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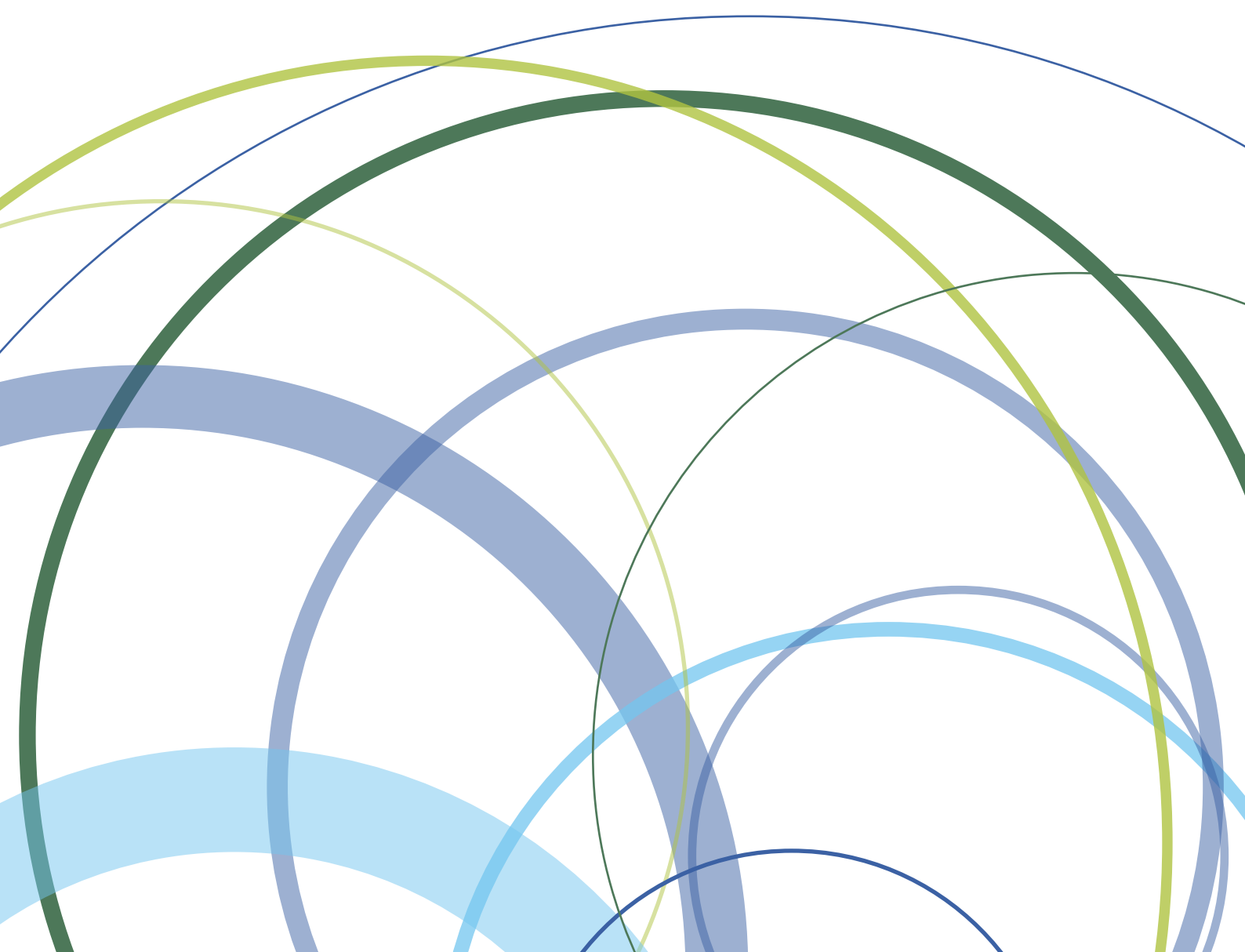


**Child and Youth
Mortality Review
Committee**

Child and youth mortality from motorcycle, quad bike
and motorised agricultural vehicle use
with a focus on deaths under age 15 years

Special Report

December 2014



- This report was written for the Child and Youth Mortality Review Committee by:
- BK White, Injury Prevention Public Health Promoter, Nelson Marlborough District Health Board
 - NJ de C Baker, Community Paediatrician and Chief Medical Officer, Nelson Marlborough District Health Board.

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Acknowledgements

The concept and background research in this report was initially prepared by Bronwyn White and Dr Nick Baker while Dr Baker was the Chair of the Child and Youth Mortality Review Committee (the CYMRC). Dr Gabrielle McDonald and Dr John Holmes (of the New Zealand Mortality Review Data Group), Bronwyn White, Dr Felicity Dumble and Dr Nick Baker completed the data extraction. Analyses in the first part of this report (on deaths in off-road settings) were done by Dr Gabrielle McDonald and Dr John Holmes. Analyses in the second part of this report (on deaths in all settings) were done by Bronwyn White and Dr Nick Baker. Dr Brandy Griffin and Joanna Minster from the Health Quality & Safety Commission (the Commission) provided writing and research support throughout.

On 20 August 2014, the Commission and the CYMRC convened a workshop to discuss the views on the draft report with stakeholders from government agencies and non-government organisations. The purpose of the workshop was to identify the key areas where policy and prevention efforts are needed, and to gather sector-wide feedback on the report findings for the development of a set of recommendations.

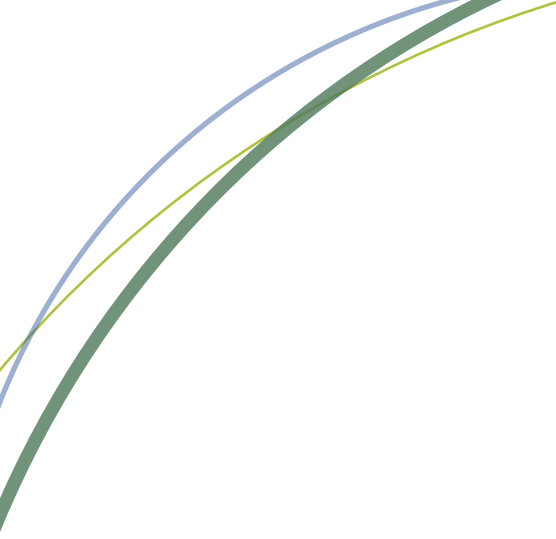
The following stakeholders were present at the workshop and contributed to the development of the report recommendations: Alan Barker (DairyNZ), Cushla Beale (Landcorp Farming Limited), Maxine Campbell (University of Waikato), Sue Campbell (Plunket), David Crawford (Motor Industry Association of New Zealand (MIA)), Tony Everett (Motor Trade Association (MTA)), Vicky Hicks (Motorcycling NZ), Darryl Lovegrove (Yamaha Motor), Al McCone (WorkSafe New Zealand), Michael McIlraith (New Zealand Police), Coroner Carla na Nagara (Coronial Services of New Zealand), Katy Sanson (WorkSafe New Zealand), Ann Weaver (Safekids Aotearoa), Bronwyn White (Lead Researcher), Richard Wood (Accident Compensation Corporation (ACC)) and John Wren (ACC).

Feedback from the workshop with stakeholders was incorporated into the report, which was revised by the Commission (Dr Brandy Griffin and Joanna Minster). The revised report was then discussed by the CYMRC and distributed to a second group of stakeholders, including those who were unable to attend the August workshop. The following stakeholders were consulted about the revised report and provided feedback to the CYMRC: Matt Claridge (Water Safety New Zealand), Rob Cousins (ACC), Nick Hanson (Federated Farmers), Judge Neil MacLean (Coronial Services of New Zealand), Tania Peters (Safe Communities Foundation New Zealand), Mark Stables (New Zealand Police) and the Injury Special Interest Group of the Paediatric Society of New Zealand.

The current CYMRC Chair, Dr Felicity Dumble, along with the current CYMRC members and Dr Nick Baker, contributed to the stakeholder workshop, the development of the report's recommendations and the completion of the revised draft. The current CYMRC members include: Dr Felicity Dumble (Chair), Dr Terryann Clark, Dr Stuart Dalziel, Dr Ed Mitchell and Dr Pat Tuohy, with Dr Janine Ryland serving as Dr Tuohy's deputy as needed.

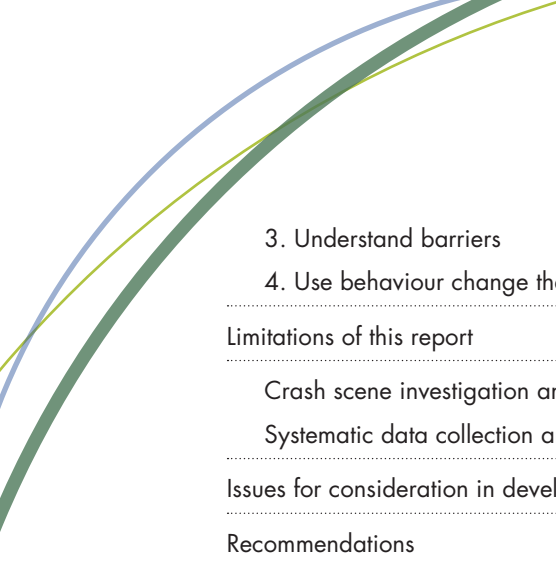
Some issues raised during the workshop with stakeholders pointed to a need for further discussion as various stakeholders had different views on where prevention initiatives should include legislative change. Legislative and regulatory changes that may require further discussion include:

- registration and warrant of fitness for vehicles used off-road (to ensure ongoing vehicle maintenance and safety)
- adoption of minimum safety standards for products, including having age-specific or age-graded safety requirements (eg, speed limiters on bikes designed for children and young people)
- licensing of vehicle riders and/or compulsory training for all quad bike vehicle riders
- re-evaluation of the exemptions under the Land Transport Act 1998
- recommending or having legislation to enforce a minimum age for quad bike use (ie, prohibiting all children under 16 years of age from operating any quad bikes versus the current approaches that specify no children under 16 years of age should ride adult-sized quad bikes).



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Chair's introduction

While this report was started before I began my term as Chair of the Child and Youth Mortality Review Committee, I have been fortunate to be involved in the multidisciplinary and multi-agency development of this work. I am very pleased to see it completed, particularly as off-road vehicle deaths and injuries are important issues where I am based in the Waikato.

By reviewing these off-road vehicle deaths we aimed to identify aspects of the environment and behaviour associated with severe injury and death, and to develop recommendations to reduce and mitigate those risks.

The findings of this report highlight the risks associated with recreational and farm-related use of off-road vehicles by children and youth. A response involving all sectors is needed to reduce the incidence of these outcomes. This is required due to the wide range of activities, settings and vehicles covered in this report. It is also a reflection of the varied responses recommended, including changes to national policy, agency response, vehicle design, attitudes and behaviours.

When developing the recommendations, the aim was to acknowledge what is reasonable, achievable and acceptable while challenging behaviours and attitudes associated with unacceptable risk for our children and youth.

I would also like to acknowledge the participation of our key stakeholders in identifying a way forward.

Dr Felicity Dumble

Chair of the Child and Youth Mortality Review Committee



Foreword

Quad bikes and motorcycles are agile and manoeuvrable, allowing for rapid travel over difficult terrain. These same properties make them highly valued and highly dangerous, especially for children and young people. Inexperience, inadequate physical size and strength as well as immature motor and cognitive development all add to the risks for children. Risks are further increased when vehicles are used outside the scope of the manufacturer's design and safety guidelines. Because these vehicles are so highly valued, parents often allow children to ride them from an early age and children actively desire to ride them as passengers or drivers at every opportunity.

As a society, we are familiar with the risks our children face in specific settings (eg, around water or crossing the road) and we anticipate the risks in order to protect our children. This report indicates that, too often, parents and caregivers fail to recognise the dangers these powerful machines pose for small children. It also seems that parents fail to recognise the developmental level required to use these machines safely, and the time taken to develop skills for safe use is often underestimated by supervising adults. The 'ages and stages safety chart' in Appendix 1 is a useful resource for mitigating the risks faced by children.

Over the last 10-year period in New Zealand, there has been a remarkable reduction in the number of deaths in children under 15 years of age that have occurred in relation to tractors, suggesting that prevention efforts have been successful in this area. It is time to catch up with similar successes for quad bikes and motorcycles. Motorcycle use must be included because this report finds motorcycles associated with more off-road deaths, and there is currently less focus on injury prevention for motorcycles compared with injury prevention for quad bikes.

Effective prevention work needs to be targeted to risk, multifaceted, consider the developmental attributes of children, and guided by established behaviour change theories. As recreational use of motorcycles and quad bikes is the second most common cause of recreation-related death in New Zealand children after drowning, it is a topic of substantial importance. In contrast to prevention related to drowning, it is possible to run highly targeted prevention initiatives for these vehicles. While the major focus of this report is around children under 15 years, there is a substantial death toll for riders and passengers over 15 that requires continuing intervention.

As a committee, we recognise we are not experts in motor vehicles or rural communities so we convened a workshop of key stakeholders to review the information in this report and help develop recommendations for prevention in this area. It was difficult to reach full consensus on some recommendations with all stakeholders. We are extremely grateful to this group for their time and input, and express our thanks.

