HOW DO WE MEASURE HARM IN TRANSPORT?

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ABSTRACT

The title question seems straightforward enough but, upon further reflection, there are some challenging issues in how we measure the level (or change in level) of harm in our land transport system. These issues may influence how we measure and manage our safety goals such as *Road to Zero*.

A traditional measure of harm in road safety is to count the number of deaths and injuries suffered in road crashes across the various transport modes. Waka Kotahi's Crash Analysis System (CAS) has typically been the main source of capturing this. The potential for this data to be under-reported has long been well known but, even then, it overlooks many other examples of casualties within the transport environment. The growing number of new "transport devices" (e-skateboards, scooters, etc) in our user mix also create definition problems within this dataset.

Recent investigations looking at the safety of people walking, biking, motorcycling and using other transport devices in Auckland identified from hospital data that considerably many more people are suffering serious injuries on roads and paths from incidents not involving other vehicles. Research looking into the cost of road crashes nationally found similarly large social costs from non-motorised user incidents. These findings may help inform funding decisions for maintenance of paths, vegetation and kerb-crossings, where many "slip, trip, fall" events occur.

While there is a (not surprising) focus on reducing deaths and injuries on our transport network, reduction targets for these can be at odds with other targets to increase numbers using low-use modes like walking and cycling. If considerable increases in active modes result in corresponding gains in personal health, does that counter the likelihood that there may also be some additional road deaths?

This paper explores these issues and others, using recent studies and examples, and suggests some possible ways forward.

INTRODUCTION

For all its benefits to society in terms of economic trade, employment and access to goods and services, transport (particularly land transport) also brings with it a number of potential harms. Obvious ones have been well known for many years, including road crash casualties and environmental effects to people and ecosystems. Less apparent harms have been identified in more recent times as a consequence of over-reliance and prioritisation of motor vehicles; these include worsening personal physical and mental health and severance of some people from community facilities.

If we focus on road safety then, while the title question seems straightforward enough, upon further reflection, there are some challenging issues in how we measure the level (or change in level) of “harm” in our land transport system. These issues may guide conversations on how we measure and manage our safety goals such as the NZ national road safety strategy *Road to Zero* (MOT 2019).

A traditional measure of harm in road safety is to count the number of deaths and injuries suffered in road crashes across the various transport modes. Waka Kotahi’s Crash Analysis System (CAS) has typically been the main source of capturing this in New Zealand. The potential for this data to be under-reported (due to the Police not recording every incident) has long been well known and is typically accounted for when evaluating safety improvement projects. However, even then, it overlooks many other examples of casualties within the transport environment. The growing number of new “transport devices” (particularly of the electric variety) in our user mix also create definition problems within this dataset.

As will be described below, recent investigations looking at the safety of people walking, biking, motorcycling and using other transport devices in Auckland identified from hospital data that considerably many more people are suffering serious injuries on roads and paths from incidents not involving other vehicles. Research looking into the cost of road crashes nationally found similarly large social costs from non-motorised user incidents.

These findings may have implications for decisions on best practice for collecting and monitoring land transport incident and injury data, and could help inform decisions on funding allocation between roads and paths, including maintenance of paths, vegetation and kerb-crossings, where many “slip, trip, fall” events occur. This think-piece explores these issues and others, using recent studies and examples, and suggests some possible ways forward.

LITERATURE REVIEW

A traditional measure of harm in road safety is to count the number of deaths and injuries suffered in road crashes across the various transport modes. In New Zealand, Waka Kotahi’s Crash Analysis System (CAS) has typically been the main source of capturing this, via traffic crash reports from the Police (Waka Kotahi 2022). The potential for this data to be under-reported (due to the Police not recording every incident) has long been well known and is typically accounted for when evaluating safety improvement projects (see Waka Kotahi 2021). Langley *et al* (2003) found for example that only 54% of motor vehicle injury crashes found in New Zealand hospital data could also be found in Police Traffic Crash Report records, and only 22% of bicycle injury crashes.

Even then, this crash reporting overlooks many other examples of casualties within the transport environment. For example, in a study of hospital data in Victoria, Australia, Oxley *et al* (2018) noted that pedestrian falls while walking in the road environment accounted for a far greater number of hospital admissions than were identified from Police crash data, and were also greater than the number of pedestrian injuries involving motor vehicles. The growing number of new “transport devices” (e.g. electric skateboards, self-balancing devices, scooters, etc) in our user mix (Lieswyn *et al* 2017) also create definition problems within traditional injury and crash datasets.

