be very familiar. The zone approach can then provide a strategy to plan for countermeasure implementation within an HIN or encourage agencies to consider how to address areas where several elements of the HIN can be treated simultaneously. For example, if a neighborhood contains several segments of the HIN, and these areas share similar land use contexts and risk factors, the zone approach allows an agency to treat these areas at once with similar treatments.

Zones are also a useful tool when applied to only a subset of a jurisdiction. Often, a cluster of similar crashes will be noted. These could be, for example, at just one or a few intersections, in a neighborhood, or near a pedestrian "collector" such as a school, hospital, transit hub, or public event space. When such clusters are detected, it can be productive to apply the process to them and the areas immediately adjacent to them. In many ways, it is more efficient to address a zone of high crash corridors and intersections at once rather than tackling each segment or intersection as a separate, standalone project. This can help identify potential problem areas to which countermeasures in the Countermeasure Resource (Dunlap et al., 2023b) can be productively applied.

Finally, although many of the examples in this handbook involve zones based on crashes, it

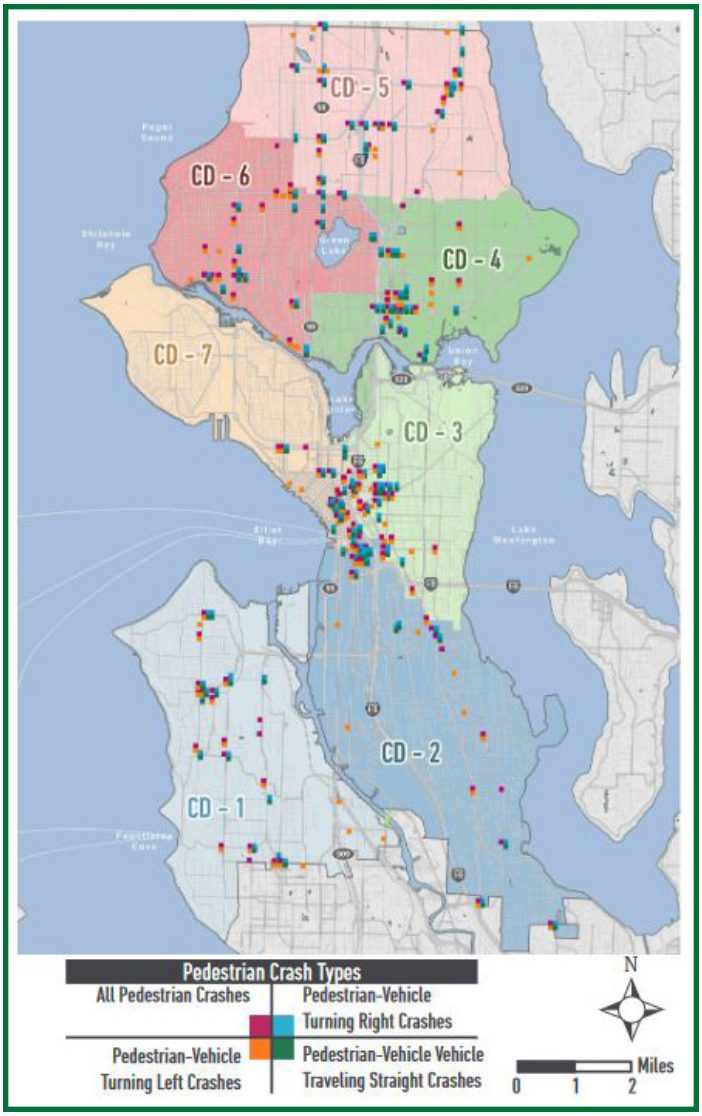

FIGURE 1
Pedestrian crashes in Seattle, by crash type

is possible to define zones on any data related to safety. For example, zones could be derived based on a common risk factor such as the absence of sidewalks, unsignalized intersections with significant numbers of left-turn movements, a high number of nighttime crashes, or high concentrations of older adult residents. In this way, the zone approach can help address the presence of risk factors to ultimately prevent future deaths and injuries, rather than simply responding to historical safety problems. One

$$\textbf{Efficiency Ratio} = \frac{\%\text{ of problem addressed}}{\%\text{ of total land area in zones}}$$

application of this approach comes from Seattle, Washington, where an effort to understand crash types involving pedestrians resulted in a better understanding of risk factors associated with these patterns (such as left-turning vehicles striking pedestrians). Once mapped (Figure 1), the Seattle Department of Transportation (2020) was able to isolate clusters of shared patterns and could then begin treating those risk factors collectively. As long as the basis of zone identification is related to a known pedestrian safety factor, this zone process should support the efficient application of low-cost countermeasures.