Dr Nick Baker

Chair of the Child and Youth Mortality Review Committee, 2007–14

Key messages

This special report provides information on the mechanisms and circumstances surrounding deaths where the person was an operator or passenger of a two-, three- or four-wheeled vehicle or motorised agricultural vehicle (collectively referred to as 'off-road vehicles' in this report).

The key findings from the analysis of data from the Mortality Review Database on children under 15 years of age who were drivers or passengers in off-road vehicles in any setting follow:

- Recreational use of off-road vehicles is the second most common cause of recreational death for children in New Zealand. While recent emphasis has focused on reducing quad bike deaths and injury in New Zealand, this report shows child fatalities from motorcycles are also a significant issue.
- During 2002–12, 33 New Zealand children aged 0–15 years died from using off-road vehicles in both on- and off-road settings.
- On average, three children aged 0–15 years die annually while driving or riding on off-road vehicles in New Zealand.
- The rate of off-road vehicle deaths is higher in rural residents (2.92 per 100,000) compared with urban residents (0.68 per 100,000). Children and young people living in urban areas were over four times less likely to die from incidents involving off-road vehicles than children and young people living in rural areas (rate ratio = 0.23; 0.17–0.32). The focus for interventions should be the rural and agricultural sectors.
- In total, 26 children died in off-road settings. Nineteen deaths occurred on private properties and six of those were children visiting a private property.
- The greatest number of children died while driving or riding on motorcycles (n=15), closely followed by those driving or riding on quad bikes (n=12).
- Seven children died while riding on a motorcycle on a public 'on-road' setting. Four of these children were driving the motorcycle."
- Although the Land Transport Act 1998 does not permit drivers aged less than 16 years to drive motorcycles or quad bikes on a public road, there were eight deaths where children were in control of motorcycles or quad bikes, either on a road (n=4) or in a place defined as a Z road (n=4).
- At the time of the crash, at least 48 percent of the vehicles were being used for recreational riding. The only recreational activity with higher mortality is swimming and recreational use of water.
- The weight and power of motorcycles and quad bikes relative to the size, strength and skills of children seems to pose a substantial risk. Improved recording of make, model and cc rating is needed to determine the full extent of the safety issues associated with various bike sizes.

During the writing of this special report, it became evident that the appropriate age of drivers in relation to the size, power and cc rating of quad bikes is still unresolved. The American Academy of Pediatrics' Committee on Injury and Poison Prevention (2000), the Canadian Paediatric Society's Injury Prevention Committee (2004; 2011) and Farmsafe Australia (2014a) recommend that all children under the age of 16 years be prohibited from operating any quad bike, including those designed and marketed for children. In New Zealand, the Accident Compensation Corporation (ACC), the Ministry of Business, Innovation and Employment (MBIE) and Safekids Aotearoa all recommend that **children aged under 16 years should not ride adult-sized quad bikes** (those with an engine capacity of 90cc or more) (MBIE 2014b; Safekids Aotearoa 2014).¹ This current sector advice in New Zealand differs from the American Academy of Pediatrics, the Canadian Paediatric Society and Farmsafe Australia, because it does not discourage children from riding the smaller quad bikes manufactured specifically for young riders.

The CYMRC does not have enough evidence to make a recommendation about the use of small quad bikes. This is because information on the vehicle size and engine capacity was not available in the sources of data (scene investigation and coroners' reports) for many of the cases reviewed. Because of this, the CYMRC's

¹ This current recommendation also aligns with the guidelines that all manufacturers provide with quad bikes sold in New Zealand (Safekids Aotearoa 2014).

position is that, at the bare minimum, the current safety advice on quad bike use in New Zealand must be adhered to until there is evidence to suggest that smaller quad bikes pose a significant risk to warrant banning quad bike use for all children aged under 16 years. Data collected from all off-road vehicle crashes need to be improved in order for an evidenced-based decision to be made on this issue. In the absence of New Zealand data, those purchasing quad bikes that may be used by anyone under 16 years of age should be informed of the risks.

The CYMRC recommends extreme caution to parents and caregivers with regard to the use of quad bikes by anyone under 16 years of age, and to consider overseas recommendations such as *'DO NOT allow riders under 16 years old to operate a quad of any engine size (kids and quads are a fatal mix)'* (Farmsafe Australia 2014b) until New Zealand data or safety modifications indicate another approach.

Adopting clear mandatory product safety standards in New Zealand, such as the ANSI/SVIA 1-2010,² would give consumers more certainty about what is being purchased, and potentially limit risks by enhancing the safety of all quad bikes, including the smaller-sized bikes manufactured for children.

Considering the evidence from the data analyses, the CYMRC would like to make the following recommendations.

A) National policy and practice recommendations

1. When serious injuries or fatalities involving off-road vehicles occur, an extensive, high-quality incident scene and vehicle assessment as well as analysis should take place regardless of the location of the event or the activity at the time.
 - a. The role of the New Zealand Police Serious Crash Unit should be reviewed with a view to ensuring it is involved with all deaths related to motor vehicles.
 - b. Coroners should be seeking analysis from the New Zealand Police Serious Crash Unit with regard to all deaths related to motor vehicles.
 - c. Information about the details and themes related to fatalities should be systematically shared with others, including the lead agency for injury prevention (see recommendation 2 below), vehicle manufacturers and distributors, and other relevant community organisations.
2. A single agency should take responsibility for child and youth injury prevention by facilitating the cross-sector planning, implementation and evaluation of interventions that address child and youth safety around the use of all off-road vehicles (motorcycles, quad bikes and motorised agricultural vehicles) in the wider contexts of work, home and recreation. This broad approach to injury prevention should be led by the Accident Compensation Corporation (ACC) and form part of its current work on injury prevention. A detailed review of all injuries sustained by children and young people from using off-road vehicles should be included in the scope of this injury prevention work.
3. The Ministry of Business, Innovation and Employment (MBIE) should continue to consider the implications of adopting the American National Standards Institute's (ANSI's) safety standards for quad bikes and side-by-side vehicles³ so all off-road vehicles entering New Zealand are built to minimum construction standards.
4. Given the increasing number of international recommendations advising that children younger than 16 years of age should not operate quad bikes of any size, parents and caregivers should be made aware of these overseas recommendations through clear, consistent and coordinated messaging from lead agencies.

2 The American National Standards Institute (ANSI) together with the Specialty Vehicle Institute of America (SVIA) developed a standard for all-terrain vehicles (ATVs) that specifies the vehicle safety requirements, labels and speed capabilities for 'youth model' ATVs designed for children ages 6–10 years, 10–12 years and >12 years. This standard was adopted as a mandatory standard in the USA under the Consumer Product Safety Improvement Act in 2007, and took effect in 2009. In New Zealand this standard is currently voluntary. See the section on 'Vehicle design standards and product safety' (p. 37) for further discussion.

3 These standards include the ANSI/SVIA 1-2010 standard for four-wheeled ATVs and the ANSI/ROHVA 1-2001 standard for recreational off-highway vehicles (and any subsequent amendments). The supply of ATVs (quad bikes) and side-by-side vehicles in accordance with both of these standards is currently voluntary in New Zealand.

5. For children who ride motorcycles, risks may be reduced by training programmes on bike safety. Training on off-road vehicles should be widely available to children and young people, and training should be encouraged **before** any child or young person ever rides these vehicles. Training programmes need to teach all vehicle users how to ride safely and strengthen awareness of the specific risks associated with riding off-road vehicles.⁴ These programmes should be targeted to the rural, farming and agricultural sectors, be multifaceted, include school-based education approaches, consider the developmental attributes of children and be guided by established behaviour change theories.
6. The CYMRC's *Ninth Data Report* shows a statistically significant decrease in road traffic deaths between 2008 and 2012 (CYMRC 2014). For young people aged 16 years and older, there has been a substantial reduction in road traffic fatalities in part due to graduated motor vehicle use. A similar approach should be adopted for off-road use.
7. Some of the current exemptions for farmers under the Land Transport Act 1998 should be re-evaluated. These exemptions include: on-road use of farm bikes, registration and ongoing maintenance requirements, helmet use and the implications for employers. While these exemptions apply to riders over 15 years of age, children aged under 15 years will be influenced by their older role models.

B) Local recommendations

1. Local rural non-governmental organisations, local government and district health boards should, with advice from national groups such as Federated Farmers, develop skills and education programmes specifically for parents, children and young people who live rurally on or near farms and are users of quad bikes. These programmes should:
 - a. be school- and community-based
 - b. include training on 'active' bike-riding skills (including how to distribute one's weight safely while riding the vehicle)
 - c. include education on injury prevention and harm minimisation (eg, helmet and protective clothing use)
 - d. identify safe recreation areas and no-go zones for children on farms
 - e. be appropriately designed for the cognitive and physical developmental level of the child or young person.
2. District health board public health services and local governments, in partnership with other agencies and health services, including emergency departments and trauma services, should participate in International Safe Community activities to address local motorcycle and quad bike injuries, as appropriate to their populations.

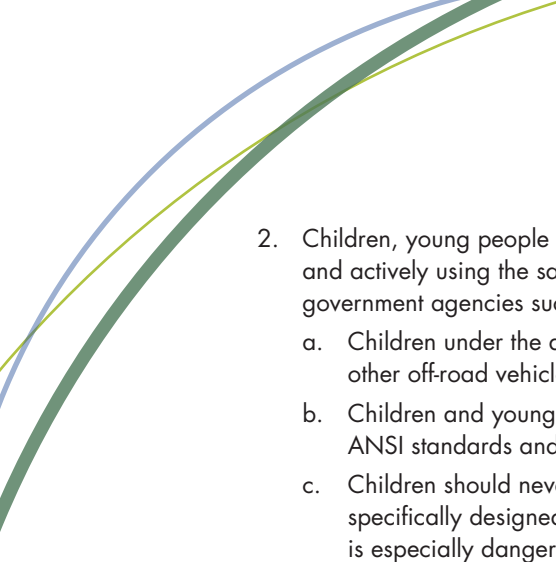
C) Best practice for vehicle design and safe use

1. Design engineers and manufactures are encouraged to consider including various vehicle safety mechanisms on quad bikes made for children and young people that prevent sudden accidental surges of power,⁵ children from using vehicles outside the manufacturer's weight recommendations, and crushing and asphyxia injuries caused by quad bike rollover.⁶

⁴ In New Zealand, recent emphasis has been placed on improving safety on quad bikes through programmes such as WorkSafe New Zealand's quad bike harm reduction project. The findings from this review suggest there should also be equal emphasis placed on motorcycle harm reduction and injury prevention, particularly for children and young people using these vehicles for recreational purposes.

⁵ For example, a 'safety catch throttle restrictor' set up so that full power is automatically inactivated unless deliberately engaged, thereby protecting inexperienced users, and those manoeuvring at low speeds and in difficult situations.

⁶ Note that there is still ongoing research being conducted on the safety performance of quad bike rollover protection systems (ROPS), and currently no consensus has been reached with regard to the overall safety of ROPS. Some ROPS may impede the rider's ability to dismount from the vehicle in situations where control over the vehicle is lost.

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2. Children, young people and parents who operate quad bikes should ensure they are familiar with and actively using the safety practices and guidelines recommended by the manufacturer, and other government agencies such as WorkSafe New Zealand and ACC. These include the following:
 - a. Children under the age of 16 years should not ride adult-sized motorcycles, quad bikes or any other off-road vehicle built specifically for an adult (see Appendix 1).
 - b. Children and young people should only drive age-appropriate bikes in accordance with the ANSI standards and as recommended in the manufacturer's guidelines for safe vehicle use.
 - c. Children should never be carried as a passenger on a motorcycle or quad bike unless it is specifically designed to carry two people. Children or inexperienced adults carrying passengers is especially dangerous.
 - d. Helmets should be worn at all times.
 - e. Safety belts should be worn when travelling in side-by-side vehicles.

Community messages

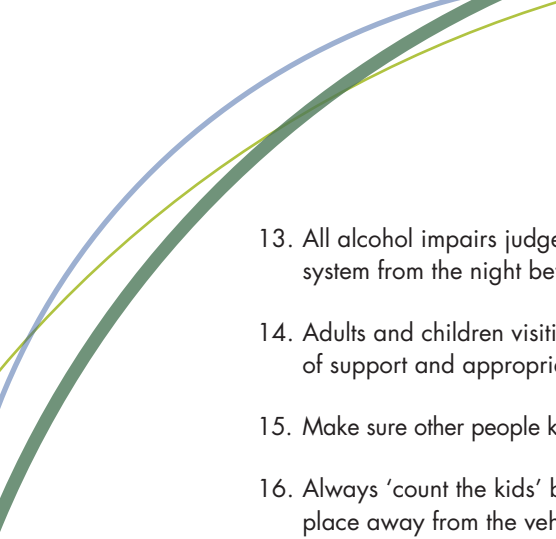
If a child is going to operate or ride as a passenger on an off-road vehicle, risk can be minimised with the following messages. See also the 'ages and stages safety chart' in Appendix 1 for other information on mitigating risks.