Defining Safety

International road safety guru Ezra Hauer noted some issues when trying to define what is meant by the frequency of "crashes" or "accidents"[1] (Hauer 1997), typically for the purposes of monitoring the relative safety of different areas or evaluating road safety initiatives. Two particular issues identified are:

- What is being counted as an "accident": As Hauer notes: *"If a passenger is injured when the bus stops suddenly, if two cars collide without visible damage, if someone has a finger amputated by a closing car door, or if a bicyclist runs over a pedestrian, are these 'accidents'?"* Typically, an official definition of an accident is defined somewhere for determining how to capture them in the records, which may vary by the purpose of data collection for different agencies.
- Whether accidents are actually reported to the relevant agencies: There may be official thresholds above which "accidents" (as they are usually referred to in transport legislation) are required to be reported (e.g. a minimum amount of property damage, presence of an injury); however, it is clear that not all accidents get reported as required. Hauer also noted the problem of *"frequency-severity indeterminacy"* whereby incidents with greater severity are more likely to be reported than less severe ones. This can also present biased numbers when some groups are more likely to suffer more serious injuries by reason of their travel mode or age (and subsequent vulnerability or frailty).

In New Zealand, transport safety incident data may be collected for different purposes by the Police and Waka Kotahi (for CAS), the Ministry of Health's (MoH) hospital admissions, Accident Compensation Corporation's (ACC) injury claims, and vehicle/personal insurance claims. The *Land Transport Act 1998* has this to say about reporting of "accidents" (***bold*** emphasis added):

> ***22 Driver's duties where accident occurs***
>
> *(1) If an accident arising directly or indirectly* ***from the operation of a vehicle*** *occurs to* ***a person or to a vehicle****, the driver or rider of the vehicle must—*
>
> *(a) stop and ascertain whether a person has been injured; and*
>
> *(b) render all practicable assistance to any injured persons.*
>
> *(2) The driver or rider of the vehicle must, if required by an enforcement officer or any other person involved in the accident, give the officer or other person—*
>
> *(a) the driver's or rider's name and address; and*
>
> *(b) the name and address of the owner of the vehicle; and*
>
> *(c) if the vehicle concerned is a motor vehicle, the number or letters or other expression on the registration plates assigned to the vehicle.*
>
> *(3) If the accident involves* ***an injury to or the death*** *of a person, the driver or rider* ***must report*** *the accident to an enforcement officer as soon as reasonably practicable, and in any case not later than 24 hours after the time of the accident, unless the driver or rider is incapable of doing so by reason of injuries sustained by him or her in the accident.*

The definition of "vehicles" under the Act is quite broad and includes cycles and various small-wheeled devices such as kick scooters, e-scooters and skateboards, as well as mobility scooters. Manual wheelchairs and children's prams/pushchairs appear to be the only transport user exceptions to this, aside from pedestrians. Also, because the Act refers to accidents arising from the "operation of a vehicle", it could be argued that a situation where a transport user has a medical event (e.g. heart attack) while travelling does not fall under the reporting requirements.

[1] Due to various documents referred to in this paper using the different terms of "crash", "accident", or even "incident", these terms will be used interchangeably depending on the reference being discussed. While "crash" is increasingly preferred in the New Zealand road safety sector it should be noted that, when it comes to definitions of transport harm, many transport accidents/incidents don't necessarily involve a crash (or collision) with another party or object.

Based on those legal definitions, anything other than a single-person pedestrian-only incident/crash (or one only involving a manual wheelchair or pram) *should* be captured by Police (typically through a Traffic Crash Report) if the Police and/or emergency services attend the crash. For incidents causing injury to any party, they should also be reported to Police by those involved.

In practice, this is generally not happening; certainly not all cycle-only or e-scooter-only incidents are currently being captured in CAS, although they're more likely to be if there is a fatality or serious injury. If the police do not attend a crash or incident, there will typically not be a Traffic Crash Report and it is unlikely that it will be self-reported to the Police for a report to be completed unless an insurance claim requires it.