Once zones are defined, pedestrian safety countermeasures such as those in the Countermeasure Resource report (Dunlap et al., 2023b) can be applied in them with what should be greatly increased efficiency. For example, by concentrating only on the zones, it may be possible to implement certain activities such as engineering improvements (e.g., altered signal timing, improved signage), educational activities (e.g., inviting an elected official to be part of a walk audit to see safety concerns and discuss potential solutions), or a safety campaign (e.g., driver-directed billboard messaging) that would simply be too expensive to introduce on a city-wide, county-wide, or other large-scale basis.

In summary, pedestrian safety zones are defined areas of a jurisdiction that share a common pedestrian safety problem. The problem can be a large number of all types of pedestrian crashes, a high incidence of a particular crash type (e.g., left-turning vehicle crashes), a specific population at risk of crashes (e.g., older pedestrians), or a physical characteristic associated with pedestrian crash risk (e.g., absence of sidewalks).

There are two primary benefits of the use of zones as part of an overall program to address pedestrian safety:

1. Efficient delivery of a countermeasure program because it is carried out where a concentration of the problem or the target audience exists; and
2. Efficient use of funds (lower cost) since this approach permits selection of activities or countermeasures that would be prohibitively expensive if applied to an entire community.

The balance of this handbook describes how to define zones and how to use the companion Countermeasure Resource (Dunlap et al., 2023b) together with those zones to create an effective, low-cost program.

Defining Zones

Identifying locations for the zone approach is simple. The first step involves selecting the basis (e.g., crash type, crash victim population, risk characteristic) on which the zones will be defined. This is best done by people who are knowledgeable about the area being treated and its pedestrian safety problems. A thorough understanding of local conditions, including politics, is essential to defining realistic and productive zones. Community members who live or work in the area should be engaged from the beginning. They bring expertise on logical boundaries for a zone and their key safety concerns. Once the basis is chosen, city-wide data can be assembled and analyzed. For example, if crashes involving pedestrians 65 and older are of concern, several years of crash data for the jurisdiction will have to be screened down to just those involving a senior pedestrian.

The second step in the definition of zones is preparing a map of the zone basis data for the entire jurisdiction. This will often be a map of all or a subset of pedestrian crashes. For example, in the Zone Study, all pedestrian crashes involving pedestrians 65 and older were mapped. This jurisdiction-wide rendition of the problem forms the basis for the definition of the zones themselves.

Step 3 involves defining the specific zones. Zones need not follow pre-established boundaries such as neighborhoods with homogeneous populations (e.g., based on income, ethnicity, age), but sometimes they will.

Detecting these patterns is yet another reason it is best if people with a thorough knowledge of the community identify the zones.

The last step involves calculating the efficiency measure. If it seems too low, an attempt can be made to modify the zones to achieve an efficiency increase. Each of these steps will be discussed in more detail below.

Steps in Defining Zones

1. Select the zone basis.
2. Map zone basis data for the jurisdiction.
3. Define zones.
4. Calculate efficiency measure and select final zones.

Step 1. Select the Zone Basis

The first step is to pick the basis for the zone definition. This will usually, but not always, be crashes themselves. In some instances, even though crash reduction is the ultimate goal, zones may be defined by other factors related to the crash problem. For example, if there has been an increase in pedestrians struck while walking in the roadway, a relatively infrequent crash type, it might be useful to create zones based on areas without sidewalks. Likewise, an increase in crashes involving drinking pedestrians might prompt creating zones based on the density of bars and/or liquor stores.

As helpful as this approach can be, not every problem can benefit from it. A zone approach is usually appropriate when all three of the following conditions exist.

- There is a problem of interest that can reasonably be expected to cluster geographically.
- Crash or other data to form the basis for zones is available and is already or can easily be geocoded.
- Instances of the crashes or other data of interest are sufficient to produce a stable map.

A community focusing zones on one of these bases would have to ensure that any necessary data for a zone definition are present in the

FIGURE 2
Map of 2007 – 2011 pedestrian crash locations in Memphis, TN

available crash or other files. If not, the needed data must be obtained—likely from police crash reports. In particular, if location data are not already coded in the database, the specific location will need to be added to pedestrian crashes in a form that can be used by GIS programs (typically latitude and longitude).

In order to ensure a reasonably stable zone measure, several years of crash data may be needed, particularly in smaller cities. Data for at least 1 entire year is an absolute minimum for defining zones in order to avoid the possibility of seasonal effects. It is also a good rule of thumb to have a minimum of 100 crashes for crash-based measures. If 100 crashes of the type of interest are not available for a given year, additional whole years of data should be added until at least the recommended 100 minimum number is reached. Obviously, the more crash records that are available for any given year, the more stable the zone definition is likely to be. For medium and large cities, samples of pedestrian crashes may total in the hundreds or thousands per year, which would be more likely to allow for identifying zones having certain crash patterns or subsets. For example, Figure 2 illustrates a map of crashes involving pedestrians in Memphis, Tennessee (Berkow, Eshleman, & Cock, 2014). The map is also overlaid with data about school locations, which is one type of data that can be used to understand areas that are similar and could be treated as zones.

