

EFFECTIVENESS OF RED LIGHT CAMERAS

A Texas Transportation Institute White Paper
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Background

Intersection traffic safety is achieved through a combination of engineering, education, and enforcement. This paper addresses only the enforcement component through use of red light cameras. A comprehensive discussion about the engineering component of signal lights can be found in the *Red-Light Running Handbook: An Engineer's Guide to Red-Light-Related Crashes*.¹

Red light cameras have been used increasingly over the past decade to assist and facilitate enforcement against red light running at signalized intersections. According to the Insurance Institute for Highway Safety (IIHS), red light cameras are in use by over 400 cities in the United States, and at least 22 countries.^{2,3}

¹ James Bonneson, Karl Zimmerman, *Red-Light Running Handbook: An Engineer's Guide to Red-Light-Related Crashes*, Product 0-4196-P1, Texas Transportation Institute, College Station, Texas, September 2004.

² "Q&As: Red Light Cameras," Insurance Institute of Highway Safety, Arlington, Virginia, January 2009, <http://www.iihs.org/research/qanda/rlr.html>, accessed October 7, 2009.

³ "Communities Using Red Light and/or Speed Cameras as of September 2009," Insurance Institute for Highway Safety, Arlington, Virginia, http://www.iihs.org/research/topics/auto_enforce_cities.html, accessed September 8, 2009.

This paper summarizes:

- The purpose of enforcement against red light running violations;
- Findings from evaluations of the effectiveness of red light cameras; and
- Conclusions regarding the use of red light cameras to increase driver adherence to traffic signals.

Purpose of Enforcement against Red Light Running

Enforcement against red light running violations is an action intended to increase safety by reducing the number of crashes and vehicle conflicts at signalized intersections. An analysis of 1997 U.S. crash data indicated that red light running crashes accounted for 44 percent of all fatalities at signalized intersections.⁴ The City of Toronto attributes as much as 40 percent of fatalities at its signalized intersections to red light running.⁵ Similarly, statewide in Iowa, about 35 percent of fatal/major injury crashes at signalized intersections between 2001 and 2006 were attributed to red light running.⁶ To understand the importance of enforcement, it is first necessary to understand the safety reasons for which intersections are signalized in the first place.

Purpose of Traffic Signals

Traffic signals are used to assign the right of way to vehicles passing through intersections so conflicting movements (i.e., vehicle paths that cross each other and create crash potential) do not occur. Traffic signals are installed when traffic engineering studies determine that certain conditions (warrants) are met in accordance with the *Manual on Uniform Traffic Control Devices (MUTCD)*.⁷ Most of the warrants are directly or indirectly associated with preventing conflicts and crashes.

Relationships between Red Light Running Violations and Crash Frequency, Severity, and Vehicle Conflicts

Traffic signals are installed to separate conflicting traffic movements (called conflicts) through intersections. Those conflicts create crash potential. For example, if a vehicle from each of two crossing streets attempts to enter an intersection at the same time, the paths of the crossing vehicles meet in the intersection and a crash can occur. Figure 1 illustrates the vehicle conflict points that occur within a typical intersection.

⁴ *Impact of Red Light Camera Enforcement on Crash Experience*, NCHRP Synthesis 310, Transportation Research Board, Washington, DC, 2003.

⁵ "Red Light Cameras Get Extended Stay on Our Roads," City of Toronto Transportation Services, http://www.toronto.ca/transportation/redlight_cameras/index.htm, accessed September 8, 2009.

⁶ Shauna Hallmark and Tom McDonald, "Evaluating Red Light Running Programs in Iowa," Tech Transfer Summary, Center for Transportation Research and Education, Iowa State University, December 2007.

⁷ *Manual on Uniform Traffic Control Devices*, Federal Highway Administration, Washington, DC, 2009 or state's adopted MUTCD.

