World Health Organization

FIA FOUNDATION

GLOBAL ROAD SAFETY PARTNERSHIP

WORLD BANK GROUP

OCCUPANT RESTRAINTS

A road safety manual for decision-makers and practitioners

Second edition

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Contents

Preface

Road traffic injuries are a major public health problem and a leading cause of death and injury around the world. Each year, approximately 1.3 million people die and millions more are injured or disabled as a result of road traffic crashes, mostly in low- and middle-income countries. As well as creating enormous social costs for individuals, families and communities, road traffic injuries place a heavy burden on health services and economies. The cost to countries, many of which already struggle with economic development, may be as much as 5% of their gross national product.

As motorization increases, preventing road traffic crashes and the injuries they inflict will become an increasing social and economic challenge, particularly in low- and middle-income countries. If the present trend continues, road traffic injuries will increase dramatically in most parts of the world over the next two decades, with the greatest impact falling on the most vulnerable citizens.

Appropriate and targeted action is needed urgently. The World Report on Road Traffic Injury Prevention, launched jointly in 2004 by the World Health Organization (WHO) and the World Bank, identified improvements in road safety management and specific actions that have led to dramatic decreases in road traffic deaths and injuries in industrialized countries active in road safety. The report showed that use of seat-belts, helmets and child restraints has saved thousands of lives. Introduction of speed limits, creation of safer infrastructure, enforcement of limits on blood alcohol concentration while driving, and improvements in vehicle safety are all interventions that have been tested and repeatedly shown to be effective.

The international community must continue to take the lead to encourage good practice in road safety management and implementation of the interventions identified above in other countries, in ways that are culturally appropriate. To speed up such efforts, the United Nations General Assembly has passed several resolutions urging that greater attention and resources be directed towards the global road safety crisis. These resolutions stress the importance of international collaboration in the field of road safety.

These resolutions also reaffirm the United Nations commitment to this issue, encouraging Member States to implement the recommendations of the World Report on Road Traffic Injury Prevention and commending collaborative road safety initiatives so far. They encourage Member States to focus on addressing key risk factors and establishing lead agencies and coordination mechanisms for road safety. These were further encouraged through the Moscow Declaration (2009), the Brasilia Declaration (2015) and the Stockholm Declaration (2020).

To contribute to the implementation of these resolutions, the FIA Foundation, the Global Road Safety Partnership, the World Bank and the World Health Organization have collaborated to produce a series of good practice manuals aimed at policy-makers and practitioners. This manual on occupant restraints is one of them.

Initially published 2009, this manual has been updated to include new evidence and case studies. Each manual provides guidance to countries wishing to improve road safety organization and implement the specific road safety interventions outlined in the World Report on Road Traffic Injury Prevention. The manuals propose simple, cost-effective solutions that can save many lives and reduce the burden of road traffic crashes around the world. We encourage all to use these manuals.

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Executive summary

Increasing motorization worldwide has brought increases in road traffic crashes and injuries to vehicle occupants, particularly in low- and middle-income countries. One of the most effective measures to protect occupants from injuries in crashes is the fitment and use of seat-belts and child restraints. These are proven to save lives and reduce injury severity. All vehicle occupants should be appropriately restrained when travelling in motor vehicles.

Seat-belts and child restraints are a secondary safety measure. Although effective, they do not reduce the crash risk, for which other primary safety measures are needed.

Worldwide, not all vehicles are fitted with seat-belts, and not all occupants use them when they are available. In countries where car use is rising most rapidly, the use of occupant restraints is low. More needs to be done to convince political leaders, police authorities, drivers and passengers that seat-belts provide essential protection from injuries and can reduce the consequences of crashes. Comprehensive programmes of legislation, policing, public education and publicity are needed to promote the benefits of use of occupant restraints and to ensure compliance once legislation is in place.

The purpose of this manual is to provide evidence, advice and examples that will lead to increased use of occupant restraints as safety devices at the national level. The manual is aimed at policy-makers and road safety practitioners. It draws on experience from countries that have succeeded in achieving and sustaining high levels of restraint use. It includes recommendations for developing and implementing technical standards and legislation, advice on monitoring and evaluating progress, and suggestions regarding other multidisciplinary measures.

A focus is the design and implementation of a programme to increase use of seat-belts and child restraints through legislation, enforcement, restraint fitters and fitting stations, and public education measures.

In developing the material for this manual, the writers have drawn on case studies from around the world to illustrate examples of good practice. Although aimed at countries with low use of seat-belts and child restraints, it is hoped the information and advice contained within the manual will also help countries with higher rates of use to further improve rates of use, reinforce their campaigns, and direct further resources towards promotion of increased use.

This second edition of the manual was produced in 2022 to reflect changes in road safety data, evidence and good practices, in particular from low- and middle-income countries and the adoption of the United Nations Decade of Action for Road Safety 2021–2030 and the need to implement a Safe System Approach.

Strategies that work in one country may not necessarily transfer effectively to another. This manual attempts to reflect a range of experiences from around the world, but it does not offer prescriptive solutions. Rather, it is hoped the manual will act as a catalyst for local initiatives and actions to improve road safety. It provides a base of information that stakeholders can use to generate their own solutions and develop advocacy tools and legislation to increase the use of occupant restraints that will work with the audiences they are trying to reach.


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Introduction

Why were these manuals developed?

Since 2006, the World Health Organization (WHO), the World Bank, the FIA Foundation and the Global Road Safety Partnership (GRSP) have produced a series of good practice manuals that provide guidance on the implementation of interventions to address specific risk factors in road safety and support the implementation of good practices in road safety to help make the world's roads safer for all.

The topics covered in the first series of manuals were helmets (2006), drinking and driving (2007), speed management (2008), seat-belts and child restraints (2009), data systems (2010), pedestrian safety (2013), road safety legislation (2013), powered two- and three-wheeler safety (2017) and cyclist safety (2020). In addition, WHO produced a road safety technical package, Save LIVES (2017), which presents 22 evidence-based interventions related to speed management, leadership, infrastructure, vehicles, enforcement and post-crash care.

Why are these manuals being revised?

Since the series of manuals was first published, the scientific evidence base relating to various risk factors and interventions has continued to expand. Contemporary research has refined our knowledge about specific risk factors, such as distracted driving, and vehicle impact speed and risk of death for pedestrians. New issues and practices have arisen, such as a tropical helmet standard and an anti-braking control standard for motorcycles. New and existing interventions have been implemented and evaluated, with increasing application in low- and middle-income countries. Research attention and policy response have also increasingly been applied to emerging road safety issues including e-bikes, drugs other than alcohol, fleet safety, urban mobility, micro-mobility options, air and noise pollution, public transport and technological advances.

As a result of these developments, the good practice manuals required revision so that they can continue to be key references for road safety policy implementation and research. This is particularly important, given the emphasis placed on road safety within the framework of the 2030 Agenda for Sustainable Development and because of the global impetus to reduce road traffic deaths and injuries resulting from the declaration of the two United Nations Decades of Action for Road Safety (2011–2020 and 2021–2030). The manuals have been revised to reflect these developments as they continue to provide the evidence-based and cost-effective solutions to save lives and reduce injuries. An extensive literature review has informed the revision and updating of all the manuals, and additional information has been collated to allow more contemporary case studies to be showcased. In addition, the need to broaden the topics covered in the manuals to include aspects such as qualitative research methods and participatory approaches to designing and evaluating interventions was identified. An emphasis on shifting traditional thinking away from blaming road users towards more contemporary frameworks, such as the Safe

System approach, is key in the revised manuals. An area requiring ongoing consideration is decolonizing knowledge and practice within the road safety field.

A review of the evidence on risk factors and interventions was conducted for information for revision of this manual. The review used text-mining techniques to gather evidence on risk factors and outcomes of interventions. This technique creates computational algorithms for reading and extracting texts from a large volume of information in a short period of time. The review was limited to January 2008 to December 2019, with the understanding that the previous manual had drawn on the evidence that existed before January 2008. Only papers in English, French, Portuguese and Spanish were included in the literature review. Studies excluded were those presented in conference proceedings, editorials and draft papers. The full search generated 125 abstracts relevant to occupant restraints, which were screened to produce 17 full studies to review for this manual. The two experts who conducted the literature review grouped the interventions into three categories – proven, promising and insufficient evidence – based on the existing best practices in road safety. The advisory committee reviewed the categories and refined them based on the existing best practices in road safety policy and their expert knowledge.

Safe System approach

The Safe System approach recognizes that road transport is a complex system and places safety at its core *(1)*. It also recognizes that humans, vehicles and the road infrastructure must interact in a way that ensures a high level of safety (Fig. 1). A Safe System therefore:

- anticipates and accommodates human errors;
- incorporates road and vehicle designs that limit crash forces to levels that are within human tolerance to prevent death or serious injury;
- motivates those who design and maintain the roads, manufacture vehicles and administer safety programmes to share responsibility for safety with road users, so that when a crash occurs, remedies are sought throughout the system, rather than solely blaming the driver or other road users;
- pursues a commitment to proactive and continuous improvement of roads and vehicles so that the entire system is made safe rather than just locations or situations where crashes last occurred;
- adheres to the underlying premise that the transport system should produce zero deaths or serious injuries and that safety should not be compromised for the sake of other factors such as cost or the desire for faster transport times.

Fig. 1 Safe System approach

Source: (2).


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Module 1
Why occupant restraints are necessary

1.1 Context and magnitude of use of seat-belts and child restraints

Road traffic injuries are a major public health problem and a leading cause of death and injury around the world. More than 90% of the approximately 1.3 million people killed globally in road traffic collisions each year occur in low- and middle-income countries *(3)*. The trends remain constant and are a far cry from achieving the Sustainable Development Goal 3.6 targets now extended to 2030.

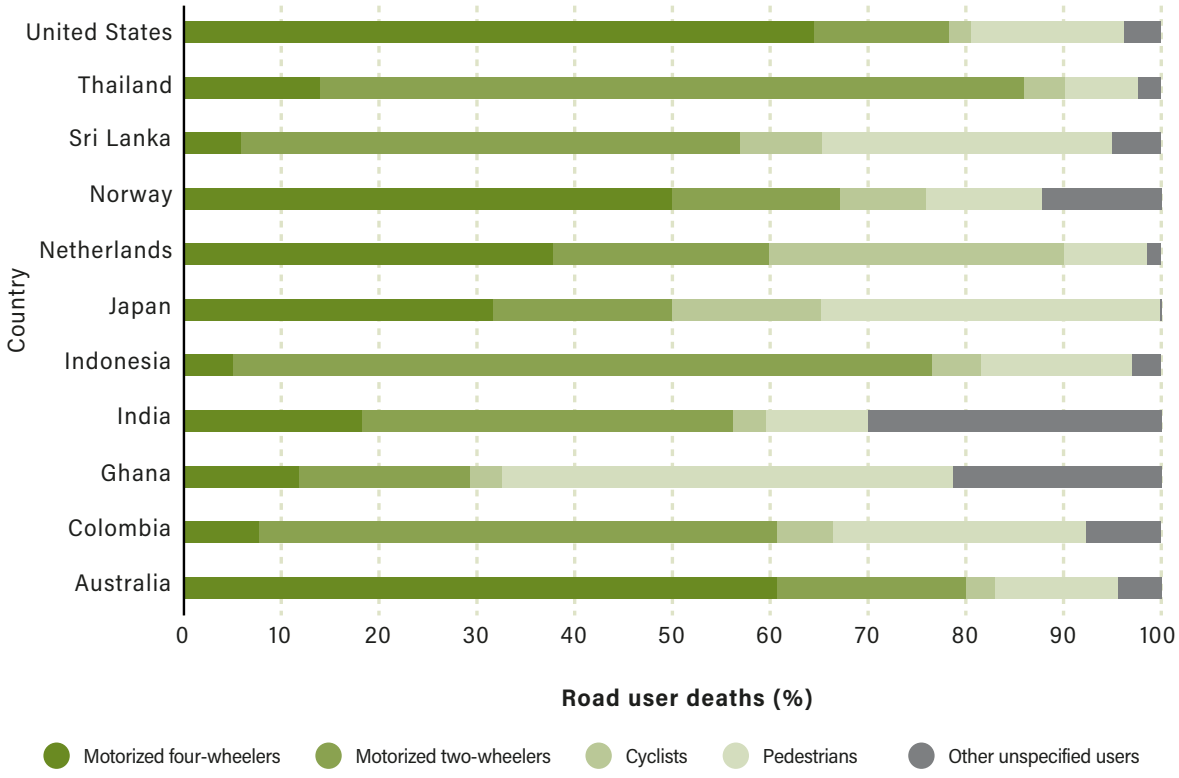
Data from the Global Health Estimates 2019 indicate that road traffic injuries are now the twelfth leading cause of death for all age groups, overtaking AIDS, tuberculosis and diarrhoeal diseases, and are the leading cause of death among people aged 5–29 years. Low-income countries have average death rates (28.3 deaths per 100 000 population) that are 3.5 times higher than high-income countries (8.2 deaths per 100 000 population). There have been few reductions in road traffic deaths in low-income countries since 2015 *(3)*.