Analysis of a cluster may show, for example, that it was related to poor signal timing that resulted in crossing pedestrians becoming "trapped." Examining zones jurisdiction-wide with the same signal timing issues is an excellent, proactive way to address the issue.

If only a single or a few clusters are examined, Steps 2 through 4 below can be skipped, and the focus can turn immediately to the selection and deployment of countermeasures starting in Step 5.

Step 2. Map Zone Basis Data

Using GIS tools, maps can be created to show the crashes not only of various target crash groups (e.g., children, adults, older adults) but also of various subgroups of victims or crash circumstances (e.g., older adult males, nighttime, turning vehicle, intersection). Focusing attention on traditionally underserved communities and specific populations who bear an outsized burden of traffic-related deaths and injuries is paramount, and the data selected for analysis of crashes can easily reflect this equity focus. Sociodemographic data available at the Census Tract and Block Group levels (U.S. Census Bureau, 2023) are ideally suited to this approach given their geographic characteristics. Communities may also select from a number of existing data layers created by third parties that can help reveal sociodemographic trends and patterns (U.S. DOT, 2023). It is also useful to have the pedestrian crash type coded into the database to allow for selecting specific crash patterns that have occurred. Pedestrian crash types were developed over years of research and represent recurring patterns of crashes characterized by the causal behavioral errors of drivers and pedestrians (e.g., failure to search) and the circumstances under which they occur (e.g., crossing in front of an ice cream truck). The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) has been developed to facilitate the process of assigning a crash type to a specific pedestrian crash.[1]

After completing Step 2, a jurisdiction should have its pedestrian crash data in a GIS system with as much detail as possible on the crash circumstances (e.g., location, time, weather, road type, crash type) and the parties and vehicles involved. This master dataset forms the basis for defining zones, which are geographic subsets of the total data containing relatively homogeneous groups of crashes (e.g., similar age pedestrians, same crash type, same type of crash location). A community may already have established equity zones or "communities of concern," which can easily be overlaid with crash data and factors described above to develop a more granular understanding of how outcomes are reflected in different communities. In a previous study, the Miami-Dade Demonstration Project (Zegeer et al., 2008), zones were successfully used to apply countermeasures to both child pedestrian crashes and those involving older adults within neighborhoods with unique cultural and demographic characteristics. Little Haiti, Liberty City, and Little Havana were each identified as having high concentrations of crashes involving younger and older pedestrians. These neighborhoods also represented high concentrations of Haitian immigrants, Black residents, and Cuban immigrants, respectively, creating somewhat formal zones in which approaches to solving these problems could be tailored to each neighborhood's unique characteristics.

Step 3. Define Zones

The next step in the zone process is to define zones from the total map of events in the jurisdiction. Since the goal is high efficiency, zones should be defined to be somewhat small in area and containing a relatively large number (high density) of crash events. In the Zone Study, zones were defined as having 10 or more crashes of interest within a 1-mile radius circle or 6 or more crashes within a 2-mile linear segment of roadway. These zone definitions worked well in two large cities—Phoenix (using 3 years of crashes involving older adult pedestrians) and Chicago (using only a single year of older adult pedestrian crashes)—and therefore are suggested for general use.

Sometimes a visual examination of the resulting map is all that is needed to show whether the

[1] The most recent version (Version 3) of PBCAT can be found at www.pbcat3.org/. The manual for this version can be found at https://pbcat3.org/PBCAT_UserGuide.pdf and includes a brief description of the derivation of crash types and their uses.

pedestrian crashes of interest cluster in any areas of the city. Other times, more sophisticated analyses included with GIS software must be used to identify significant clusters of similar events. If no clustering is apparent or derivable, then the incidence of crashes for the selected crash target may be spread essentially randomly, and that problem may not be "zonable" using the approach described herein. Figure 3 provides an illustration of GIS crash maps from the Miami-Dade Demonstration Project.

Step 4. Calculate Efficiency Measure and Select Final Zones

GIS software packages typically include functions to identify "hot spots" or clusters. Also, the criteria of 10 or more crashes in a circular zone and 6 or more in a linear zone are only guidelines. If these functions have preset definitions, the user should pick the one that comes closest to the suggested zone criteria.

It may not be possible to treat every identified zone. The available resources may simply not be sufficient. Therefore, the process of selecting the zones in which to work may also involve choosing which zones to leave for future activities. While addressing safety problems identified through crash data is the top priority, community member input, available budget and political climate may factor into zone selection.

