Road Traffic Injury in Tanzania: Preparation of a District Engineers' Guidance Note for Motorcycle Safety on Low Volume Roads

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Abstract

World Health Organization figures show that over 1.2 million people are killed on the world's roads each year, and up to a further 50 million are injured. Road traffic injury (RTI) is the leading cause of death among young people aged 15 to 29 years. Low- and middle-income countries are hardest hit, losing up to an estimated 3% of GDP as a result of crashes (WHO, 2015).

Africa has the world's most dangerous roads, with a death rate of 26.6 per 100,000 of the population. This compares to a global average of 17.5 per 100,000 (WHO, 2015), and is despite the fact that Africa is the least motorised of the world's regions: Africa has only 2% of the world's vehicles but 16% of the world's road fatalities (WHO, 2013).

Official figures for Tanzania show that around 4,000 people are killed on the roads each year (Tanzania Traffic Police, 2015), although it is widely thought, including by the World Health Organization (WHO, 2015), that there is under-reporting in this number.

The use of motorcycles is revolutionising rural access in many African countries, including Tanzania. But this revolution has a price: motorcycles now account for around 22% of all Tanzania's road deaths (Tanzania Traffic Police, 2015), and AFCAP-funded research carried out by Amend has found that crash rates among rural motorcycle drivers in Tanzania are as high as 96 per 100 drivers per year in some areas (Amend, 2015).

Amend's research has found that while road user behaviour is the primary contributory factor in rural motorcycle crashes, the design and the condition of roads also contributes to crashes. Tanzania's National Road Safety Policy recognizes that local government authorities have a responsibility to 'Design, build and maintain their roads in a safety-conscious manner'.

Amend is now working with the President's Office for Regional Administration and Local Government and Cardno-IT Transport to develop a rural road safety programme

for Tanzania, under the DFID-funded 'Improving Rural Access in Tanzania' project. One component of the rural road safety programme is a District Engineers' Guidance Note for Motorcycle Safety on Low Volume Roads.

The Guidance Note covers topics including:

- Safety improvements to all road types – new and existing, sealed and unsealed
- Providing a safe width and cross-section
- Providing a safe riding surface
- Ensuring the surrounding environment is 'forgiving'
- Encouraging the use of appropriate speeds
- Providing warning of hazards

Starting in January 2016, Amend is currently piloting the use of the Guidance Note by District Engineers during the upgrading of rural roads in two districts.

This paper summarises the research that contributed to the development of the Guidance Note, provides detail of the guidance included in the document, and gives an update on the pilots in the two districts.

Background

Context

Worldwide, over 1.2 million people are killed each year on the roads. Up to fifty million more are injured. Road traffic injuries (RTI) are the number one leading cause of death for people aged between 15 and 29 (WHO, 2015).

Over 90 percent of the world's traffic fatalities occur in low and middle-income countries. Sub-Saharan Africa has some of the most dangerous roads in the world, with an average road fatality rate of 26.6 per 100,000 people, while the global average fatality rate is 17.5 per 100,000 people (WHO, 2015). It is forecast that the situation in sub-

Saharan Africa will become worse in the upcoming years. Africa's population is forecast to rise from a little over 1 billion now to around 2.4 billion by 2050 (AfDB, 2014). Africa's rate of motorisation is one of the fastest in the world, with thousands of cars added to the roads every day. Globally, the number of private motor vehicles is forecast to triple by 2050. Two-thirds of this explosive growth will take place in non-OECD countries such as those in sub-Saharan Africa (International Energy Agency, 2008). With more vehicles, there will be a greater risk of injury and death, unless effective measures are taken to improve road safety.

In Tanzania, official figures show that in 2014 over 3,760 people were killed on the roads, and a further 14,530 were injured. Approximately one-quarter of the deaths are of motorcycle drivers or passengers. (Tanzania Traffic Police, 2015).

Figures from the Tanzania Revenue Authority, show that the number of motorcycles in Tanzania rose from just 1,884 in 2003 to 832,149 at the end of 2014.

Research background

The Africa Community Access Partnership (AFCAP) aims to promote safe and sustainable rural access for all people in Africa, sharing knowledge in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. This includes improving roads and transport services.

It is well established that improving rural roads can bring economic and social benefits. However, improved roads also result in increased traffic and often in higher speeds, which can create safety risks. It is important that the benefits of improved roads are not offset by an increase in road deaths and injuries and the associated negative economic and social consequences.