Driver and operator safety

1. Helmets should be worn at all times. Too many people think helmets are only needed when travelling at high speeds. It is important to note that helmets protect the head from serious and fatal injuries when hard objects impact with the head, at any speed.
2. Children under 16 years of age should never be in control of an adult-sized motorcycle, quad bike or any other off-road vehicle.
3. One of the key reasons why children under 16 years of age do not operate a motor vehicle on the road is because they do not have the necessary developmental skills to do it safely. These same developmental skills are required off-road.
4. A growing number of international authorities⁷ and organisations currently recommend that children under 16 years of age should not operate quad bikes of any size.
5. No child under the age of 6 years should ever be in control of a motorcycle, quad bike or any other off-road vehicle.
6. As a minimum, children aged 6–16 years should only ride off-road vehicles that are age-specific (ie, manufactured and designed specifically for a child of their age and weight in accordance with the ANSI/SVIA standards).⁸
7. Parents should carefully consider the manufacturer's recommendations and guidelines for assessing whether a child should operate a vehicle.
8. If any child is going to ride a quad bike, they must, at all times, be supervised by an adult who has the training, skills and experience to use the vehicle safely.
9. Rules that apply to the road (such as helmet use, keeping left and applying restrictions to carrying loads or passengers according to licence status) should also prevent injuries off-road.
10. Quad bikes are designed for 'active riding'. This means quad bike riders need to either stand up and/or shift their weight at times during riding to ensure the distribution of weight on the vehicle is even, and to minimise the risk of vehicle rollover.
11. Operators need to beware of oncoming vehicles and poor visibility, and apply 'keep left' rules on undulating ground, sharp corners and hilltops.
12. There are several types of off-road vehicles and motorised agricultural vehicles, so always use the right machine for the right task. Keep the vehicles well maintained and use them in accordance with the manufacturer's guidelines.

7 The American Academy of Pediatrics' Committee on Injury and Poison Prevention (2000), the Canadian Paediatric Society's Injury Prevention Committee (2004; 2011) and Farmsafe Australia (2014a) recommend that **all** children under the age of 16 years be prohibited from operating **any** quad bike, including those designed and marketed for children; see Appendix 1 for more information on age-appropriate guidelines.

8 ANSI approved the first set of product safety standards for four-wheel vehicles (quad bikes) in 1990. These standards have subsequently been modified to match the safety requirements needed for vehicles that have been designed for operation by children and young people of specific ages. See the SVIA website for more information (www.svia.org/Programs/Programs.aspx).

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13. All alcohol impairs judgement and reduces skills. Remember to allow time to remove alcohol from the system from the night before if having an early start.
 14. Adults and children visiting farms may have no idea of the risks they take and need high levels of support and appropriate safety equipment.
 15. Make sure other people know where you are so that, if an accident happens, you may be found sooner.
 16. Always 'count the kids' before you manoeuvre any vehicle, and make sure children are in a safe place away from the vehicle, or belted securely in the vehicle if they are passengers.

Carrying passengers and towing

17. Learning drivers or inexperienced drivers should never carry a passenger.
18. Children must not be carried as passengers unless the quad bike or motorcycle has been specifically designed to carry two or more people. Large seats on quad bikes are designed to let you ride safely, not to carry passengers.
19. If carrying an unsecured passenger, be aware of risks such as bumpy terrain and other hazards that might cause the passenger to fall off the vehicle.
20. Always be careful when carrying any cargo (including liquids) or towing a trailer because shifts or sudden movements could cause the vehicle to become destabilised. Check that anything being towed behind, or carried on, any off-road vehicle is within the safety guidelines as recommended by the manufacturer. When towing, be aware of the vehicle's stability, which may be compromised when towing loads over uneven or sloping grounds.
21. When operating large agricultural machinery, such as tractors, it is not possible to safely supervise children, who can quickly move to a place of danger. Check on children frequently and physically separate them from dangerous equipment by effective barriers.

Vehicle maintenance and modification

22. Mechanical checks and maintenance are just as important for off-road vehicles as they are for cars. If in doubt, get the vehicle checked or complete your own warrant of fitness. Follow the manufacturer's guidance on aspects of the vehicle (eg, brakes) that require regular maintenance.
23. Any vehicle modifications and accessories added to an off-road vehicle should be approved according to the manufacturer's standards and guidelines.

Product safety, renting, buying and selling second-hand vehicles

24. If you are a consumer and you buy a bike, then you should also buy a helmet. If you are a retailer and you sell a bike, then you should also sell a helmet.
25. Second-hand off-road vehicles should have the same product safety standards as new vehicles available for sale.
26. When off-road vehicles are sold or rented, detailed safety information should be provided with a specific focus on the hazards the vehicle might pose to children and young people, along with appropriate prohibitions with regard to use by children under 16 years of age.
27. Families and caregivers need to be aware that concerns exist with regard to the safety of 'child-sized' quad bikes, and carefully consider the weight, speed and power of any bike intended for child use.

Introduction

This is the second of two special reports examining non-traffic vehicle deaths. The first report published in 2011 (CYMRC 2011) focused on deaths related to vehicles moving at low speed regardless of setting. This second report considers deaths from incidents involving the use of motorcycles, quad bikes and motorised agricultural vehicles, with a focus on children under 15 years of age. These reports were triggered by the observations of the Child and Youth Mortality Review Committee (the CYMRC) in its *Fifth Report to the Minister of Health* that systems for reviewing non-traffic⁹ deaths are less developed and inconsistent compared with the systems currently in place for reviewing traffic deaths (CYMRC 2009).

Extensive legislation and enforcement exist to support safety on the roads. Motor vehicle deaths that occur on roads are reviewed by the New Zealand Police Serious Crash Unit and the Ministry of Transport. Workplace-related vehicle deaths may have been investigated by Occupational Safety and Health, Department of Labour¹⁰ or WorkSafe New Zealand, depending on the date of death. Off-road vehicle deaths that occur outside of the workplace may be reviewed by various organisations, such as New Zealand Police or a coroner, but the duty of review does not consistently fall to any one lead organisation. As a result, 'children and young people on farms, off-road in all-terrain vehicles or in driveways may die with no organisation maintaining a systematic overview of the whole picture for this class of death' (CYMRC 2009, p. 50).

Box 1. What is a road?

A 'road' is defined in the Land Transport Act 1998 (the Act) as:

- (a) a street; and
- (b) a motorway; and
- (c) a beach; and
- (d) a place to which the public have access, whether as of right or not; and
- (e) all bridges, culverts, ferries, and fords forming part of a road or street or motorway, or a place referred to in paragraph (d); and
- (f) all sites at which vehicles may be weighed for the purposes of this Act or any other enactment. (Land Transport Act 1998)

The New Zealand Transport Agency codes crashes that occur in locations such as a beach, a river road or mountain access road with the prefix of 'Z'. These are considered 'off-road' in nature, compared with streets or motorways. Road types c, d, and e under the Act's definition are, therefore, referred to as 'Z roads' (New Zealand Transport Agency 2014).

In this report, 'off-road' deaths (also known as 'non-traffic') are those that have occurred in a location (such as a private property, including a farm) that is not considered to be a road, as per the definition provided by the Act. In this report, deaths that occurred on Z roads were also included in the analyses of 'off-road' deaths because of the similar themes for prevention.

'On-road' (also known as 'public road' or 'traffic') deaths are those that occur in a location that meets the definition of a road as defined in the Act.

⁹ Traffic deaths are those that occur on roads. Non-traffic deaths are those that occur on driveways, footpaths, car parks and private property (including farms). See Box 1 entitled 'What is a road?' for more information.

¹⁰ In 2012 the Department of Labour was integrated into the Ministry of Business, Innovation and Employment (MBIE), and WorkSafe New Zealand was established as the primary workplace health and safety regulator in New Zealand.

What is an off-road vehicle?

This report examines mortality in relation to motorcycles, quad bikes and motorised agricultural vehicles, and categorises death events according to whether they occurred in 'on-road' or 'off-road' settings.

Therefore, for this report an 'off-road vehicle' is the collective term used to refer to motorcycles, quad bikes and motorised agricultural vehicles. The term 'off-road' also distinguishes the setting in which this group of vehicles was being used (ie, motorcycles, quad bikes and motorised agricultural vehicles being used 'off the road' compared with 'on the road').

Off-road vehicle types included in this report

Motorcycles

A motorcycle is different from a quad bike because it has two wheels; this includes scooters, motorcycles and motocross bikes. Some of the motorcycle deaths in this report occurred when the person was working on a farm, while others occurred during recreational or competitive riding. The report also includes some motorcycle deaths on public roads, but the data were not sufficient to explain whether the bike was designed for off-road or on-road use in these cases.

Quad bikes

A quad bike might also be known as a quad, three-wheeler or four-wheeler. The American National Standards Institute (ANSI) defines a quad bike as a vehicle that travels on low-pressure tyres, with a seat that is straddled by the operator, along with handlebars for steering control (Specialty Vehicle Institute of America 2012). A quad bike designed to allow a driver and passenger to sit side by side is also known as a side-by-side vehicle.

Quad bikes are also known as all-terrain vehicles (ATVs) as they were originally designed to handle a wider variety of terrain than most other vehicles. However, this report has intentionally avoided this term unless it was used in studies being cited in the report. In *Quad Bike Safety: Tips on how to stay safe*, the Accident Compensation Corporation (ACC) writes that the term ATV

suggests that you can go places that you probably can't or shouldn't. Quad bikes are deceptive beasts. They look solid, reliable and stable but they are inherently unstable. They have a narrow wheel-base and a high centre of gravity. They have a type of tyre designed to grip on soft ground but on the road they can grip suddenly and tip over before you have time to react. And remember they need quite a bit of skill to ride them properly and safely. (ACC 2012, p. 3)

Similarly, in a series of coroners' reports on quad bike deaths in New Zealand, it was recommended that the term ATV be avoided when describing quad bikes because it is an early industry marketing term that is misleading. For many of the fatalities caused by quad bikes in New Zealand, the quad bike rolled over onto the driver as a result of travelling on sloping terrain or undulated grounds.¹¹

Motorised agricultural vehicles

Motorised agricultural vehicles include farm vehicles, such as tractors and other heavy machinery, as well as four-wheel drives and utility vehicles if they are used primarily for agricultural purposes.

¹¹ Refer to the following coroners' reports: CSU-2010-WHG-000160, CSU-2010-WHG-000185, CSU-2010-WHG-000188, CSU-2011-HAM-000424, and CSU-2011-AUK-001161, available at www.justice.govt.nz/courts/coroners-court/publications.

International evidence shows mortality and morbidity from quad bike and motorcycle use is high among children and young people. A recent analysis of deaths and injuries from ATVs (quad bikes) in the USA showed that, from 1982 to 2012, children younger than 16 years of age represented almost one-quarter (24 percent) of all ATV-related fatalities and, in 2012, were estimated to account for 25 percent of all ATV-related injuries treated in emergency departments (Consumer Product Safety Commission 2014).

Overall, since 1982, there has been a trend of increasing ATV-related fatalities among all ages in the USA. A large proportion of the burden of ATV-related fatalities is among younger children, particularly boys, with children under 12 years of age accounting for 43 percent of total child fatalities (children under 16 years) from 1982 to 2012 (Consumer Product Safety Commission 2014). Trends in non-fatal ATV-related injuries among young riders aged under 15 years in the USA from 2001 to 2010 show an initial increase in the injury rate, which peaked at 67 per 100,000 in 2004, and then declined to 42 per 100,000 by 2010. This pattern might reflect decreased sales of new vehicles during the economic recession of the mid-2000s (Shults et al 2013). Other countries, such as Canada, also report a trend of increasing ATV-related injury hospitalisations since the mid-1990s (Injury Prevention Committee of the Canadian Paediatric Society 2011).

Internationally, motorcycle crash-related deaths have also increased since the 1990s, with USA rates more than doubling between 1999 and 2008 (Centers for Disease Control and Prevention 2012). The highest motorcycle injury rates in the USA between 2001 and 2008 were among young people aged 20–24 years, followed by 25–29-year-olds (Centers for Disease Control and Prevention 2012). Risk-taking behaviours are associated with high motorcycle injury and fatality rates among young people (Denning et al 2013).

Quad bikes are one of the most widely used vehicles on New Zealand farms, and are involved in approximately 28 percent of all work-related farm deaths every year (ACC 2012; MBIE 2014c). The risk of injury is particularly significant for children, with quad bike drivers under the age of 16 years estimated to be 2.5 times more likely to be injured compared with drivers aged 16–34 years (Anson et al 2009). A recent review of hospitalisations in New Zealand from 2008 to 2012 shows that, on average, at least 28 children aged 0–14 years are hospitalised each year from quad bike-related injuries. Of all children hospitalised for quad bike-related injuries during this period, over half (58 percent) were children aged 10–14 years (Safekids Aotearoa 2014).

For motorcycle use in New Zealand children under 15 years of age, very little comparable data are available. An analysis of mortality data and hospital admissions from Safekids Aotearoa showed eight deaths from motorcycle use in New Zealand children aged 0–14 years between 2001 and 2005, and a rate of 0.19 per 100,000 children (Alatini 2009). Hospital admissions for motorcycle injuries of New Zealand children aged 0–14 years during 2003–2007 were significantly higher for New Zealand European children (40.1 per 100,000), males (47.4 per 100,000) and children living in rural areas (70.2 per 100,000).

Scott et al (2011) reviewed all motorcycle traumas presenting to New Zealand's Starship Children's Hospital between November 1999 and December 2008. From a total of 146 admissions, 123 were motorcycles and 23 were ATVs (quad bikes). The authors noted that motorcycle trauma admissions were increasing, and total admissions (from motorcycles and quad bikes combined) had increased three-fold over the nine-year period.