Finally, when an analysis is jurisdiction-wide the percentages of both crashes and land area covered should be calculated for all the zones combined in order to determine program coverage efficiency. If the ratio of the percentage

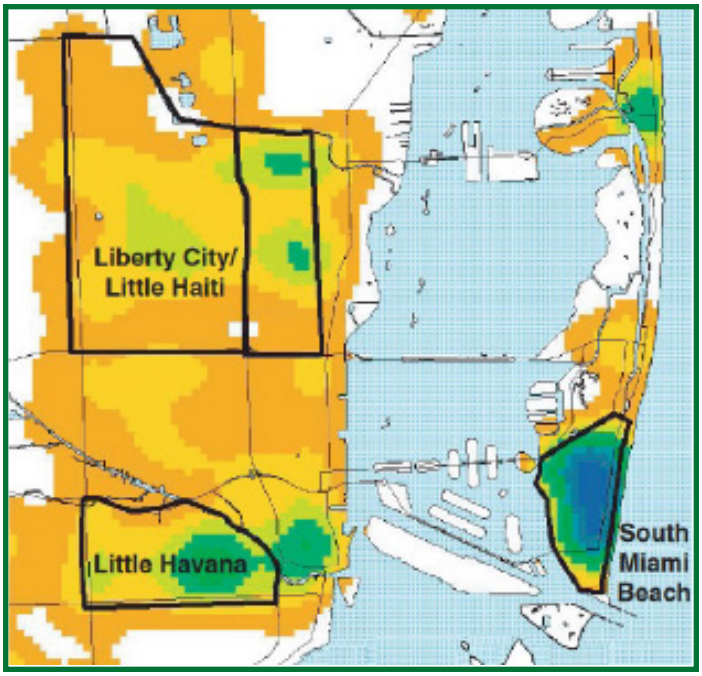

FIGURE 3
Pedestrian safety zones identified in the Miami-Dade Pedestrian Safety Demonstration Project

of the problem addressed to the percentage of the land area covered in the zones is much less than 3, it is worth re-examining the zone definition process to try to improve its efficiency. An efficiency ratio of 3 to 1 or higher (for example, 60 percent of the crashes of interest in 20 percent of the jurisdiction's land area) will almost certainly permit the application of countermeasures locally within the zones that would be prohibitively expensive if deployed jurisdiction-wide. Even an efficiency ratio of 2, however, may provide some benefit. Ultimately, if this ratio cannot be made greater than 2, the zone approach is not a good fit.

Using Zones

Once zones are defined, they must be examined to determine the problems and resources in each area. Activities to counter the problems need to be selected or developed. The practicality of implementing each countermeasure in each zone needs to be determined. Finally, program activities must be implemented and monitored.

Steps in Using Zones

5. Evaluate zones and identify resources.
6. Select program activities and countermeasures.
7. Implement program activities.
8. Monitor program activities.

Step 5. Evaluate Zones and Identify Resources

The first step here is to review each zone to assess the specific pedestrian safety problems that exist, the best ways to eliminate them, and the resources that are available to help solve the problem of interest. Community members are experts on their neighborhoods and barriers they encounter in walking to places they want and need to go. Moreover, they can add insights into places where more walking might take place if conditions were improved. In concert with community member input, crash typing is a good starting point. This requires a review of the police report for each pedestrian crash in each zone crash. City staff and community members can drive or walk through each zone to search for potential crash causes not covered by the police reports (e.g., excess vegetation hampering sight distances), to identify areas where engineering improvements can provide pedestrian safety benefits, and to identify resources that can be used to support countermeasures of all types (e.g., bus shelter poster holders that could be used for driver education). A video of the drive-through or walk-through can be an invaluable aid in documenting problem areas and available resources so additional individuals can be consulted.

With some jurisdictions it is not always possible to obtain hard-copy police reports. For example, some jurisdictions destroy these reports after a year or 2. Many locales are now using computerized crash reporting so the "hard copy" report may be a PDF or other electronic file. The investigating police officer's diagram and narrative description of each crash are valuable as they often contain details not captured by the pre-coded crash report categories. It is also useful to get computer files or printouts of the pre-coded crash information that describes the crash location, conditions, and party behaviors. A rich set of crash data allows an analyst to understand the problem more clearly and therefore make a better selection of countermeasures.

Use of a checklist during the walk-through will capture information on factors potentially related to safety. Before setting a checklist, engage community members in a conversation about their main concerns and goals and incorporate those elements into what's observed.

- **Search limitations —** anything that prevents the driver and pedestrian from seeing each other such as parked cars, tree branches, street furniture, distractions, or inadequate lighting. The failure of the driver and pedestrian to see each other is perhaps the largest cause of pedestrian crashes.

