

## MODULE 3 • Injury Prevention & Crash Dynamics

### Module Agenda: 45 Minutes

Topic	Suggested Timing
1. Introduction	3
2. Challenges to Crash Survival <ul style="list-style-type: none"> <li>• Pairs Activity: How to Use Statistics and Information</li> </ul>	12
3. The Concept of Crash Forces <ul style="list-style-type: none"> <li>• Video: 3 Stages of a Collision</li> <li>• Progress Check: Estimating Restraining Force</li> </ul>	20
4. Five Ways That Car Seats, Booster Seats, and Seat Belts Prevent Injury	5
5. Progress Check and Summary	5
<b>TOTAL</b>	<b>45 Minutes</b>

### Module Purpose

The purpose of this module is to provide participants with an opportunity to explore challenges to crash survival, including what happens during a vehicle crash. Specific ways that car seats, booster seats, and seat belts prevent or reduce the severity of injuries will also be addressed.

### Module Objectives

- Describe challenges to crash survival.
- Explain the concept of crash forces.
- Describe five ways that car seats, booster seats, and seat belts prevent injury.

### Special Media, Materials, and Resources

None

### Video Titles and Times

3 Stages of a Collision, 1:34 minutes (PPT 3-7)

### Activities

- Pairs Activity: How to Use Statistics and Information
- Progress Check: Estimating Restraining Force
- Final Progress Check

## Preparation

- Prepare to conduct the activities and progress checks.
- Review the video for this module and become familiar with the three collisions in a crash.
- Many resources are available to help participants understand the concepts in this module. Direct participants to national resources and encourage them to seek out local data specific to their community. In addition to those listed below, refer to other resources listed in this module.
  - Check for an updated listing of the National Child Passenger Safety Resources provided on the NCPSPB website at [www.cpsboard.org](http://www.cpsboard.org).
  - Research and be able to provide your participants with current injury data both locally and nationally. A possible resource is the state Highway Safety Office. To find a state Highway Safety office, go to [www.ghsa.org](http://www.ghsa.org).
  - For current car seat, booster seat, and seat belt usage rates to share with participants, refer to the most recent National Occupant Protection Use Survey and the Partners for Child Passenger Safety website at [www.nhtsa.gov](http://www.nhtsa.gov) (search NOPUS).
  - For additional injury data to share with participants, go to the Centers for Disease Control and Prevention at [www.cdc.gov/injury/WISQARS](http://www.cdc.gov/injury/WISQARS).

## 1. Introduction



### Display PPT 3-1.



Present module purpose.

The purpose of this module is to provide you with an opportunity to explore challenges to crash survival, including what happens during a vehicle crash. We will also look at ways that car seats, booster seats, and seat belts prevent or reduce the severity of injuries.

Our goal as CPS Technicians is to educate children and caregivers to make buckling up a habit for life.



### Display PPT 3-2.



Present module objectives.

As a result of this module, you will be able to:

- Describe the challenges to crash survival.
- Explain the concept of crash forces.
- Describe five ways that car seats, booster seats, and seat belts prevent injury.

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## 2. Challenges to Crash Survival



### Reference TG page 3-1.



Present an introduction to injury prevention and crashes.

Let's begin this module with a few overarching points about injury prevention and crashes.

- Motor vehicle crashes are a leading cause of death in the U.S. (CDC, 2013).
- Injury prevention is a process used to decrease injuries or death due to an injury. However, it does not work 100 percent of the time. Why not?
- There are many factors in a crash that determine the outcomes such as vehicle size, speed, and point of impact. We'll be taking a closer look at these and other factors.



### Display PPT 3-3.



Present challenges related to children, car seats, booster seats, and seat belts.

Let's first review challenges we face related to children, car seats, booster seats, and seat belts in regards to crashes.

- Car seat, booster seat, and seat belt use decrease, as children get older. Most children are restrained during the first year of life because they appear to be more fragile and need more protection (NHTSA, 2010).
- Car seat, booster seat, and seat belt misuse rates vary from 74 to 90 percent (NHTSA, 2005).
- Misuse and nonuse are important issues to address with caregivers.
- Correct selection, installation, and use of a car seat can be challenging.

**Display PPT 3-4.**

- Caregivers may have outdated or incorrect information about car seats, booster seats, and seat belts.
- Caregivers may not choose best practice over personal preferences or actual safety over perceived safety. For example, caregivers might prioritize wanting to see the child more easily and move the child to a forward-facing car seat over best practice recommendations.