Since 2012, Amend has carried out the following AFCAP-funded research projects in Tanzania in order to develop an understanding of road safety issues on rural roads:

- Three studies into road traffic injury on rural roads in Bagamoyo District and Siha District (Amend, 2013)
    1. The magnitude and characteristics of road traffic injury among rural communities
    2. The impact of a rural road traffic injury prevention programme
    3. The magnitude and characteristics of road traffic injury among motorcycle drivers
- A study to determine the causes and circumstances of motorcycle crashes on low-volume rural roads in Bagamoyo District and Siha District (Amend, 2014)
- A study to determine the magnitude and characteristics of road traffic injury in Kilolo District (Amend, 2015a)
- Opportunities to improve road safety through 'boda-boda' associations in Tanzania (Amend, 2015b)

Ethics approval for all studies was obtained from the Tanzanian National Institute for Medical Research.

A summary of the findings of these studies is provided in the following section.

Summary of research findings

High crash rates, especially among motorcycles

Crash rates among the study communities living alongside rural roads were high were found to be high: around 40 per 1,000 person years in the Bagamoyo and Siha districts, and around 60 per 1,000 person years in Kilolo District.

However, the crash rates among motorcycle drivers using the study roads were found to be many times higher than the rates among the communities living alongside the roads. Motorcycle driver crash rates were found to average 633 per 1,000 person years

in the Bagamoyo and Siha districts, and to be 960 per 1,000 person years in Kilolo District. Almost 90% of drivers involved in a crash suffered an injury.

Motorcycles were found to be by far the most prevalent form of motorised vehicle using the study roads, making up an average of 88% of all motorised traffic using the study roads in the Bagamoyo and Siha districts and 90% using the study road in Kilolo District.

Based on these findings – that motorcycles are the most common form of motorised transport on rural roads, and that crash rates among motorcycle drivers are very high – it was identified that injury prevention efforts are required to focus on this high-risk population.

Causes of motorcycle crashes

Further Amend research, again supported by AFCAP, aimed to determine the causes and circumstances of motorcycle crashes on low-volume rural roads in Tanzania, to inform the development of targeted road safety policies and interventions. It did so through a number of different data collection activities, including detailed investigations of recent crashes, risk assessments by a motorcycle safety expert and a road safety engineer, interviews with motorcycle drivers and passengers and community members, and observations of road user behaviour.

The research investigated the factors that contribute to motorcycle crashes, including those related to road design and condition, road user behaviour and motorcycle condition.

Key findings of the research included:

- Road user behaviour, including that of motorcycle drivers and other road users, is the most common contributory factor in motorcycle crashes on low-volume rural roads

- The design and condition of low-volume rural roads are also common contributory factors
- Motorcycle drivers understand what constitutes risky behaviour, and understand actions that they can take to reduce risks, but many continue to drive dangerously

Demographics and travel behaviour among motorcycle drivers

The research studies also identified common demographics and travel behaviour of motorcycle drivers, including:

- 100% of the motorcycle drivers involved in the studies were male
- Their average age was late 20s
- Around half operated mainly as motorcycle taxi ('boda-bodas') drivers, charging a fare to carry passengers or goods, with the other half using their motorcycle mainly for private transportation
- Around half of those who operated as boda-bodas do not own the motorcycle that they use
- The majority had completed primary school but not secondary school
- The average length of experience of driving a motorcycle was a little over two years
- The majority had no driving licence, and even fewer had received any formal driver training

Impact of injury prevention programme focussed on behaviour change

The RTI prevention programme implemented at the study roads in the Bagamoyo and Siha districts focussed on changing the behaviour of road users, including motorcycle drivers and other members of the community. The programme involved the following interventions:

- For 200 motorcycle drivers:
    - A one-week training course followed by testing and licensing

    - Distribution of two helmets each – one for the driver and one for a passenger
    - Distribution of reflective jackets
- For over 4,000 primary school children:
    - Road safety education and the distribution of educational materials to enable teachers to continue to address road safety
    - Distribution of reflector-enhanced school bags
- For communities:
    - Road safety awareness sessions delivered in community areas such as market places and at village offices
    - Distribution of road safety educational materials in shops, health facilities, etc.

