Urban Traffic Calming and Road Safety: Effects and Implications for Practice

January 2012

Summary

For up-to-date knowledge relating to healthy public policy

This summary is the first in a series of five[1] short documents based on a literature review published in 2011.[2] In what follows, we first present the mechanisms of action underlying traffic-calming strategies,[3] as these mechanisms help to explain and predict the effects of calming interventions on the number and severity of collisions. Next, we summarize the results of studies having evaluated two approaches to traffic calming[4] (please refer to the brief descriptions of black-spots and area-wide approaches below). Lastly, we consider the implications of such results for public health actors.

Two approaches to traffic calming

The black-spots approach is typically aimed at improving road safety. It encompasses strategies advocating the installation of calming measures (speed humps, roundabouts, etc.) at one or more specific locations considered to be at high risk for collision.

The area-wide approach, while it also often includes road-safety objectives, aims more generally to improve the living environment. It encompasses intervention strategies whose scope of application is a network comprising more than one street.

Mechanisms of action underlying traffic-calming strategies

Six mechanisms of action help explain and predict the effects of traffic-calming strategies on the number and severity of road collisions.

Reduction of vehicle speeds

The number and severity of collisions tend to increase with speed (Sergerie et al., 2005). It has been shown that increasing speed decreases a driver's field of vision and increases vehicle stopping distance, two factors that decrease the likelihood of a driver being able to stop his or her vehicle in time to avoid a collision, or slow down enough to avoid a collision causing serious injury (Bureau de prévention des accidents, 2008a; 2008b).

Traffic-calming strategies generally aim to reduce driving speeds (often to about 30 km/h), and particularly those of the fastest drivers (Transportation Demand Management Encyclopedia, 2010). Consequently, strategies that succeed on this level should reduce the number and severity of collisions.

Speed homogenization

The presence of speed differentials in the traffic flow increases the likelihood of collisions occurring (Ewing & Edwards, 2009; Ewing, 2000).

Traffic-calming strategies can cause speed differentials, for example, when drivers slow down to go over a speed hump and accelerate afterward, but they can also homogenize speeds by further reducing the speeds of the fastest drivers. Strategies that succeed in equalizing driving speeds should, thus, reduce the number and severity of collisions.

Reduction of traffic volume

The number of road collisions and injuries at a specific location on the road network in urban settings generally depends on the number of motor vehicles that circulate there (Ewing, 2000).

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1 The four other documents focus on air quality, environmental noise, active transportation and inequalities.

2 To consult the comprehensive version of the literature review, please see our document entitled *Urban Traffic Calming and Health: A Literature Review* at: http://www.ncchpp.ca/175/publications.ccnpps?id_article=686.

3 Our definition of "traffic calming" is presented in the introduction to our literature review, and its historical origins are detailed in our document entitled *Traffic Calming: An Equivocal Concept* available at: http://www.ncchpp.ca/175/publications.ccnpps?id_article=648.

4 For a detailed description of the two approaches and the political contexts surrounding them, please see our document entitled *Traffic calming: Political Dimensions* at: http://www.ncchpp.ca/175/Publications.ccnpps?id_article=670.

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Institut national de santé publique Québec

Reducing the amount of motorized travel within an area is typically one of the objectives of calming strategies based on the area-wide approach. Those that succeed on this level are likely to reduce the number of collisions and injuries.

Reduction of the number of conflict points

Conflict points are locations where "the paths of two vehicles, or the path of a vehicle and a cyclist or pedestrian cross or intersect" (Ministère des Transports du Québec, 2007). In general, the risk of collision increases with the number of conflict points.

Certain measures that can be used to calm traffic, such as the installation of roundabouts, reduce the number of conflict points at intersections. Calming strategies that include such measures are thus likely to reduce the number of collisions (Ewing, 1999).

Improvement of visibility and reduction of exposure

Improving the visibility of vulnerable road users (e.g., pedestrians and cyclists) and reducing their exposure to the risk of collision (e.g., by separating them from motorized traffic) can reduce the number of collisions involving them.

Certain measures that can be adopted within the context of calming strategies can act on these two factors. One example would be curb extensions, which improve pedestrian visibility and reduce the distances they have to travel on the roadway. Their use for this purpose should, thus, reduce the number of collisions involving these road users.

Increased driver alertness

Inattention on the part of various road users is often mentioned as a proximal cause of collisions.

Calming strategies, by helping create more complex environments, can induce drivers to pay more attention and, thus, reduce the number of collisions (Ewing, 2000).

