



PART 4

Important Considerations for Improving Pedestrian Safety Around Transit Buses

Parts 1 through 3 of this Guidebook provide a presentation of strategies for mitigating bus-and-pedestrian collisions in several different ways. Part 1 of this Guidebook presents some contributing factors to the four primary types of bus-and-pedestrian collisions, as well as a list of strategies for mitigating collisions. Part 2 presents strategies and provides detailed information about particular agency and stakeholder applications of each strategy. Part 3 presents case studies of actual situations in which agencies have implemented strategies to mitigate pedestrian collisions; why and how the strategies were selected; and the results, if any, of the implementation.

This fourth section of the Guidebook presents a discussion of pedestrian-and-bus safety from a more top-down, holistic approach. First, this section discusses contributing factors that are not necessarily directly linked to one of the four primary types of bus-and-pedestrian collisions. While not directly linked to a particular collision type, the contributing factors discussed here were reported by transit agencies and other stakeholders as playing an important contributing role in bus-and-pedestrian collisions. By understanding the indirect links these factors have to bus-and-pedestrian collisions, agencies and stakeholders can develop mitigation strategies that could not only improve pedestrian safety, but that also might result in an overall improvement in safety. Second, this section looks at how the combination of two or more strategies presented in this Guidebook can add to the potential for success in reducing bus-and-pedestrian collisions and in improving overall safety.

4.1 General Factors that Contribute to Bus-and-Pedestrian Collisions

Part 1 of this Guidebook discussed factors that contribute to each of the four primary types of bus-and-pedestrian collisions. However, during the research process, transit agencies and stakeholders reported a large number of contributing factors they felt were important, but that could not necessarily be directly linked to one of the primary four collision types. Rather, these contributing factors could contribute to any of the collision types and even to collisions with other vehicles. These factors include

- Operator distraction, multi-tasking, and fatigue;
- Pedestrian inattention and distraction;
- Tight or problematic schedules;
- Timing/scheduling of buses;
- Lack of training and follow-up enforcement by transit agency; and
- Lack of pedestrian friendly environments.

Understanding the indirect links that these general issues have to bus-and-pedestrian collisions can foster the development of mitigation strategies. These strategies, then, are not only

likely to reduce the occurrence of bus-and-pedestrian collisions, but are also likely to reduce other types of collisions, resulting in improved overall safety. Each of these contributing factors is discussed in more detail below.

4.1.1 Operator Distraction, Multi-Tasking, and Fatigue

The issue of operator distraction was raised by transit agencies and different stakeholders, including operators. Operator distraction does not necessarily suggest negligence on the part of the operator: distractions were often linked to the “stressful and distracting” environment in which the operators work, as a variety of things are constantly competing for the operators’ attention (e.g., vehicle traffic, passengers, on-board electronic equipment, inclement weather, and poor lighting). It is a common belief amongst the agencies and stakeholders participating in this research that the occurrence of collisions with pedestrians during left-turns is linked to the fact that the operators must focus on finding a gap in oncoming traffic to make the turn and, while doing so, lose sight of pedestrians in the crosswalk.

Exacerbating the problem of a distracting environment is the issue of operator multi-tasking. An operator’s workload includes performing multiple physical and cognitive duties from simple driving behaviors, to implementing procedures unique to bus operations, to providing good customer service and monitoring a route schedule. While the issues of distraction and multi-tasking are somewhat overlapping (operators are sometimes distracted due to their multi-tasking), strategies for countering operator multi-tasking may be different than strategies for countering operator distraction; therefore, it is important to note the distinction of the issues, as well as the overlap.

Bus operator fatigue was also reported as a potential contributing factor to bus-and-pedestrian collisions by a number of agencies and stakeholders. Fatigue is a result of both time spent driving and length of wakefulness (i.e., amount of time since the operator last slept). When overly tired, humans do not function optimally, which can result in slower reaction times and errors or misjudgments that they otherwise may not normally make in the same situation.

Analysis of the collision data showed that operator time on duty does in fact appear to play a role in the occurrence of bus-and-pedestrian collisions. The length of time that the operator was on duty was reported in 94 of the incident records. As shown in Figure 4-1, the number of inci-



Figure 4-1. Number of bus-and-pedestrian collisions by driver time on duty.

dents compared with the number of hours on duty remained steady (at about 8 to 9 incidents) for every hour worked until 5 hours. After 5 hours on duty, the number of incidents almost doubled. At 5 and 6 hours on duty, the number of incidents jumped to 16. Above 6 hours on duty, the number of incidents begins to fall. This drop is most likely due to the fact that there are fewer shifts that extend beyond 6 to 7 hours.