The extent to which different road users are affected by road traffic injuries differs between and within countries. The distribution of people killed in various modes of transport in selected countries is shown in Fig. 1.1. Of people killed on roads in high-income countries, the majority are drivers and passengers in cars *(4)*. Fig. 1.1 shows that motorized four-wheeler occupants accounted for as much as 65% of all road traffic deaths in the United States of America in 2015, but only 5–20% in countries in Colombia, India, Indonesia, Sri Lanka and Thailand, where two-wheeler motorized traffic predominates.

Despite current data indicating that car occupants in low- and middle-income countries do not comprise the majority of fatalities on roads *(4)*, experience from high-income countries suggests that as these countries urbanize and car ownership rises, so too will the number of vehicle occupant deaths and injuries, including among children. For example, China added 27 million new vehicles and India 3.7 million vehicles in 2021 *(5)*. In Brazil, official sources have reported a 13.8% increase in car registrations in 2018 *(6)*.

A systematic review revealed that the lack of use of seat-belts and child restraints proved to be the risk factor least addressed in low- and middle-income countries *(7)*. Most of the studies reviewed were undertaken in high-income countries, which draw upon large-scale databases (e.g. Crashworthiness Data System, National Trauma Data Bank).

Fig. 1.1 Road users killed in various modes of transport for selected countries in 2016



Source: (4).

1.1.1 Injuries sustained by vehicle occupants

Failure to use occupant restraints is a major risk factor for road traffic deaths and injuries among vehicle occupants. Passengers not wearing restraints at the time of collisions account for most occupant road traffic fatalities *(8)*. Likewise, lack of use, inappropriate use or incorrect use of child restraints can influence crash injury outcomes *(9)*.

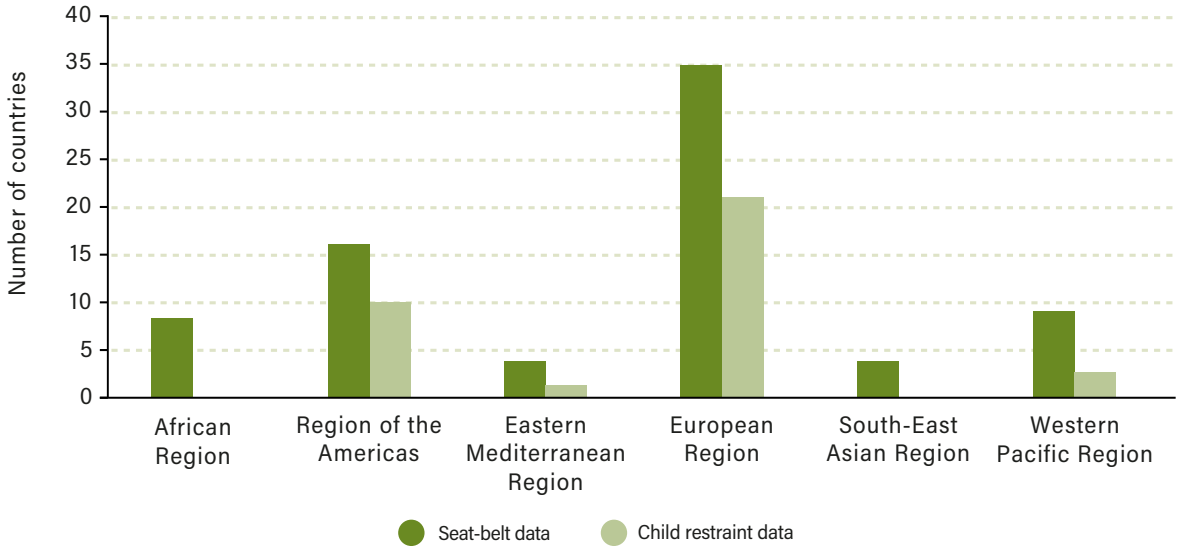
The most frequent and most serious injuries to occupants that occur as a result of frontal impacts are to the head, chest and abdomen. Disabling injuries to the legs and neck also occur *(10, 11)*. A systematic review and meta-analysis found unequivocally that the risk of major trauma among belted passengers was much lower than that among unbelted passengers; facial, abdominal and spinal injuries were significantly reduced among belted passengers *(12)*.

Injuries are not the only consequence of not wearing a restraint. In addition to significant suffering to the vehicle occupant and their family, there may also be financial burden as a result of disabilities or death of the main earner. There is also an impact on governments and local communities that pay for resources needed to deal with vehicle occupants and their families in the aftermath of crashes.

1.1.2 Restraint usage worldwide

Seventy-six countries reported their seat-belt wearing rates to WHO for the 2108 Global Status Report on Road Safety. Only 35 countries reported data on child restraint wearing rates *(4)* (Fig. 1.2). No countries in Africa or South-East Asia and only one country in the eastern Mediterranean region reported child restraint wearing rates.

Fig. 1.2 Countries with data on use of occupant restraints, 2016



Note: Regional and global aggregations have low population coverage (<50%). Interpret with caution.

Source: (4).

On average, seat-belt wearing rates for drivers were 73.5% (95% CI 67.9–79.1%), with the highest rates in the eastern Mediterranean region (although only 4 of 18 countries reported) and the high-income countries of Europe. On average, use of child restraints was 67% (95% CI 57.2–76.8%), with rates below 10% in some Latin American countries (Table 1.1).

Table 1.1 Use of seat-belts and child restraints, by WHO region, 2016

Region	Use of seat-belts (drivers only), average (%)	Use of child restraints, average (%)
Africa	48.8	Not reported
Americas	67.2	39.6
Eastern Mediterranean	87.4	Not reported
Europe	82.7	76.9
South-East Asia	38.6	Not reported
Western Pacific	80.1	65.7
Global	73.5	67.0

Note: Regional and global aggregations have low population coverage (<50%). Interpret with caution.

Source: (4).

Within regions, there is further variability in wearing rates. High-income countries report much higher rates of use of both seat-belts and child restraints. Many low-income countries where laws are absent or newly established have very low wearing rates, particularly for children (Box 1.1).

Box 1.1 Use of seat-belts and child restraints by vehicle occupants in Ho Chi Minh City, Viet Nam

As part of the Bloomberg Philanthropies Initiative for Global Road Safety programmes, statistical analysis of use of seat-belts and child restraints was conducted between August 2016 and April 2019 to assess the effectiveness of the implementation of increased fine penalties against seat-belt law violation by people in rear seats in Ho Chi Minh City, Viet Nam.

An unobtrusive multi-round observational study design was used to collect data on restraint use twice a year at six randomly selected sites. The study team observed that seat-belts were used by almost half of all vehicle occupants. Front-seat drivers were more likely than rear passengers to wear seat-belts.

Only 4.4% of children aged under 5 years and 2.5% of children aged 5–12 years were observed using child restraint systems. Almost half (46%) of children aged under 12 years were observed sitting on front passenger seats.

Use of seat-belts increased among all adult occupants over the observation period (from 46% to 64%). The odds of wearing a seat-belt were highest among rear-seat passengers after the Government imposed the fines. This had little effect on use of child restraints, possibly because there was no law in place at the time and because child restraint systems are expensive (they are not produced locally and cost US$ 60–900).

The study concluded that imposing a fixed penalty fine for violating seat-belt laws was effective, but there was a need for increased and sustained enforcement efforts to maintain increased use rates. To improve use of child restraints, there should be effective policies to restrict child passengers to rear seats and a law put in place.

Photo © Asia Injury Prevention Foundation.

Source: adapted from *(13)*.

1.2 What happens during a crash

Three "collisions" occur in every crash where occupants are unrestrained.

- The first collision involves the vehicle and another object, such as another vehicle, a stationary object (e.g. tree, signpost, ditch), a human or an animal.
- The second collision occurs between the unbelted occupant and the vehicle interior or another passenger – for example, the driver's chest may hit the steering wheel or their head may hit a window.
- The third collision occurs when the internal organs of the body hit against the chest wall or the skeletal structure.

When a crash occurs, an unrestrained car occupant continues to move at the same speed at which the vehicle was travelling before the collision. The occupant is catapulted forward into the structure of the vehicle – most likely into the steering wheel if they are driving, or into the back of the front seats if they are a rear-seat passenger or an unrestrained child. The occupant may be completely ejected from the vehicle, which increases the probability of sustaining severe serious personal injury or death *(14)*. Wearing a restraint significantly reduces injuries sustained during the second collision.

The use of seat-belts and child restraints is one of the most important actions that can be taken to prevent injuries in motor vehicle crashes. Seat-belts and child restraints do not prevent crashes from taking place, but they play a major role in reducing the severity of injuries to vehicle occupants involved in collisions. An occupant's chances of survival increase dramatically when restrained appropriately.

Note:

The American College of Emergency Physicians advocates the use of seat-belts as the best protection against ejection in crashes. Ejection from a vehicle is one of the most injurious events that can happen to a person in a crash, with 75% of all occupants ejected from a vehicle in a crash dying as a result. Seat-belts are effective in preventing ejections: 44% of unrestrained passenger vehicle occupants killed are partially or totally ejected from the vehicle, compared with 5% of restrained occupants *(15).*

1.3 How occupant restraints work

1.3.1 Seat-belts

Seat-belts and child restraints are known as secondary safety devices. They do not prevent a crash from occurring, but they are designed to prevent or minimize injury to a vehicle occupant when a crash occurs. Seat-belts achieve this by:

- reducing the risk of contact with the interior of the vehicle or reducing the severity of injuries if this occurs;
- distributing the forces of a crash over the strongest parts of the human body (hips, shoulders);

Photo © WHO.

- preventing the occupant from being ejected from the vehicle in an impact;
- preventing injury to other occupants (e.g. in a frontal crash, unbelted rear-seated passengers can be catapulted forward and hit other occupants).

A belted occupant is kept in their seat in a collision, and the kinetic energy from the impact is applied to the occupant over a longer period, resulting in less trauma.

1.3.2 Child restraint systems

Infants and children need child restraint systems that accommodate their size and weight and adapt to their different stages of development. The three-point lap and diagonal seat-belts used by adults are not designed for children – their use in children may lead to abdominal or neck injuries and may not prevent ejection from the vehicle.

Appropriate child restraint systems are specifically designed to protect infants and young children from injuries during collisions or sudden stops by restraining their movement away from the vehicle structure and distributing the forces of a crash over the strongest parts of the body, with minimum damage to the soft tissues. Child restraints are also effective in reducing injuries that can occur during non-crash events, such as sudden stops, swerving evasive manoeuvres, or doors opening during vehicle movement.

Photo © C. Saunders, University of Cape Town.

1.4 Types of restraint

1.4.1 Seat-belts

This section describes the four main types of seat-belt used in vehicles, including coaches, buses and racing vehicles:

- Three-point lap and diagonal seat-belt: this is the safest and most commonly used type of seat-belt in cars, vans, minibuses, trucks, and drivers' seats of buses and coaches. It is the best design to distribute crash forces over the strongest parts of the adult body (hips, shoulders).
- Two-point lap belt (single lap belt) with retractor device: this is inferior to the three-point lap and diagonal seat-belt, but it may be enough to maintain the seating positions of occupants in buses and coaches. Although it can reduce ejection of the occupant, it fails to prevent the occupant's head and upper body moving forward and hitting the vehicle interior. For drivers, this could result in serious head injuries from contact with the steering wheel or dashboard. Due to the size and mass of a coach, the severity of injury when involved in a collision with another vehicle is often minor compared with when used in a car or van.

- Single diagonal belt: this provides better protection for the upper body than the two-point lap belt, but it has been shown to be less effective at preventing ejection and slippage under the seat-belt ("submarining").
- Full harness (double shoulder, lap and thigh straps with central buckle device): this gives very good protection from ejection and interior contact. It is cumbersome to put on, however, and cannot be easily operated with one hand. These are important factors in achieving high wearing rates – these harnesses tend to be installed only in vehicles used for motor sport, where drivers and co-drivers are at high risk of ejection and interior contact.

Seat-belt standards set out requirements for the width of webbing and buckles, and the ease of operation and adjustment. Seat-belts have become integrated into overall vehicle safety systems that include devices such as pretensioners, load limiters and airbags (Box 1.2).

Box 1.2 Airbags and seat-belts

When used together with seat-belts, airbags are designed to provide drivers and front-seat passengers with additional protection by preventing their knees from hitting the steering column or front dashboard and stopping their head from hitting the windscreen.

Airbags were introduced in the United States in the early 1950s, and by 1998 all new cars were fitted with airbags. They were initially designed in the United States to protect belted and unbelted occupants and thus inflated rapidly under high pressure in the event of a collision. Their overall effectiveness for reducing fatalities in frontal collisions before 2002 was estimated to be around 12% *(16)*.

In Europe, airbags were introduced some years later but deployed at much lower velocity because they were designed primarily to protect belted occupants. Their effectiveness in reducing fatal injuries given a frontal collision, in combination with use of seat-belts, is estimated to around 20–25% *(14)*.

Airbags have not been without controversy. The first case of an airbag-associated death from a severe head injury in the United Kingdom of Great Britain and Northern Ireland, postulated to be the result of the driver sitting too close to the steering column, was published in 2000 *(17)*. There have subsequently been numerous reports of injuries (mostly minor) and some fatalities *(18)*.