By contrast, any person that presents themselves to a hospital or medical centre due to a transport "accident" will invariably be captured within the respective MoH and ACC datasets. However, these are more focused on the nature of the *injuries* and their treatment, rather than the nature of the incident that led to it, as is typically detailed in CAS records.

RECENT NZ STUDIES

Two recent local studies undertaken by the authors illustrate the potential scale of the transport harm problem in New Zealand away from conventional road safety metrics; they are described further below.

Auckland study of vulnerable transport users

Due to growing concerns about the numbers of deaths and serious injuries for "vulnerable transport users" (VTUs) outside of motor vehicles (i.e. people walking, biking, motorcycling and using other wheeled transport devices like skateboards and e-scooters), Auckland Transport (AT) commissioned ViaStrada to undertake a "deep dive" review (ViaStrada 2021). The purpose of this deep dive was to provide insight into the extent, nature and causes of serious harm to people travelling outside vehicles in Auckland.

Some key questions identified by AT for investigation were the scale of the problem, the nature of the harm occurring, and the systemic factors contributing to the issue. This involved a combined analysis of CAS data with additional sources from the MoH and ACC datasets, and included the extent of harm to VTUs where a motor vehicle was not involved, such as footpath falls, micro-mobility crashes, and level-crossing crashes.

Subsequent work also sought to understand the relative scale of out-of-region transfers in/out of Auckland (i.e. where the medical treatment did not occur where the person lived), the presence of unrelated medical events or conditions, incidents at AT-controlled roadwork sites, areas where residents may be more susceptible to user-only injuries such as falls, and the calculation of an alternative under-reporting adjustment table for the Waka Kotahi (NZ Transport Agency) *Monetised Benefits & Costs Manual* (Waka Kotahi 2021) that takes into account user-only VTU injuries.

The study found considerable under-reporting across all VTU modes compared with CAS-reported numbers, with typically 6-8 times as many serious injuries being recorded in hospitals (MoH, defined as at least one night stay in hospital) versus recorded by CAS (see Figure 1). For example, while serious pedestrian injuries in CAS number about 90 per year in Auckland, hospital data records about 710 pedestrian injuries a year on the street network. By far most of these incidents were user-only ones that did *not* involve a motor vehicle or other party (thus not deemed to require reporting in CAS). Rather, most of these users suffered some kind of slip or trip, typically due to loose/wet surfaces or uneven/stepped surfaces.