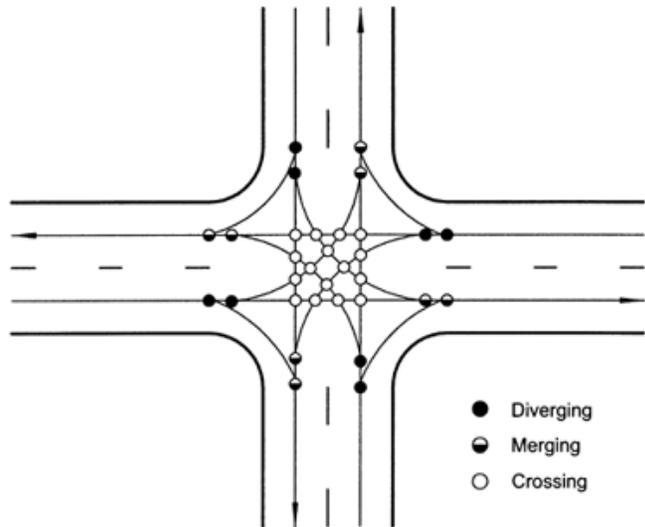


Figure 1. Traffic conflict points in a typical intersection⁸

Crashes occur when conflicting vehicle movements occur within intersections. Research has shown that the more traffic conflicts that occur, the higher the frequency of crashes. But there is more to the problem of conflicts than just crash frequency. There are different degrees of crash severity. These are most simply characterized as property damage only, injury, and fatal crashes. Certain crash types produce a higher degree of severity than others. The two most frequent types of crashes at signalized intersections are angle (vehicle paths from intersecting streets cross each other) and rear-end (one vehicles collides with the vehicle in front of it). Right-angle crashes usually have a higher (more serious) severity than rear-end crashes.

Conflicts lead to crashes. Certain types of crashes produce more serious results. No crash is a good crash, and traffic signals are installed to help prevent conflicts and crashes. Red light running violations, in addition to being prohibited by state law, are dangerous to public health and safety. Enforcement of red light running violations is intended to reduce crashes by reducing vehicle conflicts within intersections.

Purpose of Red Light Camera Enforcement

Most drivers obey traffic signals all the time. However, some drivers, due to temporary inattention, distractions, poor decision-making, or aggressive driving fail to stop for red lights. Those red light violating drivers create crash opportunities at the conflict locations shown in Figure 1.

Traffic engineers seek ways to increase compliance with traffic signals at locations where red light running is higher than normal. Sometimes engineering countermeasures can be used, such as changing signal phasing or timing or modifying signal displays. However, often the problem is driver decision-making, and enforcement becomes necessary. The traditional method of enforcement is for police officers to cite violators they observe. This requires police officers to

⁸ Lee Rodegerdts et al, *Signalized Intersections: Informational Guide*, Federal Highway Administration, Washington, DC, August 2004.

spend their time on the streets, and results in an occasional enforcement presence. It also requires police officer time away from other duties.

Red light cameras were invented to provide more comprehensive enforcement without diverting police officers from other, possibly more important, duties. They are typically used where crashes or violations (which create crash potential) are most frequent. However, they can be used at any signalized intersection. Red light cameras are normally installed after a traffic engineering evaluation shows that all reasonable and applicable engineering countermeasures have been evaluated and that violations still exist. One advantage of red light cameras is that they provide 24/7 coverage and produce a record of the violations that can be reviewed in case of question.

Hence, enforcement by use of red light cameras is for the purpose of reducing vehicle conflicts and crashes in intersections that experience red light running violations.

Effectiveness of Red Light Cameras

The effectiveness of red light cameras can be viewed in terms of reductions in crash frequency, crash severity, and frequency of red light running violations. This section provides a cross-section of past findings about the effectiveness of red light cameras in affecting those three results. It should be noted that, unless otherwise stated, the authors of this summary drew the information from published or internet summaries and did not have access to the actual data. It should also be noted that many results are based on observations of small numbers of intersections for varying periods and that the intersections may have been selected for red light camera application based on a variety of existing conditions. Therefore, readers are encouraged to consider general trends and consistency rather than to try to calculate average magnitudes of effectiveness.

Crash Frequency

Crash frequency is usually measured in total crashes per year. Some reports separate crashes by whether or not they relate to red light running or by crash type, usually right-angle or rear-end types.

Crashes at Signalized Intersections

When a traffic signal is originally installed, one purpose is to reduce right-angle crashes if they make up an inordinately high percentage of the total. It is expected that rear-end crashes may increase if drivers stopping on red are followed too closely by subsequent drivers.