Modifications and improvements over the past three decades have made airbags much safer. The United States National Highway Traffic Safety Administration estimates that 50 457 lives had been saved in the United States by 2017 as a result of the introduction of frontal airbags *(19)*.

Two cautions remain: a young child or infant in a child restraint should not be placed in the front passenger seat if there is an active airbag – instead, they should be restrained in the back seat of the vehicle; and an airbag is not a substitute for a seat-belt – they are designed to work together.

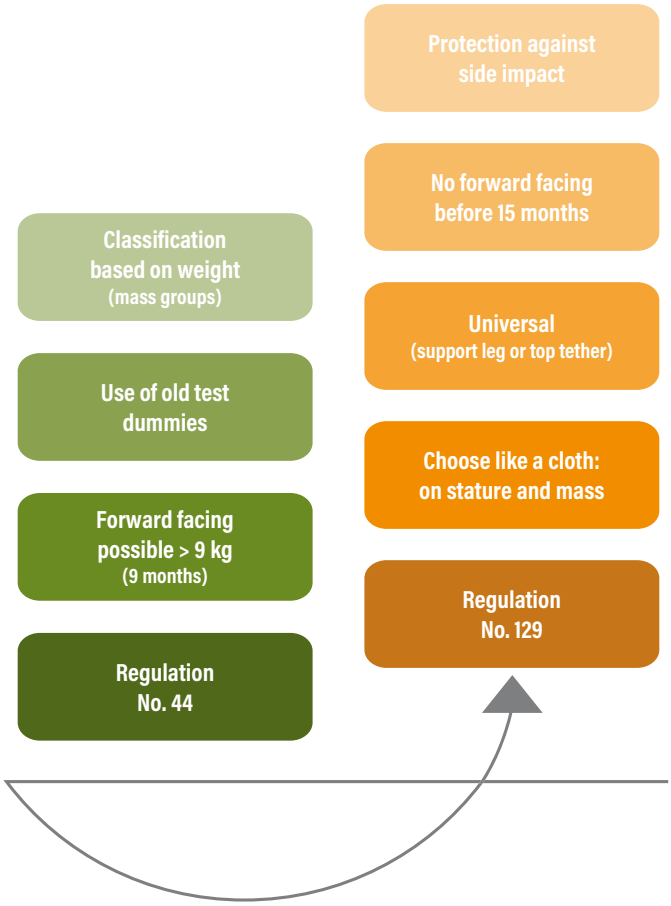
1.4.2 Child restraint systems

The safest place for a child aged 12 years and under is in the back seat, properly restrained in an approved child safety seat. Specially manufactured child restraints should be used for children. There are three main categories of child restraint: rear-facing, forward-facing and booster seats. The most appropriate child restraint depends predominantly on the height of the child (newer regulations) or the weight and age of the child (previous standards). There are two international regulations – ECE R44/04 and (since 2015) ECR129 (also known as i-Size) *(20)*.

ECE R44/04 is an older standard based on the child's weight. It is being phased out internationally and replaced by the i-Size standard based on the height of the child in centimetres.

i-Size is designed to keep children rear-facing for longer (until age 15 months to 4 years), provides better side impact protection, and makes car seats easier to fit correctly using International Organization for Standardization ISO 1321 (ISOFIX) fittings (Fig. 1.3).

Fig. 1.3 Differences between United Nations Economic Commission for Europe (UNECE) regulation no. 44/04 and no. 129 (i-Size)



Source: (20).

Several countries have also adopted their own standards, including Federal Motor Vehicle Safety Standard 213 (FMVSS213) in the United States and ASNZ1754 in Australia, the latter of which could be argued is the most stringent in the world (Table 2.3).

Table 1.2 indicates the recommended types of child restraint for both standards based on the weight and height of the child.

Table 1.2 Types of child restraint

Type of restraint	Regulation	Weight/height range	Approximate age range
Rear-facing baby seat	R44	Group 0 0–10 kg (22 lbs.)	Birth to 6–9 months
	R44	Group 0+ 0–13 kg (29 lbs.)	Birth to 12–15 months
	R129 (i-Size)	i-Size (based on height rather than weight) Phase 1 Birth to 105 cm	Birth to ≥15 months Some seats birth to 4 years
Forward-facing car seat	R44	Group 1 9–18 kg (20–40 lbs.)	9 months–4 years
	R44	Group 1, 2 and 3 9–36 kg (20–79 lbs.)	9 months to 11 years
	R129 (i-Size)	Phase 2 100–135 cm Specific vehicles 135–150 cm	4–11 years
High-backed booster seat	R44	Group 2 15–25 kg (33–55 lbs.)	4–6 years
	R44	Group 2 and 3 15–36 kg (33–79 lbs.)	4–11 years
Booster Cushion (from 9th February 2017)	R44	Group 3 22–36 kg (48–79 lbs.) and 125 cm or taller	6–11 year

Source: adapted from *(20)*.

Rear-facing child restraints (Group 0 or 0+)

At birth, an infant's head is around a quarter of their total length and about a third of their body weight. The skull and rib cage are very flexible, and a relatively small impact can result in significant deformation of the skull and brain or a large compression to the chest wall on to the heart and lungs. Infants require special seats designed to cradle them in crashes and provide protection from many crash types.

Rear-facing child restraint systems (infant car seats) provide the best protection for infants until they are aged 1 year and weigh at least 13 kg (R44). The new i-Size (R129) safety standard recommends keeping children rear-facing until at least age 15 months or about 105 cm tall. For the best protection, infants should be seated rear-facing for as long as possible *(21)*. Emerging data from Sweden and other Scandinavian countries seem to indicate it may be best to keep children in rear-facing seats until they are aged 3–4 years to minimize neck and head injuries in collisions *(22, 23)*.

Forward-facing child restraints (Group 1, 2, 3)

The bone-forming process is not complete until age 6–7 years. Throughout childhood, the skull remains weaker than that of an adult. Restraint systems need to limit forward head movement in frontal impacts and provide protection from intrusion in side impacts.

Child restraints should distribute crash forces over as wide an area as possible. Belts and harnesses need to fit well and be positioned properly, as designed by the manufacturer. Rear- and forward-facing restraints have harness-type straps. Restraint systems should also provide protection from contact with the vehicle interior in front and side impacts.

Booster seats (Group 2/3)

Once a child has outgrown a forward-facing seat, the best option is to use a Group 2 or Group 2/3 high-backed booster seat. Children using these seats are much less likely to be injured in crashes than children who are using only seat-belts or are completely unrestrained (see Section 1.5). Unlike rear- and forward-facing child restraints, high-backed booster seats do not have an integral harness to hold the child in place. Instead, the vehicle's seat-belt is used to secure the child and the seat.

Three-point lap and diagonal seat-belts used by adults are not designed for children's varying sizes and weights and the different relative proportions of children's bodies. A smaller portion of a child's abdomen is covered by the pelvis and rib cage, while a child's ribs are more likely than an adult's to bend rather than break, resulting in energy from a collision being transferred to the heart and lungs *(24)*. Booster seats raise the seating position of the child so the adult seat-belt lies properly across the chest, crossing diagonally at the child's shoulder rather than the neck, and low across the pelvis. If the adult belt is too high across the stomach, in a crash serious internal injury could result or the child could slide under the seat-belt.

Booster seats have a fixed back section and can provide some protection in side impacts. Booster seats for children aged 4–7 years have been shown to reduce risk of injury by 59% compared with use of seat-belts alone *(25)*.

Note:

Although children are best protected when secured in age-appropriate child restraints, where such restraints are not available, it is still better to use an adult seat-belt for a child sitting in a back seat than to leave the child unrestrained *(26, 27)*.

1.5 Effectiveness of restraint systems

Several studies over the past six decades have demonstrated that seat-belts are one of the most effective safety interventions, resulting in a significant number of lives saved and a substantial reduction in injuries if installed and used correctly (Table 1.3).

Seat-belts reduce fatalities by 40–50% for front-seat occupants and 25% for rear-seat occupants *(14)*. One study used counterfactual analysis to assess whether nine proven vehicle technologies would save lives if they were made available in Latin American countries. Increasing the use of seat-belts and child restraints was predicted to reduce deaths by 12% and disabilities by 13% in the region *(28)*.

Table 1.3 Effect of use of seat-belts on probability of personal injury in all types of collision (individual effects)

Injury severity (private cars and vans)	Percentage change in number of injuries	
	Best estimate	95% CI
Killed	–50	(–55 to –45)
Serious injuries	–45	(–50 to –40)
Minor injuries	–25	(–30 to –20)
All personal injuries	–28	(–33 to –23)
Front-seat passengers in light vehicles (private cars and vans)		
Killed	–45	(–55 to –35)
Serious injuries	–45	(–60 to –30)
Minor injuries	–20	(–25 to –15)
All personal injuries	–23	(–29 to –17)
Back-seat passengers in light vehicles (private cars)		
Killed	–25	(–35 to –15)
Serious injuries	–25	(–40 to –10)
Minor injuries	–20	(–35 to –5)
All personal injuries	–21	(–36 to –6)

Source: adapted from *(14)*.

An unrestrained rear-seat passenger poses a serious threat to any restrained person seated directly ahead of them *(29)*. Use of seat-belts by rear-seat passengers could reduce the likelihood and severity of injury not only to themselves but also to drivers and front-seat passengers.

Several studies have shown that women are more likely than men to wear seat-belts, but the safety features included in modern vehicles are less likely to be effective for women because current crash test dummies are scaled-down versions of a male body and not modelled to account for female anthropometric differences *(30)*. Females are prone to certain types of injury during crashes, such as pelvic fractures, because of their unique anthropometry *(31)*, and their injury tolerance may be different because of lower bone density *(32)*.

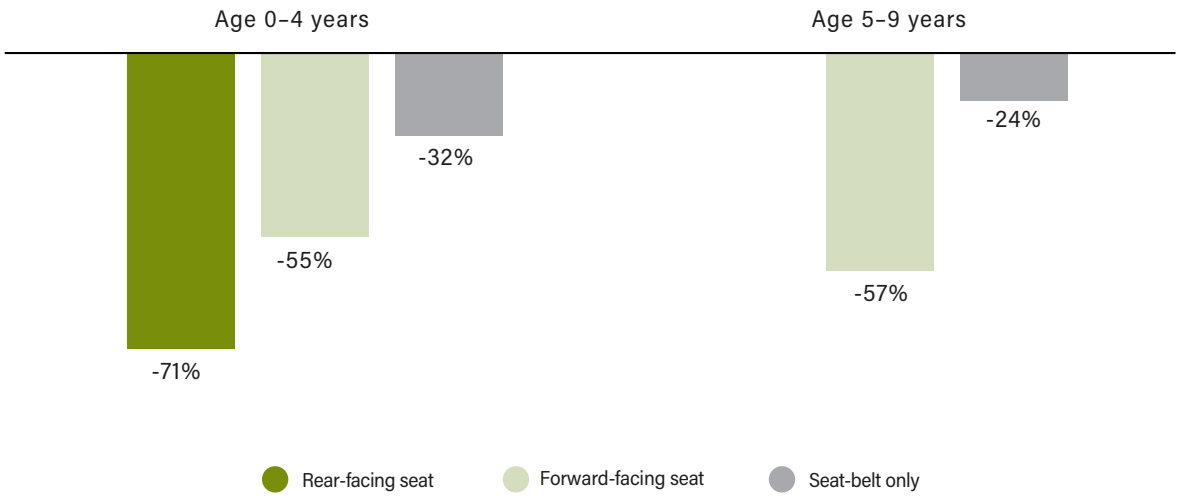
Wearing a seat-belt during pregnancy is important. A correctly worn restraint, below the gravid uterus and over the maternal hips, is associated with lower injury severity, reduced need for surgery, and a shortened hospital stay in the event of a crash *(33)*.

For child passengers in vehicles, child restraint systems cannot prevent crashes, but they can reduce the consequences of impacts by keeping children in their seats and preventing them from colliding with the vehicle interior or being ejected from vehicles. Child restraint systems distribute the forces of crashes over the strongest parts of the body. Child restraint systems are designed to align with children's developmental stages and accommodate their size and weight (see Section 1.4.2).

Using appropriate and correctly fitted child restraints can lead to at least 60% fewer deaths among children *(34)*. Although the benefits of child restraints have been shown to be greatest for younger children (Fig. 1.4), particularly those aged under 4 years *(35, 36)*, booster seats can provide some protection in side impacts. A study conducted in 15 states in the United States of America, in 2003, showed that the use of booster seats for children aged 4-7 years reduces injury risk by 59% compared with use of seat-belts alone *(25)*. For older children aged 8-12 years, a study done in 2017, in the state of Washington in the United States of America, concluded that the use of booster seats offers a 19% reduction in injury risk when compared with use of seat-belts alone *(37)*.

Most of these studies come from high-income countries, which is understandable given that few low-income countries have child restraint laws.

Fig. 1.4 Injury risk reduction (%) by type of restraint and age



Source: adapted from *(14)*.

1.6 Why restraints are not used

Seat-belt and child restraint laws cannot be successful if they are not complied with. If people do not know about the laws or understand the rationale for them, they will not obey them. Similarly, if vehicles are not fitted with seat-belts or if child restraints are difficult or expensive to obtain, usage rates are likely to remain low.