- **Potential or observed conflicts —** any conflict between vehicles and pedestrians such as vehicles that are too close to pedestrians when the vehicles are making right or left turns. Certain conflicts, like errors that lead to specific crash types, can predict pedestrian safety problems.


Source: pedbikeimages.org / Dan Burden

- **Negative behavioral indicators —** errors made consistently by either the driver or pedestrian such as the pedestrian entering the street without searching or the driver proceeding without searching. These negative behaviors can indicate unsafe conditions prompted by external factors such as distractions from advertising or unnecessary flashing lights.
- **High-risk factors —** existing conditions, practices, or behaviors that can affect the safety of the pedestrian in the roadway such as high vehicle speeds or signals that provide inadequate time for the pedestrian to cross the street. These factors can increase the likelihood that a crash will occur.

A summary of all these observations will help provide the basis for selecting or developing program activities for each zone.

Conducting the on-site analysis, observations, and discussions with people in the defined zones will also provide answers to questions such as the following:

- Does the target population reside there, work there, visit there? Are there many members of the target population visible in the zones? What does census data say?
- Are there existing resources in the zones that can be used to reach the target population?
  - Businesses
  - Senior centers/youth organizations
  - Clubs/sports leagues
  - Medical facilities
  - Neighborhood groups
  - Libraries
  - Houses of worship
  - Schools
  - Billboards
  - Police/fire stations
  - Social media groups such as a neighborhood Facebook page
- Are there any obvious factors that are causing a problem that may be relatively easy to change (e.g., refreshing crosswalk lines, replacing illegible signs)? Good countermeasure ideas often arise from people who are "immersed" in an area that is experiencing a problem.

Step 6. Select Program Activities and Countermeasures

At this point in the zone process, the companion Countermeasure Resource report (Dunlap et al., 2023b) becomes an important tool. It contains low-cost countermeasures with a high probability of effectiveness either because they have been scientifically evaluated or because they are modeled on evidence-based approaches. Each countermeasure description includes a delineation of the problems it addresses, the resources it requires, and measures to assess its effectiveness.

The combination of selected strategies all begins with a base of an engineering change that is then complemented with other strategies for greatest impact. The selection of program activities should be guided by an overall plan that includes a list of program activities and how, when, and by whom they will be implemented. As discussed earlier, the zone process is not fully applicable to some types of activities. For example, television or radio public service announcements (PSAs) cannot typically be targeted to specific areas (unless a zone were to encompass an entire television or radio market, or a zone is a media market subset already in use by a cable provider). If used, therefore, PSAs would serve as supporting (not primary) activities for in-zone pedestrian program activities. It is important to note that the low-cost zone process does not require countermeasures to be confined only to zones. For example, a program to encourage pedestrians to use crosswalks might include a city-wide mass media component and zone applications of other more localized countermeasures in areas with high midblock pedestrian crashes.

Activities and countermeasures that can be applied effectively in defined, small areas are best suited for use in low-cost zones. Every intervention should involve an engineering countermeasure or change to the physical environment that is intended to improve


Source: pedbikeimages.org / Toole Design Group

pedestrian safety. A comprehensive list of available engineering countermeasures can be found in the accompanying Countermeasure Resource report (Dunlap et al., 2023b). The key factor is to select lower-cost countermeasures that can be deployed across an entire area in locations where risk factors are present. One example is to upgrade all crosswalks in a given zone from parallel lines to high-visibility markings and equip each crossing with an in-street "Yield to/Stop for Pedestrians" sign. Choose countermeasures that address the specific risk factors present within your zone of interest.

Engineering changes can be supplemented with additional outreach, education, and other behavioral interventions to support their use and help explain the purpose of the changes. There are many ways to shift mindsets to a safety culture through engagement, information about the benefits of new countermeasures, and social norming to shift perceptions on how most

road users behave. Road users are an important audience but sometimes elected officials also require an understanding of the need for changes and what to expect from planned countermeasures. The general public's views on road safety are influenced by media coverage, so planning how to position planned changes and how to address crashes in media stories can be important opportunities to change views.

Communities may also elect to perform enforcement operations targeted to specific problems in the zones (such as targeted enforcement of excessive vehicle speeds or failure to yield to pedestrians at particular crosswalks in a zone). Agencies should carefully and thoughtfully plan any enforcement action in such a way that prioritizes equity and community safety. Be aware of community perceptions of law enforcement operations and presence of police and adjust any proposed enforcement activity accordingly.

Step 7. Implement Program Activities

Once pedestrian safety zones have been defined and countermeasures chosen, the selected program activities must be implemented. In general, the same techniques and level of care used in city-wide implementations must be applied when focusing efforts in zones. This includes a time-based plan for distribution that clearly defines activities, responsibilities, and recordkeeping. Since many of the countermeasures deployed in zones are low-cost, it should be relatively easy to plan short periods of time when they can be implemented without greatly impacting local travel. While making these changes, take special care to maintain clear, continuous paths for travel and prioritize those with disabilities who will be traveling through the work zone.