Impact of Red Light Camera Enforcement

Red light running enforcement is expected to reduce right-angle collisions by virtue of reducing improper entry to the intersection when crossing vehicles are present. At the same time, the additional vehicles stopping when red light cameras are present may result in an increase in rear-end crashes (or they may not, since drivers should be more cautious and expect drivers in front of them to stop for red).

Numerous studies have been completed to assess the impact of red light camera enforcement on

crash frequency. The examples cited here are before-and-after comparisons at intersections (the only change is the addition of red light cameras). These provide a good assessment of the impact of red light cameras since all other factors remain the same. It is assumed that the traffic volumes remain about the same since most data cover 1-2 years before and after installation – in most cases this is rarely enough time for traffic volumes to change significantly.

In one of the most procedurally robust evaluations of red light camera effectiveness, researchers evaluated 132 sites in seven jurisdictions.⁹ Findings included:

- Right-angle crashes were reduced by approximately 25 percent overall. Right-angle crashes were reduced by an average of 14 to 40 percent in six of the seven jurisdictions; in one jurisdiction those crashes increased by about 1 percent. Right-angle crashes declined by about 8 percent at other signalized intersections without red light cameras in the same jurisdictions, indicating that the use of the cameras may produce some effect across the area.
- Rear-end crashes increased in all seven jurisdictions by 7 to 38 percent. The average increase was about 15 percent. At signalized intersections without cameras, the spillover effect was that rear-end crashes increased by about 2 percent.
- The combined total of right-angle and rear-end crashes decreased by less than 1 percent. Total right-angle and rear-end injury crashes declined by about 5 percent.
- The percentage of the respective right-angle and rear-end crashes that resulted in injuries each stayed the same.

Unpublished summaries of Texas Crash Records Information System (CRIS) data for 56 red light camera-equipped intersections in 10 Texas cities indicate that:¹⁰

- Red light related crashes decreased by about 17 percent. For red light related crashes (those attributed to drivers running a red light), 6 intersections showed decreases, 3 had increases, and 1 was unchanged. Among the 4 high-crash locations, 3 showed decreases and 1 increased.
- Right-angle crashes declined 18 percent. Right-angle crashes decreased from 67 percent of total crashes before cameras to about 55 percent of the total with camera enforcement.
- Rear-end crashes increased by 56 percent. Only 11 of the 70 (16 percent) rear-end crashes per year before cameras were related to red light causes. With cameras, 15 of 109 (14 percent) rear-end crashes per year related to red light causes. Although total rear-end crashes increased, red light related causes contributed about the same percentage as before cameras.
- Total crashes were virtually unchanged. Total crashes increased at five intersections and decreased at five. Some intersections had very few crashes. However, even among those with over 20 crashes per year, half showed increases and half showed decreases.

The City of Garland, Texas compiled data for four intersections (including two frontage road intersections) each having red light cameras on one approach.¹¹ Data were available for 31

⁹ Forrest M. Council et al., *Safety Evaluation of Red-Light Cameras*, FHWA-HRT-05-048, Battelle Memorial Institute, Columbus, Ohio, April 2005.

¹⁰ Unpublished summaries, Texas Transportation Institute, May 2009.

¹¹ “Report on the Effectiveness of Automated Red Light Enforcement,” City of Garland Transportation Department, updated September 2006 plus unpublished supplemental tables received October 7, 2009.

months before installation. After data were available for 51.5 months for the arterial intersections and 29 months for the frontage road intersections. After adjustment of all data to a monthly basis, the two arterial and two frontage road intersections experienced the following changes:

- Total crashes decreased about 29 percent.
- Red light running crashes went down 60 percent (down 95 percent on approaches with cameras).
- Rear end crashes increased by 45 percent. City examination of these crashes indicated few if any were the result of changes from green to red (e.g., motorist running into the back of a queue).

Red light cameras were removed from the two frontage road intersections after 29 months. Comparing the 29 months of operation with red light cameras to the 22.5 months after camera removal, the results after removal were:

- Total intersection crashes increased by about 64 percent.
- Red light running crashes were over three times as frequent.
- Rear-end crashes declined by about 57 percent (82 percent on camera-equipped approaches);
- Total injuries increased by 29 percent.