Using occupant restraints is shaped by knowledge, attitudes, perceptions and beliefs. Unfortunately, there are still many misperceptions and myths about restraint systems (Table 1.4).

A study in Turkey in 2008 investigated the motives behind the use or non-use of seat-belts. The study found that if road users perceived their risk to be low (e.g. city roads, daytime driving, good weather), they did not use seat-belts. They also cited habit, discomfort, lack of awareness of safety, and other peoples' opinions as reasons for non-use *(38)*.

Lack of awareness, particularly about the risk to passengers in rear seats and the risks posed by unbelted passengers to other occupants, contributes to lower seat-belt wearing rates.

Table 1.4 Myths and facts about use of occupant restraints

Myth	Fact
They are uncomfortable or inconvenient They are uncomfortable on long journeys	Seat-belts have saved more lives than any other road safety intervention (see Section 1.5) – this is a small price to pay for a little discomfort or inconvenience
They might trap occupants in a burning car or a car submerged in water following a crash	This is an extremely rare situation and it takes only a few seconds to unbuckle a seat-belt
They are not needed on short trips or when travelling at low speeds	The majority of collisions occur close to home *(39)*
They are not needed by skilled drivers Passengers who wear seat-belts are criticizing their driver's ability	Restraints do not prevent collisions, but they do reduce the consequences of a collision – the skill of the driver is irrelevant (see Section 1.3)
Not wearing a seat-belt does not result in a fine Enforcement agencies do not stop and check vehicle drivers	Strict and consistent enforcement is key to the success of restraint programmes (see Section 2.2.1)
Seat-belts are not required in multi-passenger vehicles (e.g. buses)	This is true in some countries, but seat-belts are being fitted to most new buses and more countries are mandating their use
It is better to be thrown clear after a collision	44% of unrestrained passenger vehicle occupants killed are partially or totally ejected from the vehicle, compared with 5% of restrained occupants *(15)*
Pregnant women do not have to wear seat-belts	Correctly worn restraints, below the gravid uterus and over the maternal hips, are associated with lower injury severity, reduced need for surgery, and shortened hospital stays after crashes *(33)*
Sitting in the rear of a car is safe without a seat-belt	An unbelted rear-seat passenger can sustain significant injuries and injury the front-seat occupants (see Section 1.2)
Cars come with good standards so seat-belts are not needed	All cars with good standards come equipped with seat-belts because seat-belts are known to save lives

There are many barriers to the use of child restraint systems. Many studies found that participants acknowledged it was "dangerous for children to travel unrestrained" because of the high risk of injuries, but whether they put their child in a restraint was dependent on the duration of the journey, the driver's experience, the posted speed limit, and whether the driver perceived the area to be "safe" (i.e. a low-collision area). Practical issues such as the cost of restraints (Boxes 1.3 and 1.4) were a universally acknowledged barrier across all studies, along with factors such as family size (e.g. not having restraints for all children within the family) and frequent transitioning to other restraints as children grow.

A systematic review explored the facilitators and barriers to use of child restraints. A total of 17 studies were identified (14 from high-income countries, 3 from middle-income countries) *(40)*. These studies revealed:

- the perceived risks and safety benefits of use of child restraints vary by setting and type of caregiver;
- there are practical issues (e.g. correct fitting) around the use of child restraints (see Section 3.4.4) *(41)*;
- putting a child in a restraint can be considered a disciplinary mechanism in some settings, and older children may negotiate non-use;
- the adoption and enforcement of laws is helpful in shaping perceptions in all settings;
- there are cultural and linguistic differences in perceptions and norms around child safety.

Box 1.3 Use of child restraints in South Africa

In 2014, the South African road safety law was amended to mandate the use of child restraint systems for children aged under 3 years. Use of child restraints remains low, however, despite evidence from high-income settings showing them to be effective in reducing injuries among children.

To understand why restraints were not being used, an observational study and survey of parents and carers was conducted in six Cape Town suburbs. The study assessed rates of use, and parental knowledge of and attitudes towards child restraint legislation, ownership and cost.

The study showed that only 7.8% of child passengers were restrained properly in an appropriate child restraint system. Driver seat-belt use and single child occupancy were associated with higher use of child restraints.

Photo © C. Saunders, University of Cape Town.

More than 90% of survey respondents claimed to have knowledge about the current child restraint law, but only 32% were able to correctly identify the age requirements and penalties. The most common reasons cited for not owning or using a child seat included high costs and the belief that seat-belts were a suitable alternative.

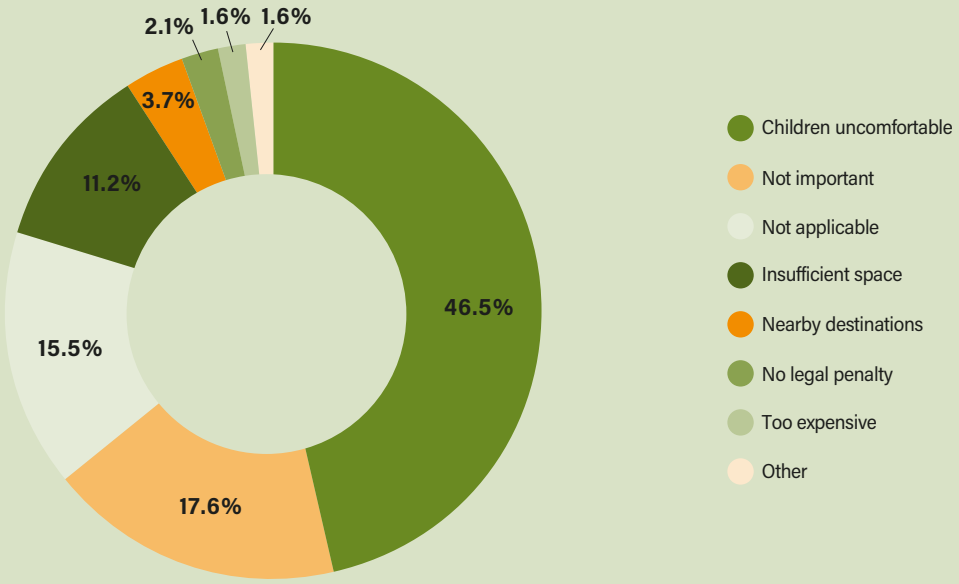
The study recommended tighter legislation, enhanced enforcement and increased fines for non-use of adult seat-belts and child restraints. In addition, the study recommended the provision of low-cost or subsidized child restraints or borrowing schemes, coupled with targeted social marketing, to increase ownership and use of child restraints.

Source: adapted from *(42)*.

Box 1.4 Why parents do not restrain their eldest children in vehicles

A study in Dubai in 2017 aimed to understand parents' knowledge of and behaviour towards restraining their children in vehicles. The study showed that although 89% of parents restrained their children aged under 1 year, the rate was much lower for children in older age groups. Multiple reasons were cited for why children aged 5 years or over were not restrained (Fig. 1.5).

Fig. 1.5. Parents' reasons for never or almost never restraining their eldest children while driving in the United Arab Emirates, 2017



Source: adapted from *(43)*.

1.7 Summary

This module has shown how correctly worn occupant restraints (child restraints and seat-belts) reduce the severity of injuries by preventing passengers from being ejected from a vehicle or colliding with other occupants or the vehicle interior. It discusses the types of restraint available and the current use rates around the world. It offers some suggestions on why wearing rates remain low despite knowledge that seat-belts have saved more lives than any other road safety intervention.

Module 2 provides the evidence base for interventions that can be included in occupant restraint programmes.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Module 2
Evidence-based interventions for occupant restraints

This module discusses specific interventions to improve the use of seat-belts and child restraints. Several specific interventions have been evaluated worldwide. These include interventions that focus on laws, behaviours, vehicle safety features and strong social marketing campaigns to promote the uptake of and compliance with legislated interventions.

2.1 Overview of effective interventions

This section looks at the effectiveness of interventions with respect to their contributions to reductions in road traffic fatalities and serious injuries, and changes in behaviour.

A summary of effective road safety interventions specific to occupant restraints are summarized in Table 2.1. This includes a review of evidence from January 2008 through December 2019, resulting in an additional 17 full studies that were considered in this update (*7*). The effectiveness of interventions relates to the reduction of fatalities or injuries as well as other measurable change(s) in the behaviour of the road user targeted by the intervention. For this manual the evidence on interventions is categorized into one of five groups: proven, promising, insufficient evidence, ineffective or harmful. The assessment of effectiveness and impact was made using several tools developed in evidence-based medicine and policy research. For the purpose of this document the following intervention category definitions are used:

- Effective – evidence from robust studies such as randomized controlled trials, systematic reviews or case–control studies shows that these interventions are effective in reducing road traffic fatalities and injuries, or in bringing about a desired change in behaviour.
- Promising – evidence from studies shows that some road safety benefits have resulted from these interventions, but further evaluation from diverse settings is required and caution is needed when implementing them.
- Insufficient evidence – evaluation of an intervention has not reached a firm conclusion about its effectiveness because of a lack of evidence. The lack of evidence does not necessarily mean an intervention is not relevant or good; rather, it means the intervention not been studied adequately, or the evaluation methods used are not robust enough, or the intervention is still being developed.
- Ineffective – robust evaluation has shown that these interventions are not effective.
- Potentially harmful – these interventions may increase risk of injuries or death.

It is important to note that the designations refer to the quality of the existing scientific evidence on the use of the interventions in a range of settings. The designations have been used in previous WHO

documents, such as the World Report on Road Traffic Injury Prevention *(44)* and the World Report on Child Injury Prevention *(45)*.

Interventions should be prioritized depending on the context. For example, in certain settings with low use of passenger vehicles, or where there are multiple children to be transported, harm reduction strategies or a phased approach should be considered.

An additional category of "potentially harmful" has been included in this manual to indicate interventions that should be avoided as they have been documented not only to be ineffective but also to inflict injury.

Table 2.1 summarizes the key measures that can be implemented to increase use of seat-belts and child restraints. A brief description of the interventions is provided below. Note that a new Cochrane review of seat-belt interventions is under way at the time of writing, and results should be available in 2023 *(46)*.

2.2 Description of evidence-based interventions

Occupant restraint systems (child restraints and seat-belts) together with airbags are among the most effective injury prevention interventions available. They do not prevent crashes from occurring, but there is strong evidence that they reduce the incidence and severity of injuries sustained in collisions.

2.2.1 Setting and enforcing strong restraint laws (effective)

To be most effective, restraint laws should cover all vehicle occupants. Most countries around the world have seat-belt laws that align with global good practices (a national law that covers all passengers), but this is not the case for child restraints (Table 2.2). In the Global report on road safety published in 2018, only 33 countries (mostly high-income) had national laws that stipulate age and height child restraint seat standards and restrictions to children sitting in front seats *(4)*.

Table 2.1 Key measures to increase use of seat-belts and child restraints

	Effectiveness in increasing use or reducing risk of serious injuries and deaths				
	Effective	Promising	Insufficient evidence	Ineffective	Potentially harmful
Setting and enforcing strong restraint laws (Section 2.2.1)					
Correct fitting and use of appropriate restraints (Section 2.2.2)					
Establishing and enforcing motor vehicle safety standards (Section 2.2.3)					
Child restraint loan schemes (Section 2.2.4)					
Education and training (Section 2.2.5)					
Insurance and public incentive schemes (Section 2.2.6)					
Standalone public awareness campaigns (Section 2.2.7)					
Airbags and children in front seats (Section 2.2.8)					

Table 2.2 Seat-belt and child restraint laws, by region and income level in 2017

Region	High-income countries			Low- and middle-income countries		
	Number of countries in region (*N*)	Number of countries with good[a] laws		Number of countries in region (*N*)	Number of countries with good[a] laws	
		Seat-belts	Child restraints		Seat-belts	Child restraints
Africa	1	1	0	44	15	1
Americas	7	4	1	23	15	1
Eastern Mediterranean	5	3	0	13	5	1
Europe	26	30	25	19	15	3
South-east Asia	1	1	0	10	5	0
Western Pacific	4	4	1	17	7	0

[a] "Good" seat-belt laws cover all passengers. "Good" child restraint laws stipulate age, height or weight.

Source: (4).

Mandatory restraint laws can be very effective at increasing use. A pre/post study conducted in Israel found that implementation of a comprehensive child restraint law (which included booster seats for older children) was associated with a 6.5% reduction in injuries and fatalities to children aged under 10 years *(35)*. A retrospective study in the United States in 2017 showed that the child restraint law saved 39 children's lives a year *(47)*.

On the other hand, a study published in 2020 about the introduction of an age-appropriate child restraint law in five Australian states and territories showed no significant change in fatal, serious or minor injuries, possibly because of ineffective enforcement, lack of awareness and the cost of devices *(48)*.

The risks to children in countries where there are no compulsory child restraint laws or there is poor enforcement is illustrated by the situation in Shantou, China *(49)*. A study reported extremely low numbers of restrained children aged 0–3 years (0.1%) and exposed risky practices such as children sitting on an adult's lap (56%) or sitting in a front seat (36%). China is working hard, however, to put in place child restraint laws, starting in some of the major cities where vehicle ownership is high.