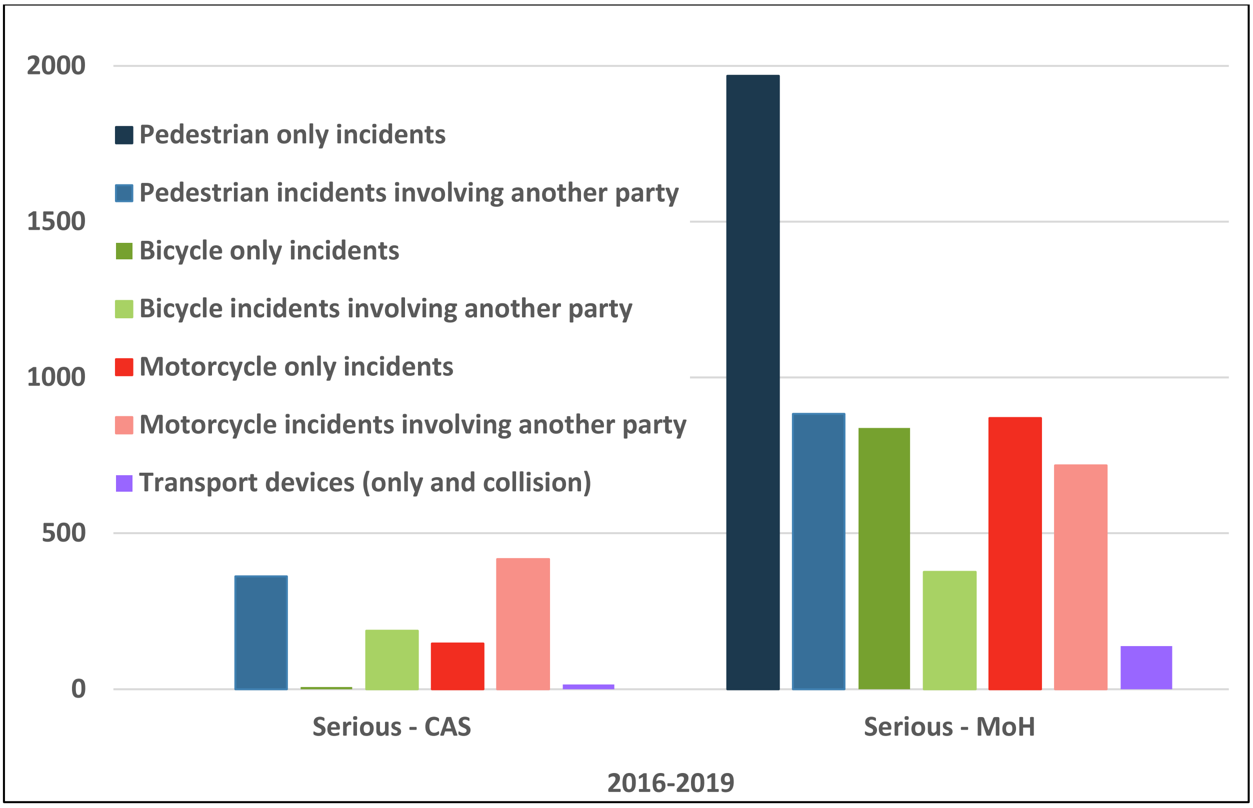

Figure 1: Number of serious injuries recorded in CAS and by MoH (2016-19 full year data)

What is noticeable from this review is that the relative proportions of injuries by travel mode shifts significantly when full hospital data is taken into consideration. Serious injuries involving VTUs go from representing only 46% of the serious injuries in CAS to 67% of the serious injuries recorded in hospitals. This change in relative harm is worthwhile considering in decisions on funding allocations for safety improvements.

The high number of serious injury events not involving a motor vehicle (particularly involving slips, trips and falls) raises the question of whether defects in the transport environment led to these injuries, or whether they were precipitated by medical events that led to the person suffering a fall of some sort. While there are no secondary codes in the MoH data that can easily determine the cause of the incident, there are some "free text" descriptive fields and standard "ICD-10AM" international incident codes that provide some information. These were requested from MoH to see whether this might glean additional clues about the nature of various incidents recorded at hospitals.

Injuries due to tripping were by far the biggest pedestrian-only injury, with over 350 a year. In looking at the reported descriptive factors for slips and trips, the most common issues reported were surface issues (19%), travelling over a kerb (17%), and alcohol or drugs (7%). Uneven surfaces (including cobblestones, gravel/stones, mud, loose pavers, and utility covers) caused a large number of injuries followed by wet surfaces. Running to catch a bus or train was a relatively frequent factor in injuries too. Lesser issues still resulting in serious injuries included tree roots and landscaping, boarding or alighting vehicles, and traffic devices such as signs and bollards.

Of particular note is the fact that older people are much more over-represented in serious injuries, particularly from age 60 onwards. This highlights the relative fragility of the older population, where a simple fall can lead to quite serious injuries (including broken bones) that would not affect a younger person as badly.

National Domestic Transport Costs and Charges Study

The NZ Ministry of Transport (MOT) commissioned a consortium featuring ViaStrada to identify all the costs imposed by the domestic transport system on the wider New Zealand economy and the countervailing burdens, including charges faced by transport system users. ViaStrada was given the task of investigating the costs of transport-related accidents, particularly focusing on costs to road users (ViaStrada 2022). The study included calculating estimates of the total and average (social) costs per year, based on willingness-to-pay (WTP) to avoid pain, grief and suffering associated with accidents.

Conventional road accident costs involving motor vehicles were calculated using CAS data and standard under-reporting factors; collectively across all modes this totalled $5.6 billion per year. An interesting exercise was in comparing how these costs were allocated by travel modes, with three different methods used as described in Table 1. The differences in these were particularly evident when comparing the calculated costs for motor vehicle accidents involving pedestrians and cyclists.

