

# A NEW ANALYTICAL FRAMEWORK FOR ROAD SAFETY DECISION MAKING IN SIERRA LEONE

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## ABSTRACT

Road safety has been identified as a key aspect of rural access and mobility development in Sierra Leone. Having established a policy to reduce the burden of deaths and disabilities through road traffic crashes in the country, the Government of Sierra Leone was seeking to ensure that appropriate strategies are identified and applied to address road safety needs, based on analytical methods.

To achieve this objective, a comprehensive road traffic crash database was needed to capture crash data and to provide a better understanding of the road safety needs so that appropriate interventions can be applied. This is a fundamental aspect for reliable and effective road safety decision making.

Nowadays, few data are collected by various agencies in Sierra Leone and no communication and centralisation of data is done. There is an urgent need for establishing a reliable framework for data collection, management and analysis.

A pilot study was conducted with twofold objectives:

- Set up a methodology for data collection with relevant attributes and related protocols for road safety management.
- Develop and implement an electronic data management system for road traffic crash data storage, analysis and retrieval.

Various activities were conducted to these aims:

- Overview of road safety data needs, identification of data types required and stakeholder consultations.
- Definition of a conceptual framework for road traffic crash data collection and its validation during a stakeholder workshop.
- Pilot data collection in three regions of Sierra Leone.
- Definition of a framework for data analysis and implementation of an accident data management system tailored to Sierra Leone characteristics.
- Demonstration and validation of the accident data management system during a stakeholder workshop.
- Training of selected staff to use the data collection framework and the accident data management system.

This paper provides an overview of the activities carried out and of the main project results. It especially focuses on a new analytical framework developed for road traffic crash data collection, management and analysis, tailored to Sierra Leone specific needs and tested during the pilot exercise. This framework allows the various agencies involved in road safety to collect data, to store them into a national database, to activate road safety management functions and to perform in-depth data analysis, as well as to support road safety decision making.

## 1 BACKGROUND

Based on the WHO's estimation (1), Sierra Leone had 1,661 road traffic crash fatalities in 2013 or 27.3 fatalities per 100,000 population, which is one of the worst figures in the world, ranking 160<sup>th</sup> among 179 countries/regions.

The road fatality rate of 27.3 per 100,000 population also compares unfavourably with the average of 26.6 in the African region. Considering the current high growth in the number of vehicle registrations of above 19% per year (2), there is a high probability of further increase in road crashes in the country.

These figures are attributed to several factors such as excessive speeding in towns and cities and the operation of overloaded trucks on rural roads in poor condition. Overloaded goods trucks travelling on roads in poor condition easily get toppled due to a lack of stability causing Road Traffic Crashes (RTC). Even though motorcycle crashes may not have been recorded extensively, they are also a major cause of RTC fatalities in Sierra Leone.

Having established a policy to reduce the burden of premature deaths and disabilities caused by road traffic crashes in the country, the Government of Sierra Leone (GoSL) is seeking to ensure that appropriate strategies are applied to address road safety needs including road traffic crash situations on low volume rural roads.

A comprehensive RTC database is necessary to capture crash data and to provide a better understanding of the road safety needs on Low Volume Roads (LVRs) so that appropriate interventions can be applied.

To this aim, a pilot study to collect more robust accident data in Sierra Leone has been realised with twofold objective:

- Set up a methodology for RTC data collection using sample data collected on a pilot basis on Low Volume Roads in Sierra Leone.
- Develop and implement an electronic accident data management system for RTC data storage, analysis and retrieval for LVRs in Sierra Leone.

A new framework to the RTC data collection and management was then defined, accompanied by stakeholder consultations.

The pilot study has been funded by the Africa Community Access Partnership (AfCAP) and UKaid.

## 2 SITUATION ANALYSIS

Various sources of information for RTC data exist in Sierra Leone. However, they are not homogeneous and provide different figures.

Main entities involved in the RTC data collection and management are as listed below and presented in Figure 1:

- Sierra Leone Police (SLP). They are in charge of data collection when a crash occurs. SLP utilises a data collection form containing generic information on victims, number of vehicles and persons involved. However, no detailed information is collected, so the analysis of crash patterns and risk factors is not possible.
- Sierra Leone Road Safety Authority (SLRSA). They are in charge of management of the national RTC database. They also collect RTC data when a crash occurs. SLRSA also has its own data collection form (different from that of SLP). Similar to that of the SLP it only contains generic information on victims, number of vehicles and persons involved.
- Health services (hospitals, emergency centres, mortuary department). They collect information on RTC victims (deaths or injured). However, this information is usually not shared with other stakeholders (e.g. SLP, SLRSA, other health services).
- Statistics Sierra Leone (SSL). They are in charge of issuing official statistics for Sierra Leone, including among others also those about RTC. They receive data from entities in charge of data collection. However, the sharing of information is not done frequently.

- Sierra Leone Roads Authority (SLRA). They manage all the road infrastructures in Sierra Leone. To this aim, they are interested in receiving information on RTC data. This would, for instance, facilitate the treatment of black spots.
- Sierra Leone Insurance Commission (SLICOM). Insurance companies could be a good source of data for RTC with only damage to vehicles. However, road users do not often report a crash to their insurance company, to avoid issues with police and additional insurance costs. Thus, the amount of information currently available is limited.