The City of Dallas installed red light cameras at 60 sites during the first half of 2007.¹² Preliminary results from data through the beginning of 2009 showed for 17 camera sites with two years implementation that:

- Red light running crashes decreased by an average of about 61 percent (all intersections showing reductions).
- Total crashes were down by 30 percent.

For the other 43 sites with 18 months in place:

- Red light running crashes were down an average of 39 percent (79 percent of intersections have reductions).
- Total crashes were down 23 percent.

Preliminary data obtained from the City of Irving, Texas, indicate that during the first 18 months of operation, red light camera enforcement resulted in a:

- Reduction of total intersection crashes by 56 percent below the 18 months preceding implementation.¹³

The Insurance Institute for Highway Safety evaluated results of red light camera effectiveness in Oxnard, California.¹⁴ Eleven of Oxnard's 125 signalized intersections were equipped with red light cameras. Results reported covered the effects of the cameras on all 125 intersections. They found that:

¹² "Red Light Safety Program," City of Dallas, Dallas, Texas, <http://www.dalascityhall.com/pubsafe/safelight.html>, accessed October 9, 2009.

¹³ Data received from Christopher Bruton, City of Irving, October 7, 2009.

¹⁴ *Impact of Red Light Camera Enforcement on Crash Experience*, NCHRP Synthesis 310, Transportation Research Board, Washington, DC, 2003.

- Total intersection crashes decreased by 7 percent.
- Right-angle crashes decreased by 32 percent.
- Injury crashes declined by about 29 percent.
- Rear-end crashes increased 3 percent.

There was no evaluation focused solely on the red light camera intersections.

A study of 24 red light camera intersections in Phoenix and neighboring Scottsdale, Arizona, reported effectiveness of camera enforcement.¹⁵ For 10 intersections in Phoenix:

- Total intersection crashes were about unchanged.
- Angle crashes decreased by about 42 percent.
- Left-turn crashes were approximately unchanged.
- Rear-end crashes increased by about 20 percent.

For 14 intersections in Scottsdale:

- Total crashes declined by about 11 percent.
- Angle crashes were down by about 20 percent.
- Left-turn crashes declined by about 45 percent.
- Rear-end crashes increased by about 41 percent.

An evaluation of effectiveness of six red light camera intersections in Mesa, Arizona, another Phoenix area community, showed:¹⁶

- The total crash rate decreased by about 10 percent.
- Half of the intersections experienced small increases in total crashes of 1 to 4 percent) while half experienced large decreases (16 to 28 percent).

The same document showed that a North Carolina study of red light camera effectiveness in Raleigh and Chapel Hill showed before-and-after comparisons (seven months of after data).

- Red light related crashes declined by about 32 percent.
- Angle crashes decreased by about 51 percent.
- Total crashes were down by about 30 percent.
- Rear-end crashes increased by an average of about 2 percent.

The researchers cautioned that the seven months of after data might omit some seasonal effects.

The Howard County, Maryland, Traffic Engineering Division reported early results, including that:¹⁷

- Total crashes declined by between 21 and 44 percent at individual camera-enforced intersections.
- Right-angle collisions decreased by an average of 42 percent.
- Rear-end crashes decreased by an average of about 29 percent.

¹⁵Kangwon Shin and Simon Washington, "The Impact of Red Light Cameras on Safety in Arizona," *Accident Analysis and Prevention*, Vol. 39, 2007, www.elsevier.com.

¹⁶ *Impact of Red Light Camera Enforcement on Crash Experience*, NCHRP Synthesis 310, Transportation Research Board, Washington, DC, 2003.

¹⁷ "Automated Enforcement of Traffic Signals: A Literature Review – ITS Report," Mitretech, August 13, 2001, http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/13603.html .

After 10 years of operation with up to 30 camera locations in Howard County:¹⁸

- Total crashes had decreased by 12 to 18 percent (varied by length of service).
- Angle crashes decreased 36 to 57 percent (average 45 percent).
- Rear-end crashes ranged from a long-term 5 percent reduction to shorter-term increases of 2 to 10 percent.