For tractors, this CYMRC special report shows child mortality associated with their use, or exposure to them as passengers, appears to have decreased. In the 1980s, on average two children aged under 15 years were killed every year on tractors (Clark and Langley 1995). Tractors and motorcycles/ATVs equally contributed to the deaths of 14 children aged under 15 years in a workplace during 1985–1998 and 40 percent (39/87) of total workplace-related fatal injuries in this age group occurred on New Zealand farms (Lilley et al 2004).

In this special report, we provide information on the mechanisms and circumstances surrounding deaths where the person was an operator or passenger of a two-, three- or four-wheeled vehicle or motorised agricultural vehicle (collectively referred to as 'off-road vehicles').



Structure of this report

This report firstly examines non-traffic deaths from off-road vehicles in children and young people aged 28 days to 24 years from 2002 to 2012. The report then examines both traffic and non-traffic deaths from off-road vehicles in children under 15 years of age from 2002 to 2012.¹² The deaths of these children, particularly those who were driving the vehicle at the time of the death event, pose an interesting dilemma for injury prevention because these children were not old enough to legally drive on-road in New Zealand. The Land Transport Act 1998 does not permit drivers aged under 16 years to drive motorcycles or quad bikes on a public road, but such transgressions generally go unpunished unless the adult who permitted it was in breach of the Crimes Act 1961 or the Health and Safety in Employment Act 1992.¹³ With this information, we hope to support the development of effective prevention strategies. Successful strategies are likely to be developmentally appropriate, culturally acceptable and use elements from every aspect of the Spectrum of Prevention as described in the Ottawa Charter.¹⁴

Child and Youth Mortality Review Committee

The CYMRC is a mortality review committee appointed under section 59E of the New Zealand Public Health and Disability Act 2000 by the Health Quality & Safety Commission (the Commission). One of the functions of the CYMRC is to review and report to the Commission on deaths that fall within the scope of the CYMRC, with a view to reducing these deaths and contributing to continuous quality improvement.

To achieve this function, the CYMRC collects information on deaths from a variety of sources, including Births, Deaths and Marriages, Child, Youth and Family, Coronial Services of New Zealand, the Ministry of Health and the Ministry of Transport. This information is stored securely in the New Zealand Mortality Review Database.

Data are also entered into the Mortality Review Database by Local Child and Youth Mortality Review Groups (LCYMRGs), which sit individually within each district health board (DHB). These LCYMRGs collect data and review the deaths, within their region, of children and young persons aged between 28 days and 24 years. The review process provides a mechanism for identifying causal pathways associated with deaths in this age group, and the LCYMRGs are able to add additional contextual information to the Mortality Review Database that provides greater detail on many of the cases.

By monitoring patterns over time, or specific clusters of events, the review process can provide evidence-based information on systems and services. This information is used to assist the development of strategies and initiatives that have the potential to reduce preventable deaths in the future.

¹² While the original impetus of this report was to examine non-traffic deaths (ie, non-work-related deaths that occurred off-road), the second part of the report includes seven motorcycle deaths that occurred on roads. For these seven deaths, the existing data did not allow the reviewers to differentiate between motorcycles designed for off-road use and motorcycles designed for on-road use; therefore, all types of motorcycles are included in this analysis.

¹³ There have been a few cases in New Zealand where a parent, caregiver or employer was found to be in breach of the Crimes Act 1961 or the Health and Safety in Employment Act 1992. In each instance, the charges received considerable media attention and garnered considerable debate as to whether the charges were appropriate.

¹⁴ The Spectrum of Prevention is a tool for developing a multifaceted approach to injury prevention. The tool comprises six levels of increasing scope beginning with a focus on the individual and family, then expanding to consider community norms, institutional practices and laws. The spectrum seeks to aid practitioners to reduce injuries and their severity by identifying the need for a systems approach. For more information see Cowan and Swift (1999).

Methods

Analysis of data from the Mortality Review Database

Definitions

The analyses in this report include children and young people aged between 28 days and 24 years who died in New Zealand between 1 January 2002 and 31 December 2012, where the main underlying cause of death was included in the range listed in Appendix 2. Three deaths of overseas residents were included in many of the analyses because they resulted from off-road incidents in New Zealand. The three deaths of overseas residents were excluded from analyses using rural/urban place of residence, and from rate calculations. One death from a New Zealand resident overseas was excluded.

This report categorises death events according to whether they occurred in an 'on-road' or 'off-road' setting. Off-road deaths are those that have occurred on a location (such as a private property, including a farm) that is not considered to be a road as per the definition provided by the Land Transport Act 1998 (the Act). Refer to Box 1, 'What is a road?' (p. 9) for a more detailed explanation.

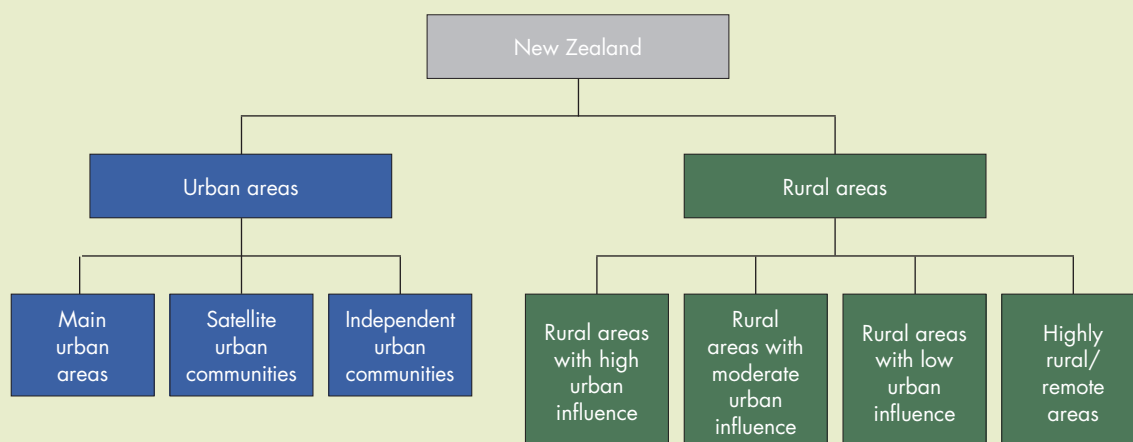
Data sources

The data used in this report were taken from the Mortality Review Database. The data were extracted from the database on 28 May 2014.

The denominators used in the analyses were based on the estimated resident population from census years 2001 and 2006, as supplied to the Ministry of Health by Statistics New Zealand (Statistics NZ). Linear extrapolation was undertaken to calculate the estimated resident population between 2001 and 2006, and projected out to 2012. Rates in this report are presented as per 100,000 age-specific population for most age groups (see Appendix 3 for more information on statistical methods).

The grouping of urban and rural residence used in Tables 5, 6 and 7 are based on Statistics NZ urban/rural classifications, which have been applied to the residential domicile code supplied in the Ministry of Health data (Statistics NZ n.d.). The Statistics NZ urban/rural classification system categorises all residential areas along a spectrum of seven types: main urban areas; satellite urban communities; independent urban communities; rural areas with high urban influence; rural areas with moderate urban influence; rural areas with low urban influence; and highly rural/remote areas. The first three of these seven area types can also be classified as 'urban', and the remaining four can be grouped together and classified as 'rural', as shown in Figure 1 (Statistics NZ n.d.). Each rural area type has distinguishing characteristics; for example, a 'rural area with a low urban influence' is characterised by a resident population that also works in the area, whereas a 'rural area with a high urban influence' is characterised by a resident population that lives rurally, but mostly commutes and works in a nearby main urban area. 'Highly rural/remote areas' are characterised by small populations that have minimal dependence on urban centres for employment (Statistics NZ n.d.).

Figure 1: Urban/Rural profile classification



Source: Statistics NZ. URL: www.stats.govt.nz/browse_for_stats/people_and_communities/Geographic-areas/urban-rural-profile/defining-urban-rural-nz.aspx.

Data selection, classification criteria and analysis

DHB was assigned using DHB of residence, rather than DHB of death.

There are multiple sources of ethnicity data in the database (ie, Births, Deaths and Marriages; Coronial Services; and the Ministry of Health records) so these sources are prioritised based on evidence as to their accuracy generally in New Zealand.

Cause of death was assigned using the Underlying Cause of Death data from the national Mortality Collection, Ministry of Health. This is coded in ICD-10-AM. The initial ICD codes used for this analysis included:

- V10–V19 Pedal cyclist injured in transport accident
- V20–V29 Motorcycle rider injured in transport accident
- V30–V39 Occupant of three-wheeled motor vehicle injured in transport accident
- V40–V49 Car occupant injured in transport accident
- V50–V59 Occupant of pick-up truck or van injured in transport accident
- V60–V69 Occupant of heavy transport vehicle injured in transport accident
- V70–V79 Bus occupant injured in transport accident
- V80–V89 Other land transport accidents
- V90–V94 Water transport accidents
- V95–V97 Air and space transport accidents
- V98–V99 Other and unspecified transport accidents
- W24 Contact with lifting and transmission devices not elsewhere listed
- W30 Contact with agricultural machinery
- W31 Contact with other and unspecified machinery
- X81 Intentional self-harm by jumping or lying before moving object
- X82 Intentional self-harm by crashing of motor vehicle
- Y03 Assault by crashing of motor vehicle
- Y32 Crashing of motor vehicle, undetermined intent
- Y85 Sequelae of transport accidents

(See Appendix 2 for the final list of ICD-10-AM codes used for this analysis.)

Two reviewers independently selected the cases used in this report from the full set of cases that matched the ICD-10-AM codes. Cases were selected based on whether the deceased had been a driver or passenger of a two-, three- or four-wheeled vehicle or a motorised agricultural vehicle. Vehicles such as four-wheel drives and utility vehicles were selected if their use at the time was primarily for agricultural purposes. Where discrepancies occurred, the two reviewers held discussions to resolve the discrepancy. A third reviewer was available to independently review any unresolved discrepancies.

These methods used in selecting cases for inclusion do not always capture cases where a death follows sometime after the initial injury; for example, a severe head injury that led to premature death some years later.

The data presented in this report was computed from the Mortality Review Database by the New Zealand Mortality Review Data Group. Percentages are expressed to one decimal point. In some cases, due to rounding, percentages do not sum to 100 exactly.

Where presented, 95 percent confidence intervals (95% CIs) for rates have been calculated using the Fay's and Feuer's Method (Fay and Feuer 1997) according to the Centers for Disease Control and Prevention's National Vital Statistics Report (Murphy et al 2013).

Discrepancies with other collections and reports

When interpreting CYMRC data, it must be remembered that they are derived from a database that is constantly being updated. As well as details of new cases, there can also be new information for existing cases and, at times, changing information for existing cases. The result of this is that details can change from year to year, even for cases where the death took place some years previously. This is particularly true of cases that require an inquest, and in some cases this process may not be completed until years after the death.

The data presented in this report may differ from official collections. This is due to the multiple data sources, which may provide more comprehensive data than other collections. In addition, the way that data are coded may result in variations from official collections. In all analyses, the year of death relates to the calendar year in which the individual died, rather than the year the death was registered. This is different to some official collections, where the year the death is registered is used.

Analysis of themes from the Mortality Review Database

For the selected cases of deaths among children aged under 15 years, the details available in the Mortality Review Database were subjected to further analysis to identify the main themes. The information available in the Mortality Review Database was coded to the following fields: vehicle type; year, month, and day of week; location of activity and the child's relationship to the location (eg, own home or visiting); activity of the child and the child's relationship to the vehicle; circumstances of the crash; and mode of death.

The activity of the child was categorised according to what the child was doing at the time of the incident. The content of the narrative contained in police reports, local mortality reviews and coroners' reports was examined to answer these questions:

- What was the main activity the person was using the vehicle for at the time preceding the death event?
- What was the person's interaction with the vehicle at the time of the crash?

The two reviewers independently examined the data to answer these questions, and the third reviewer adjudicated any discrepancies. Clinical review of information was used to decide on the mechanism of death by considering post-mortem reports and narrative information from police and coroners' reports.

From the information available, prevention factors were grouped by vehicle type and in accordance with individual, vehicle, physical environment or social environment factors. In a few cases, the CYMRC database contained some conflicting information. Where this occurred, in keeping with standard CYMRC practice, the information from the coroners' reports was used.