Concept	Description	Yearly Costs
Neutral costs "shared"	• Allocation of the estimated cost for each accident type (by number/type of road users involved) ***evenly*** across the road user types involved (e.g. for an accident involving 2 cars and 1 truck, 2/3 of cost allocated to cars, 1/3 to trucks).	Bike: $110m Ped'n: $219m **TOTAL: $319m**
Costs "caused"	• Allocation of total costs across vehicle types according to the vehicle type judged to be ***primarily at fault***. Calculated from CAS data, with fault allocation based on different crash movement types.	Bike: $87m Ped'n: $199m **TOTAL: $286m**
Costs "suffered"	• Allocation of total costs across vehicle types in proportion to the road users ***experiencing the injuries***. Based on a "vulnerability hierarchy", whereby the least protected users involved in an accident were presumed to be the most affected first, in the absence of other information.	Bike: $201m Ped'n: $435m **TOTAL: $636m**

Table 1: Transport harm cost allocation concepts for bicycle and pedestrian accidents

For "non-motorised users" (i.e. pedestrians, cyclists, wheelchair users, users of small-wheeled devices such as skateboards, scooters, e-rideables, etc), a separate calculation of accident costs involving these users only was determined using a combination of CAS and ACC data. Although the vagaries of the ACC data required some assumptions about the nature of the incidents recorded, it was estimated that the social costs of accidents not involving motor vehicles by these users was an additional $830 million yearly, i.e. *much more* than the figures for those involving motor vehicles (Table 1).

As with the AT study, the non-motorised group not involving motor vehicles featured large numbers of pedestrians colliding with cyclists or users of small-wheeled devices, pedestrians stumbling when trying to avoid conflict with motor vehicles, or pedestrians slipping on the road / footpath surface. Pedestrians who do require medical attention as the result of a slip / trip / fall are more likely to be vulnerable (e.g. the elderly) and thus likely to suffer serious injuries (e.g. broken hip).

DISCUSSION AND IMPLICATIONS

The above investigations highlight how non-motorised travel modes can often be systemically under-played using traditional road safety harm metrics, with the appearance given of a greater problem with motor vehicle road safety (and thus a greater share of the funding). This is not to deny the significant safety problem posed for motor vehicle occupants (particularly in rural areas), nor the under-reporting found by a factor of roughly 2-3 in injury crashes by these modes. However, the typical under-reporting for serious injuries by non-motorised users in Auckland at least was found to be in the order of 6-8 times greater than the reported CAS data, much of this due to incidents not involving a motor vehicle at all. It is notable too that the annual road safety summary produced by the Ministry of Transport focuses only on the social costs of crashes involving motor vehicles and does not record at all those involving non-motorised users only (Ministry of Transport 2021).

These findings agree with a study of non-motor vehicle injuries to pedestrians in NZ by Frith & Thomas (2010), which found that most pedestrian injuries here involve no motor vehicle interaction and are therefore not reported as part of CAS traffic crash data; the difference is even more prevalent with older pedestrians. Previous research on cycle-only accidents in NZ (Munster *et al* 2001) also noted a 2:1 ratio of cyclists admitted to hospital for on-road incidents not involving a motor vehicle, compared to those with a motor vehicle.

Some of this reflects the systematic bias in what gets reported, as traditionally a motor vehicle has had to be involved for a crash to reported in CAS. Therefore, it is only through other data sources like ACC and MoH that other forms of transport harm can be uncovered. Unfortunately, these data sources do not provide a lot of consistently useful transport-related information regarding the nature of these injuries (e.g. where exactly they occurred, road/path environment at the location, specific obstacles struck), which is where the CAS dataset has much greater utility (and hence why it is relied on by transport practitioners).

This is not to suggest that CAS should be used to also capture user-only incidents by pedestrians, cyclists and the like; the administrative burden would be immense. CAS also has some data analysis problems too, whereby pedestrians involved in a crash are not treated like another road user entity in the same way that vehicle occupants are. A better option would be to improve the way that health datasets like ACC and MoH can also be used for interrogating transport-related injuries.

The potential for these datasets to be used in conjunction with the standard CAS database for road transport-related injuries has been explored before in NZ by the SORTED inter-agency pilot study (Ministry of Transport 2022). A similar proof-of-concept exercise was also undertaken across Police and health datasets in Australian jurisdictions (Harrison *et al* 2019). While there was great potential in matching injuries across the various datasets, it would require a concerted ongoing effort. There are also differences in how the relative injury severities are reported in each case; for example, while CAS uses a “minor/serious/fatal” system of categorising, elsewhere a “minor/moderate/severe/fatal” scale is common, often based on the 75-point Injury Severity Score (ISS) and the 6-point Maximum Abbreviated Injury Scale (MAIS).