Enforcement of the law is key. In Chile, the new child restraint law, which was initially associated with a 19% reduction in severely injured children a year after its enactment, failed to sustain these reductions because of inadequate police enforcement *(50)*.

Evidence clearly demonstrates a direct relationship between enforcement and wearing rates. For example, in Pakistan in 2013, as enforcement activities increased, so too did wearing rates, particularly on roads where enforcement was known to be high *(51)*. Drivers using roads that were regularly patrolled by police were more likely to have been penalized for a seat-belt violation than drivers who did not use those roads.

The evidence shows that robust, sustained, high-visibility enforcement is called for to increase compliance. For example, 6 years after the adoption of a restraint law in Serbia in 2014, there was an 8.2% reduction of injured children aged 4–12 years and a 1.1% reduction of injured children aged under 4 years because implementation of the law was accompanied by longer-term enforcement *(52)*.

Most countries have seat-belt laws, but lack of robust enforcement remains a critical issue to be addressed. Many barriers are cited (Box 2.1).

Box 2.1 Barriers to seat-belt enforcement in Ghana

A study in Ghana in 2021 showed the main barriers to enforcement of seat-belt laws were *(53)*:

- institutional factors – inadequate resources and logistics, and inability to enforce vehicle safety standards;
- political factors – external interference and lack of consensus on implementation of seat-belt law;
- human factors – poor public attitudes and non-recognition of road safety as an individual and collective responsibility.

The enforcement of road safety laws could be enhanced by adequately resourcing officers, addressing external interference of police duties, and empowering officers to perform their duties without fear or favour. These findings are useful in informing sustained public education campaigns and enhanced enforcement of seat-belt laws.

Source: adapted from *(53)*.

Photo © Global Road Safety Partnership.

2.2.2 Correct fitting and use of appropriate restraints (effective)

Incorrect use of child restraint systems is a major concern, even in high-income countries. An observational study in Norway showed that 38% of children aged 0–15 years were incorrectly restrained, with the highest frequency of restraint misuse among children aged 4–7 years *(54)*. The most common errors were loose or improperly adjusted harness straps and incorrectly fitted child restraints (Box 2.2) *(55)*.

Box 2.2 Child restraint fitting checklist

- Is the child restraint system the correct type for the child's size?
- Is the anchor fitting tight, undamaged and the correct type?
- Is the tether connected and adjusted correctly to the anchorage?
- Is the seat-belt routed correctly through the restraint?
- Is the seat-belt tension appropriate?
- Are the seat-belt and buckle free from any obvious faults?
- Are the harness straps set at the correct height for the child?
- Is the webbing untwisted?
- Are the adjustment and harness buckles free from any obvious faults?
- Is the tether webbing undamaged, untwisted and free from any obvious faults?
- Are the fittings used of a suitable nature and used appropriately?

Source: adapted from *(55)*.

Children placed in the wrong restraint system have a greater risk of being injured or dying during a collision *(41)*. A Canadian study found that 70% of children were being transported in the wrong child restraint or were incorrectly fitted. The most common errors were seen in rear-facing infant seats and included incorrect placement of the chest clips in 59% of all incorrectly used seats, which could place the child at increased risk of injury in a collision *(56)*.

An Australian study confirmed that 82% of child occupants aged 2–8 years who were suboptimally restrained sustained more severe injuries than those who were optimally restrained *(57)*. A follow-up study showed that restraint fitting stations, which teach parents how to fit a restraint system into a vehicle correctly and how to buckle a child into the restraint, have a beneficial effect *(58)*.

Less is known about the effectiveness of booster seats, possibly because of the shortage of high-quality cross-country comparative data. The American Academy of Pediatrics recommends that children remain in booster seats up to age 12 years. A study has shown a 29% reduction in injuries among children aged 8–12 years if boosters and seat-belts are used, compared with using only seat-belts *(37)*.

It appears that it is important and relevant to shift the focus from age to size (using height and weight criteria) because of a wide variation in child growth patterns *(59)*.

2.2.3 Establishing and enforcing motor vehicle safety standards (effective)

Seat-belt and child restraint standards ensure the forces from restraint systems are applied to the most robust parts of the human body. For adults, this is the lap part of the seat-belt, which restrains the lower torso through the rugged structure of the bony pelvis, and the diagonal part of the belt, which distributes forces across the robust rib cage and protects the more sensitive underlying organs. For children, who have less robust bony structures, the use of two shoulder straps, a lap belt and a crotch strap applies forces more evenly over the body *(41)*.

Seat-belt and child restraint standards are the minimum safety requirements required by a country. They can be set by a national or international body. Examples are the United Nations vehicle regulations for seat-belts (no. 16), seat-belt anchorages (no. 14) and ISOFIX child restraint anchorage points (no. 145), and ECE R44/04 and ECR129 for child restraint systems (see Section 1.2.1). Table 2.3 shows the current standards for child restraint systems implemented in selected countries.

Table 2.3 Child restraint system regulations in selected countries, 2021

Country or area	Child restraint regulation
Australia	AS/NZS 1754:2013 AS/NZS 3629:2013
China	GB 14166–2013
European Union	R129
India	AIS-072
Japan	Reg 129 JIS D 040122000
Malaysia	R129
New Zealand	R129
Republic of Korea	KMVSS 103–2
Russian Federation	R129
Turkey	R129
United Kingdom	R129
United States	FMVSS 213

Source: (60).

Seat-belts and seat-belt anchorage regulations ensure seat-belts are fitted in vehicles during manufacture or assembly and that seat-belts can withstand the impacts incurred during crashes (Box 2.3). Child restraint regulations ensure seats meet minimum safety standards. United Nations regulation 145 ensures the vehicle is equipped with ISOFIX anchorage points that secure the restraint directly to the frame of the vehicle.

Box 2.3 Introducing occupant safety into vehicles in India

In 2018, India achieved its first Global NCAP 5-star rating for a locally produced vehicle. In 2020, another locally produced vehicle achieved a 5-star rating for adult occupant protection and a 3-star rating for child occupant protection *(61)*.

In late 2020, another locally produced vehicle achieved a 5-star rating for adult occupant protection and a 4-star rating for child occupant protection. The latter 4-star rating was achieved through testing rear-facing child seats using ISOFIX anchorages.

Source: adapted from *(61)*.

Photo © Global NCAP.

The United Nations Economic Commission for Europe (UNECE) and WHO recommend that countries enact legislation requiring all occupants be properly secured in restraint systems. For children, this should consider their age, height and weight. UNECE also recommends that countries require the use of only approved child restraint systems and consider prohibiting sale of restraints that do not meet the standards for use in vehicles *(62)*.

2.2.4 Child restraint loan schemes (promising)

For children to be properly restrained in child seats, restraints need to be available and affordable. Many countries are now manufacturing or importing child restraints, but cost is an important barrier to uptake. A study in South Africa found that the high cost of child restraints was the main reason parents did not use them (see Box 1.4). Even in high-income countries such as Australia, cost is a factor for some families *(63)*.

Subsidizing restraints or loaning seats to vulnerable families has shown some promise. For example, infant car seats donated by manufacturers were loaned to prospective parents in Greece for 6 months for a small fee. Results showed that 92% of parents reported using the devices properly, and 82% had already bought second-stage seats for their children when they returned the loaned seats. The loan system was found to be highly cost-effective, with a ratio of €418–3225 per life-year saved, depending on whether the modest administrative fee is considered *(64)*.

Box 2.4 illustrates how a loan scheme has been set up in Tajikistan with the support of a private organization.

Box 2.4 Child restraint loan scheme in Tajikistan

Photo © Eastern Alliance for Safe and Sustainable Transport.

The Eastern Alliance for Safe and Sustainable Transport and Kier launched a child seat recycling and loan scheme for low-income families in Tajikistan in 2018. Managed by the Young Generation of Tajikistan, the scheme was implemented to raise awareness of the importance of restraints and to provide child car seats to families who could not afford them. More than 100 car seats were collected from the Kier group's household waste recycling centre in Somerset in the United Kingdom, and then checked, packed and transported to Dushanbe *(65)*.

Young Generation of Tajikistan colleagues identify families in need and distribute the seats. The project hopes to overcome one of the main challenges to putting children in restraints – cost – and increase use by raising awareness.

Source: adapted from *(65)*.

2.2.5 Education and training (promising)

Research shows that standalone awareness-raising events and group education make little difference to behaviour change or reducing road traffic injuries and deaths *(66)*. A Cochrane review found that if education is combined with other incentives or the distribution of restraints, it can have a beneficial effect on subsequent use *(67)*. Teaching parents how to install and use child car seats through hands-on demonstrations or at fitting stations has been shown to make a difference to the proper use of child restraints (Box 2.5) *(39, 58, 68)*. Use of educational apps instead of conventional car seat manuals to demonstrate correct car seat inspection and use is proving promising in the United States *(69, 70)*.

Box 2.5 Child restraint fitting stations reduce incorrect use

Several high-income countries have implemented child restraint checking or fitting stations where parents or carers can seek expert advice and resolve fitting errors. Fitting stations have been implemented to reduce the incorrect use of child restraint systems. An observational ecological study in New South Wales, Australia found that parents who had not used a fitting station were 1.8 times more likely to be using their child restraint systems incorrectly.

Source: adapted from *(58)*.

2.2.6 Insurance and public incentive schemes (insufficient evidence)

The motor insurance industry can play a key role in encouraging wearing of seat-belts within a country through the wording of their crash compensation policies. For example, compensation can be reduced significantly if it is established that a vehicle occupant was not wearing a restraint at the time of a crash. This can be applied to private and company policies. Insurance companies can also promote use of occupant restraints by supporting advertising and public education. The effectiveness of such policies could be limited by how well the insurance system works, the extent of standard cover and compensation provided for people involved in crashes, and how well insurance clients are informed about the clause.

Employers have a significant role to play in increasing use of seat-belts, especially in countries where legislation and enforcement have not been implemented widely. One of the earliest examples of this was the Snowy Mountains scheme in Australia in the 1960s, where the penalty for not wearing a seat-belt was instant dismissal from their job.

Companies and government organizations can help save lives and reduce injuries to their employees and contractors by:

- fitting good-quality seat-belts to company and contractor vehicles;
- making use of seat-belts a company regulation for work-related journeys and staff commuting trips;
- including seat-belt fitting requirements and wearing rules in contracts with road transporters;
- carrying out regular checks of use of seat-belts by staff and contractors;
- providing incentives for compliance and penalties for noncompliance;
- informing and training staff and contractors on good driving practices, including use of seat-belts;

- adopting comprehensive road safety management systems with road safety targets for which all staff, especially senior management, are held responsible.

Although some successful private-sector campaigns have been conducted (Box 2.6), most have not been published or there is insufficient evaluation information available to include the intervention in the package of good practices.

Box 2.6 Supporting children with disabilities to travel in child restraints and seat-belts

A high proportion of children with disabilities get out of their child restraints or seat-belts during car travel, causing serious road safety risks for the child, family and other road users *(71)*. In an Australian study, parents reported that their children with disabilities got out of their child restraints (45%) or seat-belts (35%) while the vehicle was moving, with 10% of these children escaping into the road environment *(72)*.

In response, Mobility and Accessibility for Children in Australia, with funding from the Australian Office of Road Safety, undertook a project to better understand the challenges associated with buckle release. Mobility and Accessibility for Children in Australia partnered with La Trobe University, Melbourne to deliver the project, which included developing a Buckle Cover Model Policy[1] aimed at allied health professionals and organizations with responsibility for transporting children with disabilities. The policy provides guidance on best practice road safety approaches and legal requirements for prescribing and using child restraint and seat-belt buckle covers for people in motor vehicles in Australia.

The project has resulted in legislative change with new legal requirements for using buckle covers, making it easier for health professionals to prescribe buckle covers and for families to access them and comply with the law.

[1] https://www.macahub.org/resources/policies.

2.2.7 Standalone public awareness campaigns (ineffective)

Standalone public awareness campaigns have little impact on road traffic injuries and deaths. They may improve knowledge – and sometimes attitudes – in the short term, but they are unlikely to result in long-term behaviour changes *(14)*.

When campaigns are used in conjunction with other behaviour change methods, including legislation and law enforcement, and are targeted at a specific audience, they can positively influence behaviour *(73)*. For example, a targeted media-based education and outreach campaign combined with strong enforcement in Nevada in the United States showed a significant increase in seat-belt wearing rates for men and women, for both drivers and passengers *(74)*.

The United Kingdom Department for Transport THINK! campaign on seat-belts and child restraints provides information to the general public on current laws, which restraint systems to purchase, how to install restraint systems, and the benefits of using restraints *(75)*.

2.2.8 Airbags and children in front seats (potentially harmful)

Airbags (supplementary restraint systems) are important safety features in most vehicles, but they have been associated with fatal and serious non-fatal injuries among children in rear-facing restraints placed on front passenger seats. When an airbag deploys, it can cause severe head and neck injuries to children

in rear-facing restraints *(18)*, but the protective effect of airbags in terms of lives saved outweighs those lost and consequently should still be used in passenger vehicles *(76, 77)*.