An evaluation of red light camera experience over 12 to 34 months at 12 intersections in San Diego showed that:¹⁹

- Crashes attributable to red light running decreased by about 41 percent.
- Rear-end crashes increased by about 37 percent. Rear-end crashes increased at 14 intersections and decreased at 5.
- Total crashes increased by about 1 percent. Total crashes declined at 11 of the 19 intersections, but increased at the others.
- Right-angle and ran signal crashes decreased at 12 intersections but increased at 2.

Some of the camera-equipped intersections in San Diego had very low crash experience to begin with. One intersection that had about 25 percent of the recorded red light violations had only 1.5 crashes per year before camera installation. The report cited above referenced a report by the California State Auditor that stated that following the introduction of the California red light camera law:

- Crashes attributable to red light running declined statewide by about 3 percent per month and in cities with red light cameras those crashes were down 10 percent per month.
- Only one California city showed an increase in red light running crashes (5 percent).

Finally, the same source stated that following suspension of the San Diego red light camera program, red light crashes increased by 14 percent citywide and by 30 percent at former camera intersections.

An evaluation of four to six red light camera intersections in San Francisco used five years each of before-and-after crash data. The evaluation showed that:²⁰

- Injury crashes decreased by about 9 percent.
- Fatalities were 50 percent lower (although the numbers are small).

The same source reported that for 17 red light camera intersections in Baltimore County, Maryland, a comparison of one-year before-and-after crash data showed that:

- Total intersection related crashes decreased by about 57 percent, with 14 intersections experiencing decreases and 3 increases.
- Red light related crashes decreased by about 21 percent (6 intersections decreased, 4 increased, 7 unchanged)

¹⁸ George E. Frangos, "Automated Enforcement: 10-Year Evaluation of Red Light Running Detection, Howard County, Maryland," Howard County Traffic Engineering Division, Columbia, Maryland, undated.

¹⁹J. Golob et al, "Impacts of San Diego Red Light Enforcement on Traffic Safety," for presentation to 82nd Annual Meeting of Transportation Research Board, Washington, DC, November 14, 2002.

²⁰ *Impact of Red Light Camera Enforcement on Crash Experience*, NCHRP Synthesis 310, Transportation Research Board, Washington, DC, 2003.

- Injury crashes decreased by about 49 percent (10 intersections had decreases, 4 had increases, 3 were unchanged).

The same source also reported an evaluation of Charlotte, North Carolina, experience for 17 red light camera intersections. There the results were:

- Total intersection crashes were unchanged (10 intersections decreased, 7 increased).
- Angle crashes declined by about 37 percent (13 intersections decreased, 3 increased, 1 was unchanged).
- Rear-end crashes increased by about 16 percent (6 intersections decreased, 10 increased, 1 unchanged).

On approaches equipped with cameras:

- Total crashes decreased about 19 percent (12 approaches decreased, 5 increased).
- Angle crashes declined by about 60 percent (14 approaches decreased, 2 increased, 1 unchanged).
- Rear-end crashes increased by about 4 percent (5 approaches decreased, 10 increased, 2 unchanged).

A report on red light camera effectiveness in Georgia indicated a variety of results from various cities.²¹ That report focused on total and rear-end crashes.

- In Rome, where one red light camera was installed the first year:
 - Total crashes decreased by 14 percent.
 - Rear-end crashes decreased by 32 percent.
- In Brunswick (3 locations):
 - Rear-end crashes increased by about 70 percent.
- One installation in Duluth showed no clear trend.
- In Snellville, results for 2 locations showed that:
 - Total crashes declined 43 percent at one intersection and increased 2 percent at the other one.
 - Rear-end crashes decreased 36 percent at one and increased 25 percent at the other.
- In Alpharetta, results for two locations showed:
 - Total crashes decreased by about 5 percent.
 - Rear-end crashes increased about 4 percent.

In Seattle, where red light cameras were installed on six approaches of four intersections, over the first two years:²²

- Total crashes decreased by 11 percent.
- Angle crashes showed no change.
- There were no red light related rear-end crashes.
- Injury crashes decreased by about one-third.