Because the heads of young children are disproportionately large compared to their bodies, and their pelvic bones and spines are underdeveloped, correctly installed and used car seats, booster seats, and seat belts help to protect children in vehicles.

**Display PPT 3-5.**

Fatalities are just the tip of the iceberg. Many more injuries occur than deaths each year. Some injuries have lifelong effects and can be costly.

We must provide caregivers with the information and resources they need to prevent injuries and deaths.

**Conduct a pairs activity.**

Take a couple minutes to talk with a partner about the statistics and information we have just reviewed. The information is also in your TG on page 1 of this module.

Think about the following question with your partner and be prepared to share your thoughts.



Ask question.

***Q. Which of the statistics or information from page 1 of this module do you think would be most valuable to share with caregivers?***

**[INSTRUCTOR NOTE]**

[Ask for two to three pairs to share the statistics or information they chose, reasons for their choice, and ways they would use the information. Make observations about similarities and differences between the choices.]



Present key points about the value of car seat, booster seat, and seat belt education.

By understanding the correct use of car seats, booster seats, and seat belts, it is easy to see errors and misuse – and offer information and resources to caregivers to correct the errors and misuse.

- It is harder to change the views and actions of those not using car seats, booster seats, and seat belts.
- An example of changing the actions of others might be to have the caregiver move a child to the rear seat of the car. That behavior may conflict with caregiver's desires or beliefs that they want to see the child easily or believe that their child is ready to "graduate" to seat belts and front-seat riding.
- Your job as a CPS Technician is to educate caregivers about correct use overall and how to avoid future misuse.
- Remind caregivers that children may not hear what you say, but they will do what you do. Caregivers must buckle up!



**Reference TG  
page 3-2.**



Present resources for injury statistics, misuse rates, and related data.

A list of resources for current data is available at [www.cpsboard.org](http://www.cpsboard.org). Review educational materials (articles, websites, videos, brochures, handouts, etc.) every year to be sure you are providing accurate and current information.

Examples of available resources include:

- American Academy of Pediatrics (AAP) at <http://www.aap.org>
- Car seat and booster seat and vehicle manufacturer websites
- Centers for Disease Control and Prevention (CDC) at [www.cdc.gov/injury/WISQARS](http://www.cdc.gov/injury/WISQARS)

- Children’s Hospital of Philadelphia (CHOP) at <http://www.chop.edu/service/car-seat-safety-for-kids/index.html>
- Governors Highway Safety Administration (GHSA) at [www.ghsa.org](http://www.ghsa.org)
- Insurance Institute for Highway Safety (IIHS) at [www.highwaysafety.org](http://www.highwaysafety.org) or <http://www.iihs.org>
- National Highway Traffic Safety Administration (NHTSA) at [www.safercar.gov](http://www.safercar.gov)
- NHTSA’s National Center for Statistics and Analysis (NCSA) at [www.nhts.gov](http://www.nhts.gov)
- Safe Kids Worldwide at <http://www.safekids.org>
- State and local health departments

**[INSTRUCTOR NOTE]**

[Explain that misuse rates vary depending upon what is considered misuse by the organization doing the survey. Local misuse information should be used if available.]

There are a few reasons why misuse statistics vary. Some are based on studies that only look at harnessed car seats, while others include booster seats (which often have a substantially lower misuse rate than car seats). Some studies include all types of misuse while others focus more on what is defined as a “critical” misuse.]



Transition to crash forces.

Now, let’s learn about crash forces.

### 3. The Concept of Crash Forces



Reference TG page 3-2.



Display PPT 3-6.



Introduce factors related to injury prevention.

There are many factors related to injury prevention that must be considered before, during, and after a crash to prevent or minimize injuries from occurring. Here are a few examples:

- Road conditions before the crash
- Car seat use during the crash
- Seat belt use (such as using lap belt correctly or incorrectly) during the crash
- Emergency response time after the crash



Present the concept of crash forces.

You might do everything correctly when driving safely and still get into a collision. One way to understand the value of occupant protection and how it helps you survive a collision is to look at the dynamics of a collision. Every vehicle collision actually includes three crashes:

- The vehicle crash
- The human crash
- The internal crash



Reference TG  
page 3-3.



Display PPT 3-7.



Introduce 3 Stages of  
a Collision video  
(1.34 minutes).

Let's watch the 3 Stages of a Collision video to learn more about these crashes.

- Watch carefully for the crashes or stages of a collision.
- Take notes about the characteristics of each crash in your TG as you watch the video.