Regardless of which data source is being considered, the growing number of new “transport devices” (skateboards, scooters, etc, particularly of the electric variety) in our user mix also create definition problems within these datasets. The term “scooter” is problematic for starters, potentially referring to moped-style scooters, powered or unpowered kick scooters, and mobility scooters. Examination of the MoH hospitalisation dataset noted several situations where a readmitted case was deemed in one record to be a “moped” but then referred to in another record as a “wheeled device”, suggesting possibly it was some kind of powered micro-mobility device. Meanwhile in CAS, various mobility scooter incidents have been separately coded under “wheeled pedestrian”, “pedestrian” and “other” (Lieswyn *et al* 2017). With the likely future change to classifications for wheeled micro-mobility devices under the Accessible Streets legislation proposals (NZTA 2020), it seems like a timely opportunity to also introduce greater consistency across the various transport datasets too.

The findings described earlier around pedestrian injuries may help inform decisions on funding of maintenance of paths, vegetation, and kerb-crossings, where many “slip, trip, fall” events occur. While a lot of road safety funding attention tends to be focused on road-based treatments such as safety barriers, raised platforms and improved intersections, there is a strong argument to be made that investment in better off-road facilities is also a road safety investment.

A large amount of transport investment and subsidy (billions each year) goes into road construction, improvement, and maintenance, including targeted road safety projects. However, it is telling that until only fairly recently, national subsidy was not available for assisting local authorities to maintain footpaths, despite the relatively small cost nationally (NZTA 2008).

New measures for Transport Harm

While there is a (not surprising) focus on reducing deaths and injuries on our transport network, reduction targets for these can be at odds with other public agency targets to increase numbers using low-use modes like walking and cycling. If considerable increases in active modes result in corresponding gains in personal health, does that counter the likelihood that there may also be some additional road deaths?

For example, currently Auckland Transport has some objectives to reduce deaths and serious injuries (DSIs) by ~60-70% between 2018 and 2028 (Auckland Transport 2019). Although not entirely clear from the Programme Business Case, it is assumed that active mode casualty numbers are expected to reduce (in absolute terms) by a similar proportion. However, at the same time there is a considerable push to increase the use of active modes within Auckland; external factors have also seen a considerable rise in use of transport devices like e-scooters (both public and privately owned). A similar planned growth in patronage across the city's public transport network is also likely to see accompanying growth in "first/last mile" journeys to and from transport stops.

While this growth in sustainable transport modes is to be welcomed, there is a very real likelihood that it will be accompanied by a growth in casualty numbers for these modes, even if efforts are made to improve the environment for travelling using these means. As a comparison, the Netherlands (generally agreed as the safest place internationally to cycle on a per-km basis) still see approximately *200* cycling deaths a year, compared with the NZ average of 10 a year (Wagenbuur 2020), simply reflecting the considerable amount of cycling that occurs there.

Therefore if, hypothetically, the amount of cycling in Auckland (or anywhere else) doubled and the number of DSIs increased by only 50%, the resulting 25% *relative* reduction in per-km casualty rate may not be considered a "success" due to the *absolute* increase in casualty numbers. This is despite the fact that the additional people cycling are likely to be gaining considerable improvements to their personal health, particularly if they have not done much prior physical activity before. It is interesting that, while organisations (including transport-related ones) focus a lot of attention on "health and safety", there appears to be a much greater concern about the reduced *safety* outcomes from encouraging more active mode use than about the reduced *health* outcomes from encouraging continued sedentary motor vehicle use…

This dilemma suggests that road controlling authorities may need to consider other performance metrics that better reflect the overall "life mortality costs" of any intervention. "Disability-adjusted life years" (DALYs) gained or lost due to lifestyle changes is already a common metric used in the health sector (e.g. May *et al* 2015), and may have merit in the transport sphere as well. For example, Lindsay *et al* (2011) found that shifting 5% of short urban vehicle-kilometre trips in New Zealand to cycling would result in about 116 deaths *avoided* annually because of increased physical activity, six fewer deaths due to local air pollution from vehicle emissions, but an *additional* five cyclist fatalities from road crashes.