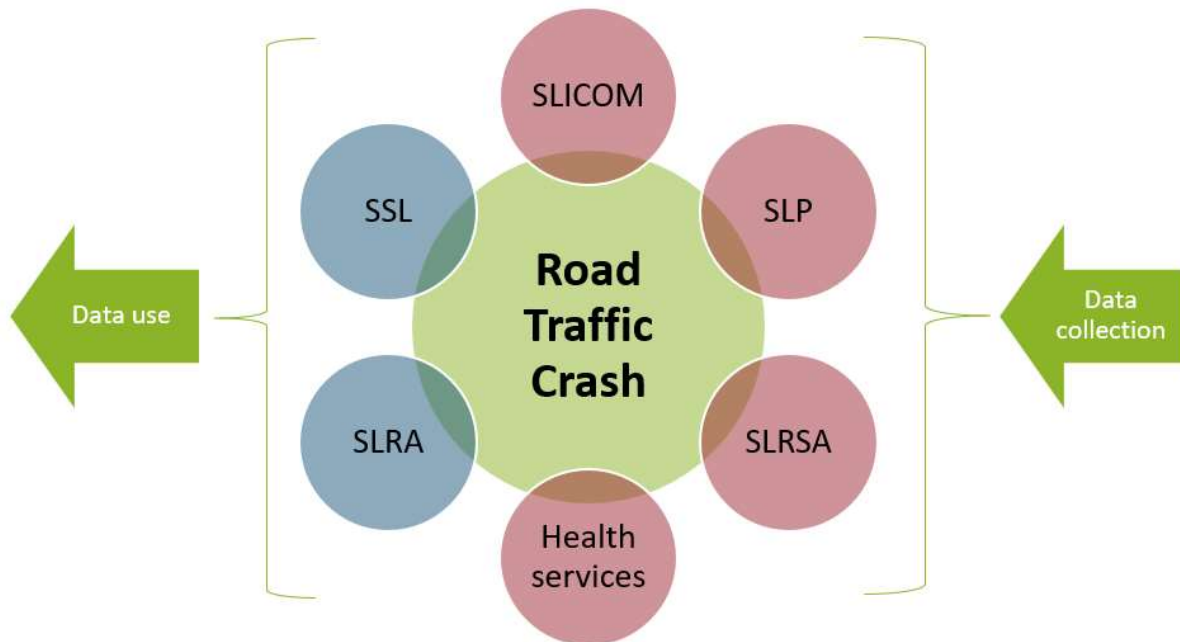


Figure 1 Entities involved in RTC data collection process

Main challenges highlighted for Sierra Leone refer to:

- Missing standard data collection forms complying with international standards.
- Missing information allowing for the location of each RTC situation.
- Missing information in the data collection form allowing for an understanding of the patterns and causes of RTC.
- Absence of a national database on RTC where all data and information are centralised.
- Lack of database validation methodology (i.e. crosschecks with other databases).
- Missing use of IT tools to fill out data collection forms and to perform analysis.
- Missing instructions for the correct compilation of completed RTC data collection forms.
- Lack of training for those involved in the RTC data collection.

### 3 CONCEPTUAL FRAMEWORK FOR RTC DATA COLLECTION AND MANAGEMENT

The framework for RTC data collection and management defines a common platform for merging information collected by police forces and health services into a single national database with provision for a follow-up on injured persons.

In defining the framework, a set of standardised definitions related to road traffic crashes with reference to those recommended by the World Health Organization (WHO) has been established.

The proposed RTC data collection and management framework is shown in Figure 2. The key actors of this framework are:

- SLP should collect RTC data. For each crash analysed by SLP, a form for data collection on paper or through an electronic device (computer or tablet) must be filled in by police officers.
- SLRSA has the following responsibilities:
  - Collection of RTC data. For each crash analysed by SLRSA, a data collection form, on paper or through an electronic device (computer or tablet) should be filled in by police officers.
  - RTC analysis and reports on road safety.
  - Maintenance of the national RTC database.
- Hospitals, Emergency Centres, mortuary department should collect data on persons injured in RTC and transported to a health service (this is valid for persons injured as well as who die within 30 days because of the crash). Data are collected on paper or through electronic means.
- SSL is in charge of preparing official statistics on RTC. It should receive data periodically from SLRSA.
- SLRA should receive statistics and analysis of RTC data to be used for assessment of road infrastructure quality and safety conditions.

