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Toolbox of Pedestrian Countermeasures and Their Potential Effectiveness

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Introduction

This issue brief documents estimates of the crash reduction that might be expected if a specific countermeasure or group of countermeasures is implemented with respect to pedestrian crashes. The crash reduction estimates are presented as Crash Modification Factors (CMFs). Some of the crash reduction estimates are also presented in terms of left-turn crashes, certain crash severities, or total crashes.

Traffic engineers and other transportation professionals can use the information contained in this issue brief when asking the following types of question: What change in the number of pedestrian crashes (and/or other crash types) can be expected with the implementation of the various countermeasures?

Crash Modification Factors (CMFs)

A CMF is the proportion of crashes that are expected to remain after the countermeasure is implemented. For example, an expected 20 percent reduction in crashes would correspond to a CMF of (1.00 – 0.20) = 0.80. In some cases, the CMF is negative, i.e. the implementation of a countermeasure is expected to lead to a percentage increase in crashes.

One CMF estimate is provided for each countermeasure. Where multiple CMF estimates were available from the literature, selection criteria were used to choose which CMFs to include in the issue brief:

- First, CMFs from studies that took into account regression to the mean and changes in traffic volume were preferred over studies that did not.
- Second, CMFs from studies that provided additional information about the conditions under which the countermeasures was applied (e.g. road type, area type) were preferred over studies that did not.

Where these criteria could not be met, a CMF may still be provided. In these cases, it is recognized that the estimate of the CMF may not be as reliable, but is the best available at this time. The CMFs in this issue brief may be periodically updated as new information becomes available.

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The Desktop Reference for Countermeasures includes most of the CMFs included in this issue brief, and adds many other CMFs available in the literature. A few CMFs found in the literature were not included in the Desktop Reference. Those excluded CMFs were considered to have smaller sample sizes or too large a standard error to be meaningful, or the original research did not provide sufficient detail for the CMF to be useful.

A CMF should be regarded as a generic estimate of the effectiveness of a countermeasure. The estimate is a useful guide, but it remains necessary to apply engineering judgment and to consider site-specific environmental, traffic volume, traffic mix, geometric, and operational conditions which will affect the safety impact of a countermeasure. Actual effectiveness will vary from site to site. The user must ensure that a countermeasure applies to the particular conditions being considered. The reader is also encouraged to obtain and review the original source documents for more detailed information, and to search databases such as the National Transportation Library (ntlsearch.bts.gov) for information that becomes available after the publication of this issue brief.

Using the Tables

The CMFs for pedestrian crash countermeasures are presented in three tables, which summarize the available information. These tables are:

- **Table 1: Signalized Countermeasures**
- **Table 2: Geometric Countermeasures**
- **Table 3: Signs, Markings, and Operational Countermeasures**

Each table has the following columns:

- **Countermeasure** = the countermeasure name.
- **Crash Severity** = the crash severity used in the analysis. Where available, separate CMFs are provided for different crash severities. The crash severities are: all, fatal/injury, fatal, or injury. The categories depend on the approach taken by the original study. For example, some studies referred to fatal/injury (fatal and injury crashes combined). Some distinguished fatal from injury. "All" is used for CMFs from studies which did not specify the severity.
- **CMF for Crash Type (SE)** = the CMF value selected from the literature, listed under the column(s) for the appropriate crash type (All, Left-Turn, or Pedestrian). CMFs listed under the Pedestrian column refer to the reduction in crashes involving pedestrians crossing the street, unless otherwise specified. Standard error (SE) for the CMF is provided in parenthesis where available. The standard error is the standard deviation of the error in the estimate of the CMF. The true value of the CMF is unknown for a given treatment type. The standard error provides a measure of the precision of the estimate of the true value of the CMF. A relatively small standard error indicates that a CMF is more precisely

known. A relatively large standard error indicates that a CMF is less precisely known.

- **Reference Number** = the reference number for the source information, as given in the reference list in this document.
- **CMF ID** = ID number of the CMF in the CMF Clearinghouse.
- **Star Rating** = an indicator of the quality or confidence of the CMF and is based on the following factors: study design, sample size, standard error, potential bias, and data source. The ratings range from 1 to 5 where 5 indicates the highest or most reliable rating.

Cells with "—" indicate that no information is reported in the source document. For additional information, visit the FHWA Office of Safety website (safety.fhwa.dot.gov).

Example

COUNTERMEASURE	CRASH SEVERITY	CMF FOR CRASH TYPE (SE)			REFERENCE NUMBER	CMF ID	STAR RATING
		ALL	LEFT TURN	PEDESTRIAN			
Exclusive Pedestrian Phase	All	—	—	0.49 (0.16)	2	4117	2

Using the first countermeasure from Table 1 as an example, the following information can be gained from the table:

- The countermeasure name is "Exclusive Pedestrian Phase."
- The crash severity is "All," meaning that the original study calculated the CMF for all crash severities combined or did not specify a crash severity.
- A CMF of 0.49 is listed under the "Pedestrian" column, meaning that a (1.00 – 0.49) = 51% reduction in pedestrian crashes is expected for this countermeasure.
- The "—" in the "All" and "Left-Turn" columns indicates that CMFs for these crash types were not provided in the original study.
- The standard error for this CMF is 0.16.
- The reference number is 2, which refers to the 2012 study by Chen, Chen, Ewing, McKnight, Srinivasan, and Roe in the references list.
- The CMF ID is 4117 in the CMF Clearinghouse.
- This study has a 2 star rating.