Results of evaluative studies

Study results are categorized into the two approaches described to highlight their respective effects.

Effects of the black-spots approach

Reduction of collisions, injuries and deaths

All of the articles consulted report substantial reductions in collisions, injuries and deaths related to the presence of the calming measures evaluated (Retting, Bhagwant, Garder, & Lord, 2001; Stout, Pawlovich, Souleyrette, & Carriquiry, 2006; Mountain, Hirst, & Maher, 2005; Tester, Rutherford, Wald, & Rutherford, 2004). Among the calming measures evaluated, single-lane roundabouts have been shown to be particularly effective, leading to reductions in collisions and personal-injury collisions in the order of 61% and 77% respectively when they replace stop signs, and of 35% and 74% respectively when they replace traffic lights (Retting et al., 2001).

Speeding, collisions, injuries and deaths

One article reports that the more calming measures reduce vehicle speeds, the more effective they are at reducing collisions, injuries and deaths at the locations where they are installed (Mountain et al., 2005). In this regard, calming measures comprising vertical deflections, such as speed humps, stand out among other measures, for they lead to speed reductions in the order of 14 km/h, to reductions in personal-injury collisions of 44% and to reductions in collisions causing serious injury or death of 35% (Mountain et al., 2005).

Effects of the area-wide approach

Reduction of collisions, injuries and deaths

Three meta-analyses focusing on the effects of area-wide strategies report reductions in personal-injury collisions of between 11 and 15% (Bunn et al., 2003; 2009; Elvik, 2001). As regards studies focused on specific area-wide interventions, these all report substantial reductions in collisions, injuries and deaths (Cloke et al., 1999; Grundy, Steinbach, Edwards, Wilkinson, & Green, 2008a; Grundy et al., 2009; Hyden & Várhelyi, 2000; Jones, Lyons, John, & Palmer, 2005; Zein, Geddes, Hemsing, & Johnson, 1997). To take one example, the 399 20-mph (32-km/h) zones installed in London led to a 42% reduction in personal-injury collisions there, which represents, according to the most moderate estimates, 203 fewer injuries per year, including 27 serious injuries or deaths (Grundy et al., 2009).

Protection of the most vulnerable

Neither version of the meta-analysis which focuses on effects on pedestrians notes any effect on this category of user (Bunn et al., 2003; Bunn et al., 2009). The authors suggest that these results could be linked to an increase in pedestrian activity following the calming interventions. As regards studies focused on specific interventions, these report substantial reductions in collisions involving pedestrians, cyclists and motorcyclists (Grundy et al., 2008a; 2009; Hyden & Várhelyi, 2000; Jones et al., 2005). Studies also indicate that these strategies are more effective at protecting children travelling by foot or bicycle than adults using the same modes of travel (Grundy et al., 2008a; 2009; Hyden & Várhelyi, 2000).

Collision migration

Area-wide strategies generally seek to redirect some of the traffic on an area's residential streets toward the main arteries of a road network. Notwithstanding this fact, one meta-analysis (Elvik, 2001) and one of the articles focused on a specific intervention (Grundy et al., 2009) indicate that collisions do not migrate with redirected traffic, but that the number of collisions also decreases on the arteries to which the traffic is redirected (Elvik, 2001; Grundy et al., 2009). However, the studies in question do not explain these results.

Reduction of inequalities

Two studies indicate that area-wide strategies have the potential to help reduce inequalities in road collisions and injuries when they are implemented in deprived areas (Grundy, Steinbach, Edwards, Wilkinson, & Green, 2008b; Jones et al., 2005). For example, the 399 20-mph (32-km/h) zones in London, mainly implemented in deprived areas, led to a 15% reduction in the growth of inequalities in road injuries across London (Grundy et al., 2008b).

Density of installed calming measures

One article indicates that the density of installed calming measures (number of measures/km) in an area is significant, because it is inversely correlated to the rate of child pedestrians injured per 1000 residents (Jones et al., 2005). In other words, the more calming measures per kilometre of road in an area, the fewer child pedestrians are injured.

Implications for practice

Traffic calming is mainly promoted as a way to improve road safety and thus prevent collisions, injuries and deaths. The studies consulted demonstrate that the black-spots and area-wide approaches effectively allow for substantial reductions in the numbers of collisions, injuries and deaths. The promotion of traffic calming for this purpose is thus supported by the evaluative literature.