Operator distraction, multi-tasking, and fatigue could lead to any type of collision; however, the relevance of discussing these issues in this Guidebook is that pedestrians are the most vulnerable road users. Due to pedestrians' size (as compared with automobiles) and the speed at which they move relative to a bus, operators—if distracted or overly tired—are more likely to overlook a pedestrian than they are to overlook another vehicle. For example, a distracted or multi-tasking operator may just happen to catch a moving vehicle in his or her peripheral vision in enough time to avoid a collision. Due to the size and movement of pedestrians, in the same situation the pedestrians are far less likely to catch the eye of the operator before a collision occurs.

Therefore, the environment in which the operator operates, the tasks he or she is asked to manage, and the number and combination of hours and days an operator works in a week are important issues to consider when thinking about pedestrian safety. One suggested strategy was to minimize on-board operator tasks such as eliminating the need for operators to collect fares by using smart cards.

4.1.2 Pedestrian Inattention and Distraction

Bus-and-pedestrian collisions involve two parties: the bus operator and the pedestrian. While bus operator distraction, multi-tasking, and fatigue can lead to collisions with pedestrians, pedestrian inattention and distraction can also lead to collisions. Getting pedestrians to understand, appreciate, and respect their role in their own safety is an important part of reducing the occurrence of bus-and-pedestrian collisions. Pedestrians are often times distracted by the use of cell phones and other portable electronic devices. For instance, pedestrians who use earphones may not be paying attention to their surroundings; however, they also may not be able to pick up important audible cues that could warn them of potential danger.

Even pedestrians admit to being in a hurry too often. Pedestrians, like operators, are less likely to respect other road users when they are in a hurry or running late, especially if they are trying to catch a bus that is about to leave. Other pedestrian behaviors that were reported as contributing factors to bus-and-pedestrian collisions included not using crosswalks, challenging the right-of-way, and violating the traffic signals.

With all of these pedestrian-related contributing factors, there is a place for well-planned and well-developed pedestrian outreach and education in an overall pedestrian safety program. Education programs like Transit 101 (see Table 2-7 and Section 3.2.2) have been successful at keeping pedestrians on a college campus from being involved in bus-and-pedestrian collisions and are relatively low in cost.

4.1.3 Tight or Problematic Schedules

Tight or problematic schedules were also reported by agencies, pedestrian groups, and operators as a contributing factor in collisions, particularly in bus-and-pedestrian collisions. Schedules that are too tight or unrealistically set can lead to operators getting off schedule, which can result in the operators being counseled by their supervisors. In an attempt to avoid counseling, operators may feel they have to rush to stay on schedule and to make up time on their runs. It is human nature that when we rush, we lose sight of things that we otherwise would not.

There were a number of suggested strategies involving bus schedules. Stakeholders, particularly bus operators, suggested more realistic schedules and more time to complete routes. One interesting suggestion was to bring together the scheduling department and the operators to talk about the schedules. By doing this, operators would have the opportunity to voice their concerns about routes with problematic schedules and their potential safety consequences.

4.1.4 Timing/Scheduling of Buses

There was a lot of discussion during both pedestrian focus groups about safety issues surrounding the timing of buses at transfer locations. Most of the pedestrians felt that when the buses are not well timed or do not arrive when they should (i.e., they are behind schedule), it can put bus riders in a position of running to catch a bus. In addition, the actual bus stop placement at these locations (usually intersections) can add to the problem. For example, if bus riders must alight one bus and then cross to the far side of the intersection to catch their next bus, bus schedules, heavy traffic, and poorly timed signals (e.g., not providing enough time for pedestrians to cross or providing too much time to the major street as compared with the minor street) can make it nearly impossible for a rider to make a smooth transfer.

At locations where a number of bus lines stop at the same location, bus stops should be well thought out and well laid out, and bus schedules should be developed to accommodate riders making transfers. Signal timing—such as the pedestrian scramble (i.e., all pedestrian phase)—might also be altered to accommodate pedestrians at busy times of the day.