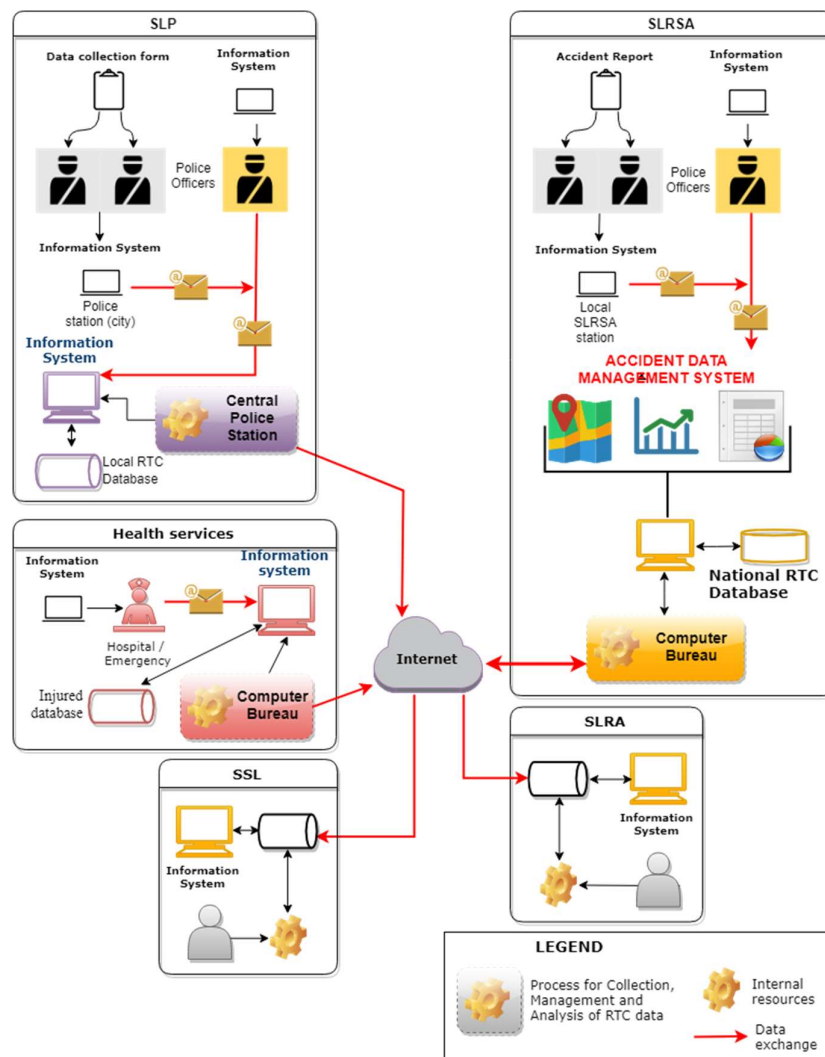


Figure 2 RTC data collection and management framework

Two RTC data collection forms were also recommended for use in Sierra Leone: one for police forces and one for health services.

The police form was developed based on the minimum set of RTC data elements recommended by WHO. Data elements are divided into four categories:

- Crash related elements, describing the overall characteristics of the crash (including for instance crash type and causes of the crash).
- Road related elements, describing the characteristics of the road and associated infrastructure at the place and time of the crash.
- Vehicle related elements, describing the characteristics and events of the vehicle(s) involved in the crash.
- Person related elements, describing the characteristics, actions, and consequences relating to the people involved in the crash. These elements are to be completed for every person injured in the crash, and for the drivers of all vehicles (motorised and non-motorised) involved in the crash.

#### **4 PILOT RTC DATA COLLECTION**

To test the RTC data collection framework, a pilot data collection exercise was undertaken. Three enumerators collected RTC cases for two weeks in three regions of Sierra Leone (northern, eastern and southern).

The RTC data collection in the field was performed by the enumerators using the data collection form developed for the police force. In addition to the collection of RTC data in the field, the enumerators identified the victims of crashes and performed a follow-up to verify their health status. This was done in connection with hospitals or emergency centres. In this case, the enumerators used the data collection form developed for health services.

##### **4.1 Main challenges of the pilot data collection**

In carrying out the data collection for this study, some challenges were encountered:

- Some vehicle drivers or motorcycle riders were very reluctant to respond and cooperate. Some of them ran away before being questioned (especially motorcycle riders).
- Some RTC were hardly reported to health facilities (sometime victims prefer to go to herbalists or local bone specialists for health treatments).
- Some vehicles or motorcycles were unregistered and with no registration plates affixed.
- Some drivers or riders were unlicensed.
- Accurate information about age and date of birth was not obtained in most cases (due to illiteracy and poor data recording).
- Inclement weather, bad road conditions also posed challenges as some locations where remote and/or hardly accessible.

##### **4.2 Statistical analysis of collected RTC**

All the RTC were collected on Low Volume Roads. Globally the enumerators were able to collect 25 RTC cases during the two weeks of pilot data collection. The pilot task was not deemed to be statistically significant. Its objective was to verify the effectiveness of the framework defined.

The majority of RTC occurred between two or more vehicles or between a vehicle and a pedestrian (eight out of 25 RTC respectively). Five out of 25 RTC occurred with an obstacle (parked vehicle or another kind of obstacle). The other RTC's were single vehicle crashes (Figure 3).

The majority of RTC's occurred in clear weather conditions (14 RTC out of 25). However, 11 out of 25 RTC occurred in adverse weather conditions (rain, hail, wind). This is quite normal since the pilot data collection has been done at the beginning of the raining season. Half of the collected RTC occurred during darkness (Figure 4).