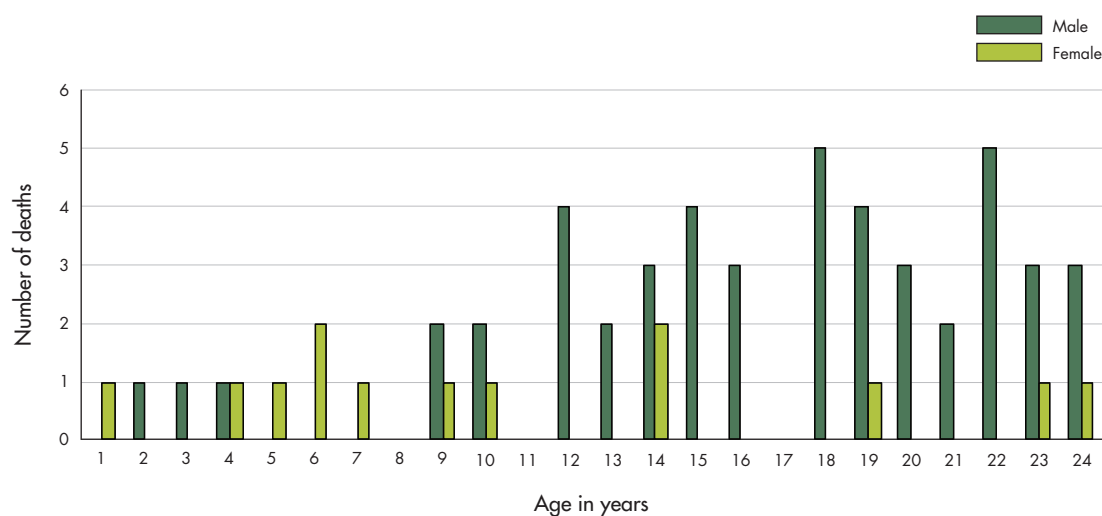
Deaths of children and young people from motorcycles, quad bikes and motorised agricultural vehicles in off-road settings

Off-road vehicle deaths by age and gender

In New Zealand, from 2002 to 2012, there were a total of 61 children and young people aged 28 days to 24 years who died from incidents involving the use of off-road vehicles (motorcycles, quad bikes and motorised agricultural vehicles) in an off-road setting. Males featured prominently in all off-road vehicle deaths, particularly in young people aged 15–24 years (Figure 2). Most of the off-road vehicle deaths among children and young people from 2002 to 2012 occurred in children aged 10–14 years (23 percent), and in young people aged 15–19 years (28 percent) and 20–24 years (30 percent) (Table 1).

The pattern of deaths occurring among young people, particularly males, aged 15–24 years, is consonant with the general pattern of unintentional injuries observed during the 'risk-taking years'.¹⁵ As discussed in the CYMRC's *Fifth Report to the Minister of Health*, deaths from unintentional injuries in young people increase dramatically between age 15 and 24 years, especially for young males. Motor vehicle crashes are the leading cause of death in this age group, with rates being much higher among males (CYMRC 2009).

Figure 2: Total number of deaths in children and young people aged 28 days to 24 years from off-road causes, by year of age and gender, New Zealand 2002–12 (n=61)



Source: Mortality Review Database.

¹⁵ 'Risk-taking' is defined as engaging in voluntary behaviours, such as reckless use of motor vehicles and alcohol, which are associated with heightened risk of injury (CYMRC 2009).

Table 1: Mortality (number of deaths) in children and young people aged 28 days to 24 years from off-road causes by age group and year of death, New Zealand 2002–12 (n=61)

AGE GROUP	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	Percentage (%)
28 days–<1 year	0	0	0	0	0	0	0	0	0	0	0	0	0
1–4 years	0	0	0	3	0	0	0	0	1	1	0	5	8.2
5–9 years	1	0	0	0	1	0	0	2	0	0	3	7	11.5
10–14 years	5	1	2	1	0	0	2	0	1	1	1	14	23.0
15–19 years	1	2	0	1	2	5	1	1	1	1	2	17	27.9
20–24 years	1	3	2	2	0	2	3	1	2	0	2	18	29.5
Total	8	6	4	7	3	7	6	4	5	3	8	61	100.0

Source: Mortality Review Database.

Off-road vehicle deaths by vehicle type and age

Quad bikes and motorcycles were the most common vehicle types implicated in deaths from off-road vehicles among children and young people in New Zealand from 2002 to 2012. In total, 26 of the deaths (43 percent) in children and young people were due to incidents involving the use of quad bikes. This was followed closely by deaths involving the use of motorcycles, which accounted for 22 deaths (36 percent) among children and young people during this period (Table 2). Together, motorised agricultural vehicles (tractors, utility vehicles and other) were cited as a cause of death in one-fifth (21 percent) of all deaths in children and young people aged 28 days to 24 years from 2002 to 2012 (Table 2).

Table 2: Mortality (number of deaths) in children and young people aged 28 days to 24 years from off-road causes by vehicle type and age group, New Zealand 2002–12 (n=61)

VEHICLE TYPE	<1 year*	1–4 years	5–9 years	10–14 years	15–19 years	20–24 years	Total	Percentage (%)
Motorcycle	0	0	2	6	7	7	22	36.1
Quad bike	0	1	4	7	9	5	26	42.6
Motorised agricultural vehicle								
Tractor	0	1	0	0	1	4	6	9.8
Utility vehicle	0	2	1	1	0	0	4	6.6
Other#	0	1	0	0	0	2	3	4.9
Total	0	5	7	14	17	18	61	100.0

* This category represents infants 28 days and older, and less than one calendar year in age.

'Other' motorised agricultural vehicle includes fertiliser spreaders, drum rollers and other general farming and agricultural vehicles.

Source: Mortality Review Database.

Off-road vehicle deaths by location of activity and age

Almost two-thirds of the children and young people in New Zealand aged 28 days to 24 years who died from incidents involving the use of off-road vehicles from 2002 to 2012 were engaged in activities on a private property (64 percent). Some children and young people were using the vehicle on a Z road (15 percent) or at an event location (13 percent). Event location was a more prominent location of activity among young people aged 15–24 years (Table 3).

Table 3: Mortality (number of deaths) in children and young people aged 28 days to 24 years from off-road causes by location and age group, New Zealand 2002–12 (n=61)

LOCATION OF ACTIVITY	<1 year*	1–4 years	5–9 years	10–14 years	15–19 years	20–24 years	Total	Percentage (%)
Private property	0	5	5	9	10	10	39	63.9
Z road	0	0	1	3	2	3	9	14.8
Event location#	0	0	0	2	3	3	8	13.1
Adventure park	0	0	1	0	0	1	2	3.3
Other off-road+	0	0	0	0	2	1	3	4.9
Total	0	5	7	14	17	18	61	100.0

* This category represents infants 28 days and older, and less than one calendar year in age.

An 'event location' is used to describe places where events are held, including motocross courses and speedways. This includes death events that took place both during competing or practising at the event location.

+ 'Other off-road' is used to describe other off-road areas such as landfills, railway crossings, public parks, and so on.

Source: Mortality Review Database.

Off-road vehicle deaths by ethnicity

In total, 51 of the 61 New Zealand children and young people aged 28 days to 24 years who died as a result of using off-road vehicles from 2002 to 2012 were of New Zealand European/Other European ethnicity. There were 10 Māori children and young people who died from off-road vehicle use during this period. The overall rate for Māori children and young people who died from using off-road vehicles (0.27 per 100,000) was half the rate of New Zealand European/Other European children and young people (0.54 per 100,000). This difference was statistically significant (Table 4).

Table 4: Mortality (number of deaths, rates per 100,000, rate ratios and 95% confidence intervals) in children and young people from off-road causes aged 28 days to 24 years by ethnicity, New Zealand 2002–12 (n=61)

ETHNICITY	<1 year*	1-4 years	5-9 years	10-14 years	15-19 years	20-24 years	Total deaths	2002-12 overall mortality rate	Rate ratio	Rate ratio 95% CIs
Māori	-	1	1	3	4	1	10	0.27	0.50	0.25-0.99
Pacific peoples	-	-	-	-	-	-	-	-	-	-
Asian	-	-	-	-	-	-	-	-	-	-
NZ European/ Other European	-	4	6	11	13	17	51	0.54	1	-
Middle Eastern, Latin American and African	-	-	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-	-	-	-
Total	0	5	7	14	17	18	61	0.37		

* This category represents infants 28 days and older, and less than one calendar year in age.

Source:

Numerator: Mortality Review Database.

Denominator: New Zealand Mortality Review Data Group Estimated Resident Population 2002–12.

Off-road vehicle deaths by residential area type (urban/rural), road setting (off-road/on-road) and age

When the motorcycle, quad bike and motorised agricultural vehicle deaths in New Zealand children and young people from 2002 to 2012 are categorised according to the Statistics NZ residential domicile areas,¹⁶ mortality rates are higher in those living in rural areas (2.92 per 100,000) compared with those living in urban areas (0.68 per 100,000) (Table 5). Children and young people living in rural areas were over four times more likely to die from incidents involving off-road vehicles than children and young people living in urban areas (urban/rural rate ratio 0.23; 95% CI 0.17–0.32).

Deaths from using these vehicles for children and young people who reside in rural locations are equally as likely to occur in on-road settings as for off-road settings (rate ratio = 1.07; 95% CI 0.65–1.76). In contrast, for those children and young people living in urban areas, the on-road rate of death is more than twice that of the off-road mortality rate (Table 5). This finding highlights an important public health issue for rural children and young people living in rural areas. Any health promotion intervention for rural children and young people will need to ensure that the safety messages for using motorcycles, quad bikes and motorised agricultural vehicles are emphasised for both off- and on-road settings. This finding may also point to a need for culture change in terms of how and when rural children and young people use public roads for riding these types of vehicles.

¹⁶ See 'Methods' section (p. 13) for more information on Statistics NZ residential domicile areas.

Table 5: Mortality (number of deaths, rates per 100,000, rate ratios and 95% confidence intervals) in children and young people aged 28 days to 24 years from off-road and on-road causes by urban/rural profile, New Zealand 2002–12 (n=156)

LOCATION OF RESIDENCE	Off-road deaths	On-road deaths	Total deaths	Off-road rates	On-road rates	Total rates	Rate ratio (off-road v on-road)	Rate ratio 95% CIs
Urban	27	67	94	0.19	0.48	0.68	0.4	0.26 – 0.63
Rural	32	30	62	1.51	1.41	2.92	1.07	0.65 – 1.76
Total	59	97	156	0.37	0.6	0.97	0.61	0.44 – 0.84

Note: One on-road and two off-road deaths in overseas residents are excluded.

Source:

Numerator: Mortality Review Database.

Denominator: New Zealand Mortality Review Data Group Estimated Resident Population 2002–12.

Table 6: Mortality (number of deaths, rates per 100,000, rate ratios and 95% confidence intervals) in rural children and young people aged 28 days to 24 years by age group and vehicle type, New Zealand 2002–12 (n=62)

LOCATION OF DEATH AND VEHICLE TYPE	Under 15 years deaths	15–24 years deaths	Total deaths	Under 15 years rates	15–24 years rates	Total rates	Rate ratio (under 15 yrs/ 15–24 yrs)	Rate ratio 95% CIs
Off-road	15	17	32	1.03	2.53	1.51	0.41	0.20–0.82
Motorcycle	5	5	10	0.34	0.74	0.47	0.46	0.13–1.60
Quad bike	5	7	12	0.34	1.04	0.56	0.33	0.10–1.04
Tractor	1	3	4	0.07	0.45	0.19	0.15	0.02–1.48
Utility vehicle	4		4	0.28	-	0.19	-	-
Other*		2	2	-	0.3	0.09	-	-
On-road	1	29	30	0.07	4.32	1.41	0.02	0.00–0.12
Motorcycle	1	26	27	0.07	3.87	1.27	0.02	0.00–0.13
Quad bike		1	1	-	0.15	0.05	-	-
Tractor		2	2	-	0.3	0.09	-	-
Total	16	46	62	1.1	6.85	2.92	0.16	0.09–0.28

* 'Other' motorised agricultural vehicle includes fertiliser spreaders, drum rollers and other general farming and agricultural vehicles.

Note: Deaths in overseas residents are excluded.

Source:

Numerator: Mortality Review Database.

Denominator: New Zealand Mortality Review Data Group Estimated Resident Rural Population 2002–12.

Table 7: Mortality (number of deaths, rates per 100,000, rate ratios and 95% confidence intervals) in urban children and young people aged 28 days to 24 years by age group and vehicle type, New Zealand 2002–12 (n=94)

LOCATION OF DEATH AND VEHICLE TYPE	Under 15 years deaths	15–24 years deaths	Total deaths	Under 15 years rates	15–24 years rates	Total rates	Rate ratio (under 15 yrs/ 15–24 yrs)	Rate ratio 95% CIs
Off-road	11	16	27	0.14	0.28	0.19	0.49	0.23–1.05
Motorcycle	3	9	12	0.04	0.16	0.09	0.24	0.06–0.87
Quad bike	7	5	12	0.09	0.09	0.09	0.99	0.31–3.12
Tractor	-	2	2	-	0.03	0.01	-	-
Other*	1	-	1	0.01	-	0.01	-	-
On-road	6	61	67	0.07	1.06	0.48	0.07	0.03–0.16
Motorcycle	6	58	64	0.07	1.01	0.46	0.07	0.03–0.17
Tractor	-	3	3	-	0.05	0.02	-	-
Total	17	77	94	0.21	1.34	0.68	0.16	0.09–0.26

* 'Other' motorised agricultural vehicle includes fertiliser spreaders, drum rollers and other general farming and agricultural vehicles.

Note: Deaths in overseas residents are excluded.

Source:

Numerator: Mortality Review Database.

Denominator: New Zealand Mortality Review Data Group Estimated Resident Urban Population 2002–12.

For children under 15 years who died in off-road settings and resided in rural areas, the mortality rate was 1.03 deaths per 100,000 (Table 6) compared with 0.14 deaths per 100,000 for those who resided in urban areas (Table 7). The rate for children aged less than 15 years who died in on-road settings was the same (0.7 per 100,000) for children who resided both in rural areas and in urban areas.