Play 3 Stages of a  
Collision video.



Ask questions.

***Q. What new information about a crash did you learn from the video? What points are important to emphasize with caregivers?***

A. When talking to caregivers, always emphasize how best practices prevent collisions and each type of crash – vehicle, human, and internal.

### [INSTRUCTOR NOTE]

[As participants share responses, provide clarifications and/or raise additional points that should be shared with caregivers. Tell participants that a summary of the three crashes is in their TGs.]



Display PPT 3-8.



Reference TG  
page 3-4.



Transition to restraining force.

In any crash, even a minor one, occupants in a vehicle can be seriously injured. Most people are unaware how much force a vehicle has when moving. Consider:

- A vehicle going 40 mph would hit a tree with the same force as hitting the ground after falling off a 50-foot cliff. A person inside the vehicle would hit the windshield with the same force as hitting the ground after a fall from a 5-story building.
- It is important for caregivers to understand that the forces involved in a crash can kill or cause serious injuries to themselves and their child.
- One way to help caregivers understand such forces is to explain that the force needed to restrain an occupant approximately equals the weight of the occupant multiplied by the vehicle speed.

**Example:** A 10-pound infant in a vehicle moving at 30 miles per hour could require at least 300 pounds ( $10 \times 30 = 300$ ) of restraining force to keep from moving forward.

When talking with caregivers, it is important to emphasize that:

- Holding a child in their lap or unrestrained presents great risk to the unbelted child.
- Unbuckled front or back seat passengers can hit and injure or kill other people in the vehicle as can loose objects like toys.



**Reference TG**  
page 3-4.



Conduct a progress check.

Take a couple of minutes to calculate restraining forces.

Estimate restraining force using your weight and a crash at 30 miles per hour.



Ask questions and respond to comments.

***Q. Does someone have an example they would like to share? How did you calculate that restraining force?***



**Display PPT 3-9.**



Introduce types of crashes.

Dangerous crash events can occur in almost any type of collision or chain of crash events. Here are the most common types of crashes and their related injuries.





Transition to rollovers, rotations, and ejections.

- Frontal crashes are the most frequent and can result in head, neck, upper body, and lower body injuries.
- Rear-end crashes are also common and can result in back and neck injuries.
- Lateral or side impact crashes can result in torso, head, hip, and leg injuries.
- A **rollover** crash occurs when the vehicle rolls over onto its side or top (upside down) one or more times. A **vault** is similar, but the vehicle flips end over end. A rollover/vault is often responsible for occupants being thrown from vehicles.
- In a **rotation** (or spin), unrestrained occupants are more likely to be injured as they hit the vehicle interior repeatedly and are much more likely to be thrown from the vehicle than restrained occupants.
- In an **ejection**, vehicle occupants are thrown out a window or door, skid along the pavement, and may be pinned or crushed under a vehicle. Landing gently on a soft surface is highly unlikely.
- A common myth about car seat, booster seat, and seat belt use is that occupants are better off being thrown clear of a crash. People thrown from a vehicle are four times more likely to be killed than those who remain inside (NHTSA, 2009).

Even in the very rare chance of a vehicle fire or landing in the water, a properly belted occupant is more likely to be uninjured and conscious, thus able to exit from the vehicle.



Ask questions and respond to comments.

***Q. What questions do you have about crash forces and the risks associated with not being belted in a crash?***



Transition to ways that car seats, booster seats, and seat belts prevent injuries.

Now let's look closely at how car seats, booster seats, and seat belts help to prevent injuries and deaths.

#### 4. Five Ways That Car Seats, Booster Seats, and Seat Belts Prevent Injury



**Reference TG**  
page 3-5.



Introduce ways that car seats, booster seats, and seat belts prevent injuries.

The use of car seats, booster seats, and seat belts is one of the most important actions that can be taken to prevent injury in a vehicle crash.

- While car seats, booster seats, and seat belts do not prevent crashes from taking place, they play a major role in reducing the severity of injury to vehicle occupants involved in a collision.
- An occupant's chance of survival increases dramatically when appropriately restrained.



**Display PPT 3-10.**



Present five ways that car seats, booster seats, and seat belts prevent injury.

Here are five main ways that car seats, booster seats, and seat belts prevent injury. They:

- Keep people in the vehicle.
- Contact the strongest parts of the body.
- Spread forces over a wide area of the body.
- Help the body to slow or "ride down" the crash forces.
- Protect the head, brain, and spinal cord.