Other Useful Resources

- www.cmfclearinghouse.org
- www.walkinginfo.org
- www.walkinginfo.org/pedsafe/
- safety.fhwa.dot.gov/provencountermeasures/

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TABLE 1. SIGNALIZED COUNTERMEASURES

COUNTERMEASURE	CRASH SEVERITY	CMF FOR CRASH TYPE (SE)			REFERENCE NUMBER	CMF ID	STAR RATING
		ALL	LEFT TURN	PEDESTRIAN			
Exclusive Pedestrian Phase	All	—	—	0.49 (0.16)	2	4117	2
Improved Signal Timing (ITE)	Fatal/Injury	—	—	0.63	14	383	2
Replace Existing "Walk/ Don't Walk" Signals with Pedestrian Countdown Signal Head	All	—	—	0.75	9	—	—
Replace Existing "Walk/ Don't Walk" Signals with Pedestrian Countdown Signal Head	All	—	—	0.3	15	5272	4
Implement Leading Pedestrian Interval (LPI)	All	—	—	0.413 (0.064)	4	1993	3
Remove Unwarranted Signals (One-Way Street)	All	—	—	0.83	12	331	3
Pedestrian Hybrid Beacon (PHB)	All	—	—	0.45 (0.167)	17	9020	4
PHB and Advanced Yield/Stop Markings/ Signs	All	—	—	0.43 (0.134)	17	9021	4
Increase Pedestrian Crossing Time	All	—	—	0.49 (0.10)	2	4658	3
Add New Traffic Signals, when Warranted	All	0.75 (0.07)	—	—	2	4658	3

TABLE 2. GEOMETRIC COUNTERMEASURES							
COUNTERMEASURE	CRASH SEVERITY	CMF FOR CRASH TYPE (SE)			REFERENCE NUMBER	CMF ID	STAR RATING
		ALL	LEFT TURN	PEDESTRIAN			
Convert Unsignalized Intersection to Roundabout	Fatal/Injury	—	—	0.73	3	—	—
Install Pedestrian Overpass/Underpass	Fatal/Injury	—	—	0.1	6	—	—
Install Pedestrian Overpass/Underpass	All	—	—	0.14	6	—	—
Install Pedestrian Overpass/Underpass (Unsignalized Intersection)	All	—	—	0.87	8	—	—
Install Raised Median	All	—	—	0.75	6	—	—
Install Raised Median at Unsignalized Crossing	All	—	—	0.69 (0.183)	17	8799	3
Install Raised Pedestrian Crossing	All	0.7	—	—	1	—	—
Install Raised Pedestrian Crossing	Fatal/Injury	0.64	—	—	1	—	—
Install Sidewalk	All	—	—	0.12	10	—	—
Provide Paved Shoulder	All	—	—	0.29	6	—	—
Narrow Roadway from Four Lanes to Three Lanes (Two Through Lanes with Center Turn Lane)	All	0.71	—	—	7	199	5
Road Diet—Urban Area	All	—	—	0.81 (0.005)	11	5554	4
Road Diet—Suburban Area	All	—	—	0.53 (0.02)	12	2841	4

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TABLE 3. SIGNS, MARKINGS, AND OPERATIONAL COUNTERMEASURES

COUNTERMEASURE	CRASH SEVERITY	CMF FOR CRASH TYPE (SE)			REFERENCE NUMBER	CMF ID	STAR RATING
		ALL	LEFT TURN	PEDESTRIAN			
Add Overhead Lighting	Injury Crashes	—	—	0.77	7	199	5
Improve Pavement Friction (Skid Treatment with Overlay)	Fatal/Injury	—	—	0.97	6	—	—
Increase Enforcement	All	—	—	0.77	16	—	—
Prohibit Right-Turn-on-Red	All	0.97	—	—	7	199	5
Prohibit Left Turns	All	—	—	0.9	6	—	—
Restrict Parking Near Intersections (to Off-Street)	All	—	—	0.7	6	—	—
High-Visibility Crosswalk	All	—	—	0.52 (0.17)	2	4658	3
Convert Parallel Lane to High-Visibility Crosswalk (School Zone)	All	—	—	0.63	5	2697	3
Advanced Stop/Yield	All	—	—	0.75 (0.230)	17	9017	3
Rectangular Rapid-Flashing Beacon (RRFB)	All	—	—	0.53 (0.377)	17	9024	2

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