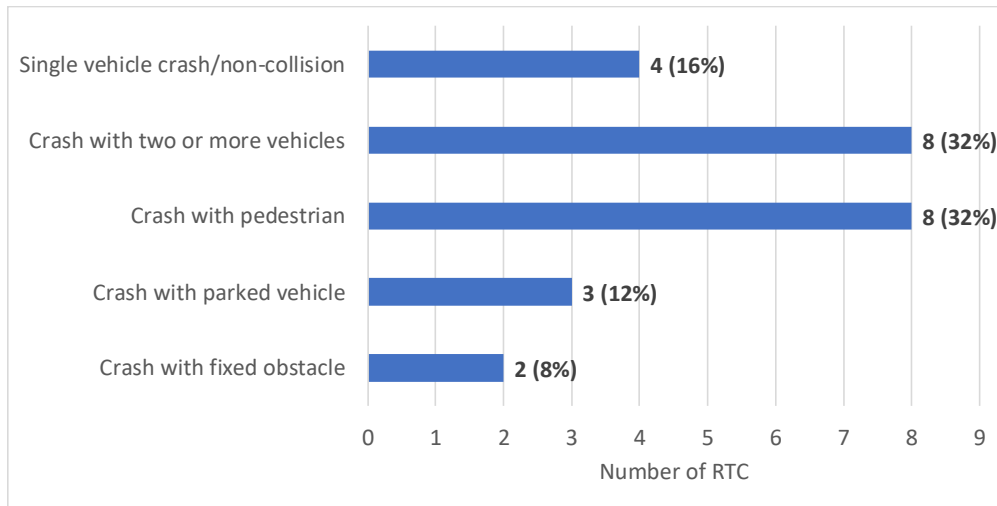


Figure 3 Collected RTC by impact type

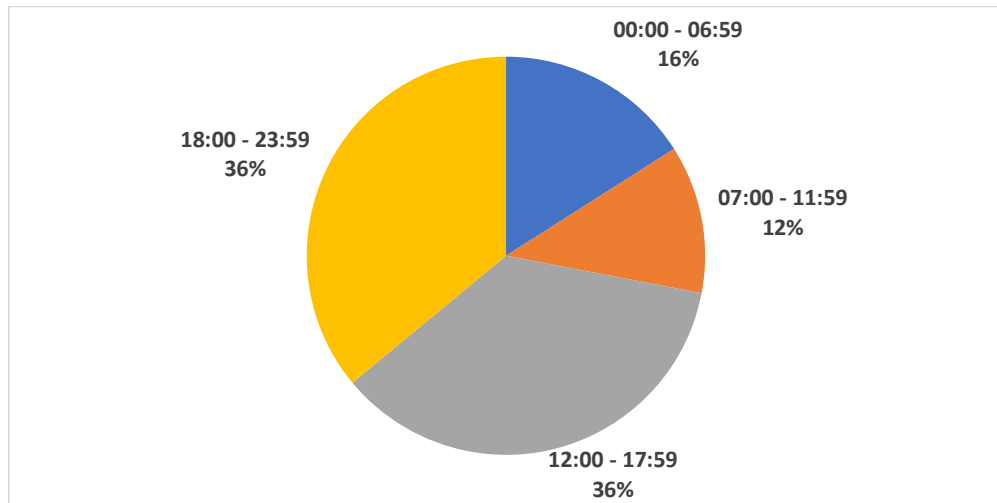


Figure 4 Collected RTC by time of the day

About 25% of the collected RTC were single crashes (Figure 5). This percentage is significant and is typical of low volume roads and of rural environments.

The majority of RTC involved motorcycles (18 out of 25 crashes). Private cars are involved in 11 out of 25 RTC (Figure 6). Few heavy vehicles have been reported in the collected data. This could be related to the main reported cause of crashes: speeding (heavy vehicles have usually lower speeds than motorcycles or cars, even on low volume roads).

Figure 6 also shows the number of vehicles involved in RTC. 35 vehicles were involved in the 25 collected RTC. Most vehicles were motorcycles (21 out of 35), followed by cars (11 out of 35). It is worth mentioning that most vehicles (especially the motorcycles) were used as taxi (more than 50% of vehicles).

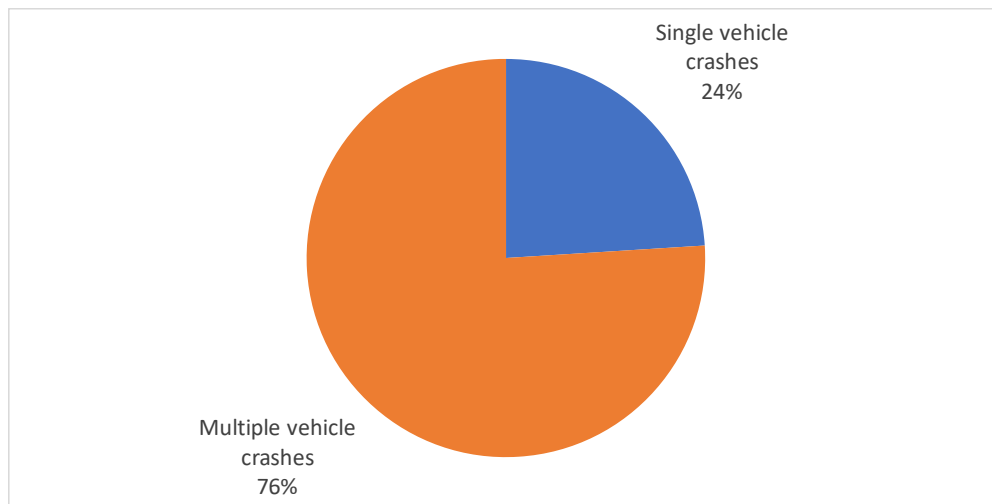


Figure 5 Single vs multiple vehicle RTC crashes

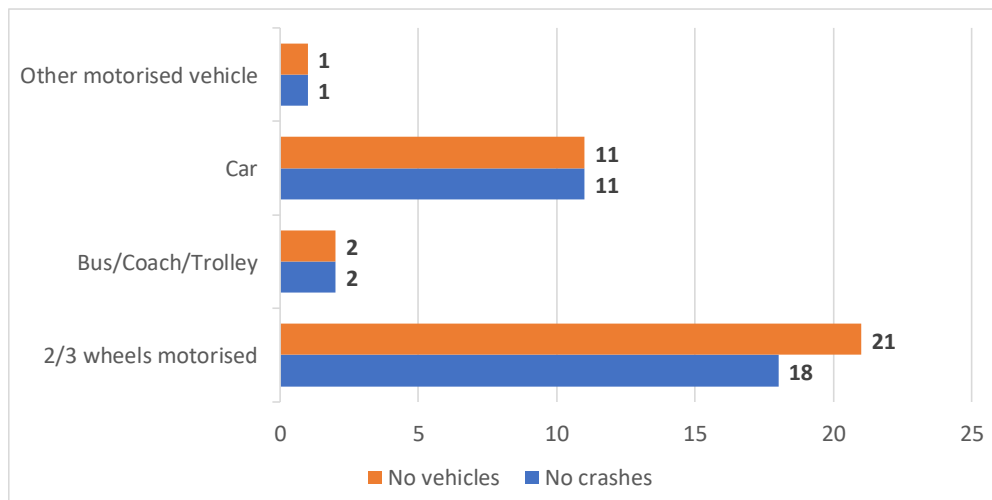


Figure 6 Number of RTC and vehicles by vehicle type

The collected RTC involved 44 persons. Most road users involved in the collected RTC were male. Only 23% of female were reported. While most persons involved in RTC were drivers (48% of road users), a high percentage of pedestrians have also been reported (about 23%). 29% of road users were passengers of a vehicle (often a motorcycle – Figure 7).

About 43% of RTC had serious consequences for road users involved. 14 out of 44 persons had serious injuries, while 5 out of 44 persons (about 11%) died to RTC (Figure 8). Only 8 persons had no injuries and 15 out of 44 persons had minor injuries.