Children aged under 10–12 years should not sit in front passenger seats, and manufacturers are obliged to include warnings about airbags in vehicles. The evidence is clear: airbags used together with three-point seat-belts are effective at saving lives but placing a young child in a rear-facing child restraint system on the front passenger seat where there is an airbag is harmful practice.

2.3 Summary

This module has provided the evidence base for interventions to improve current use of seat-belts and child restraints. It has shown that current best practices include seat-belt and child restraint laws and their enforcement, together with the correct fitting of appropriate restraint systems. These three main interventions can be supported with appropriate training, targeted education, and loan schemes for child restraints.

Getting employers involved through company policies or insurance schemes may be beneficial, but there is currently insufficient evidence to recommend this as a standalone intervention. Similarly, public awareness campaigns that do not support a specific policy change are unlikely to be effective in the long term.


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Module 3
Implementing and evaluating occupant restraint interventions

3.1 Cycle of improvement

Improving the road safety situation in a country requires continued planning, execution and evaluation of programmes. It is not a one-off undertaking, which implies that the policy planning stages used in specifying the actions required are mainly to illustrate a continuous cycle. There are both opportunities and challenges that need to be managed as the cycle moves on in each country.

Implementing a continuous cycle of road safety improvement begins with an assessment of the existing system, followed by the development, execution, evaluation and refinement of a national or local plan of action. A plan of action will not yield improvements unless it is translated into practical solutions. In addition to identifying and prioritizing actions that should be taken, the following key issues should be considered and made available or developed: human and financial resources, sharing responsibility among different agencies, and political commitment *(1, 78–80)*.

3.2 Pathways to change

Applying the Safe System approach to road safety results in a complex set of interacting interventions, which makes it difficult or even unethical to evaluate them using traditional research methods such as randomized controlled trials. For this reason, some researchers have proposed that "understanding the public health intervention's underlying theory of change and its related uncertainties may improve the evaluation of complex health interventions" *(78)*.

A theory of change is the pathway(s) that will be followed to achieve the objective of a programme. It "explains how activities are understood to produce a series of results that contribute to achieving the final intended impacts. It can be developed for any level of intervention implementation – an event, a project, a programme, a policy, a strategy or an organization" *(79)* or the evaluation of such interventions or set of interventions (impact evaluation). It encourages "systems thinking" through the understanding of the complex social change processes, different perspectives, assumptions and the contexts needed to optimize success.

A theory of change is a systematic approach to understanding the pathway to change in order to reach a long-term goal. It should always begin with a good situational assessment to understand the causes, risk factors, opportunities and challenges in the local situation where an intervention is to be implemented. It should then be guided by a participatory approach, bringing together multiple key stakeholders, through a workshop for example, to discuss the proposed approaches or interventions that need to be implemented to optimize impact.

Although developing a theory of change is an iterative process, and there are many ways it can be developed, it should include the following basic steps *(80)*:

- Identify the long-term outcome.
- Develop a pathway of change.
- Operationalize outcomes (set realistic goals and targets).
- Develop interventions.
- Articulate assumptions.
- Monitor and evaluate the process.

As a final output of stakeholder discussions, a visual map of the change being explored should be developed to show the relationships between proposed actions, interventions and outcomes and how these interact to achieve the goal.

The benefits of developing a realistic and implementable theory of change are shown in Box 3.1. In general, this process challenges the status and gets stakeholders to "think outside the box" so that mistakes are not made when interventions are implemented. It also forces stakeholders to think about resources and how they are best used to bring about the required change.

The process develops a shared understanding of the actions to be taken and expected outcomes on the one hand and accountability on the other.

Box 3.1 How a theory of change would benefit your programme

A theory of change will provide:

- a clear and testable hypothesis about how change will occur that allows stakeholders to be accountable for results, and makes the results more credible because they were predicted to occur in a certain way;
- a visual representation of the desired change and how stakeholders expect it to come about;
- a blueprint for evaluation with measurable indicators of success identified;
- an agreement among stakeholders about what defines success and what it takes to get there;
- a powerful communication tool to capture the complexity of the initiative.

Source: (81).

The following sections outline some of the steps involved in assessing, implementing and evaluating an effective seat-belt or child restraint programme in a country.

3.3 Assessing current use of restraints

Conducting a well-planned, thorough situational assessment is strongly advised before starting any new programme. This does not need to be a prolonged or complicated process. The most important data to collect are on current use of seat-belts and child restraints. Evidence on injury rates for belted and unbelted occupants is useful to support the case for legislation on mandatory use.

A situational assessment is essential to obtain initial and continued support from policy-makers and funding for programmes. It shows the gravity of the problem in the specified location(s). Once the programme is implemented, the initial results can be compared with post-implementation data to demonstrate its effectiveness.

There are three reasons to assess the situation before implementing an occupant restraint programme:

- to identify the problem, and its scale, of lack of use of restraints;
- to provide evidence for arguments on why use of restraints is essential and why it should be supported;
- to provide baseline indicators that can be used for monitoring and evaluating programmes.

The following sections provide basic guidance on where or how to collect data. Documents such as Data Systems: A Road Safety Manual for Decision-makers and Practitioners should be consulted to supplement this information *(82)*.

3.3.1 Injury and death data

Some countries have national data collection systems on road traffic deaths, injuries and disabilities, but most low-income countries have yet to implement such systems. If a country does not have such a database, the following data sources can be consulted:

- Police data – these usually include crashes, injuries and deaths. Some countries also record whether occupants were wearing restraints at the time of collisions. There may be gaps in the data or issues of underreporting.
- Hospital data – these tend to be biased towards more severe injuries, but they do give reliable information on the types of injury sustained, the body regions involved, the severity of injuries, and whether occupants were wearing restraints.
- Death certificates – this information may be of limited use unless a postmortem examination has been conducted and a report written.

Data on various aspects of collisions may also be obtained from insurance companies and employer records. Alternatively, specialized surveys or studies may be conducted.

3.3.2 Observational surveys

If current information on the extent of use occupant restraints is lacking, it is necessary to carry out observational surveys. These may be local (concentrated regions or at specific locations) or national. If there is a focus on increasing use of seat-belt and child restraints, it is useful to establish a regime for measuring and monitoring use on a regular basis.

Sites should be selected such that all road types are represented, so as far as possible correlation may be made between urban and rural roads, motorways and unclassified roads, built-up areas and non-built-up areas, and so on. Sites should be assessed for the ease with which they allow survey staff to safely observe and record the use of seat-belts and child restraints by vehicle occupants. For example, sites where traffic lights are installed allow survey staff time to view vehicle occupants clearly. This helps to ensure results can be generalized to represent different vehicles and different journeys. The

need to accurately observe the vehicle occupants is a limiting factor in carrying out surveys on high-speed roads such as motorways.

Site(s) for observation should be selected randomly but cover a wide geographical area, preferably including some high crash risk locations. Compromises can be made on the data being nationally representative to ensure quality over quantity of data. It is better to conduct methodologically robust surveys in one or two smaller locations than to blanket large parts of the country and generate inaccurate data. To ensure consistency in data, researchers should try to use the same sites for every subsequent observation. Box 3.2 gives a generic example of conducting a simple seat-belt wearing observational study.

Box 3.2 How to conduct an observational study on seat-belt wearing

Simple counts of drivers and passengers using seat-belts, at different locations and at different times of the day provide a rough estimate of how many motorists are using seat-belts. This information is useful to develop actions to be taken.

Because of cost, this type of study is often done on a small scale. If it is already known that a high proportion of crashes and injuries occur on certain roads or in certain areas, it is recommended that the study be carried out in those high-risk locations.

An observational survey such as that described below could be used to:

- assess the baseline situation;
- conduct on a regular basis to monitor trends;
- evaluate the impact of an intervention or set of interventions.

Planning period Before conducting an observational survey, the target population should be clearly defined in terms of who they are, where they live, and over what period data will be collected. Detailed roadmaps and data on traffic volume and estimated population prevalence of use of seat-belts from other sources should be collected for the area of interest.

Develop a data collection protocol This is a detailed written document describing the approach to be used to collect data. It includes what will be done, how it will be done, who will do it and when it will be done.

Develop data collection instruments These include a form or set of forms used to collect information, such as questionnaires and interview schedules. Training material should be developed for staff carrying out roadside observations.

Sampling The observed population should be representative of the population of interest in the target area. This means that a random sample of the population should be observed. Although non-random samples may be more feasible in certain situations, such as observations made at fuel stations or outside schools, consideration should be given to how generalizable or representative the results from such selective samples would be.

Seat-belt wearing may differ across different road types. For example, drivers may be more or less likely to wear seat-belts on highways than on local roads. The sampling frame should be designed such that it ensures adequate counts to enable an estimate of use of seat-belts across different road types, and ensures a mix of road types, volumes and locations (urban, suburban, rural).

All possible road segments should theoretically be eligible for sampling. Depending on the size of the target area, the sampling frame may be divided into two or three stages.

Number of sites The number of observational sites depends largely on funding and other logistical issues. If funding is limited, it may be more practical to make a greater number of observations from a smaller number of sites. Consulting a statistician to determine the appropriate number of sites to give a statistically precise estimate is recommended.

Site selection Ensure observational sites are selected randomly from all available sites. This may be done by creating a numbered grid, overlaying it on a map and randomly selecting sites from the grid. Whenever possible, the observational sites should be near intersections where cars slow down. For example, sites may be selected at signalized intersections where vehicles are stationery and observations of seat-belt wearing are easier to conduct. Narrow roads are better for observing passing traffic. On wider roads, observations may be taken on one side of the road only for traffic passing in one direction.

Predetermined protocol This should allow for variations in methods for observations or site selection. If traffic volume is too heavy at a site to accurately record information, the protocol may state that one observer observes front-seat occupants only and the other observes rear-seat passengers. Along with direct observations recorded by observers, a video camera may be used to record traffic flow at sites with heavy flows and where traffic travels at high speed. Each site that does not satisfy the selection criteria should have another alternative site on the same road – for example, if the original site or time selected is unsuitable due to inclement weather such as heavy rain, if police are in attendance at a particular site, or if observations cannot be made safely at a site (e.g. due to roadworks).

Observations should be made for a predetermined period. Time periods should be the same at each site to allow comparisons between sites. Observations of use of seat-belts may include categories such as age, sex, seating position, and seat-belt present but not worn. Depending on the volume and speed of traffic at observation sites, it may not be practical to observe and record more information than whether a seat-belt is worn or not worn; for example, estimation of the age of car occupants may be too difficult unless this information is gathered through reviewing video footage.

Safety of researchers Project leaders should take safety into account when planning observational work and seek to minimize any likely measurement errors. Observers should be trained to remove any possible bias. Project leaders should consider where training takes place, how it is conducted and who delivers it. A written guideline for observers and others involved in the evaluation should be produced, and protocols adhered to. Observations may be made by two or more trained observers – these can be compared to assess the level of agreement between them. A safe, convenient location from which to make observations should be identified. For safety and security reasons, observers should work in pairs and wear reflective vests.

Repeating measurements after the intervention Repeat observations should be made by the original observers when feasible, using the same protocol, on the same days and times, and at the same sites as measurements made before the programme.

Photo © Johns Hopkins International Injury Research Unit.

3.3.3 Qualitative studies

Observational studies are useful to assess who is not using a restraint system, but they do not fully explain why occupants do not use seat-belts or put their children into child restraint systems. To put in place targeted interventions for a restraint programme, this "why" information is very useful.

Qualitative studies such as focus group discussions, in-depth interviews and surveys, and mixed methods can be used to understand the barriers and facilitators to use of restraints. A systematic review of qualitative studies that focused on the perceptions, values and experiences of children, parents, caregivers and other relevant stakeholders to child restraint systems was conducted in 2018 *(40)*. The following themes emerged:

- Perceived risk for injuries versus perceived safety benefit of child restraints vary by setting and caregiver.
- Practical issues around the use of child restraints are a major barrier to its uptake.
- Restraint use is considered a disciplinary mechanism rather than a safety device by some parents, and children begin negotiating non-use as they get older.
- Adoption and enforcement of laws shape perceptions and use in all settings.
- Perceptions and norms of child safety differ culturally and linguistically.

A qualitative study in Cape Town, South Africa (see Box 1.3) showed that parents had little understanding of the current restraint law, were not aware of the benefits of putting their children in restraints, and did not own child restraint systems because they were deemed too expensive. Parents who themselves did not use seat-belts were more likely not to strap their children into restraints *(42)*.

There are many factors to consider when putting in place a restraint programme. Conducting a qualitative study alongside a standard assessment will help to target the programme to address equity issues and focus the intervention culturally and linguistically. This applies as much to high-income settings as to low- and middle-income settings.

3.3.4 Stakeholder analysis

Stakeholder analysis can shed light on the social environment in which a restraint programme is to be developed and implemented. It provides clarity on which stakeholders have high interest and power and should be engaged in policy discussions and change, versus those with low interest and power who should nevertheless be kept informed. Stakeholder analysis also reveals any stakeholders who have opposing views and possible conflicts of interest. Experience shows that involving people from a wide variety of sectors and groups, and representing diverse interests, is important and sustainable (Box 3.3).

Involving the public through participatory research approaches and co-design of interventions can help to overcome initial concerns and opposition. It is important to identify supporters and opponents and to understand the reasons for their positions in order to develop an intervention package that optimizes uptake.