In addition, zoned countermeasures may involve door-to-door and on-street activities rather than distribution by mail. They also typically rely quite heavily on the cooperation of people and organizations within the zones for a successful outcome, especially when any sort of enforcement activity is planned. Consider the weather, planned events or traffic closures, and other factors that may interrupt the deployment of your campaign.

Step 8. Monitor Program Activities

Did the countermeasures make a difference? The goal is to see a reduction in serious and fatal pedestrian crashes, of course. For the specific countermeasures selected, are the desired results being seen? Are motorist speeds going down? Is yielding improved? Do pedestrians have the crossing time they need? Program activities need to be monitored to ensure that they are proceeding on schedule, reaching the intended audience, and achieving the intended results. Again, staff are needed to ensure that all activities are being carried out as planned. In addition, for certain countermeasures, a survey of community member perceptions about road safety, reports of their own experience as pedestrians, and feelings about the countermeasures can be very valuable.

In addition to program activities, the zones themselves need to be monitored periodically since they can be fluid. For example, a zone might contain some land use (such as a trailer park) that, if removed, would remarkably change the characteristics of the zone. Or some element might be added to the zone (such as a school, hospital, restaurant/bar, or senior residence) that would affect the zone definition process or how zone activities are carried out. For an ongoing, long-term effort, the basic zone definition itself might change with preexisting zones disappearing or changing and new zones being added.


Source: pedbikeimages.org / Mike Cynecki

The Bottom Line

This handbook and the companion Countermeasure Resource report (Dunlap et al., 2023b) form the basis for developing and applying a low-cost zone approach to pedestrian safety in a community. Addressing a problem with zones is not a panacea and is not always applicable. Zones, however, are a proven, cost-effective tool that should be considered among other approaches. Zones should be particularly helpful when crashes cluster by crash type and/or pedestrian characteristic. They also have been shown to be beneficial when addressing the pedestrian safety problems of demographic groups that tend to cluster such as older adults or children.

Moreover, focusing on low-cost countermeasures and limited areas through the use of zones is a good way to start a comprehensive, jurisdiction-wide safety program. It can allow things to get going on a very limited budget. If successful, zones can increase support for a wider use of countermeasures and encourage the allocation of more resources to pedestrian safety efforts.

As a potential user of zones, you are urged to look for ways to employ the technique effectively to address your problem. Do the crashes cluster? If so, by what characteristic? Is the information needed to use zones efficiently (e.g., GIS-coded crashes) readily available? Do you have sufficient resources on hand or readily available to implement even a minimal zone approach? If the answer to these and similar questions is "yes," try the zone approach discussed in this handbook using countermeasures from the Countermeasure Resource report (Dunlap et al., 2023b). It should prove to be a valuable addition to the tools available to you to reduce pedestrian crashes. The following pages include a template for a Pedestrian Zone Plan to help guide your planning and deployment efforts.

Template Pedestrian Zone Plan

The zone process provides a method to apply pedestrian safety improvements in a cost-effective manner in one or more manageable subsets of a jurisdiction that contain a concentration of a pedestrian problem or risk characteristic of interest. This document is intended to serve as a working template that a community can use to build a plan for addressing pedestrian safety using the zone approach. It includes prompts and checklists to assist communities in the development of their own, tailored plans.

Background

Your plan should include basic information about who is leading the plan and who will be involved. Take some time to explain how this process will fit into the other planning activities you are pursuing related to pedestrian safety.

N**ame of community/jurisdiction:**

Name of person creating the plan:

Name of person involved in implementation of the plan:

Describe the community's motivation for completing this plan:

How will this plan interact with other plans and documents that are already adopted? (Vision Zero [2018] plans, pedestrian/bicycle plans, etc.)

Describe the timeline for plan development and implementation. Identify key dates for milestones such as defining zones, implementing countermeasures, and monitoring activities.

Step 1. Select the Zone Basis

The first step is to pick the basis for the zone definition.

Identify potential factors that can be used to develop pedestrian safety zones:

Describe how you identified the factors listed above. Were these revealed in a previous crash analysis or plan development? Were they identified as priorities by key stakeholders or decision makers? Provide details about the scope of the problem and the reason for selecting these as the basis of your zones.

Step 2. Map Zone Basis Data

Using GIS tools, maps can be created to show the crashes not only of various target crash groups (e.g., children, adults, older adults) but also of various subgroups of victims or crash circumstances (e.g., older adult males, nighttime, turning vehicle, intersection). Focusing attention on traditionally underserved communities and specific populations who bear an outsized burden of traffic-related deaths and injuries is paramount, and the data selected for analysis of crashes can easily reflect this equity focus.