These numbers result in a very high severity index (i.e. number of fatalities plus number of injuries divided by number of RTC). 34 casualties were reported for 25 RTC, leading to a severity index equal to about 136%. This means that about 1.4 people is injured or dies for each RTC.

It is worth mentioning that half of the road users involved in the collected RTC are vulnerable road users (i.e. pedestrians or motorcycle passengers – Figure 9). This is coherent with the high presence of motorcycles involved in RTC. However, 10 out of 44 road users were pedestrians.

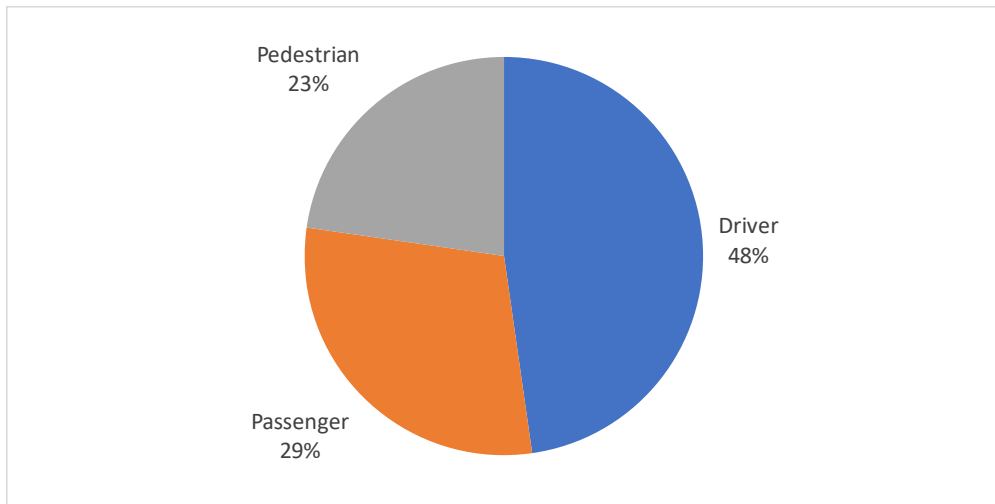


Figure 7 Collected RTC by road user type

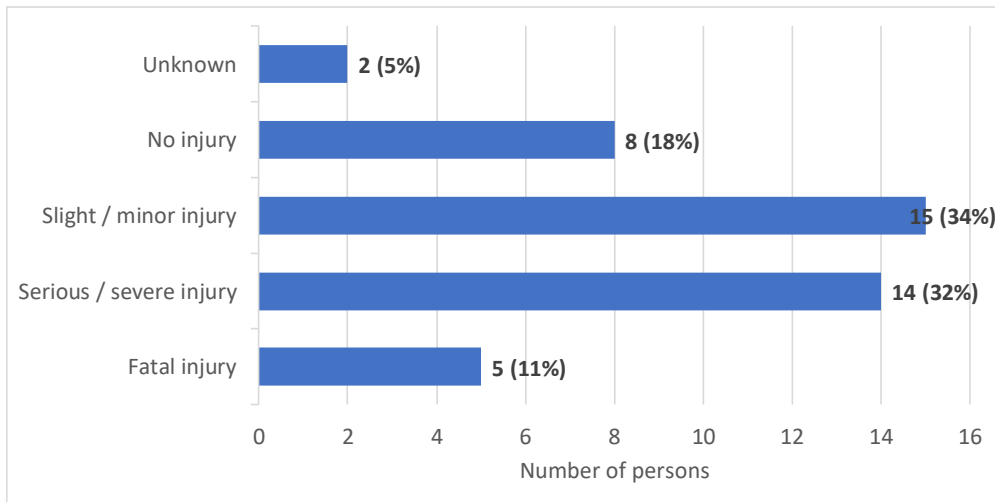


Figure 8 Collected RTC by injury type

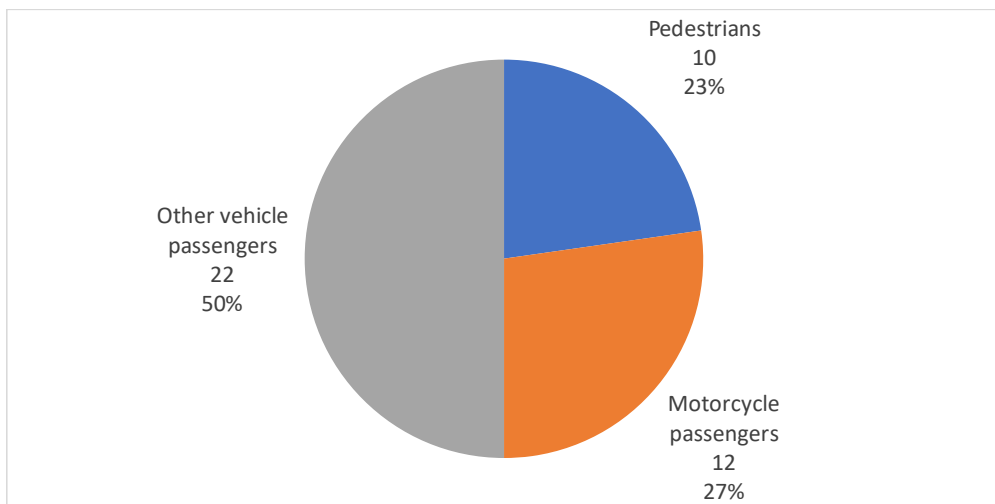


Figure 9 Vulnerable road users vs other road users

The analysis of RTC severities by transport mode (Figure 10) shows that most of the fatalities and serious injuries occur to vulnerable road users (i.e. moto riders / pillions and



pedestrians): 80% of fatalities occur to moto riders / pillions, while 86% of serious injuries occur to moto riders / pillions and pedestrians.