Data was collected on numerous indicators to evaluate the impact of the injury prevention programme on RTI rates, with the study road in Bagamoyo District used as the trial road and the study road in Siha district used as the control.

The primary indicator was RTI rates before and after implementation of the injury prevention programme. The RTI rate at the trial road was found to be higher after the implementation of the programme than before, which perhaps would suggest that the programme had been ineffective. However, the RTI rate was also found to be higher at the control road, which could suggest that RTI rates in general are increasing.

Secondary indicators suggested the following impacts of the programme (although the samples sizes were too small to show any statistical significance):

- A very slight reduction in motorcycle speeds
- A slight increase in use of motorcycle helmets
- Increased understanding of road safety issues among motorcycle drivers
- Increased knowledge of road safety lessons among primary school children

Opportunities for improving safety through motorcycle taxi associations

In an attempt to regulate the use of motorcycle taxis, in order to improve road safety (among other reasons), in 2014 the Tanzanian Government announced the introduction of a new registration system as well as the strengthening of enforcement of regulations requiring drivers to be members of associations. Associations are required to register with their local council, and members are required to comply with rules such as obtaining a driving licence, wearing a helmet, and carrying no more than one passenger.

Our research found that the formation of associations in some regions of Tanzania has coincided with a reduction in the numbers of motorcycle-related deaths and injuries. While many factors may have contributed to the reduction in deaths and injuries, and it is not possible to say with confidence that the presence of associations was one of those factors, it is possible that associations have the potential to play a positive role in improving safety.

However, experience in other African countries has shown that strong enforcement of motorcycle-related regulations can create inconvenience, economic difficulties and, at worst, riots and deaths.

Our investigations identified that associations need good leadership, including transparent financial management to give members confidence that money is being well used. They need a strong relationship with local officials, and in particular with the local Traffic Police as this will help them to enforce their own rules. If associations can encourage members to operate in line with national regulations, this will ultimately benefit all as the associations will be able to represent the needs of their members.

Government needs to provide greater assistance to associations, including by developing guidance on their set-up and management. National systems for training, testing and licensing need to be improved, and special consideration is needed for associations in rural areas, including how to facilitate rural members' access to such services.

The lessons learned from Tanzania may have applicability in other African countries, including in countries where motorcycle use is not yet widespread. Developing a model of regulation in Tanzania that improves safety and other areas of boda-boda operations has the potential to benefit millions of people across Africa.

District Engineers' Guidance Note

Following these research studies, Amend was commissioned by Cardno-IT Transport to work with the Tanzanian President's Office for Regional Administration and Local Government to develop a rural road safety programme under the DFID-funded 'Improving Rural Access in Tanzania' (IRAT) programme.

Based on the research, and in particular on the finding that driver behaviour is the most common contributory factor in motorcycle crashes, it was identified that a behaviour-change component would be key to the road safety programme. It was also identified that, as some element of road design and condition also commonly contributes to motorcycle crashes, engineers have a part to play in improving safety through their work to plan, design, construct and maintain rural roads.

This paper focuses on the engineering aspect of improving safety for motorcycles on rural roads, which is being approached through the development of a District Engineers' Guidance Note for Motorcycle Safety on Low-Volume Rural Roads.

Focus of the Guidance Note

The decision to focus the Guidance Note on motorcycle safety was made as a result of the findings of the research, specifically that the vast majority of motorised vehicles on rural roads are motorcycles and that injury rates among motorcycle drivers are incredibly high. However, the recommendations in the Guidance Note will also make the roads safer for other types of road user.

The Guidance Note is designed to be an easy-to-use reference document for District Engineers working in Local Government Authorities, compiling together a

comprehensive set of recommendations to improve motorcycle safety. Many of the recommendations are not new: they are included – and largely in line with – existing manuals and guidance available to and used by District Engineers. It also contains some new guidance, in particular related to specific types of road surface which have recently been trialled in Tanzania and are under consideration for broader use.

The recommendations have been designed considering the lowest classifications of rural roads: those which commonly have fewer than fifty motorised four-wheel vehicle movements per day, but which can easily have several hundred motorcycle movements per day.

The Guidance Note is still very much in the draft stages, requiring further piloting and input from stakeholders. The intention is that the finished document will be approved by government for use by District Engineers across Tanzania.