²¹ “Experience in Georgia with Photo Enforcement,” Georgia Section ITE Safety Committee, ITE 2008 Technical Conference, Miami, Florida, March 31, 2008.

²² “City of Seattle Traffic Safety Camera Evaluation, Year II Evaluation,” City of Seattle Police Department, Seattle, Washington, December 2008.

However, the Seattle analysts did not think there were enough data to reach a definite conclusion on effectiveness based on crash frequency.

The City of Calgary reported in early 2009 that since 2001, when they installed red light cameras:²³

- Right-angle crashes have decreased at red light camera locations by about 48 percent.
- Rear-end collisions have dropped by about 39 percent.

A review of 10 controlled before-and-after studies in Australia, Singapore, and the United States by The Cochrane Collaboration found:²⁴

- Right-angle crashes were reduced by 24 percent reduction.
- There was no significant change in rear-end crashes.

A different canvass of U.S. and international red light camera evaluations found that:²⁵

- Angle collisions due to red light cameras decreased by 10 to 50 percent.
- Rear-end collisions increased from zero to 60 percent.

Crash Severity

Crash severity measures how serious the results of a crash are to those involved. Severity is most often described as a percentage of crashes that involve injuries or fatalities. Sometimes an index is used based on a sliding scale of point values ranging from a high for a fatal crash to a low for no significant damage.

Crash Severity at Signalized Intersections

Some intersection crash types have a higher incidence of injuries and fatalities than others. This results from the angle of vehicle impact and speed of collision. Angle crashes account for more intersection fatalities than any other type (59 percent).²⁶ They usually involve moderately high speeds and collisions involving the passenger compartment of at least one vehicle. They comprise the majority of red light running crashes. Rear-end crashes, the other prominent type associated with red light enforcement, account for only about 4 percent of fatal intersection crashes.

²³ “Getting Around is Safer,” City of Calgary official website, http://www.calgary.ca/portal/server.pt/gateway/PTARGS_0_2_761372_0_0_18/Getting+around+is+getting+safer.htm, accessed October 14, 2009.

²⁴ “Q&As: Red Light Cameras,” Insurance Institute of Highway Safety, Arlington, Virginia, January 2009, <http://www.iihs.org/research/qanda/rlr.html>, accessed October 7, 2009.

²⁵ Sarah Rocchi and Suzanne Hemsing, “A Review of the Safety Benefits of Red Light Cameras,” Compendium of Technical Papers, 1999 Technical Conference of Institute of Transportation Engineers, March 1999.

²⁶ *A Guide for Reducing Collisions at Signalized Intersections*, NCHRP Report 500, Volume 12, Transportation Research Board, Washington, DC, 2004.

Impact of Red Light Camera Enforcement

In an evaluation of red light camera effectiveness of 132 sites in seven jurisdictions:²⁷

- Total of right-angle and rear-end crashes decreased by less than 1 percent.
- Total right-angle and rear-end injury crashes declined by about 5 percent.

The City of Garland, Texas, evaluated four arterial intersections, each with a camera on one approach, and compiled injuries per year before and after implementation.²⁸ The comparison of 31 month before-and-after periods showed that:

- Total injury crashes decreased by about 28 percent.

Raw data from Irving, Texas, show that in the first 18 months of red light camera use.²⁹

- The severity index dropped by 73 percent using a 10 point crash severity scale.

The City of Toronto reported that red light cameras resulted in:³⁰

- Fatal and injury angle crash decrease of about 48 percent.
- Property damage only crash reduction of about 26 percent.

An Insurance Institute for Highway Safety review of international red light camera experience found that with red light camera enforcement:³¹

- Injury crashes decreased by 25 to 30 percent.

A review of 10 controlled before-and-after studies of red light cameras in Australia, Singapore, and the United States showed that:

- Total injury crashes decreased by an average of about 16 percent.³²

Red Light Violations

Red light violations result in the possibility that two (or more) vehicles will collide within an intersection. Hence, every red light running violation creates potential for a crash. Reductions in violations should produce crash reductions, especially in right-angle crashes. However, it is recognized that increased stopping for red lights can cause an increase in rear-end crashes.

²⁷ Forrest M. Council et al, *Safety Evaluation of Red-Light Cameras*, FHWA-HRT-05-048, Battelle Memorial Institute, Columbus, Ohio, April 2005.