4.1.5 Lack of Training and Follow-up Enforcement by Transit Agency

Agencies should take responsibility for providing quality training that places a focus on operator retention; the rules, policies, and procedures that are set forth in the training program should be enforced. For example, while operator cell phone use while driving is almost always forbidden, it was reported that it is not always enforced. When policies are not enforced and operators are not held accountable, they will have no respect for the policy. A reward system could be put in place to provide praise to operators who uphold safety policies and procedures, which will also contribute to operator retention. In the long run, the agency will save money as there will be more experienced operators and fewer new hires who need training. Experienced, well-trained operators with good safety records will result in fewer collisions and fewer claims.

4.1.6 Lack of Pedestrian Friendly Environments

Another big issue voiced by the pedestrian groups was the need for more pedestrian-friendly environments. There was a reported “lack of sensitivity about investing in walkable, pedestrian friendly environments around transit stops and along transit corridors.” Pedestrians also reported they had seen collisions that occurred when people slipped or tripped on poor sidewalks and fell under a bus. In fact, broken and uneven sidewalks, narrow sidewalks, sidewalk obstacles, and lack of sidewalks or other positive separation were all rated as being some of the most common hazards to pedestrians by the pedestrian focus groups.

Improving sidewalks, removing obstacles, and providing pedestrian-friendly amenities at and around bus stop locations could be an effective way of reducing collisions involving pedestrians falling under the bus. Partnerships with the local department of transportation or public works, as well as pedestrian advocacy groups and input from the public, will assist with the identification of stops most in need and strategies most likely to improve pedestrian safety.

4.2 Combining Strategies for Added Potential for Success

This research has shown that the circumstances of and contributing factors to bus-and-pedestrian collisions are multi-faceted. For any collision type, the bus operator, the pedestrian, and the environment (i.e., bus design, bus stop location, and roadway geometry) play a part. There is no simple single answer to mitigating collisions. Instead, various approaches may reduce collision frequency, severity, or both. In many cases, implementing two or more strategies in combination might make the most sense and provide the “biggest bang for the buck.” Some principles for successful strategy selection include the following:

- **Consider all circumstances.** When a collision occurs, it is tempting to focus on the assignment of fault. However, this research shows that it is likely that multiple factors contributed to a collision—the pedestrian, the bus operator, and the environment. Implementing a strategy that focuses only on one aspect of the collision overlooks the depth of the collision problem. For instance, we must assume that humans are prone to error. Thus, bus operators and pedestrians must both behave defensively when navigating roads, assuming the worst about the other’s intentions. The extra energy and costs involved in fully addressing the collision problem (versus narrowly focusing on one aspect) might in the long-run be the most economical approach.
- **Collaborate and partner.** When a collision occurs, the results are felt most directly by the pedestrian, the bus operator, their families, and the transit agency. Also impacted, however, are many in the community at large (pedestrians and bus riders, law enforcement officials, transportation engineers, etc.). When implementing a collision mitigation plan, it is wise to take advantage of all of these stakeholders through brainstorming, collaboration, and partnership to implement a pedestrian-and-bus safety plan. Bringing together a “meeting of the minds” will contribute to greater success of the mitigation strategies and the safety program as a whole.
- **Follow-up.** Once an application is in place, follow-up is required in order to promote success of the application. Follow-up could include enforcement of a policy or procedure (through on-board or roadside safety checks or observations) or of a law (through police enforcement). Follow-up could include refresher training or safety reminders posted at regular intervals, counts of near misses and related incidents, and candid discussions with operators and pedestrians.
- **Evaluate.** One challenge of this research was to assess the success and effectiveness of the applications. Bus-and-pedestrian collisions, while often catastrophic, are relatively infrequent. Thus, before-and-after measures of the number of collisions are often an inappropriate approach to measuring success due to the length of time needed to gather and analyze a statistically significant set of data. Instead, candid discussions with operators and pedestrians and subsequent analysis of the information should be used to assess whether the application is having the intended results. Measures of effectiveness could be near misses; claims; and ratings of success by operators, bus riders, and community stakeholders. In addition, the accurate, consistent, and detailed reporting of information associated with bus-and-pedestrian collisions will greatly improve the ability to determine causal factors, as well as appropriate solutions.

The following are some examples of how to combine two or more different types of strategies in order to increase the success of the individual strategies implemented alone.

4.2.1 Policy and Pedestrian Outreach

Running after buses was one of the most commonly reported behaviors resulting in bus-and-pedestrian collisions across all stakeholder groups. One suggested application to counter this

problem was to set the policy of not stopping to let passengers on after the bus has left the stop. While some agencies have these policies, many leave it up to the operator's discretion to determine whether it is safe to stop and let a rider on the bus. Stopping at non-stop locations can be very dangerous, not only to the pedestrian, but also to other operators. When operators do stop to let passengers on after they have left the stop, it reinforces the running behavior because passengers know the bus will stop for them. On the other hand, if the operator does not stop, it is viewed as poor customer service by bus patrons.

