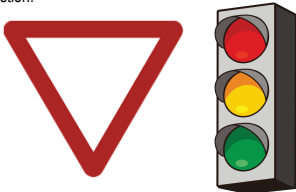


## Abstract.

Intersections are considered to be high-risk areas due to non-compliance with traffic rules. Failure to yield right of way and running red lights are major issues, but improper turning manoeuvres, like illegal U-turns and improper signalling, are also contributor factors to accidents. Vulnerable road users are particularly at risk at these locations, as these violations may result in severe injuries and congestion.



The EU has set ambitious road safety goals in order to reduce the number of killed and injured in road crashes and has recognized the importance of using key performance indicators (KPIs) for assessing road safety performance as a support of road safety policies implementation. In this line of view, the EU promoted several initiatives, where the Baseline and the Trendline projects stand out.

The Trendline project introduces several innovative KPIs, including red-light violations at intersections. The gathering of these KPI, using consistent criteria, is a novel effort across multiple European countries. Portugal's prevalent speeding issue emphasizes the significance of this endeavour, especially for the country. This paper focuses on the preliminary analysis of intersection compliance, analysing factors like traffic signals, yielding right of way, pedestrian safety, and infrastructure design, whose analysis is crucial for improving road safety.

## Introduction

Road safety is a global concern, with intersections being recognized as high-risk areas due to non-compliance with traffic rules. One critical issue of this is the failure to yield right of way at intersections. When drivers neglect to yield, it can result in collisions with other vehicles, pedestrians, or cyclists who have the right of way. This violation often occurs due to driver negligence, lack of attention, or a lack of understanding of traffic rules. The outcomes of these collisions can be devastating, involving high-speed crashes and multiple points of impact.



Another problem is the act of running red lights. Disregarding red traffic signals is extremely dangerous and substantially increases the risk of accidents at intersections. Drivers who run red lights not only endanger their own safety but also put other road users at risk. These violations frequently lead to side-impact collisions, also known as "T-bone" accidents, as vehicles from different directions collide perpendicularly. Improper turning manoeuvres also contribute to the problem. Illegally or incorrectly executed turns at intersections can lead to serious accidents. Examples include making prohibited U-turns, improperly turning left or right, or failing to use turn signals, which can confuse other drivers and pedestrians. These violations often result in collisions with oncoming vehicles, pedestrians crossing the street, or cyclists sharing the road.



The consequences of intersection-related violations can be severe due to the complex interactions among various road users. Vulnerable road users, such as pedestrians and cyclists, are particularly at risk as they may be caught off guard by drivers who fail to yield or violate traffic rules. High-speed collisions resulting from red-light running or improper turning manoeuvres can cause life-threatening injuries, including traumatic brain injuries, spinal cord injuries, fractures, and fatalities.

Additionally, intersection-related violations can disrupt traffic flow and contribute to congestion. When a driver fails to yield or runs a red light, it disrupts the smooth progression of vehicles, leading to delays, gridlock, and an increased likelihood of rear-end collisions or conflicts between drivers navigating the intersection.

Addressing intersection-related violations needs a comprehensive approach. This includes improving driver education and awareness, enhancing traffic signage and signalization, implementing stricter enforcement measures, and designing intersections with improved visibility and clear right-of-way rules. By specifically targeting these violations, road safety stakeholders can work towards reducing accidents, injuries, and fatalities at intersections, ultimately creating safer road environments for all road users.

## Assessing road safety performance

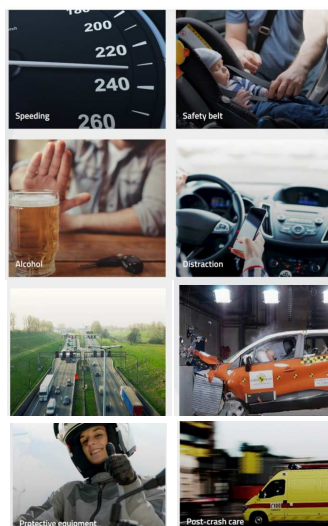
The European Commission has set ambitious goals to reduce road fatalities, aiming to halve the number by 2030 and move towards zero fatalities by 2050. Based on the 'Safe System' approach, which focuses on protecting road users through layers of protection and on the definition of road safety KPIs, which are crucial in measuring progress and effectiveness of initiatives at national and European levels, the EU promoted the Baseline project.



This project aimed to produce comparable KPI values across EU Member States, contributing to capacity building and data collection efforts. By providing standardized KPI values, the project enhanced the understanding of road safety performance and supported evidence-based policies to reduce fatalities. Following the Baseline project, the European Union has provided funding for the subsequent initiative called Trendline.



The Trendline project focuses on a core set of eight KPIs derived from the EU Road Safety Policy Framework 2021-2030: speed compliance, safety belt usage, protective equipment usage, alcohol consumption, distraction from handheld mobile devices, vehicle safety ratings, infrastructure safety ratings, and post-crash care response time.



## Red-light violations and speed

In addition to these established KPIs, the Trendline project introduces ten new experimental and complementary indicators to further enhance road safety assessment, where **red-light violations at intersections** are included.

The work has recently begun, and primary steps are being taken to define the variables relevant for the behaviour analysis. Differences in type of environment are being taken into account as speeding in consolidated urban areas is not frequent, particularly in the presence of traffic calming measures and traffic lights. However, challenges emerge at the boundary between urban and rural regions, as drivers need to adjust their speed and behaviour in response to altered environment. This problem is heightened on rural roads that pass through compact villages featuring a short urban section (through roads), given that drivers typically maintain their speed in these sections.

Driver's behaviour at intersections is shaped not just by the established right-of-way rules but also by the intersection's layout and the actions of other road users. Hence, this information will also be taken into account for gaining a deeper understanding of how and why road users adopt a risky behaviour at intersections.

Portuguese drivers also follow this pattern of behaviour. In a recent study developed within the Baseline project, it was concluded that the percentage of drivers speeding is lower in urban areas, when compared with rural areas. Following the establishment of the proper harmonized data collection methods, an adequate campaign for gathering information will be established, covering intersections from all over the country, in different types of roads and environments.



Speed compliance in Portugal

	Motorways	Rural roads	Urban streets
<b>Portugal</b>	44%	36%	73%

## Conclusion

The use of harmonized European KPI enhances the understanding of road safety performance and supports evidence-based policies to reduce fatalities.

Compliance with traffic rules at intersections is an innovative KPI, being collected for the first time with the same criteria in several European countries.

One of these countries is Portugal, particularly critical in terms of speed compliance. The aim is to identify areas for improvement and devise evidence-based strategies to enhance intersection safety, mitigate conflicts, and optimize traffic flow efficiency.

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