Recommendations on geometric design

The width of the road is critically important for motorcycle safety. The reason for this is that four-wheeled vehicles often do not slow down or yield to motorcycles. If the road is not wide enough for a motorcycle to pass a four-wheeled vehicle safely, the motorcycle will be forced to leave the road. If the motorcycle cannot leave the road safely, there is the risk of a crash.

The Guidance Note recommends that District Engineers:

- Aim for a minimum carriageway width of 3.8 metres, excluding shoulders, assuming:
    - Car width 2.0 metres
    - Motorcycle width 1.0 metres
    - Clearance between vehicles 0.4 metres
    - Clearance to either shoulder 0.2 metres
- On both sides of the road, provide a shoulder that is safe for use by motorcycles:

    - Minimum width of 0.5 metres
    - At-grade with the main carriageway, without a significant drop (of more than 150 millimetres) between the carriageway and the shoulder
    - Free from loose material
    - Free from oversize material
    - Free from vegetation
- Maintain the shoulders regularly, to ensure that they remain in a condition that is safe for use by motorcycles

A main carriageway of any less than 3.8 metres will endanger motorcyclists when they pass four-wheeled vehicles, especially if the shoulders are not maintained to a high standard.

If there are no shoulders or shoulders are poorly maintained, motorcyclists will be at risk of a crash, as will other vulnerable road users such as bicyclists and pedestrians.

As well as width, horizontal alignment is also important for motorcycle safety. As low-volume rural roads often follow existing alignments and pass through unmanaged terrain, it is common to find sharp bends. For motorcycles, sharp bends present the risk of running off the road if approached at too high a speed and of collision with other road users due to poor visibility.

District Engineers are advised to widen the carriageway at sharp bends, to increase the radius and improve visibility.

Recommendations on road surfaces

Having only two points of contact with the road, motorcycles are particularly sensitive to the road surface. While a poor road surface may cause discomfort to occupants of four-wheeled vehicles, it can be dangerous for motorcyclists. The majority of roads managed by District Engineers are partially-engineered earth roads and gravel roads, although with the adoption of the Environmentally Optimised Design and Spot

Improvement philosophies, an increasing number of sections of rural roads will be paved.

Motorcycle-related crashes on earth and gravel roads occur due to elements of both the design of the road surface and the condition of the road surface. Damaged or slippery surfaces may directly cause a crash, and a surface of varying quality may encourage a motorcycle driver to weave to select the best line, putting them at risk of collision with other road users.

For earth and gravel roads, the Guidance Note provides the following recommendations:

- Regularly maintain the surface to ensure a consistent surface quality and to avoid occurrence of potholes, corrugation and rutting
- Remove large stones (of size 37.5 millimetres or greater) from the carriageway. In some areas, these are naturally occurring. In some cases, they can be found in gravel if it is not well prepared. In all cases, they should be removed as they create risk for motorcycles and other road users
- Minimise the degree of camber. Camber is essential for effective drainage on gravel roads, with a recommended minimum of 4% (Manual for the Provision of Low Volume Roads (second draft), 9-19). Wherever possible, this should not be exceeded as the steeper the camber, the greater the risk to motorcycles – especially those carrying heavy loads
- Where an unpaved road surface contributes to risk, for example on a stretch of road that becomes very slippery when wet, or in an area where dust can obscure vision, consider paving the road

For paved roads, the Guidance Note provides the following recommendations:

- Avoid smooth surfaces with a mean texture depth of less than 1.5 millimetres, as they may be slippery when wet. Sand seals, for example, may be inappropriate for use on roads used by motorcycles

- Ensure the correct mix of bitumen and aggregate is used to prevent 'bleeding', which causes the most-used sections of the surface to become slippery
- Regularly maintain the surface to avoid occurrences such as the creation of potholes and the build-up of loose material
- Roughen concrete surfaces during construction to provide texture and enhance skid resistance
- Avoid surfaces that are overly rough as these can cause vibrations and tiredness in motorcyclists' hands creating a risk of loss of control
- Prevent, through regular maintenance, the creation of edge-drops at the edge of concrete surfaces, where the concrete meets soft earth
- Where a concrete surface meets an earth surface, angle the concrete down to create a smooth transition from one surface to the other, also regularly maintaining the area where the two surfaces meet to prevent the creation of a drop or step
- Ensure that the point where one surface type meets a different surface type can be easily seen. This point should not be at the brow of a hill or on a curve
- If using hand-packed stone, avoid the use of sharp-edged stones and avoid large spaces between stones, to reduce the severity of injury should a motorcyclist fall on this surface