When it comes to this situation, there is a definite conflict between safety and customer service. Ironically, not stopping for pedestrians is in their best interest, as well as in the interest of other road users who could be impacted by a bus stopping where it is not supposed to.

This situation requires a multi-faceted approach. The policy of not stopping for passengers who are not at a stop is a good one; however, the transit agency must uphold its duty to provide reliable bus service. If buses arrive at stops in “clumps,” passengers will have no reason to wait for the next bus because there is no telling when the next bus will arrive—and passengers know it. If running after buses is an issue on routes where bus service is reliable, the policy of not stopping outside of designated stop locations could be implemented hand in hand with a public education and outreach program. Posters could be hung at stops, shelters, or on-board buses, and flyers could be handed to passengers letting them know of the new policy and why it is going into effect. It should be explained to them that it is for their own safety as well as the safety of others. In return for riders not running after the bus, the transit agency might let the riders know how they are working to keep the buses on schedule so that riders will not have to wait too long for the next bus or that the agency is adding extra service or an extra bus at the end of the day. By doing so, riders will be more understanding and accepting of the policy and will feel that there is a “give-and-take” exchange on the part of the transit agency not only to improve safety, but also to improve service.

4.2.2 Defensive-Driving Techniques, Policies, Training, and Enforcement

Defensive driving can be an effective way of improving bus safety around pedestrians. Defensive-driving techniques and policies can be developed in an attempt to mitigate future collisions. After developed, the bus operator must apply the techniques and policies with knowledge, judgment, and skill; therefore, operating techniques and policies should be implemented as part of an operator training program. New hires should be taught the techniques and policies, and these techniques and policies can be reinforced through refresher training. But this is not enough. In order to have continued success with special techniques and policies, the transit agency must be committed to keeping the ideas in the forefront of operators' minds. This can be done relatively inexpensively through bulletins, posters, flyers, and videos that express the importance of the techniques and policies, as well as the commitment of the agency and drivers to upholding them. Finally, operator use of the strategies can be checked or reinforced through on-board and roadway observations. Check rides or proficiency checks may be performed by agency staff or a contracted service.

When carried out as part of new hire and refresher training, the cost of implementing specific operating techniques and policies is relatively low since it is only one of several components of the training program. The cost, however, can be high if the techniques and policies are implemented to address a particular pedestrian safety issue and are outside of the usual operator training cycle.

4.2.3 Lack of Lighting and Visual Obstructions

Lack of lighting and visual obstructions were both big issues voiced by many stakeholders. Both issues deal with the ability of the operator to see pedestrians whether waiting at a stop or

shelter or when crossing the street. An operator's visibility is reportedly limited due to bus features (e.g., mirrors, farebox, or door) and roadway features that block the line of sight from the driver's seat to pedestrians (e.g., light poles, traffic signals, trash cans, electrical boxes, and vendors). Therefore, when a location is found to have problems with bus operators reportedly not seeing pedestrians, the problem should be addressed from different angles.

Lack of lighting was rated by both pedestrian groups and one stakeholder group as one of the most common hazards to pedestrians. Agencies should solicit information from operators and the public about locations with particular lighting problems. There are a variety of low-cost solutions that can be implemented, including retro-reflective paddles, flashing beacons, and pocket and pen lights (see Table 2-12). The cost effectiveness of these strategies will be improved if potential problem locations are examined on a case-by-case basis rather than taking a one-size-fits-all approach.

Bus design and its impact on operator visibility are controversial. Some agencies reported that bus features can cause obstructions that play a role in collisions, while others did not agree. Bus operators almost always reported that bus features can cause visibility problems that can lead to collisions. To counter visual obstructions on buses, agencies should work with operators and manufacturers to minimize the impacts of the bus-related obstructions (e.g., mirror size and placement). As mirror size, configuration, and placement are challenging and ongoing issues for many transit agencies, agencies could participate in peer-exchange activities to share ideas, successes, and failures.

To counter visual obstructions outside of the bus, transit agencies should develop partnerships and working relationships with their local DOT or public works—as well as pedestrian advocacy group—to identify problem locations and to create workable solutions that involve removing or re-locating objects and bus stops and shelters to locations where obstructions are minimized or eliminated.