When comparing the mortality rates for young people aged over 15 years, those who resided in rural areas had a much higher off-road death rate compared with young people residing in urban areas. For off-road deaths, the rates were 2.53 per 100,000 for young people who were residents in rural areas (Table 6) compared with 0.28 per 100,000 for young people who resided in urban areas (Table 7). The mortality rate for young people aged over 15 years who died on the road was 4.32 per 100,000 for those living in rural areas (Table 6), compared with 1.06 deaths per 100,000 for young people who resided in urban areas. This on-road finding has implications for road safety intervention planning.

Overall, young people aged 15–24 years had higher rates of death compared with children aged under 15 years for most vehicle types in both on- and off-road settings. This was true for all rates except those for utility vehicles used in off-road settings by children and young people who live in rural areas (Table 6), and also for quad bikes and other agricultural vehicles used in off-road settings by urban children and young people (Table 7). Young people had statistically significantly higher mortality rates from on-road and off-road causes overall than children.

Off-road vehicle deaths by DHB, road setting (off-road/on-road) and age

In New Zealand children and young people aged 28 days to 24 years, deaths from using motorcycles, quad bikes and motorised agricultural vehicles during 2002–12 occurred in every DHB throughout the country. (See Appendix 4 for more information.)

Deaths of children under 15 years of age from motorcycles, quad bikes and motorised agricultural vehicles in all settings

In this section, we narrow our focus to the deaths of children under 15 years of age who were drivers or passengers in off-road vehicles (motorcycles, quad bikes and motorised agricultural vehicles), either in an off-road or on-road setting. These cases are of special interest to the CYMRC because these children are not old enough to legally drive on-road in New Zealand; however, no current legislation prevents them from driving in off-road settings, unless the adult who permitted it was in breach of the Crimes Act 1961 or the Health and Safety in Employment Act 1992. Moreover, while there are some off-road vehicles designed for children aged between 6 and 16 years, it is still difficult for parents to recognise the developmental level required for using these machines safely, and the time taken to develop skills for safe use is often underestimated by supervising adults.

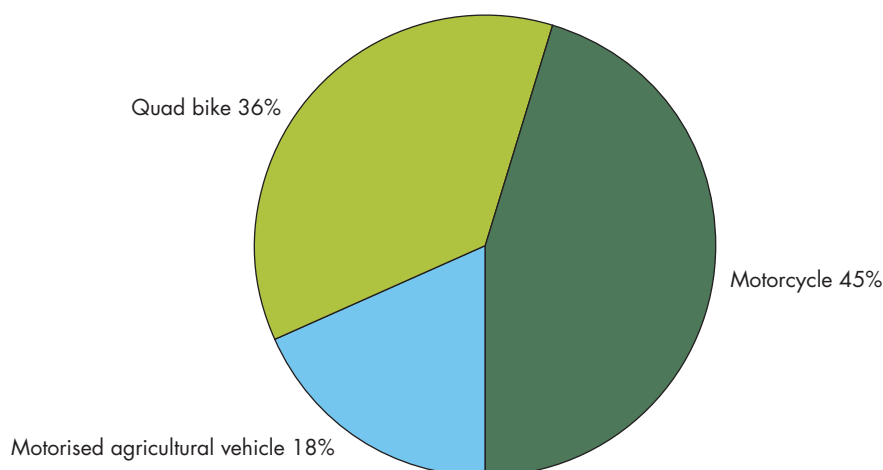
Analysis of data from the Mortality Review Database

Vehicle type

Over the 11-year period from 2002 to 2012, 33 children under 15 years of age died in incidents involving the use of motorcycles, quad bikes and motorised agricultural vehicles.

Figure 3 shows the distribution of off-road vehicle deaths by vehicle type. Motorcycles (15/33, 45 percent) were the most frequent vehicle implicated in child off-road vehicle deaths in New Zealand from 2002 to 2012, followed by quad bikes (12/33, 36 percent) and motorised agricultural vehicles (6/33, 18 percent). Four of the motorised agricultural vehicles were utility vehicles and two were other types of motorised agricultural vehicles.

Figure 3: Vehicle type in deaths of children aged 28 days to 14 years from motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)



Source: Mortality Review Database.

Information on the cc rating of quad bikes was recorded in five of the 12 (42 percent) deaths occurring on quad bikes, out of which only one was compliant with the WorkSafe New Zealand guidelines regarding age.¹⁷ Of the 15 motorcycle deaths, the cc rating was available for nine (60 percent) cases. Guidelines regarding age and cc rating for motorcycles were not available to determine compliance at the time this review was conducted.

Year, month and day of week

Of the 12 deaths on quad bikes, five occurred in 2002. There were five years where no deaths on quad bikes occurred. The frequency through the other years was one or two per year. The 15 motorcycle deaths occurred throughout all but one of the years included in this review.

January was the month with the highest number of deaths (n=7), followed by February (n=6), then August and October, with five deaths in each of these months. There were no deaths in May through to July in any of the years. The distribution over the remaining months was, on average, two deaths per month. The days of the week with the highest number of deaths were Friday, Saturday and Sunday (20/33, 61 percent, deaths in total).

Location of activity and the child's relationship to the location

Table 8 shows the location of activity where the motorcycle, quad bike or motorised agricultural vehicle death occurred. Twenty-six (79 percent) of the deaths in children occurred in off-road settings, while seven (21 percent) occurred in on-road settings. Of those that occurred in off-road settings, 19 deaths (58 percent) were on private property (eg, farms), four (12 percent) occurred on Z roads, and three (9 percent) occurred on an event track or at an adventure park.

All seven deaths that occurred on-road involved motorcycles. The child was the driver in four of the seven deaths. For three of the seven deaths (43 percent), the child was moving from one part of their home property to another part of the property via a road.

Table 8: Location of activity in deaths of children aged 28 days to 14 years from motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)

LOCATION OF ACTIVITY	Number	Percentage (%)
Off-road		
Z road	4	12.1
Private property	19	57.6
Event/Adventure park	3	9.1
Off-road total	26	78.8
On-road total	7	21.2
Total	33	100

Source: Mortality Review Database.

¹⁷ Children aged under 16 years should never ride adult-sized quad bikes. Adult-sized quad bikes in New Zealand are those with a cc rating of 90cc and over (WorkSafe New Zealand 2014a).

The rurality of the deceased's residence in relation to the location of the activity at the time of the death event is shown in Table 9.

Of the 19 deaths that occurred on a private property, in 13 cases (68 percent) the private property was also the residential home of the child. This included four private properties on the outskirts of urban locations. It was noted that the child was a visitor to the property (generally farms) in six of the 19 deaths on private properties. Of these six, four resided in an urban area. Of the seven deaths that occurred on the road, six were children who resided in urban locations.

Table 9: Location of residence and location of activity in deaths of children aged 28 days to 14 years from motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)

LOCATION OF RESIDENCE	Location of activity				Total
	Event/ Adventure track	Road	Z road	Private property	
	n	n	n	n	
Rural	2	1	2	11	16
Urban	1	6	2	8	17
Total	3	7	4	19	33

Source: Mortality Review Database.

Activity of the child

Table 10 shows the main activity the child was undertaking in the time preceding the death event. For the 29 cases where the activity type was known, 13 cases involved children using the vehicle for recreational riding using either quad bikes or motorcycles. A further two cases involving motorcycles occurred during a competition, indicating that, for at least 15 of the 33 deaths (45 percent), the main purpose of vehicle use related to recreation or sport (see Table 10).

Table 10: Main activity preceding the death event of children aged 28 days to 14 years from motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)

ACTIVITY	Age category			Total
	0–4 years	5–9 years	10–14 years	
Accompanying parent on farm	5	1	1	7
Farm or work duties			5	5
Competing			2	2
Recreational riding	1	5	7	13
Transport			2	2
Unknown		3	1	4
Total	6	9	18	33

Source: Mortality Review Database.

Table 10 shows that seven children were accompanying a parent on a farm in the main activity preceding the death event. However, at the time of the death event for five of these seven cases, the nature of the relationship to the vehicle changed to driving the vehicle for recreational riding (n=1), riding unsecured on the back of a utility vehicle (n=2) or being used as a place to play in that was sheltered from the weather (n=2).

In two of the five cases where the main reason the child was using the vehicle was to assist with farm duties, the activity changed to recreational riding or for transport on the road. This means that, while for 15 children the main purpose of vehicle use related to recreation or sport, an additional two children could be considered as also undertaking recreational riding at the time of the death event.

Child's relationship to vehicle

Table 11 shows the relationship to the vehicle for children at the time of the death event. Two-thirds of the children (22/33, 67 percent) were the driver of the vehicle at the time of the death event. This was most notable in the 10–14 year age group.

Table 11: Relationship to vehicle at the time of the death event and age group for children aged 28 days to 14 years who died from incidents involving motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)

RELATIONSHIP TO VEHICLE	Age category			Total
	0–4 years	5–9 years	10–14 years	
Driver/Operator	1	5	16	22
Passenger/Occupant	3	2	1	6
Riding on*	2	2	1	5
Total	6	9	18	33

* 'Riding on' represents those who were riding on a vehicle in a manner that was outside the vehicle's usual or designed use.

Source: Mortality Review Database.

Child drivers

Of the 22 children who were vehicle drivers, 10 were operating quad bikes and 12 were operating motorcycles. Of those 22, four were driving a vehicle on a road, four were driving on a Z road, three were competing at an event or riding at an adventure park and 11 were driving on a private property. The eight children who were driving on a road (n=4) or a Z road (n=4) would have been driving in violation of the Land Transport Act 1998, which does not permit drivers under 16 years of age to drive motorcycles or quad bikes on public roads.

At the time of the death event, 12 of the 22 drivers were recreation riding, including the two children who had initially been out accompanying the parent on the farm and assisting with farm duties. They were recreation driving in a range of locations: two were riding on a road, three were riding on a Z road, one was at an adventure park, and six were on private property.

Loads were being carried by three of the 22 cases where the child was the driver – all on motorcycles. For two of these cases, the children were carrying a pillion passenger, one while recreation riding and for the other one, the activity was unknown. In the third case, a liquid container was being carried while carrying out farm duties.

Child passengers/occupants

Of the six children who were passengers or occupants at the time of the death event, two were pillion passengers on motorcycles, both driving on the road. In one of these two cases, the driver was a child who also died and their main activity leading up to the death event was unknown. The main activity preceding the death event in the other case was recreational riding.

One of these six children was a passenger on a quad bike on a private property and the main activity was unknown. Two children were initially accompanying their parent on the farm and they subsequently used the vehicle as a place to play in that was sheltered from the weather. One child was a passenger on a tractor while accompanying the parent on a farm.

Children riding on the vehicle

Five children died while riding on a vehicle in a manner that was outside the vehicle's design or usual use. These occurred in a number of different circumstances, including:

- on a motorcycle being driven by an unlicensed adult driver
- unsecured on the back of a utility vehicle
- on a quad bike being driven by an adult
- riding on a motorised agricultural vehicle.

Circumstances of the crash

Loss of control preceded the crash in the majority of cases. Cornering, descending slope, speed and loose road surface were factors in losing control of the vehicle. Loss of control was, at times, compounded by carrying a liquid load, mechanical faults, towing a trailer, carrying a passenger, driver inexperience, not being big enough to engage the brakes effectively, rough terrain and high cc rating. At times, sudden changes in speed or direction occurred when the rider misused the controls, engaging too much power inappropriately, using the wrong gear or moving in the wrong direction. Such actions seemed to have the greatest impact with inexperienced riders, and when there was a mismatch between the power of the vehicle and the size and age of the child.

It was noted that, for a small number of cases, the child was riding in circumstances where good prevention systems and rules were in place. In these cases, the child was known as 'an experienced driver' but, unfortunately, the child did not appear to maintain control or exercise good judgement in the circumstances they were riding in.

Flipping or rolling over was the most frequent nature of the crash, occurring in eight of the 10 deaths where children were the drivers of the quad bikes. Injuries were most frequently inflicted as a result of being pinned under the vehicle. For those riding motorcycles, in most cases, a collision followed loss of control and deaths were usually from injuries sustained from colliding with trees, rocks, wire fences or the ground. However, it was noted that being blind to oncoming vehicles was also a theme, particularly for crashes that took place at the brow of a hill, on undulating ground and at sharp corners.

Four children were riding unsecured on a vehicle which resulted in them falling from the vehicle and then subsequently being run over by the vehicle.

Mode of death

The mechanisms by which lethal forces led to the deaths of these children in off-road vehicle crashes were a direct result of impact with a stationary or moving object, a fall or when a quad bike rolled. Death occurred because of head injury (n=16), internal injuries (n=8), neck injury (n=4), and asphyxia and drowning (n=5) (see Table 12). The most common mechanism of death from rollover was by asphyxia, where the child was unable to breathe due to being trapped under the quad bike. Asphyxia deaths did not occur in other settings. Rollover also caused death by head, internal and neck injuries.

In two cases, death occurred when a child was run over by a slow-moving vehicle after falling from the vehicle. In these cases, the circumstances of the death were similar to many of the deaths reviewed in the CYMRC's special report on low speed run over mortality (CYMRC 2011).

It was observed that, for some of these deaths, considerable time probably elapsed between the death event and other people becoming aware and starting a rescue. In most cases, the child had died before emergency services arrived. It is not possible to tell if this time delay contributed to the fatality.