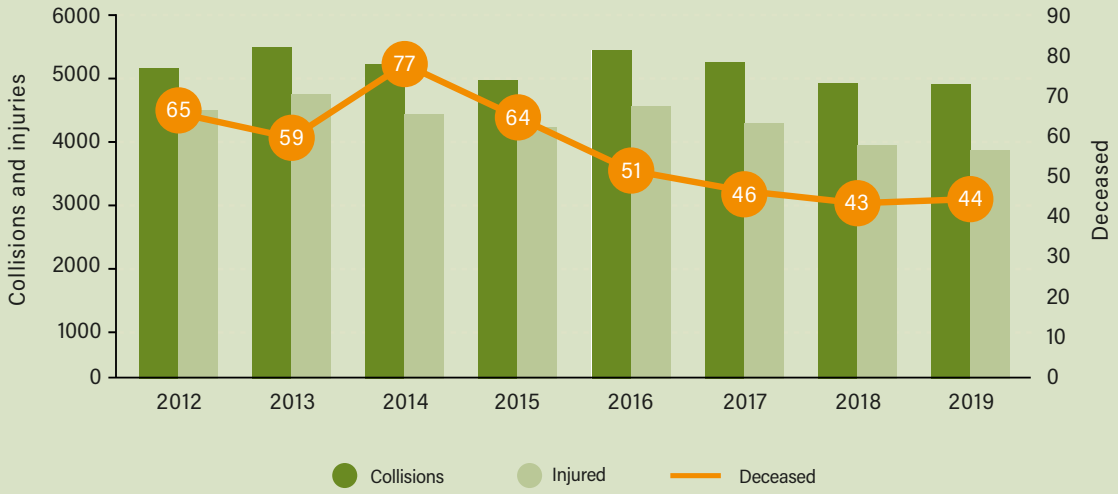
Box 3.3 Reducing child injuries and fatalities in Chile through a partnership approach

The Fundación Gonzalo Rodríguez designed and implemented a complex set of interventions jointly with the Chile National Traffic Safety Commission in the Ministry of Transport and Telecommunications and the FIA Foundation to reduce child fatalities by promoting and strengthening the use of child restraint systems.

This joint effort between government, civil society organizations, the private sector and the general public focuses four long-term strategies to strengthen use of child restraints: improving vehicle technologies; controlling laws and regulations; developing institutional capacities; and using social marketing campaigns to promote a culture change.

The programme ran between 2012 and 2019. It showed a marked reduction in the number of children aged under 12 years involved in collisions who sustained injuries or died.

Fig 3.1 Children aged under 12 years killed or injured in car crashes in Chile, 2012–2019



Source: adapted from *(83)*.

3.4 Implementing interventions

Increasing the use of seat-belts and child restraints calls for a combined approach involving a range of sectors and disciplines. Activities are usually included in the national road safety plan or strategy. The most powerful intervention is enforcement of strong laws. To be effective, laws need to be implemented after the public has been informed about restraints and the laws through appropriate social marketing campaigns and awareness-raising. These two approaches can be complemented with other voluntary measures such as employer regulations and incentive schemes and insurance and public incentive schemes.

Table 3.1 provides a useful checklist for developing a restraint programme.

Table 3.1 Checklist for designing and implementing a restraint programme

Step	Components	Done?
Implement restraint programme	Assess restraint use Identify problems Secure political support Agree activities and options through community engagement and involvement Select objectives and activities Developed monitoring and evaluation framework	
Develop legislation, create penalty system, and develop or improve standards	Review current legislation Consider institutional, cultural or financial constraints Draft new or amended legislation Create penalty system Approve legislation Implement legislation	
Develop enforcement strategy	Assess enforcement capacity Increase enforcement capacity if appropriate Train police on restraint enforcement	
Increase voluntary use of restraints by public	Develop and implement publicity campaign Set objectives, targets and performance indicators for campaign Select agency for campaign Create campaign messages and select creative concept that will reach target audience Consider how best to incorporate and work with media Develop campaign plan in relation to legislation and strengthened enforcement by police Implement and evaluate campaign Develop and encourage other voluntary approaches Engage employers in increasing use of restraints among staff and contractors through employee regulation and incentive schemes Implement public education and training programmes to reach diverse segments of public such as children and new drivers Set up fitting stations to show parents how to fit restraints in vehicles, and how to fit children in restraints Engage insurance sector in proactive schemes to encourage use of restraints Encourage vehicle manufacturers to provide evidence-based information with new car sales	
Ensure appropriate response at and after crash scenes	Develop legal framework and delivery of first-aid education programmes Train and equip rescuers to ensure prompt and safe removal of vehicle occupants	

3.4.1 Setting restraint laws

The overall objective of a restraint law should be to make use of occupant restraints universal. This can be achieved through targeted and appropriate legislation on restraint fitting and wearing for various vehicle classes that is consistently enforced and well understood by the public.

The key requirements needed to pass a restraint law require:

- strong support from the highest levels of government, sending a clear message to society that seat-belts and child restraints are critical road safety interventions;
- enough public support to ensure enforcement of the law will be accepted by the public;
- significant commitment from enforcement and communication agencies to ensure their full participation – these should be on a continuous basis and part of the regular enforcement process.

In most cases, restraint wearing laws will involve amendments to a law already in existence, such as a road traffic or motor vehicle act. For example, an existing law could be expanded to include use of seat-belts for rear-seat occupants. A completely new piece of legislation may be necessary if there are too many gaps in the current legislation, such as including a section on age, height and weight criteria for child restraint systems.

In addition to stipulating who should use seat-belts and child restraints, the legislation should also clearly identify who is responsible for:

- fitting of seat-belts – this is usually manufacturers but may be vehicle owners;
- ensuring children are appropriately restrained – it is strongly recommended that the adult driver is made responsible for all children within the vehicle;
- ensuring passengers on public service vehicles wear seat-belts.

In some countries, national legislation also specifies the penalty levels for violators.

Widespread exemptions under the law are not advisable as they can undermine the effectiveness of restraint programmes and can complicate enforcement practices. If exemptions are unavoidable, the legislation should ensure there are clear definitions to avoid ambiguities. Exemptions for drivers such as drivers of taxis and delivery vehicles are strongly discouraged.

Many exemptions arose when the first seat-belts were introduced. These seat-belts were nonretractable, and their use was perceived to interfere with drivers exiting their vehicles regularly. With the introduction of retractable seat-belts more than two decades ago in most countries, such exemptions are invalid and significantly increase the risk of road trauma for professional drivers.

For further information, the WHO document Strengthening Road Safety Legislation provides detailed guidance on developing and enacting a strong restraint law and includes examples of good laws *(62)*.

3.4.2 Implementing seat-belt laws

Campaigners believe the best approach is to see full vehicle occupant legislation (covering front, rear and child vehicle occupants) introduced in a single phase. This sends a consistent message that seat-belts save lives and dispels any misperception that wearing seat-belts in the rear is not as important as in the front.

Most governments, however, consider this too much to ask of the public and have adopted a phased approach endorsed by the UNECE Consolidated Resolution on Road Traffic *(84)*.

Malaysia, for example, used a 6-month phased approach to implement its backseat passenger seat-belt law. The first phase involved a social marketing campaign and education about rear seat-belt safety and retrofitting vehicles that did not have backseat belt mountings. The second phase included community awareness programmes and warnings for non-use issued by the police. Full implementation and enforcement of the law took effect on 1 January 2009. An evaluation of the effectiveness of the introduction and enforcement of the phased-in law found that a 20% reduction in the number of people who sustained serious and slight injuries *(85)*.

Box 3.4 illustrates the steps taken in the Philippines to implement the child restraint law.

Box 3.4 Child restraint system law in the Philippines: a good model and a team triumph despite COVID-19

In 2019, the Philippine Government enacted Republic Act No. 11229 (Child Safety in Motor Vehicles Act). This law requires drivers of private motor vehicles to properly secure children aged 12 years and younger and with a height under 150 cm in a child restraint system appropriate to the child's age, height and weight.

Full implementation of the new law was suspended in February 2021 due to the COVID-19 pandemic, but the Government and civil society partners continued to work towards ensuring the lead enforcement agency, the Land Transportation Office (LTO), was prepared for full implementation.

Photo © Land Transportation Office.

Strategies adopted addressed key problems raised in the course of meetings between the Government and civil society organizations:

Low familiarity with child restraint systems among enforcers Since child restraint systems involved new technology, there was very low familiarity with these devices among law enforcement officers. To address this, civil society organization ImagineLaw donated one of each type of child restraint system (rear-facing, forward-facing, booster seat) to enforcers in regional LTO offices so they could become familiar with them.

Low familiarity with enforcement strategies Unlike enforcement of seat-belt mandates, enforcement of the new law involved dealing with children and unfamiliar devices in potentially sensitive situations. To help operationalize implementation of the law on child restraint systems, ImagineLaw supported LTO to develop enforcement guidelines and provided training of trainers for enforcement, with support from the Global Road Safety Partnership. The enforcement guidelines included a mechanism for enforcers to warn rather than penalize apprehended drivers for inappropriate or improperly installed child restraint systems. Drivers were instructed to immediately correct the installation of the device, or to go to the nearest fitting station to reinstall the device. The enforcement guidelines prohibit enforcers from directly addressing children.

Low familiarity with child restraint systems among the public Although child restraint systems are already available, the public is generally unfamiliar with them. To increase awareness and assist parents and drivers in properly installing child restraint systems, the implementing rules of the new law required LTO to establish a network of fitting stations in the country. The Global Road Safety Partnership worked with Kidsafe Western Australia to develop a training course tailored to specific needs in the Philippines. ImagineLaw coordinated a series of fitters' training sessions for representatives from all regional LTO offices, culminating in a train-the-trainer session to encourage certified fitters to train more fitters within their regions. A total of 47 fitters were certified under this programme.

Low familiarity with choosing correct child restraints The introduction of fitting stations ensures the correct choice and use of child restraints. Decades of research in early-adopter countries found that misuse was the biggest contributing factor to ineffective introduction of mandatory child restraint laws. Difficulties included choosing the correct size restraint for the child, correct attachment to the vehicle, and correct harnessing of the child. Australia and the United States experienced successes in reducing misuse by establishing networks of fitting stations using trained personnel to assist with choosing correct restraints.

Low familiarity with the law on child restraint systems among the public ImagineLaw supported Government partners in planning their information, education and awareness campaigns to help the public understand and prepare to comply with the new law.

Media officers in the different LTO regions were trained to develop key messages that emphasized the purpose of the law – to protect children. The LTO Traffic Safety Division at its central office regularly monitored the activities of regional offices to ensure the information, education and communication campaign was effective and sustained. Civil society partners provided an information, education and communication package for media officers to adapt into their own dialect and to suit the context within their regions.

3.4.3 Enforcing restraint laws

A good restraint law without a strong policing strategy will not be an effective use of resources. The community needs to understand that there is a strong likelihood they will be detected and penalized if they do not use restraints appropriately. The strategy should be intelligence-led – it should be based on an understanding of which occupants are most at risk, which groups are not using restraints, community perceptions, and whether there is political commitment. Political will is critical in ensuring a consistent and rigorous policing process.

Enforcing a new law can be a long process and creates an additional burden on the police. It is important to understand the capacity of the police and how to best integrate the strategy into current policing activities. Additional resources and training may be required. Strategic road policing integrates the fundamental principles of policing in a multidimensional intervention (Table 3.2).

Table 3.2 Fundamental principles for restraint policing

Principle	Action
Increased visibility of policing immediately after new laws are enacted	Includes highly visible, publicly observable and strategically located checkpoints and roadblocks that are varied in location, intensity and time of day or night There should be many police officers in each working team Visibility includes signage about the enforcement activity, safety vests for police and adequate lighting at night
Specific deterrence policing (longer-term approach)	After road users become accustomed to new seat-belt or child restraint laws, greater use of specific deterrence-based policing is required, such as: ▪ police officers positioned on roadside to observe vehicle occupants – where non-use of restraints is identified, police tasked with stopping vehicles should signal drivers to stop and issue infringements or penalties for offences detected ▪ police officers using motorcycles or cycles observing vehicle occupants in low-speed zones and stopping vehicles and taking enforcement action where offences are detected These operations prevent vehicle occupants from correctly wearing seat-belts only when they see highly visible enforcement Operations should operate on an "anywhere, any time" basis so that road users cannot predict where or when policing will occur Enforcement locations should be chosen across the road network but use locations where the visibility of vehicle occupants allows clear observation (e.g. daylight, adequate street lighting)
Repetition of enforcement campaigns	Indicates to motorists that the risks of being caught are high – anywhere, any time
Strict and consistent enforcement	After an initial public warning period, policing should be strict, non-discriminatory, fair and consistent – not only short term, on highways or where police enforcement can be anticipated If there is no policing, there will be limited or no compliance
Well-publicized enforcement (general deterrence)	To achieve maximum effectiveness, compliance-driven policing (specific deterrence) must be combined with coordinated education and publicity campaigns (general deterrence) involving engagement of government, local government, mass media and other agencies Publicity campaigns should be conducted before, during and after policing activities with reinforced safety messages Safety brochures on correct use of seat-belts and child restraints may be handed out with warnings as an alternative to issuing a fine immediately after new laws are enacted; warnings are not effective in the long term and should be avoided after road users have a reasonable period (about 3 months) to be educated about new seat-belt and child restraint laws Education and instruction includes reminders of the benefits of use of seat-belts and child restraints and the constant promotion of safety messages

Penalties for noncompliance must be perceived as sufficiently serious to deter potential law-breakers *(86)*. The penalties should be set in line with those for other traffic law violations. They can be linked to a penalty points system that leads to more serious penalties, such as the cancellation of driving licences when accumulated points pass predetermined limits. The law could specify more serious penalties for repeat offenders. In general, it is simpler and easier to police and administer if there is a fixed fine for noncompliance.