The probability of being injured (including minor injuries) for moto riders / pillions and pedestrians is very close to 100%. Only one moto rider / pillion had no injuries. On the opposite, car drivers / passengers were mostly not injured in RTC or had minor injuries.

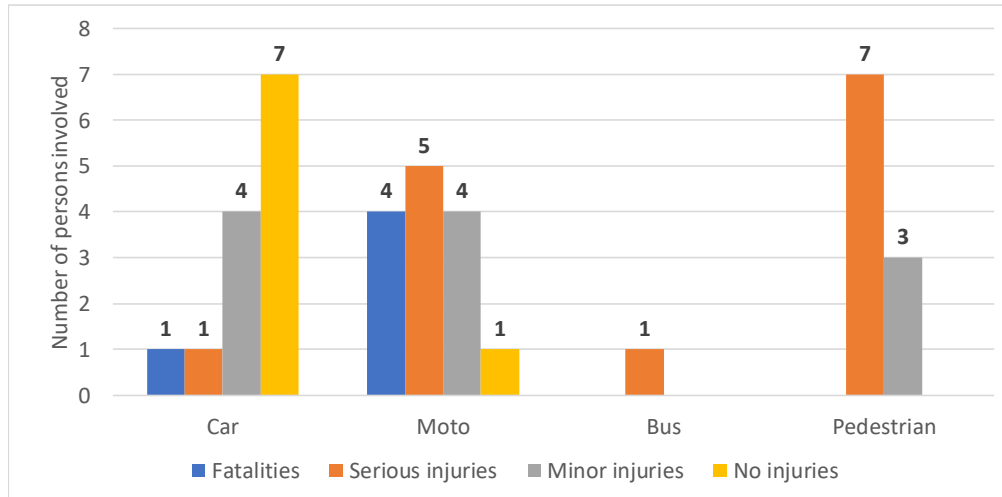


Figure 10 Persons involved in RTC by transport mode

Most of the RTC (about 66%) occurred with a vehicle going straight forward or having a normal driving. Overtaking manoeuvre and changing lane contributed together to about 25% of RTC.

Another contributing factor for RTC was the non-use of safety equipment. About 38% of vehicle passengers (i.e. drivers, riders, pillions and car passengers) did not wear the seatbelt or a helmet. In some cases (6% of RTC) the information about safety equipment use was missing.

About half of the pedestrians involved in RTC were walking on the carriageway, while only 20% were crossing the carriageway. Probably the road infrastructures where RTC occurred had poor or no facilities for pedestrians (such as footpaths). It is worth mentioning that most of the RTC were collected outside urban areas, on low volume roads, and that over-speeding was reported as the main cause of RTC. The combination of these factors makes highly probable having an accident when walking on carriageway.

Figure 11 shows the percentages of RTC by type of road users and type of injuries as reported by health services. About 50% of drivers / riders had only minor injuries. However, about 25% of them had a head injury, while 13% had multiple fractures. Passengers of vehicles had mostly minor injuries (64%), while 18% of them had multiple fractures.

The situation of quite different for pedestrians. Only one out of five pedestrians had minor injuries. 40% of them had a multiple fracture or a leg fracture.

The type of injuries is strongly related with the type of vehicle used by road users. In fact, most of car drivers or passengers (67%) had minor injuries, while about 46% of riders or pillions had a serious injury (15% of them had a head injury or a multiple fracture).

Head injuries (occurred to riders or pillions) contributed to one third of fatalities, while the other fatalities recorded were due to multiple fractures (Figure 12).

Most of the serious injuries (56%) were associated by health services to leg fractures. One third of serious injuries were due to multiple fractures and 11% of them to head injuries.