It is recommended that special consideration should be given to the use of parallel concrete strips as there are specific motorcycle-related safety concerns associated with these. Concerns include:

- The strips give a sense of 'ownership' to the drivers of four-wheeled vehicles, meaning that they are unlikely to yield for motorcycles
- The strips enable motorcycles to travel at high speeds and drivers risk losing control if coming off the strip onto a rough surface at the side or in the middle of the strips

- Erosion may occur to the shoulders and the central portion of the road, resulting in edge drops at the sides of the strips and uneven chevrons between the strips
- Parallel concrete strips also have safety risks (as well as practical limitations) associated with their use by powered three-wheelers, such as 'Bajajis' or 'Toyos', which are becoming increasingly common across Tanzania

To mitigate these risks, where parallel concrete strips are used, the following should be considered:

- The roadway needs to be sufficiently wide to allow a motorcycle and a four-wheeled vehicle to pass, assuming that the four-wheeled vehicle will not leave the parallel concrete strips
- Maintenance should be carried out to prevent the formation of edge drops between the concrete and the earth shoulder and around the central chevrons, and to keep them clear of vegetation and loose and oversize material
- They should only be used on straight stretches of road where motorcycle drivers are able to see approaching vehicles from afar, to allow drivers time to safely pull off to the side of the road and stop
- They should not be used on corners, at the brows of hills, and other places of limited visibility
- The transition points between the strips and any other road surface should be on flat, straight sections of roads. They should not be on slopes, at brows of hills, bottoms of valleys or on bends
- It may be possible to provide passing places on sections of parallel concrete strips, although this is yet to be piloted and proven effective. Considerations related to passing places are:
    - Passing places could be constructed of concrete slab covering the full width of the road, or they could be concrete strips widened in specific places

- The width of the passing place should allow a motorcycle to pass a four-wheeled vehicle safely
- When used on a slope, passing places should be long enough to allow a motorcycle not to have to stop, but only to reduce speed while waiting for the other vehicle to pass. (Motorcycles often carry heavy loads and can struggle to re-start if forced to stop on an uphill gradient)
- The distance between passing places will depend on the sight distance: the shorter the sight distance, the more frequent passing places should be

Recommendations for providing a 'forgiving' roadside

The driving behaviour of many motorcyclists using low-volume rural roads is generally poor, for reasons including a lack of training and a lack of law enforcement in rural areas. Through their own behaviour, drivers put themselves at risk of making mistakes that lead to crashes. However, the severity of crashes can be reduced if the environment surrounding the road is designed to 'forgive' mistakes.

Recommendations for how District Engineers can improve the safety of roadsides include:

- Avoid steeply-angled side-slopes at the edge of the carriageway. A slope of ratio 1:4 is considered to be 'recoverable' by a four-wheeled vehicle. For motorcycles, flatter than this is preferable
- Avoid deep and steep side drains. If deep drains are absolutely necessary, provide the maximum distance possible between the carriageway and the drain, and ensure that they can be clearly seen by road users, for example by regularly clearing vegetation that may obstruct vision
- Remove large hard objects, such as big rocks and trees, from within 5 metres of the edge of the carriageway, and within 10 metres from the edge of the carriageway on the outside of curves
- Use road signs or marker posts to warn of hazards

- In high-risk areas, when budget allows, guard rails may be used to protect road users from a roadside hazard

Bridges and drifts can themselves present hazards, and so should be considered carefully.

Recommendations for how District Engineers can improve safety related to bridges and drifts include:

- The edges of bridges should be demarcated and protected by guard rails on each side. The guard rails should be painted and the bridge should be signed, to alert drivers to their presence
- Because bridges are often at a low point of the road, with slopes leading down to and up from them, with bends and with vegetation, drivers' vision is often obscured. Efforts should be made to keep the height of vegetation under control, to allow longer lines of sight on the approach to a bridge
- The edges of drifts should be demarcated by bollards or masonry blocks on both sides, to mark the location of the road at times when they are covered with water. These bollards or masonry blocks should have reflectors and should be of sufficient height to be seen during times of flood
- If a bridge or drift is narrower than the approaching road carriageway, ensure that a warning sign is provided
- Speed humps can be used to reduce vehicle speeds on the approach to a potentially dangerous bridge or drift

Recommendations for encouraging appropriate speed

Speed is widely recognised as a key risk factor in road traffic crashes. On low-volume rural roads, motorcycle speeds are often not high, but that does not mean that speed-related crashes are uncommon. Speed-related motorcycle crashes occur on low-volume rural roads often due to the use of inappropriate speed for the surrounding

environment, for example vehicles failing to slow down when passing through settlements or on stretches of road with short lines of sight.