Table 12: Mode of death for children aged 28 days to 14 years from motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)

MODE OF DEATH	Impact/Fall	Rollover	Total
Head injury	13	3	16
Internal injury	7	1	8
Neck	3	1	4
Asphyxia/Drowning	1	4	5
Total	24	9	33

Source: Mortality Review Database.

Helmet use would not have been expected for six of the deaths where the child was an occupant or riding on a motorised agricultural vehicle (eg, riding on a utility vehicle or other agricultural vehicle). For the 20 cases where information on helmet use was recorded, 14 children (70 percent) were wearing a helmet and six children (30 percent) were not. Information on helmet use was not available for seven cases.

Of those who died on a motorcycle, 13 of the 15 children (87 percent) were wearing a helmet; although, in two cases, the helmets were not considered suitable. Of the 12 children who died on quad bikes, there was no information collected on helmet use in six cases, five were not wearing helmets, and one child was wearing a helmet.

Helmets failed to prevent death for a variety of reasons including helmets coming off due to the force of the impact, helmets not designed for the use they were put to (eg, cycle helmet) or helmets destroyed by the extreme forces involved. Some helmets that came off during the crash were the wrong size or poorly secured (eg, the straps were not fastened).

Analysis of themes from the Mortality Review Database

Each of the 20 LCYMRGs review the deaths of children and young people aged between 28 days and 24 years that occur within their respective regions. The LCYMRG process allows for an in-depth review of each case, thus allowing for the collection of information on the details of each child or youth death.

After each review, the LCYMRGs add additional information on the context of the death to the Mortality Review Database. This information is valuable because it provides detail on many of the deaths that cannot be gathered from other sources. Caution must be used when interpreting this information, however, because it is not always collected systematically and the numbers are small.

Given those limitations, it is interesting to note a number of common themes from the LCYMRG data on the cases that were included in this report.

- **Rules of the road should be applied.** Child drivers (unlicensed drivers) should never use public roads under any circumstances. Normal road safe practices such as keeping left to the road or off-road track and wearing helmets should be applied in all locations.
- **Issues with helmets** include lack of use (especially for quad bikes), unfastened straps and sub-standard helmets for motorcycles and quad bikes. The belief that helmets may not be needed if you are not travelling fast was also identified as an issue.
- **Inexperienced and unlicensed users carrying passengers or loads** was a lethal combination.
- **Imbalance between the size and strength of the rider and the size and cc rating** of the machine and the **cognitive development** required for safe riding were themes for both motorcycles and quad bikes across age groups and locations.
- **Insufficient child care or safe places for children** to be close to parents for rural families was also noted as an issue. LCYMRGs have previously highlighted this with a number of other farm-related deaths (eg, drowning). The CYMRC's special report on low speed run over deaths (CYMRC 2011) highlighted the importance of safe play spaces for children.
- **Consistent, high quality vehicle injury scene assessment** should occur whenever a death occurs. LCYMRGs noted that these investigations did not happen if the death occurred off-road and was not a workplace-related death and, as a result, there was less information available about the circumstances of the death event.

Developing effective prevention strategies

This section brings together evidence from a review of the international literature on effective prevention strategies with findings from previous sections in the report, identifies some of the current prevention approaches taking place in New Zealand and presents the final recommendations for policy makers and local organisations.

Based on a comprehensive literature review on effective occupational health interventions in agriculture, Lilley et al (2009) identified common problems associated with ineffective interventions. These were:

- poor targeting to risk
- little consideration of other interventions beyond education, such as engineering and design, organisational solutions and legislative solutions
- no understanding of barriers that can block the successful implementation of interventions
- poor use of established behaviour change theories when designing interventions.

Effective interventions must:

1. be targeted to risk
2. be multifaceted
3. address barriers to safety and barriers to the uptake of interventions
4. use established behaviour change theories (Lilley et al 2009).

In this section, we will consider each element of effective interventions.

1. Target to risk

In order to develop interventions that effectively target risk, it is important to understand the size of the problem, and also to identify the risk factors for prevention initiatives.

1A. Measuring the problem

a) Off-road vehicle mortality

The key findings from the analysis of data from the Mortality Review Database on children under 15 years of age who were drivers or passengers in off-road vehicles in any setting follow:

- On average, three children aged 0–15 years die annually while driving or riding on off-road vehicles (motorcycles, quad bikes or motorised agricultural vehicles) in New Zealand.
- In this review we observed rates of 0.12, 0.28 and 0.54 per 100,000 children aged 0–4, 5–9 and 10–14 years, respectively, between 2002 and 2012 for all off-road vehicles.
- The greatest number of children died while driving or riding on motorcycles (n=15), closely followed by those driving or riding on quad bikes (n=12).
- Children and young people living in rural areas were over four times more likely to die from incidents involving off-road vehicles than children and young people living in urban areas (urban/rural rate ratio 0.23; 95% CI 0.17–0.32). The focus for interventions should be the rural and agricultural sectors.
- In total, 26 children died in off-road settings. Nineteen deaths occurred on private properties and six of those were children visiting a private property.
- Seven children died while driving a motorcycle on a public 'on-road' setting.
- Although the Land Transport Act 1998 does not permit drivers aged under 16 years to drive motorcycles or quad bikes on a public road, there were eight deaths where children were in control of motorcycles or quad bikes, either on a road (n=4) or in a place defined as a Z road (n=4).
- At the time of the crash, at least 48 percent of the vehicles were being used for recreational riding. The only recreational activities with higher mortality are swimming and recreational use of water.

b) Motorcycle injuries

- Safekids Aotearoa notes that during 2003–2007, motorbike injuries of New Zealand children aged 0–14 years were significantly higher for New Zealand European children (40.1 per 100,000), males (47.4 per 100,000) and children living in rural areas (70.2 per 100,000) (‘Alatini 2009).
- Scott et al (2011) reviewed all motorcycle traumas presenting to New Zealand’s Starship Children’s Hospital between November 1999 and December 2008. From a total of 146 admissions, 123 related to motorcycles and 23 related to quad bikes. Admissions had increased three-fold over nine years.

c) Quad bike injuries

- Drivers aged under 16 years are 2.5 times more likely to be injured than those aged 16–34 years (Anson et al 2009; Safekids Aotearoa 2014).
- A recent review of hospitalisations in New Zealand from 2008 to 2012 shows that, on average, at least 28 children aged 0–14 years are hospitalised each year from quad bike-related injuries. Of all children hospitalised for quad bike-related injuries during this period, over half (58 percent) were children aged 10–14 years (Safekids Aotearoa 2014).

d) Tractor injuries

- One child (aged 14 years or under) died while riding on a tractor during 2002–12 and no children died while operating a tractor during this time. This was an unexpected finding given that, during the 1980s, on average two children aged under 15 years were killed every year on tractors (Clark and Langley 1995).
- It could be hypothesised that deaths from operating or riding on quad bikes have replaced tractor deaths, the latter of which seem to have declined in recent years. Box 2 (p. 31) considers whether tractor use or exposure to riding tractors as a passenger have ceased.

Box 2. Tractor use and exposure to tractors as passengers

It could be hypothesised that deaths from operating or riding on quad bikes have replaced tractor-related deaths. From information available, it appears that use of quad bikes (Campbell 2008; Aitken et al 2012) and quad bike injuries (Campbell 2008; Anson et al 2009) have increased; however, this does not necessarily mean that children are no longer riding on or operating tractors.

In a survey by Cryer et al completed between 2007 and 2008, 148 out of 385 New Zealand farms (28 percent) in their two samples reported having children living on the farm (n=304 children living on farms). For these families it was common for the following:

- Children under 5 years of age (n=46) to be riding quad bikes as passengers (33 percent) or riding on tractors as passengers (22 percent).
- By ages 5–9 years (n=89), the proportion of children riding as passengers on quad bikes was 54 percent and 34 percent were riding as passengers on tractors. No children were operating tractors and 4.5 percent (4/89) were operating quad bikes. However, 17 percent of children in this age group were operating motorcycles.
- For those in the 10–15 years age group (n=151), 60 percent were riding quad bikes as passengers, 42 percent were operating quad bikes, 43 percent were operating motorcycles, 42 percent were riding tractors as passengers and 15 percent were operating tractors (Cryer et al 2009).

Nineteen of the 33 child deaths in this review occurred on a rural property, most of which were farms of various types. It is probable that riding on tractors as a passenger for children 0–15 years of age and operating tractors for children 10–15 years of age are still relatively common practice on farms, albeit not as common as riding quad bikes (Cryer et al 2009). Therefore, it would be expected that a small number of passenger or operator deaths would have occurred in the time period if effective prevention was not in place.

It is important to note that this review focused on children riding on or in vehicles and does not include child pedestrians or bystanders who were run over. To determine whether there may have been children who died as a result of being struck or run over by a tractor who may not have been captured in this review, the full mortality data set was checked. It was observed that a range of run-over deaths had occurred between 2002 and 2012 that involved vehicles used for agriculture, such as trucks, utility vehicles and tractors. Prevention messages and interventions aimed at preventing low speed vehicle run overs have been outlined previously in the CYMRC's *Low Speed Run Over Mortality* report (CYMRC 2011) and these could be applied to these settings.

1B. Identifying risk factors

In addition to measuring the size of the problem, good prevention initiatives also seek to identify potential risk factors. Collins et al (2007) highlighted the dangers of children on other motorised vehicles in addition to quad bikes, and argued that an understanding of the risk to children on these other motorised vehicles is also needed in order to identify issues for prevention that must be considered in the development of recommendations, guidelines and legislation.

Table 13 summarises the risk factors for prevention identified from this in-depth review of deaths in children aged under 15 years. Although the review included in this report does not include a comparable range of vehicles as the Collins et al study, by comparing the elements for motorcycles and quad bikes in Table 13, some common themes occur, including young age, inexperience with sudden changes in speed, excess speed, unlicensed drivers using public roads or Z roads, drivers carrying loads, breaking farm rules, inadequate training and, in most cases (but not all), unsafe driving activities.

Table 13: Summary of risk factors for prevention identified in relation to the deaths of children aged 28 days to 14 years from motorcycles, quad bikes and motorised agricultural vehicles in off-road and on-road settings, New Zealand 2002–12 (n=33)

	Quad bike (n=12)	Motorcycle (n=15)	Motorised agricultural vehicles (n=6)
Human factors			
Child lacked sufficient development to control the vehicle	✓	✓	
Age of driver inappropriate for the size, power and cc rating of bike	✓	Not known	
Not wearing a helmet, or helmet unsuitable for child	✓	✓	
Travelling at high speed	✓	✓	
Inexperience in relation to sudden changes in speed and unexpected uneven surfaces	✓	✓	
Medical condition that impaired child's ability to respond appropriately	✓	✓	
Carrying loads, including liquid	✓	✓	
Vehicle and equipment factors			
Inherent vehicle design characteristics and structure (easy rollover, no reverse gear)	✓		
Mechanical faults	✓	✓	
No warrant of fitness		✓	
Passive system on parking brakes to prevent unintentional release			✓
Physical environmental factors			
Mixed terrains (flat, bumpy, gentle slope, steep slope, farms and rural terrain)	✓	✓	✓
Features of rural properties (drains, wire fences and solid debris)	✓	✓	
Track conditions poor (rough surfaces, unsuitable for the vehicle and unsuitable for age of child)	✓	✓	
Flooding	✓		
Loose and uneven road surfaces		✓	
Social environmental factors			
Social norms: <ul style="list-style-type: none"> • high speed use • inappropriate use of vehicle and safety equipment for child's age and size • having unlicensed child drivers on public roads and Z roads, and weak adherence or enforcement of legislation 	✓	✓	
Supervision of children	✓		✓
Norm of inappropriate carrying of passengers (carrying too many passengers for vehicle's designed use or carrying unsecured passengers)	✓	✓	✓
Limited rules and training on operation of vehicles	✓	✓	
Limited rules and training in relation to visitors on farms	✓		✓

Note: The development of this table was influenced by Haddon's matrix. For more information see: injuryprevention.bmj.com/content/4/4/302.full.

a) Vehicle design and structure

Some risk factors that should be targeted for prevention are specific to each vehicle's design characteristics and structure. Quad bikes, for example, have a higher centre of gravity due to their structure, making them highly susceptible to vehicle rollover. Internationally, there is ongoing research in relation to quad bike rollover protection systems (ROPS) and currently there is no consensus on whether such design considerations will ever be successful in improving quad bike safety.

Because quad bikes are highly susceptible to vehicle rollover, quad bikes require an 'active' riding style – where the rider uses skills, such as shifting their weight and standing occasionally to enhance the stability of the machine as it travels over changing surfaces and terrain (Campbell 2008; MBIE 2014c). With a lightweight child or inexperienced rider, effective active riding is not possible.

The ease with which quad bikes can roll over and pin the child underneath, even on flat terrain, was evident in the deaths reviewed by Shulruf and Balemi (2010). In a review of 355 cases of serious harm accidents associated with quad bikes in New Zealand, including 45 fatalities, the authors found that having no formal training contributed to the severity of quad bike injuries – the likelihood of a fatal outcome related to both human behaviour and quad bike rollover (Shulruf and Balemi 2010).

b) Age-appropriate vehicle use

Children are particularly susceptible to injuries because 'their physical and cognitive abilities, degrees of dependence, activities and risk behaviours all change substantially as they grow older' (Peden et al 2008, p. 8).