A simple measure could be to start using exposure-based metrics, e.g. DSIs per km walked or cycled. That way, improvements in the *rate* of injury are better reflected, regardless of the change in usage. In many cases, this would require considerable improvement in the way that usage data is currently collected (or not at all currently) by transport organisations, particularly for non-motorised modes. Doing so would also have the side benefit that ongoing changes in usage by less common (but often more sustainable) travel modes can be better monitored.

This paper started out by noting that transport brings both societal benefits and costs with it. While the focus of this think-piece has been largely on road safety harm, efforts to reduce motor vehicle use and harm and encourage more active modes (by measures such as lower speed limits, protected pathways and crossings, and street closures/restrictions) may also help achieve reductions in many other forms of transport harm as well, certainly outweighing any absolute increase in active mode injuries. This has the potential to improve holistic health (*hauora*) for our communities, as described by Mason Durie's *Te Whare Tapa Whā* four-dimensional model for health and well-being (Durie 2004). The connection to improving physical well-being (*taha tinana*) for active modes is clear and the measure most directly linked to traditional measures like reductions in DSIs and obesity prevalence. But it is also well known that greater use of safe and active travel can bring about better mental and emotional well-being (*taha hinengaro*), and the resulting improved accessibility within communities will contribute to social well-being (*taha whānau*).

It is no coincidence that efforts to reduce the impact of motor vehicles on society will also bring about reductions in other transport harms, such as noise and vibration, pollution of ecosystems, and community severance. Ultimately these can all contribute to reducing the biggest potential harm of them all to our society – global climate change.

CONCLUSIONS AND RECOMMENDATIONS

The above investigations have highlighted the considerable under-reporting of injuries to vulnerable transport users in Auckland and nationally, particularly for incidents not involving a motor vehicle. It is likely that commonly used transport data sources such as CAS under-estimate the true scale of harm occurring to our least protected users, both from motor vehicles and from hazards in the surrounding transport corridor environment.

Some suggestions are proposed by the authors as a way forward when assessing transport harm in the future in New Zealand and potentially elsewhere:

- Make further improvements to the CAS database (and associated Traffic Crash Report forms) to recognise the different and new alternative transport devices in the system so that they are not coded as pedestrians, other, null, etc, and to recognise motorcycle riders and cyclists as specific entities and not as “drivers”. Further changes should also be made to the CAS reporting processes, particularly in terms of data that is made available about non-vehicle participants such as pedestrians.
- Continue to link information from different agencies (Waka Kotahi, MoT, ACC, MoH) to provide an accurate picture of road trauma in New Zealand for all modes of transport. Transport agencies should work with the ACC and MoH to standardise entries to make analysis of transport harm events using their databases more efficient.
- Encourage MoH to collect location data (i.e. where an incident occurred) as a field to allow data to be used to identify localised transport issues that can be addressed.
- Further work is recommended with ACC to make better use of the existing data and to also investigate options for making captured data even more useful (including standardised use of free-text fields). The ability to identify suitable injury data that could help properly quantify minor injuries is also recommended.
- Waka Kotahi should consider the safety role of footpath maintenance, and relative risk metrics from Census/MoH data when allocating funding for this work across RCAs. Consider targeted investment of footpath maintenance in areas identified as high priority or where pedestrian injury density is already high.
- Agree on consistent categorising of "wheeled transport devices" of all types, including clear categorising of "scooters" of all types to differentiate between powered and non-powered scooters, moped style scooters and mobility scooters.
- Reporting to key decision-makers regarding road safety should provide specific metrics for walking, cycling, motorcycling and other small transport devices, including usage and incidents not involving motor vehicles. Roading authorities should look to use specific scaling factors to estimate likely true DSI numbers (including user-only injuries) based on reported CAS numbers. They should also identify slips, trips and falls through data sources such as Council Customer Response Management databases.

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AUTHOR CONTRIBUTION STATEMENT

Glen Koorey was the lead author for this paper and project manager for the two ViaStrada reports referred to in this paper (including some data analysis and review). Gemma Dioni (previously with ViaStrada) undertook much of the data sourcing, analysis, report-writing and presentation of the findings. Ping Sim was the client for the Auckland VTU study and provided comprehensive feedback on that report and advice on the draft paper.

Note that the views expressed in this paper are those of ViaStrada, and not necessarily Auckland Transport, Christchurch City Council, or the Ministry of Transport.

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