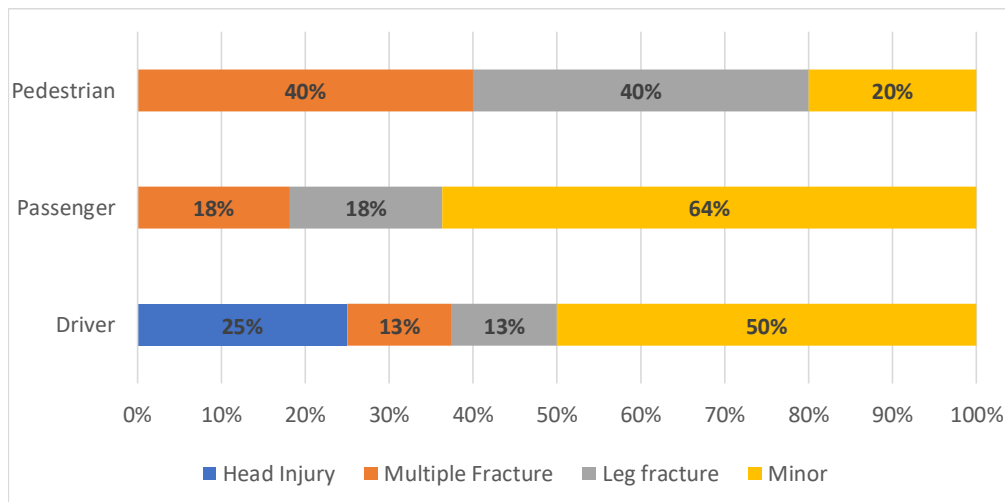


Figure 11 RTC by road user's type and injury type

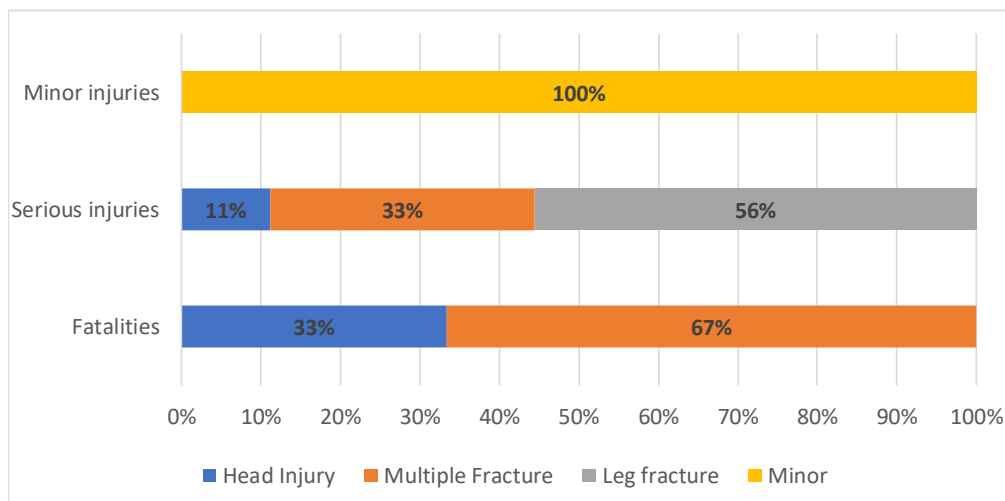


Figure 12 RTC by severity and injury type

## 5 ACCIDENT DATA MANAGEMENT SYSTEM

An accident data management system was developed by adapting and integrating two already existing information systems:

- **SFINGE** is a web-based modular software allowing for the collection and analysis of RTC data and for geo-coding of data on maps (Figure 13). It is developed by the private company I.T. Ingegneria dei Trasporti Srl, based in Italy.
- **Safety Manager** is a web-based information system allowing for storage, management and detailed analysis of RTC (Figure 14). It is developed by the Research Centre for Transport and Logistics of "Sapienza" Università di Roma, based in Italy.

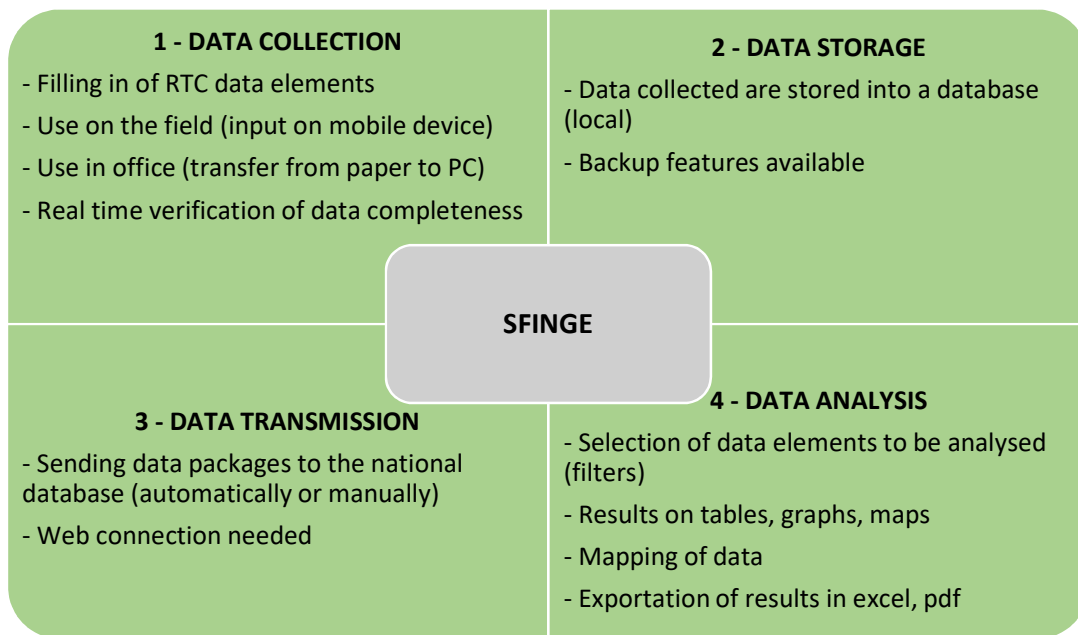


Figure 13 Outline of SFINGE modules

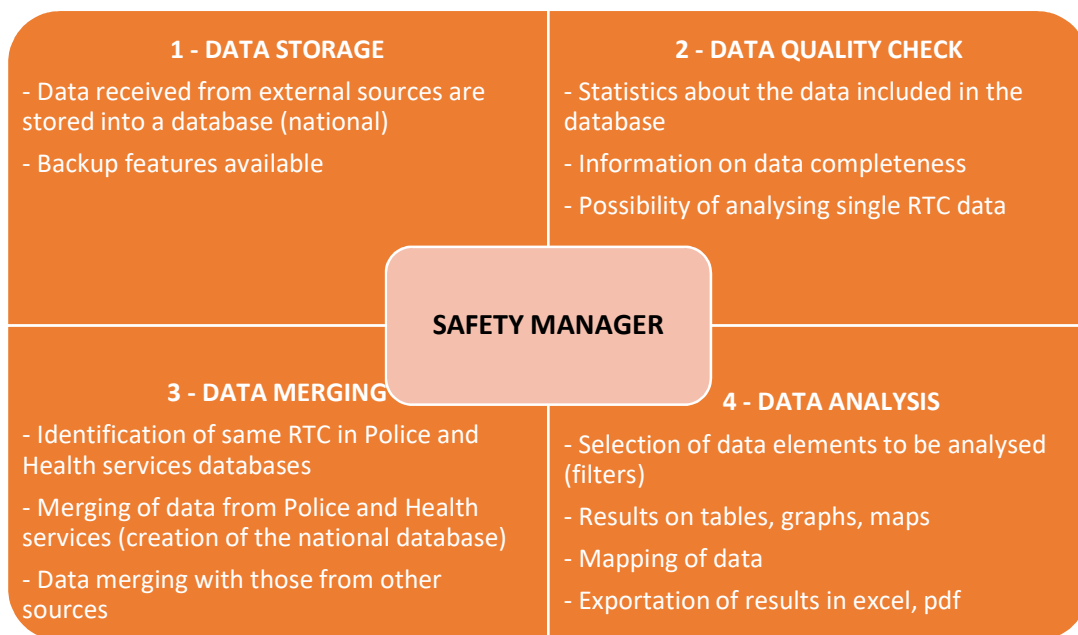


Figure 14 Outline of SAFETY MANAGER modules

The two software are integrated in order to facilitate the transmission of data between the entities charged with the collection and management of RTC data (SLRSA, SLP, health services) and those charged with RTC data analysis (SLRSA, SLRA, SSL). Data exchange protocols between the entities are embedded into the software.