²⁸ "Report on the Effectiveness of Automated Red Light Enforcement," City of Garland Transportation Department, updated September 2006 plus unpublished supplemental tables received October 7, 2009.

²⁹ Data received from Christopher Bruton, City of Irving, October 7, 2009.

³⁰ "Red Light Cameras Get Extended Stay on Our Roads," City of Toronto Transportation Services, http://www.toronto.ca/transportation/redlight_cameras/index.htm, accessed September 8, 2009.

³¹ R. Retting, S. Ferguson, S. Hakkert, "Effects of Red Light Cameras on Violations and Crashes: A Review of International Literature," *Traffic Injury Prevention*, Volume 4.

³² "Q&As: Red Light Cameras," Insurance Institute of Highway Safety, Arlington, Virginia, January 2009, <http://www.iihs.org/research/qanda/rlr.html>, accessed October 7, 2009.

The Insurance Institute for Highway Safety reported that they found red light camera enforcement:³³

- Reduces violation rates by about 40 percent.

The Garland, Texas evaluation showed that:³⁴

- Violations per camera declined by about 56 percent from the first month of implementation to the thirty-first month. This is about 2.2 percent per month.

In College Station, Texas, the violation rate over the first year of operation for six camera-equipped approaches:³⁵

- Decreased by about 49 percent.
- Showed violations by movement type during one 4 month period as:³⁶
 - Through: 50 percent.
 - Right turn: 47 percent.
 - Left turn: 3 percent.

During the first year of red light camera enforcement, violations were found to have:³⁷

- Decreased by about 41 percent in Fairfax, Virginia.
- Decreased by over 70 percent in Charlotte, North Carolina.
- Decreased by about 68 percent in San Francisco.
- Decreased by about 92 percent in Los Angeles.

During the first year of operation in Georgia:³⁸

- Violations at one Rome intersection decreased by about 32 percent.
- Violations at six locations in Alpharetta declined by an average of about 64 percent.

The City of New Orleans installed red light cameras at 17 intersections. After seven months of operation:

- Violations dropped by about 85 percent.³⁹

³³ “Red Light Cameras Yield Big Reductions in Crashes and Injuries,” *Status Report*, Vol. 36, No. 4, Insurance Institute for Highway Safety, Arlington, Virginia, April 28, 2001.

³⁴ “Report on the Effectiveness of Automated Red Light Enforcement,” City of Garland Transportation Department, updated September 2006 plus unpublished supplemental tables received October 7, 2009.

³⁵ Data by telephone from City of College Station, Troy Rother, October 12, 2009.

³⁶ “Red Light Camera Quick Stats,” City of College Station, Texas, <http://www.cstx.gov/Index.aspx?page=2777>, accessed October 14, 2009.

³⁷ “Using Red-Light Cameras to Reduce Red-Light Running,” Issue Brief 7, Institute of Transportation Engineers, Washington, DC, April 2004.

³⁸ “Experience in Georgia with Photo Enforcement,” Georgia Section ITE Safety Committee, ITE 2008 Technical Conference, Miami, Florida, March 31, 2008.

³⁹ “61,000 Photo Enforcement Violations Cited in 2008,” Mayor’s Press Office, City of New Orleans, February 20, 2009.

The evaluation of red light camera experience in San Diego showed that at 19 red light camera intersections:⁴⁰

- Violations decreased by a median amount of 3.2 percent per month over 12 to 34 months.
- Violations at 18 of the 19 intersections decreased by at least 2.1 percent per month.
- Violation trend decreases continued throughout the evaluation period, although with a declining rate (32 percent the first year and 54 percent cumulative for two years).

The same evaluation supported confirmed the contention that extension of the yellow change interval will solve most of the red light running problems; yellow intervals were extended by varying amounts up to about 1.6 seconds, with the result being that:

- Violations decreased by 30 to 88 percent with an average of about 50 percent.
- That still left 50 percent to be addressed by other means, such as enforcement.