3.4.4 Putting in place restraint standards

Standards mostly include technical requirement specifications and test methods regarding the construction and installation of the different seat-belt types, their components and child restraints.

The key to achieving success is consultation and partnership with vehicle manufacturers. If countries can ensure vehicles sold have seat-belts and ISOFIX attachments installed as standard, and manufactured to the specified regulations set out within legislation, stakeholders can start to work towards increasing wearing rates.

Ideally stakeholders should harmonize with one specific standard to ensure consistency at a global level. It is recommended that countries base standards on the UNECE regulations, recognizing that R129 might be difficult for some low- and middle-income countries to implement if their vehicles do not have ISOFIX attachments. Countries can make additions to these standards – for example, to meet local environmental conditions.

Stakeholders should note, however, that ease of use and comfort will inevitably affect wearing levels. Therefore, recommendations are based on types that have proved to be effective in providing satisfactory support in crashes and that minimize inconvenience to vehicle occupants when fastening and wearing.

The selection of appropriate child restraint systems can be complicated since there are two international standards. The Global Road Safety Partnership has published a guide to assist countries in implementing restraint programmes (Box 3.5).

Box 3.5 Technical guide to assist the implementation of child restraint systems in low- and middle-income countries

The Global Road Safety Partnership Technical Guide to Assist the Implementation of Child Restraint Systems (CRS) in Low- and Middle-income Countries is intended to assist countries to introduce child restraint systems once necessary laws are in progress *(41)*.

The guide provides step-by-step guidance on choosing restraint systems, deciding the most appropriate standard, correctly fitting restraints, measuring use, enforcing child restraint laws, and communication techniques.

To download the manual please go to: Technical_Guide_to_Assist_the_Implementation_of_CRS.pdf (grsproadsafety.org)

Several devices have been developed to remind vehicle occupants to buckle up. Typically, they comprise a flashing light on the dashboard and a loud warning tone, which increases in intensity with higher speed. Initially these operated only for the driver's seat, but new systems are now applied to all seats in a vehicle if a weight over a certain amount is detected. A study in the United States found that audible reminders lasting at least 90 seconds and a speed-limiting interlock were more effective for increasing use of seat-belts than intermittent audible reminders, but reminders were found more acceptable to drivers.

Researchers estimated that if the existing United States safety standards were modified to require audible reminders lasting at least 90 seconds for front-seat occupants, approximately 1489 lives could be saved every year in the United States alone *(87)*.

3.4.5 Education and training

Community education programmes on the need to use seat-belts and child restraints are important to raise awareness of the benefits of using restraints, understanding restraint laws and penalties, encouraging use, and ultimately bringing about a sustainable long-term increase in use, particularly when combined with a strong enforcement strategy. Education and public information programmes can be used to:

- increase public awareness of and support for a policy or law;
- create a supportive environment for the passage of laws and policies that increase use of seat-belts;
- stimulate and reinforce behavioural change;
- influence social norms, making use of seat-belts and child restraints more socially acceptable.

Several approaches can be used to inform vehicle owners and occupants on the need to use seat-belts or appropriate child restraints. Some key options are shown in Table 3.3.

Table 3.3 Key educational and training appropriates to supplement restraint campaigns

Stakeholder	Approaches
Health personnel and officials	Provide literature and advice, e.g. to new parents on the need to use child restraints, or to people involved in road traffic crashes, or through health promotion presentations or exhibitions
Manufacturers	Provide guidance on use of safety features within a vehicle, e.g. information in vehicle manual showing vehicle owners how to identify damage or faults to a seat-belt that indicate replacement is required Commercial marketing by vehicle manufacturers and retailers, particularly for child restraints, can play an important role in increasing voluntary use of seat-belts
Road safety practitioners	Increase the knowledge of the whole community, using a wide range of methods Consider providing resources and holding special events educating vehicle occupants about how identifying faults and maintaining seat-belts
Parents, caregivers, teachers, media	Getting messages across about the benefits of using seat-belts early in life is desirable; this can be particularly beneficial as informed children can use their knowledge to influence their siblings and friends Once children have increased their knowledge and adopted good safe practices, they may try to correct their parents or guardians exhibiting poor safety behaviour such as not using seat-belts

3.4.6 Social marketing campaigns

A publicity campaign is usually the most visible part of an initiative to raise restraint use rates and is often mistaken for the whole initiative itself. Social marketing techniques are used to inform, advise, encourage and persuade the target audience to undertake a behaviour. On its own, publicity is of limited effectiveness, but it is an essential part of a coordinated programme in support of legislation.

A campaign undertaken only once, even if it includes dedicated enforcement, will not have a long-term sustainable impact on increasing use of seat-belts or child restraints. Regular enforcement accompanied by repetition of the key messages is needed.

Conducting a publicity campaign requires expertise in marketing or advertising, development of specific campaign objectives, articulation of the campaign messages, identification of the target audience, specifying a timeframe for implementation, and a methodology for evaluating the initiative.

For more information on implementing and evaluating a social marketing campaign, see the WHO Road Safety Mass Media Campaigns *(88)* and Reporting on Road Safety *(89)*.

3.4.7 Combined approaches

Most restraint programmes use a combined approach. Coordination between initiatives is critical if maximum benefit is to be achieved. For example, use of seat-belts in Shanghai, China was boosted during a combined strategy that included the training of police, a social marketing campaign and the deployment of high-tech police enforcement. This approach resulted in an increase in seat-belt wearing rates from 61% in October 2015 to 85% in December 2017 *(90)*.

3.5 Evaluating progress and using results for improvement

Monitoring and evaluation are integral elements of all road safety campaigns. Through the implementation of monitoring and evaluation techniques, stakeholders can determine the success or failure of a campaign and design future campaigns accordingly.

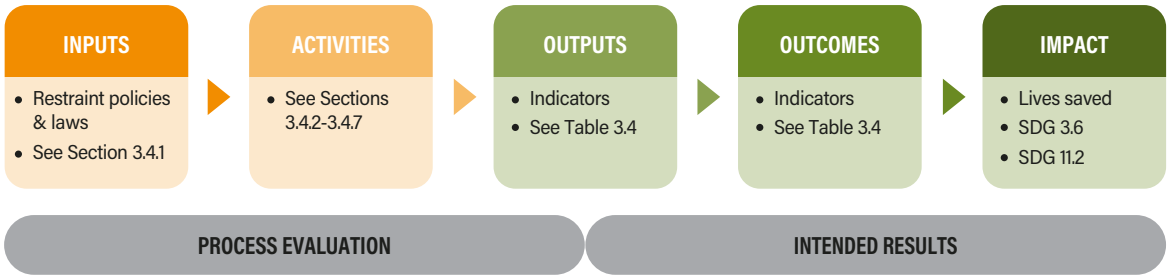
Monitoring through the regular collection of appropriate information and data links activities and their resources to project or campaign objectives. It provides continuous information, which tracks progress and offers opportunities for modifications to projects so they reach their goals.

All governments should routinely monitor the effectiveness of their occupant restraint programmes through regular surveys and the analysis of casualty and police data. According to UNECE, this allows "governments to better target effective use of resources, to sustain the increased seat-belt/child restraint use, to reduce the number of road traffic fatalities and injuries, and to defend their programme resources" *(84)*.

Evaluation of restraint campaigns is essential to assess whether the activities are being delivered as planned, whether they are attaining the expected results, any obstacles or unexpected outcomes that have arisen, and the overall impact of the intervention.

A sound monitoring and evaluation framework provides a clear and explicit understanding of how the intervention is expected to lead to the desired outcomes and impacts. The conceptual framework, known as a results chain (Fig. 3.2), supported by well-defined indicators, allows visualization of this logical sequence.

Fig. 3.2 Results chain for monitoring and evaluating a restraint campaign



Outputs (performance indicators) may include:

- knowledge and attitudes about restraint use;
- the extent of police enforcement;
- the frequency of public awareness campaigns;
- the number of police trained in occupant restraint enforcement;
- the number of organizations with seat-belt and child restraint policies.

Knowledge and attitudes are often slow to change but can be measured by regular, possibly annual, surveys conducted by interviews. As with observational surveys, these interview surveys should be able to detect differences between population groups. It is sometimes possible to use regular road safety surveys by adding several questions relating to attitudes to seat-belt wearing and to other road safety measures. This can be very useful in providing wider information with which attitudes to safety can be correlated. Police and casualty data may also be useful – but these are subject to numerous external influences, may not accurately reflect the effect of the campaign, and may be influenced by enforcement practices or admission policies.

The primary outcome of a restraint campaign is that restraints are used by all occupants, irrespective of seating place or age. This outcome is best measured by regular, independently conducted surveys, discussions and interviews, before, during and after the campaign. Ideally, these surveys should take place every 6 months during the campaign, and annually once the campaign has reached its maintenance stage. The cost of surveys should be built into the overall cost of the programme. The survey should be sufficiently large to identify significant differences between different age groups, between men and women, between drivers and front-seat and rear-seat passengers, between cities and smaller towns, between urban roads and highways, and in different regions of the country. As differences are found in surveys, it may be necessary to adjust the campaign focus more towards groups with lower use rates.

Table 3.4 summarizes the most common indicators used to monitor and evaluate restraint programmes.

Table 3.4 Objectives and indicators used to evaluate restraint programmes

Objective	Indicator
Increase occupant knowledge and awareness about restraint use	Percentage increase in knowledge about the law and penalties Percentage increase in knowledge about benefits of using seat-belts and child restraints Percentage increase in awareness of increased enforcement by police
Increase fitting of standard driver and passenger seat-belts	National seat-belt and child restraint standards and regulations approved Percentage increase in number of vehicles fitted with standard seat-belts (front and rear, trucks, buses) and ISOFIX for child restraints
Increase use of seat-belts and child restraints	Percentage increase in use of seat-belts (front and rear, child restraints, trucks, buses) Percentage increase in use of child restraints Percentage decrease in violations (after enforcement has already made significant impact)
Reduce occupant fatalities	Percentage reduction in fatalities of car drivers Percentage reduction in fatalities of front-seat occupants of vehicles Percentage reduction in fatalities of rear-seat passengers in vehicles Percentage reduction in fatalities of child passengers Percentage reduction in fatalities of truck drivers Percentage reduction in fatalities of unrestrained vehicle occupants

The impact of increasing use of restraints can be calculated through assessing the number of lives saved, as this if the primary goal of getting occupants to use seat-belts. As shown in Box 3.6, many thousands of lives have been saved through the use of seat-belts, child restraints and airbags in the United States alone, and many more could be saved if everyone used a restraint.

Box 3.6 Lives saved by restraint use in the United States, 2013–2017

The National Highway Traffic Safety Administration in the United States has estimated the number of lives saved using restraints since 1975. Table 3.5 shows how many lives were saved using seat-belts among occupants aged 5 years and over, child restraints among children aged 4 years and under, and frontal airbags among occupants aged 13 years and older. In these 5 years alone, a total of 83 623 lives were saved. A further 13 383 lives could have been saved if there was 100% use of seat-belts.

Table 3.5 Estimated lives saved by restraint use, 2013–2017

Year	Lives saved, age ≤4 years	Lives saved, age ≥5 years	Lives saved, age ≥13 years	Additional lives that could have been saved with 100% seat-belt use
	Child restraints	Seat-belts	Frontal airbags	
2013	263	12 644	2398	2771
2014	253	12 801	2400	2877
2015	273	14 063	2597	2715
2016	334	14 753	2774	2471
2017	325	14 955	2790	2549

Source: (91).

Once an evaluation is complete, it is important to provide feedback to the programme stakeholders. Dissemination of results helps to garner further support for the programme if it is successful, and helps others gain support for the introduction of similar programmes. Publicity from dissemination activities may increase the impact of the programme. If the programme has not been successful, it is important to share this with others so that weaknesses or relevant issues are considered in other similar interventions, including whether to introduce such interventions.

Dissemination may involve presenting the results at public meetings, using the media to publicize the outcomes of the programme, or publishing reports and papers in scientific literature. Dissemination, translation and diffusion activities are often planned to increase the chances for nationwide adoption of effective interventions.

3.6 Summary

Monitoring and evaluation should be integral components of any restraint programme or campaign. This module encourages the design of an assessment, monitoring and evaluation framework before the implementation of a restraint programme. It provides some general guidance on how to implement the campaign and directs readers to more comprehensive publications on various aspects. It concludes by encouraging practitioners to develop an effective evaluation strategy to help identify and correct any problems that arise during the programme.

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