Recommendations in the Guidance Note related to speed humps include:

- Use speed humps in areas where speeds must be reduced for the safety of the driver or other road users, including pedestrians. Speed humps should be used on all different road surface types, including unpaved roads. Considerations related to speed humps include:
    - They should be included as standard where roads pass through settlements, with the first hump located a minimum of 50 metres before the entrance to the settlement, and the last hump located 50 metres after the exit of the settlement. Other humps should be situated at consistent intervals of between 50 metres and 100 metres
    - The locations of humps should be discussed with local communities, to identify the specific locations where pedestrians use the roads and where vehicles use inappropriate speeds
    - On new roads or roads being upgraded, humps should be included as a standard part of the design
    - On existing roads where there are currently no speed humps, they should be provided where the need is identified
    - Speed humps should cover the full width of the road, to prevent motorcycles from trying to pass around the side of them
    - If speed humps are not incorporated into the design of the road, it is common for local communities to construct them themselves. Informally-constructed speed humps can create hazards, for example as they are often poorly constructed and unsigned, and can also damage the road surface. In such cases, an assessment of the informally-constructed hump should be made, the local community should be consulted, and a speed control strategy should be developed

- Ensure that warning of speed humps is provided, with a road sign situated 50 metres before the hump and marker posts alongside it. Ensure that the marker posts can be seen at night, through use of reflectors
- The use of humps should be avoided on slopes

There is currently no standard design for speed humps on unpaved roads. A number of different types of hump have been identified as currently in use on rural roads in different districts of Tanzania, some of which have been installed by District Engineers and some by local communities. These include:

- Humps constructed only of earth
- Humps constructed of earth and stones
- Humps constructed of a tree trunk covered in earth
- Humps constructed of concrete
- Humps constructed of cement and stones
- Humps built into paving brick surfaces

District Engineers are encouraged to use their professional judgment and knowledge of the local environment to assess which type of speed hump is most appropriate in each given situation.

Recommendations for providing warnings

Clear and efficient signing is an essential part of the road system. Road users depend on signs for information and guidance, and road authorities rely on signing for traffic control and regulation, and for road safety. Tanzania's 'A Guide to Traffic Signing' (2009) provides guidance on how traffic signs should be used.

Warning signs are used to alert drivers to danger or potential danger ahead. Regulatory signs are used to control the actions of road users in the interest of safety.

Examples of warning signs that may be required on low-volume rural roads include:

- Signs W204 to W211 can be used to warn of significant bends

- Signs W307 and W308 can be used to warn of pedestrians, including children
- Signs W310 and W313 can be used to warn of animals
- Signs W326 to W330 can be used to warn of significantly narrow carriageways
- Sign W332 can be used to warn of speed humps

Warning of some hazards, such as bridges, drifts, large culverts, bends, roadside drop-offs, roadside hazards, and changes in surface type, may best given by marker posts with reflectors (W401, W402 or D3). An upright sign may be necessary if a marker post cannot be seen from a distance.

Examples of regulatory signs that may be required on low-volume rural roads include:

- Signs R201 to 205 can be used to restrict speed, weight and length
- Sign R239 can be used to restrict width

Temporary signage (for example signs TW336 or TW338) should be used when roadworks are being carried out or are required.

Progress of pilots

Two pilots of the use of the Guidance Note by District Engineers are intended to be carried out, starting in late January 2016 and finishing in May 2016.

Data on motorcycle speeds and other elements of driver behaviour will be collected both before and after the implementation of safety measures on two study roads. The data will be analysed to assess whether there has been a change in the behaviour of motorcycle drivers as a result of the safety improvements.

At this stage, the pilots are not designed to be scientifically robust, but rather will be used to inform the process of developing the Guidance Note. A further study is planned to be undertaken at a later date to assess the effectiveness of the wider road safety

programme – including the Guidance Note, and also behaviour change and possibly enforcement components – using a more robust methodology.

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Competing Interests

The authors declare no competing interests.