Using the prompts below, create a list of data sources that your community will use to identify zones.

Essential Data

- **Crash Data –** Ideally person-level data reflecting crashes involving pedestrians, with accompanying location (e.g., latitude/longitude) data for mapping.
- **Roadway Network –** Base map of roadways within the jurisdiction of interest, with variables showing number of lanes, presence of pedestrian/bicyclist facilities (e.g., sidewalks).
- **Sociodemographic Data –** Available at the Census Block Group level.

Additional Data

- **Schools –** Locations of schools and/or school zones.
- **Transit –** Maps of routes, stops, and accompanying data such as boarding/alighting.
- **Pedestrian Facilities –** Standalone layers showing sidewalks, crossings, intersections, and other features.
- **Equity Areas –** Existing geographies identifying traditionally underserved populations.

The following data sources will be used to generate maps and identify zones.

Step 3. Define Zones

The next step in the zone process is to define zones from the total map of events in the jurisdiction. Since the goal is high efficiency, zones should be defined to be somewhat small in area and containing a relatively large number (high density) of crash events. In the Zone Study, zones were defined as having 10 or more crashes of interest within a 1-mile radius circle or 6 or more crashes within a 2-mile linear segment of roadway. Sometimes a visual examination of the resulting map is all that is needed to show whether the pedestrian crashes of interest cluster in any areas of the city.

Describe the process your community will use to identify potential zones based on your mapped data.

Identify the zones you revealed during your analysis:

Step 4. Calculate Efficiency Measure and Select Final Zones

GIS software packages typically include functions to identify "hot spots" or clusters. Also, the criteria of 10 or more crashes in a circular zone and 6 or more in a linear zone are only guidelines. If these functions have preset definitions, the user should pick the one that comes closest to the suggested zone criteria. Percentages of both crashes and land area covered should be calculated for all the zones combined in order to determine program coverage efficiency. If the ratio of the percentage of the problem addressed to the percent of the land area covered in the zones is much less than three, it is worth re-examining the zone definition process to try to improve its efficiency. An efficiency ratio of three to one or higher (for example, 60 percent of the crashes of interest in 20 percent of the jurisdiction's land area) will almost certainly permit the application of countermeasures locally within the zones that would be prohibitively expensive if deployed jurisdiction wide. Even an efficiency ratio of two, however, should provide some benefit. Ultimately, if this ratio cannot be made greater than two, the zone approach is not a good fit.

For the zones you identified in Step 3, calculate efficiency measures and rank the zones based on these measures.

	Observed Crashes of Interest	Area (sq mi.) or Segment Length (mi.)	Efficiency Measure
Zone 1			
Zone 2			
Zone 3			

Using Zones

Once zones are defined, they must be examined to determine the problems and resources in each area. Activities to counter the problems need to be selected or developed. The practicality of implementing each countermeasure in each zone needs to be determined. Finally, program activities must be implemented and monitored.

Step 5. Evaluate Zones and Identify Resources

Review each zone to assess the specific pedestrian safety problems that exist, the best ways to eliminate them, and the resources that are available to help solve the problem of interest.

From the list below, describe the methods you will use to evaluate your identified zones:

Conduct Pedestrian Road Safety Audits (RSAs):
Interview community members, organizations, and stakeholders:
Review plans for future development and roadway projects within the zone:
Review police crash report and narrative details:
Other:

Step 6. Select Program Activities and Countermeasures

At this point in the zone process, the companion Countermeasure Resource report (Dunlap et al., 2023b) becomes an important tool. It contains low-cost countermeasures with a high probability of effectiveness either because they have been scientifically evaluated or because they are modeled on evidence-based approaches. The combination of selected strategies all begins with a base of an engineering change that is then complemented with other strategies for greatest impact. The selection of program activities should be guided by an overall plan that includes a list of program activities and how, when, and by whom they will be implemented.

Identify the engineering countermeasures that will be deployed in your zones. How do these countermeasures address the observed safety problems?

Describe the behavioral programs that you will deploy to support the engineering countermeasures described above. Provide details about how the behavioral programs will be sequenced following the engineering countermeasure installation.

Identify funding sources that you will use to support the deployment of these countermeasures.

Step 7. Implement Program Activities

Once pedestrian safety zones have been defined and countermeasures chosen, the selected program activities must be implemented. In general, the same techniques and level of care used in city-wide implementations must be applied when focusing efforts in zones. This includes a time-based plan for distribution that clearly defines activities, responsibilities, and recordkeeping.

Use the table below to identify the implementation timeline and responsible people involved with the deployment of countermeasures.