#### [INSTRUCTOR NOTE]

[It is important that participants understand these five key points to educate caregivers effectively about preventing or reducing injuries through proper car seat, booster seat, and seat belt use.

Use the following as an example of spreading crash forces:

- Poke your arm with your finger directly with pressure.
- Do you feel it in one place or all over? If you did it hard enough and long enough, could it possibly cause a bruise or sore spot?
- Now, use the palm of your hand with the same pressure. Does it feel the same?

- The force has been spread to a wider area and is not as intense.

Also emphasize that unbuckled front or back seat passengers can hit and injure or kill other people in the vehicle.]



**Reference TG**  
page 3-6.



Present additional information about how car seats, booster seats, and seat belts prevent injury.

Here are additional important points to understand and emphasize when talking with caregivers or others.

### **[INSTRUCTOR NOTE]**

[Highlight additional points from TG as time permits.]

- Car seats, booster seats, and seat belts are designed to contact the body at the strongest parts of its structure. For an older child and adult, these parts are the hips and shoulders.
- Car seats, booster seats, and seat belts are designed to spread crash forces over a wide area of the body, putting less stress on any one part.
  - Lap-and-shoulder belts and car seat harnesses spread the force across a large area of the body.
  - A rear-facing car seat spreads the crash force across the shell of the seat, protecting the child's head, neck and spinal cord.
- A quick change in speed is what causes injury.
  - During a motor vehicle crash, the vehicle crush zones help to extend the time it takes for the vehicle and its occupants to slow down.
  - Car seats, booster seats, and seat belts allow the body to slow down with the crash. This extends the time when the occupant experiences the forces during a crash.
- A shoulder belt or harness helps to keep the head and upper body away from the hard interior surface of the vehicle.



Ask question and respond to comments.

***Q. What questions do you have about the ways that car seats, booster seats, and seat belts prevent injuries?***



**Display PPT 3-11.**



Conclude topic.

Remember the following points:

- Car seats/booster seats, seat belts, and air bags = the best chance of survival.
- An occupant's chance of survival increases dramatically when appropriately restrained.
- As CPS Technicians, we can also share information with caregivers to ensure children are safe in and around vehicles even when not on the road. Tips for discussing injury prevention are located in your TG on page 3-6.

## 5. Progress Check and Summary



**Reference TG page 3-7.**

### [INSTRUCTOR NOTE]

[Conduct the following progress check as a large group activity. Pose each question and ask for responses from the group. Add any information not provided by participants.]



Conduct progress check.

Let's review what we learned in Module 3 through a progress check. Answer questions to prepare for conversations you will have with caregivers to educate them about injury prevention and crash dynamics. Write down correct responses in your TG.

1. What are two challenges related to children, crash survival, and car seat, booster seat, and seat belt use?

#### **Answers:**

- Car seat, booster seat, and seat belt use decrease, as children get older. Most children are restrained during the first year of life because they appear to be more fragile and need more protection.
- Car seat, booster seat, and seat belt misuse rates vary from 74 to 90 percent. Misuse and nonuse are both issues to address with caregivers.

- Correct selection, installation, and use of car seats can be challenging.
  - Caregivers may have outdated or incorrect information about car seats, booster seats, and seat belts.
  - Caregivers may not choose best practice over personal preferences or actual safety over perceived safety. For example, caregivers might prioritize wanting to see the child more easily and move the child to a forward-facing car seat over best practice recommendations.
2. What are the three crashes involved in every vehicle collision?

**Answer:**

- Vehicle crash
  - Human crash
  - Internal crash
3. What is the equation for estimating restraining force?
- Answer:** WEIGHT X SPEED = RESTRAINING FORCE
4. How much force would a 10-pound infant in a vehicle moving at 40 mph require to keep from moving forward?
- Answer:** At least 400 pounds of force to keep from moving forward
5. What are the five ways car seats, booster seats, and seat belts help prevent or reduce injuries?

**Answer:**

- Keep people in the vehicle.
- Contact the strongest parts of the body.
- Spread forces over a wide area of the body.
- Help the body to slow or "ride down" down the crash forces.
- Protect the head, brain and spinal cord.



Conclude module.

Remember, the best way to reduce injury in a crash is through correct use of car seats, booster seats, and seat belts.

Now that you are more familiar with injury prevention and crash dynamic principles, let's take a closer look at occupant protection systems that consist of seat belts, air bags, and car seats and booster seats.

- When used properly, the vehicle's occupant protection system saves lives.
- As a CPS Technician, you play an important role in teaching caregivers about the correct use of these systems.