Over the first five years of its program involving up to 30 camera locations, Howard County, Maryland, red light camera citations for red light running compared violations and found:

- Red light running citations decreased by 18 to 67 percent.⁴¹
- Cameras at two locations were retired after daily violations decreased from 114 and 121 to less than three per day each.⁴²

A two-year evaluation of red light camera effectiveness in Seattle covered six approaches at four intersections and found:⁴³

- Red light violations decreased by about 44 percent after one year and 59 percent after two years.

A study of red light camera enforcement in northeastern Virginia compared violation rates between the first and second three-month periods of implementation.⁴⁴ It found that:

- Red light camera citations were 21 percent less in the second three months than they had been during the first three.

An international canvass of red light camera evaluations included violation comparisons for 11 cities. Findings showed that:⁴⁵

- Violations declined by between 21 and 75 percent with an average of 46 percent.

⁴⁰ J. Golob et al, "Impacts of San Diego Red Light Enforcement on Traffic Safety," for presentation to 82nd Annual Meeting of Transportation Research Board, Washington, DC, November 14, 2002.

⁴¹ George E. Frangos, "Automated Enforcement: 10-Year Evaluation of Red Light Running Detection, Howard County, Maryland," Howard County Traffic Engineering Division, Columbia, Maryland, undated.

⁴² "Automated Enforcement of Traffic Signals: A Literature Review – ITS Report, Mitretech, August 13, 2001, <http://www.itsdocs.fhwa.dot.gov/jpodocs/reports/13603.html> .

⁴³ "City of Seattle Traffic Safety Camera Evaluation, Year II Evaluation," City of Seattle Police Department, Seattle, Washington, December 2008.

⁴⁴ Lawrence F. Decina, et al, *Automated Enforcement: A Compendium of Worldwide Evaluations of Results*, DOT-HS-810-763, TransAnalytics LLC, Kulpville, Pennsylvania, September 2007.

⁴⁵ Sarah Rocchi and Suzanne Hemsing, "A Review of the Safety Benefits of Red Light Cameras," Compendium of Technical Papers, 1999 Technical Conference of Institute of Transportation Engineers, March 1999.

The City of Philadelphia implemented a two-phase program to reduce red light running.⁴⁶ First they lengthened the yellow signal interval, then added six red light cameras. A study by the Insurance Institute of Highway Safety found that:

- Violations declined by 36 percent with the lengthened yellow interval.
- Red light camera enforcement reduced the remaining violations by 96 percent.

An IIHS review of international red light cameras studies revealed that the cameras:

- Reduced red light running violations by 40 to 50 percent.⁴⁷

Another IIHS evaluation found that during the first four months of camera use in Oxnard, California:

- Violations declined by about 42 percent.⁴⁸

Conclusions

The findings described above are the results of many different evaluations performed on differing data of differing sample sizes for differing types of intersections using different evaluation methods. However, the trends are quite clear and undeniable even if the numerical values may not be fully certain.

If installed at locations with significant red light running crashes and/or violations, over a group of intersections, red light cameras:

- Substantially reduce red light violation rates;
- Reduce crashes that result from red light running;
- Usually reduce right-angle collisions;
- May result in an increase in rear-end collisions;
- May or may not reduce total crashes, but rarely result in a substantial increase; and
- Usually reduce crash severity by virtue of reducing the more severe right-angle crashes while sometimes increasing the less severe rear-end collisions.

Red light cameras are to aid enforcement and should not be considered a substitute for proper traffic engineering of signalized intersections. If a signalized intersection has been analyzed and all reasonably practical measures have been taken to help drivers see the signals, and if red light running still persists, increased enforcement by red light cameras or other means will likely be effective.

⁴⁶ Richard Retting, Susan Ferguson, Charles Farmer, "Reducing Red Light Running through Longer Yellow Signal Timing and Red Light Camera Enforcement: Results of a Field Investigation," *Accident Analysis and Prevention*, Volume 40, 2008, www.elsevier.com.

⁴⁷ R. Retting, S. Ferguson, S. Hakkert, "Effects of Red Light Cameras on Violations and Crashes: a Review of International Literature," *Traffic Injury Prevention*, Volume 4.

⁴⁸ "Camera Use Deters Red Light Running in Virginia Community," Status Report, Vol. 33, No. 10, Insurance Institute for Highway Safety, December 5, 1998.