	Timeline for Implementation	Responsible People	Other Implementation Notes
Counter-measure 1			
Counter-measure 2			
Counter-measure 3			

Describe the steps you will take to alert local community members about these projects:

Step 8. Monitor Program Activities

Did the countermeasures make a difference? The ultimate goal is to see a reduction in serious and fatal pedestrian crashes, of course. For the specific countermeasures selected, are the desired results being seen? Are motorist speeds going down? Is yielding improved? Do pedestrians have the crossing time they need? Program activities need to be monitored to ensure that they are proceeding on schedule, reaching the intended audience, and achieving the intended results.

The specific monitoring and evaluation steps you choose will depend upon the countermeasures you deploy. The menu of metrics below is adapted from the San Francisco Municipal Transportation Agency's Safe Streets Evaluation Handbook (Vision Zero SF, 2018), which is a valuable resource for any type of safety evaluation. Crashes are included in the table, but due to the infrequency of pedestrian-involved crashes at a particular site, it may be difficult to draw conclusions about the effectiveness of the program based on before/after crash counts. In many cases, changes in surrogate safety measures (speeds, traffic volumes, yielding) will allow you to perform an evaluation more quickly.

Using the table below as a prompt, select the measures you will use to monitor and evaluate your program activities. Describe the frequency for collecting this data and the overall timeline for evaluation.

	Description of data source or collection method	Frequency for compiling data	Timeline for data collection
Crashes			
Pedestrian Volumes/Counts			
Traffic Volumes			
Motor Vehicle Speeds			
Motorist Yielding Behavior			
Conflicts or "Close Calls"			
Public Perception/ Feedback			
Audience Reached			

Describe how you will document the results of your evaluation. How will it be packaged, and to whom will this information be presented?

References

Berkow, M., Eshleman, A. & Cock, J. (2014, August 19).(2014). *Pedestrian crash analysis + safety analysis*. [Memorandum]. Memphis STP Pedestrian Sidewalk Project. https://bikepedmemphis.files.wordpress.com/2015/06/memphis-pedestrian-crash-analysis-final-8-19-14-opt.pdf

Blomberg, R. D., & Cleven, A. M. (1998, February). *Development, implementation and evaluation of a pedestrian safety zone for elderly pedestrians* (Report No. DOT HS 808 692). National Highway Traffic Safety Administration. https://ntlrepository.blob.core.windows.net/lib/25000/25900/25984/DOT-HS-808-692.pdf

Dunlap and Associates, Inc., UNC Highway Safety Research Center, & Center for Education and Research in Safety. (2023b, August). *Low-cost pedestrian safety zones: countermeasure selection resource* (Report No. DOT HS 813 479). National Highway Traffic Safety Administration.

Goughnour, E., Peach, K., Dunn, M., Mitman, M., and Gelinne, D. (2021). *Primer on safe system approach for pedestrians and bicyclists* (Report No. FHWA-SA-21-065). Federal Highway Administration. https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa21065.pdf

Seattle Department of Transportation. (2020, February). *City of Seattle bicycle and pedestrian safety analysis, phase 2*. www.seattle.gov/documents/Departments/SDOT/VisionZero/SDOT_Bike%20and%20Ped%20Safety%20 Analysis_Ph2_2420(0).pdf

U.S. Census Bureau. (2023). 2020 Census - Census Block Maps. United States Census Bureau. Accessed May 9, 2023.

U.S. Department of Transportation. (2022, October 13). *What is a safe system approach?* [Web page]. www.transportation.gov/NRSS/SafeSystem

U.S. Department of Transportation (2023, May 2). Resources: Data Sources for Identifying Problems. Safe Streets for All Grants. [Web page]. Accessed May 9, 2023. www.transportation.gov/grants/SS4A/resources

Venkatraman, V., Richard, C. M., Magee, K., & Johnson, K. (2021, July). *Countermeasures that work: A highway safety countermeasures guide for State Highway Safety Offices, 10th edition,* 2020 (Report No. DOT HS 813 097). National Highway Traffic Safety Administration. www.nhtsa.gov/sites/nhtsa.gov/files/2021-09/Countermeasures-10th_080621_v5_tag.pdf

Vision Zero SF. (2018). Safe Streets + Vision Zero. San Francisco Municipal Transportation Agency. Safe Streets Evaluation Program. www.sfmta.com/sites/default/files/reports-and-documents/2018/10/safestreetsevaluationhandbook_july2018.pdf

Zegeer, C. Henderson, D., Blomberg, R., Marchetti, L., Masten, S., Fan, Y., Sandt, L., Brown, A., Stutts, J. & Thomas, L. (2008, June). *Evaluation of the Miami-Dade Pedestrian safety demonstration project* (Report No. DOT HS 810 964). National Highway Traffic Safety Administration. www.nhtsa.gov/sites/nhtsa.gov/files/810964.pdf

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