A noteworthy conclusion of the studies reviewed is that the **black-spots approach** allows for substantial reductions in collisions, injuries and deaths occurring at specific locations with a high risk of collision on a road network. For public health actors wishing to promote this approach, roundabouts, often used at relatively high-volume, high-speed intersections, represent an intervention with a great deal of potential, when the urban context allows for their installation. In particular, single-lane roundabouts are identified as having led to reductions in collisions and personal-injury collisions in the order of 61% and 77% respectively when they replace stop signs, and of 35% and 74% respectively when they replace traffic lights (Retting et al., 2001).[5] The effectiveness of roundabouts is due, in part, to a reduction in vehicle speeds and in the number of conflict points at intersections where they are installed. Another category of calming measures, used mainly on residential streets with low traffic flow, is also of particular interest. Calming measures comprising vertical deflections, such as speed humps, have

Figure 1 A single-lane roundabout

Source: www.flickr.com. Photograph: WSDOT.

[5] In fact, we will be devoting an entire briefing note to roundabouts.

proven particularly effective at reducing personal-injury collisions (-44%) and collisions causing serious injury or death (-35%). These results are due, in particular, to substantial reductions in vehicle speeds (-14 km/h) at locations where these types of calming measures are used (Mountain et al., 2005).

Replacing stop signs with single-lane **roundabouts** allows for reductions in collisions and personal-injury collisions in the order of 61% and 77% respectively. When they replace traffic lights, reductions are in the order of 35% and 74% respectively (Retting et al., 2001).

The main point worth noting with regard to evaluative studies focused on the **area-wide approach** is that this approach allows for substantial reductions in collisions, injuries and deaths occurring throughout an area, without causing these to simply migrate toward adjacent areas. Thus, when a deprived area is targeted for an area-wide intervention, this can help reduce inequalities in road collisions and injuries. To take one example, the 399 20-mph (32-km/h) zones installed in London led to reductions of 42% for personal-injury collisions and of 49% for collisions involving children (0-15 years old) in that area. These data represent, according to the most moderate estimates, 203 fewer persons injured per year, including 27 fewer persons seriously injured or killed. Since these area-wide strategies were mainly implemented in deprived areas, they led to a 15% reduction in the growth of inequalities in road injuries across London (Grundy et al., 2008a; 2008b; 2009). It is also worth noting that it seems preferable to promote strategies that make intensive use of calming measures in intervention areas when the objective is to prevent the greatest number of collisions, injuries and deaths (Jones et al., 2005).

The 399 **20-mph (32-km/h) zones implemented in London** allowed for reductions of 42% in personal-injury collisions and of 49% in collisions involving children (0-15 years old) (Grundy et al., 2008a; 2009).

For public health actors in a position to promote the area-wide approach, three factors seem to indicate that this approach carries greater potential, for urban environments, than the black-spots approach:

1. Because it leads to the implementation of systematically planned strategies in areas comprising several streets, the area-wide approach is better adapted to respond to the **geographic dispersion** of collisions that typically occurs in urban environments;
2. By often aiming to reduce **traffic volumes** on residential streets in calmed areas, whether by encouraging other modes of transportation (e.g., walking, cycling, etc.) or by diverting through traffic using these streets to roads better adapted to receive it, the area-wide approach makes use of an important mechanism of action that black-spots strategies do not usually use;
3. By explicitly managing traffic seeking to avoid the calming measures installed on residential streets by directing it toward roads designed for higher speeds and volumes and by ensuring the safety of the latter, notably, through the use of appropriate calming measures (e.g., curb extensions, roundabouts, etc.), the area-wide approach seems better equipped to prevent "**collision migration**," that is, a displacement of collisions accompanying diverted traffic.

While this briefing note is limited to a presentation of the effects of calming strategies on the number and severity of collisions, the decision to promote such a strategy should be based on a **global perspective** that also takes into consideration its effects on other health determinants. The literature review we carried out demonstrated that, in general, the interventions evaluated: (1) increased per vehicle air pollutant emissions, but that area-wide strategies that reduce traffic volumes can reduce total emissions; (2) reduced environmental noise levels, except for certain strategies that affected heavy vehicles and; (3) were, in some cases, accompanied by an increase in active travel, although it was not possible to determine why this increase was not observed in other cases (Bellefleur & Gagnon, 2011). In urban environments, the mechanisms of action lead to the conclusion that better results can be expected from strategies based on the area-wide approach. However, excepting the effects on air pollutant emissions, the evaluative studies are inconclusive in this regard.

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Author: Olivier Bellefleur, National Collaborating Centre for Healthy Public Policy

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