The accident data management system was adapted to the specific context of Sierra Leone based on:

- The RTC data collection form designed for Sierra Leone (in terms of software interface, database organisation, statistical analysis).
- Integration of the RTC data database embedded into the software with existing databases on vehicle registration and driver licences available at SLRSA.

## 6 CONCLUSIONS AND RECOMMENDATIONS

The pilot study to collect more robust accident data in Sierra Leone allowed to adapt to the characteristics of Sierra Leone a detailed RTC data collection framework, that has been tested for use in three regions inside the country (Low Volume Roads).

Some recommendations can be provided to ensure moving from a pilot study to a process fully established at national level (Table 1).

Table 1 Final recommendations

No	Challenge	Recommendation
1	Some road users could be reluctant to respond and cooperate during RTC data collection.	Education ahead of the data collection could be useful to engage road users. The services of opinion leaders could also be engaged to this.
2	In some cases, law enforcers, charged of data collection, could be uncooperative and they could ask for financial incentives.	Education towards law enforcers is crucial to reduce under-reporting of RTC. Persons charged of RTC data collection should be provided with sufficient resources and tools to perform their tasks.
3	During the pilot data collection, it was observed that most RTC cases are hardly reported to health facilities or police, but rather to herbalists or local bone specialists.	More sensitization should be done on the advantages of RTC victims accessing hospitals and medical health facilities immediately after the crash. Consulting herbalists or native doctors should be discouraged. Moreover, collection of data on persons injured should also involve non-official health services like herbalists, as well as communities.
4	During the pilot data collection, it was observed that victims prefer to cover up for vehicle drivers/motorcycle riders and reach settlement with them; instead of reporting to assigned authorities (they are critical of any dealings with the police).	Education ahead of the data collection could be useful to engage road users and explain that collection of statistical RTC data has nothing to do with police prosecution.
5	Some vehicles are unregistered and with no registration plates affixed. Furthermore, some drivers or riders are unlicensed. Therefore, getting accurate information from them could be impossible at times.	Sierra Leone Government has already in place of process to eliminate unregistered vehicles and unlicensed drivers or riders. Anyway, it is recommended to accelerate as far as possible this process.
6	During the pilot data collection, it was observed that some of the people involved in RTC are semi-illiterate or illiterate, so understanding some of the questions in the form and providing	As far as possible, communication could be also done in local dialect.

No	Challenge	Recommendation
	appropriate or responsive feedback was a challenge.	
7	During the pilot data collection, it was observed that inclement weather, bad road conditions posed challenges as some crash locations were remote and/or hardly accessible. The law enforcement officers lack the necessary equipment for drug and alcohol use testing and the logistics to get to certain remote locations during inclement weather.	Providing adequate equipment and resources to law enforcement officers is highly important. Various equipment would be useful, such as:
8	During the pilot data collection, it was observed that often the RTC causes are related to overspeeding.	Drivers should be sensitized on the dangers of overspeeding and be encouraged to pay attention to speed limit signs and other cautionary signs in order to prevent or minimize the probability of RTC. A greater enforcement against overspeeding is also recommended.
9	During the pilot data collection, it was observed that several drivers or riders do not use seatbelts or wear helmets.	Drivers, riders and vehicle passengers should be encouraged to use seatbelts and wear helmets at all times during the journey. A greater enforcement against missing use of protective equipment is also recommended.
10	During the pilot data collection, it was observed that several drivers or riders involved in RTC run away.	The general public and in particular RTC victims and on-lookers should be sensitized on the implications of roadside justice which results mostly to drivers or motor cycle riders being lynched (the cause of most drivers or riders running away from RTC scene).
11	Police officers lack of resources and equipment to perform their tasks, including RTC data collection.	Policemen and traffic wardens should be specifically provided with equipment, such as: alcohol and drug testing kits and GPS devices.
12	RTC occurring in remote provinces, especially on low volume roads, can sometime be difficult to reach. Sometimes, police officers lack of logistics to rapidly go to the crash scene.	Policemen and traffic wardens should be provided with adequate logistics for their trips to reach RTC scenes.
13	Some police stations could lack of equipment for storage of collected RTC data.	Adequate informatic equipment and internet facilities should be provided in all police stations across the Country, so

No	Challenge	Recommendation
		that storage and transmission of RTC data can be performed.
14	The framework for RTC data collection and management is still in a pilot phase and would need to be expanded to the whole country	Policemen and traffic wardens should be routinely trained for RTC data collection and management (i.e. use of data collection forms as well as of the accident data management system).
15	Currently the activities performed for RTC data collection and management by the various road safety stakeholders in Sierra Leone are not uniform. Each stakeholder (SLP, SLRSA, health services) execute their tasks independently of the others and in different ways. There is also little communication between the stakeholders	It is highly recommended that the road safety stakeholders in Sierra Leone agree on the roles and responsibilities for RTC data collection and management. Preparing a memorandum of understanding to be signed by each stakeholder, based on the framework developed in this pilot study, could be a first step to give continuity to the pilot study.

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