In terms of prevention, the age of drivers appropriate for the size, power and cc rating of quad bikes is still under contention internationally. In 2000, the American Academy of Pediatrics' Committee on Injury and Poison Prevention (2000) and, in 2004 and 2011, the Canadian Paediatric Society's Injury Prevention Committee (2004; 2011) called for children under the age of 16 years to be prohibited from operating any quad bike. Farmsafe Australia has also recently adopted this stance, recommending that no children aged under 16 years should ride quad bikes of any size, as operators or passengers (Farmsafe Australia 2014a). In New Zealand the current approach is less prohibitive, with both WorkSafe New Zealand and Safekids Aotearoa currently recommending that children aged under 16 years should not ride adult-sized quad bikes (those with an engine capacity of 90cc or more) (MBIE 2014b; Safekids Aotearoa 2014). This recommendation aligns with the guidelines that all manufacturers provide with quad bikes sold in New Zealand (Safekids Aotearoa 2014).

Box 3 (p. 34) lists WorkSafe New Zealand's quad bike safety steps, with step 4 reinforcing the recommendation that children under 16 years of age should not ride adult-size quad bikes (MBIE 2014b). The quad bike safety steps are part of the quad bike harm reduction project – a broader current prevention initiative aimed at minimising quad bike harm in New Zealand.¹⁸

The CYMRC notes that there are current limitations to the information collected in New Zealand that make it difficult to gather evidence for evaluating the safety of smaller quad bikes. These relate to the lack of systematic recording and reporting of data on the make, model and cc rating of quad bikes and other off-road vehicles involved in fatal crashes. These are discussed in more detail in the 'Limitations of this report' section (p. 44).

Based on the limitations surrounding the evidence presented in this report, the CYMRC's position is that WorkSafe New Zealand's fourth step in the quad bike safety steps, and the manufacturer's guidelines on the minimum age for using quad bikes, should be followed. There is currently not enough New Zealand evidence available on the safety and risks associated with children using smaller quad bikes (ie, bikes manufactured specifically for children, with engine capacities lower than 90cc) to provide New Zealand-specific advice.

¹⁸ The quad bike harm reduction project began in November 2010 and has focused on improving quad bike safety on New Zealand farms. The programme has involved rewriting quad bike safety guidelines, media releases to promote safety messages, and face-to-face contact between farmers and health and safety inspectors (MBIE 2014a).

However, the CYMRC believes that families and caregivers should be informed that there are increasing numbers of international recommendations that children younger than 16 years of age should not operate quad bikes of any size. Such information is especially important for parents and caregivers purchasing commercial products. Adopting mandatory product standards in New Zealand would also provide guidance about appropriate speeds by age groups and ensure that only compliant machines are available (see Table 14).

To assist parents in understanding the developmental capabilities of their children, the CYMRC would like to see the development of guidance on the safe use of off-road vehicles for parents and caregivers, based on the developmental stages of children and young people. The guidance should draw comparisons between cautions needed in familiar settings, such as close to water or on the road, and cautions needed around the use of motorcycles, quad bikes and motorised agricultural vehicles. The CYMRC has begun to develop this guidance (see Appendix 1), but it is clear that there is still considerable debate within New Zealand on appropriate guidelines for children aged between 7 and 15 years in relation to off-road vehicles.

Box 3: WorkSafe New Zealand's quad bike safety steps (MBIE 2014b)

Step 1 – Riders must be trained/experienced enough to do the job.

Before anyone rides your quad bikes, assess their skills. If they need training the best option is a skills course. For information on accredited training providers, visit the New Zealand Qualifications Authority (NZQA) website¹⁹ or call 0800 697 296. Or contact your local quad bike dealer and ask about courses in your area.

Step 2 – Choose the right vehicle for the job.

When choosing the right vehicle for the job pay close attention to what your quad bike owner's manual says about carrying passengers. Most manufacturers' manuals say passengers should not be carried. Also consider the maximum towed and carried load limits for your quad bike.

Step 3 – Always wear a helmet.

Helmets can be the difference between walking away from an accident and suffering a permanent, life-changing brain injury.

Step 4 – Don't let kids ride adult quad bikes.

Quad bike manufacturers set minimum ages for using their bikes based on the age when young people have sufficient strength, body weight and mental ability to master the safe riding techniques. On all adult-sized quad bikes (over 90cc) sold in New Zealand, that age is 16 or older.

¹⁹ www.nzqa.govt.nz/providers/index.do?frameworkId=75178&unitStandardId=24557

1C. Considerations for future injury prevention initiatives

The findings included in this report show that, for children and young people operating off-road vehicles, training is needed to build the skills necessary for operating the vehicle. This is particularly true for developing the active riding skills needed for safer quad bike operation among young people. As the CYMRC discussed with stakeholders attending the workshop during the development of this report, training programmes should be specifically designed to match children's cognitive and physical developmental stage. Some rural communities in New Zealand have designed specific safety programmes for children,²⁰ and the CYMRC encourages all rural communities to follow suit.

Alongside the recent emphasis on preventing quad bike injuries in New Zealand, it should be noted that motorcycle injuries are also an issue requiring attention within the scope of injury prevention work. This report shows that, in children aged under 15 years, there were comparable numbers of deaths involving both motorcycles and quad bikes (see Figure 3), and that all seven of the child deaths that occurred on the road involved motorcycles. Motorcycle use is also an issue for young people, particularly young males, aged over 15 years (see Table 2). This report shows a large proportion of the off-road vehicle mortality burden for young people was from motorcycle use. This was particularly evident in the high rates of motorcycle deaths that occurred both off and on the road in young people living in rural areas (see Tables 6 and 7). Future injury prevention strategies in New Zealand should, therefore, also include a focus on motorcycles within their scope.

The high rate of on-road motorcycle deaths in young people is similar to trends seen internationally with young quad bike users aged 16–25 years – where more fatal crashes tend to occur on the road than off (Denning et al 2013). For young quad bike and motorcycle users, the risk of off-road vehicle injuries and fatalities is linked closely with risk-taking behaviours that are prevalent in this age group, and a number of other issues that were not examined in this review because the focus was on child off-road vehicle users. Future injury prevention work in New Zealand should also include an in-depth review on the circumstances, risk factors and preventive factors surrounding off-road vehicle injuries in young people.

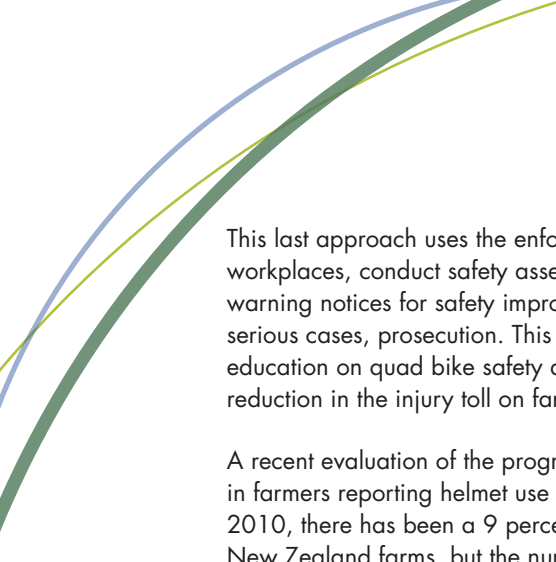
2. Develop multifaceted interventions

Interventions that were introduced to prevent tractor passenger and operator deaths in New Zealand included a combination of education, engineering and design, and legislative interventions. This multifaceted approach should be considered in relation to off-road vehicle deaths because it appears to have successfully assisted with the reduction in tractor deaths.

WorkSafe New Zealand's quad bike harm reduction project is a New Zealand example of a multifaceted approach targeting the farming sector. Since its launch in late 2010, this programme has incorporated a wide variety of approaches that collectively aim to influence cultural change among farmers using quad bikes as a workplace vehicle. These approaches have included the following:

- Rewriting the best practice guidelines on the safe use of quad bikes. The revised guidelines were written for those owning or using quad bikes in agricultural workplaces (ie, farm owners, employers and people contracting others to work on farms) as these are the most common quad bike users (WorkSafe New Zealand 2014a). These guidelines help those in the farming and agricultural sector meet their safety obligations towards themselves and employees in relation to quad bike use and the provisions under the Health and Safety in Employment Act 1992 (WorkSafe New Zealand 2014a).
- Writing media releases to promote safety messages.
- Engaging with and informing stakeholders and the broader farming community on the four quad bike safety steps (see Box 3, p. 34).
- Establishing face-to-face contact between farmers and health and safety inspectors (MBIE 2014a; 2014c).

²⁰ As an example, see Box 4 (p. 40) for information on Waimakariri and its 'Down the Back Paddock' programme.



This last approach uses the enforcement powers of health and safety inspectors, giving them authority to visit workplaces, conduct safety assessments and investigate accidents. Modes of enforcement include issuing warning notices for safety improvement requirements, prohibiting use of dangerous equipment and, in serious cases, prosecution. This enforcement approach was added to the programme more recently because education on quad bike safety alone was not resulting in the necessary behaviour change to lead to a reduction in the injury toll on farms (WorkSafe New Zealand 2014b).

A recent evaluation of the programme reports some early successes such as a statistically significant increase in farmers reporting helmet use by quad bike users on their farms. Overall, since the programme began in 2010, there has been a 9 percent reduction in ACC injury entitlement claims for quad bike injuries on New Zealand farms, but the number of injury fatalities has not changed (MBIE 2014a).

The Australian response to quad bike safety has mirrored the New Zealand response, partly because both countries developed their harm reduction programmes in parallel, as both had representatives on a working party formed specifically to address quad bike harm on farms (MBIE 2014c). Australian approaches to quad bike safety have included:

- mandatory wearing of approved helmets
- introduction of nationally recognised rider training
- compliance with manufacturers' guidelines on rider age (ie, children not to operate adult-sized quad bikes), carrying passengers and carrying loads
- improving point-of-sale materials to help guide farmers to choose the best vehicle suited to their needs
- guidance materials on matching quad bike accessories and making modifications to existing vehicles (MBIE 2014c).

More recently, Farmsafe Australia has recommended that no children aged under 16 years should ride quad bikes of any size, as operators or passengers (Farmsafe Australia 2014a).

2A. Safety messaging and education

Education, media, guidelines and other interventions that aim to promote safe vehicle use are a key component of multifaceted interventions. There is a dearth of published evidence evaluating the effectiveness of safety education interventions. One recent quantitative study investigated the short-term impact of a school-based ATV safety education intervention for over 4600 adolescents delivered in 30 different schools in the USA. The programme used specialised ATV safety educators to highlight the 10 Safety Tips for ATV Riders (STARS) for students as part of their health and safety curriculum. A post-intervention survey showed that almost half of the students reported they were likely/very likely to use the safety information. Student knowledge on ATV safety had also improved, with increased numbers of students correctly reporting that:

- most ATVs are designed for use by one person (increased from 52 percent before intervention to 92 percent after intervention)
- they knew the recommended vehicle size for their age (increased from 25 percent before intervention to 82 percent after intervention)
- they recognised that riding ATVs on the road was only legal for agricultural purposes (increased from 42 percent before intervention to 76 percent after intervention).

Qualitative studies investigating the effectiveness of safety messaging for quad bike users show some important factors to consider when developing education and media tools. Brann et al (2012) stressed the need to include the target population as part of the approach to the development of safety messages. Their study used focus group discussions with youth and adult ATV users in rural Arkansas to gather feedback on existing nationally available ATV safety materials in the USA. Study participants identified a need for safety messages to use a combination of:

- hands-on training messages – with information on controlling the vehicles over specific terrain, shifting gears and manoeuvring the vehicle
- skill-building messages – with information on selecting appropriate-sized vehicles and how to assess readiness to ride

- proper use messages – to emphasise key messages on safety gear, passengers, speed and vehicle size
- awareness-raising messages – to identify potential risks and consequences associated with vehicle use.

Adults and young people focused on different aspects of safety during their discussions, with young people focusing more on the lack of licensing requirements or regulations regarding age of use, lack of parental supervision, and their lack of understanding of the seriousness of potential injury risks (Brann et al 2012). These differing discussion foci between adults and young people highlight the importance of including the message's target population during safety material development and evaluation stages. In terms of safety messaging for children and young quad bike users, including the target populations means including parents and youth populations in design and evaluation processes.

Aitken et al (2012) were concerned that, despite the mixture of education, policy and regulatory interventions in the USA to reduce quad bike injury in children, current quad bike use and increasing injury trends did not indicate widespread knowledge of safe practices. Their study used focus groups to explore the knowledge, practices and beliefs of youth (aged 12–18 years) and adult quad bike users, with the aim of helping to develop more effective safety education strategies. Participant discussions showed that both adults and youth see parents as the key to promoting safe riding among young people, and that targeted education of parents and youth is the most likely means of reducing quad bike injury in children. Youth, in particular, discussed a preference for safety messages, such as graphic representation, that strongly convey the seriousness of medical consequences of inappropriate vehicle use (Aitken et al 2012).

Related to the issue of age-appropriate use of quad bikes, Aitken et al also found that, although focus group participants were aware of the manufacturers' recommendation that children aged under 16 years should not ride the larger bikes, most had started riding quad bikes from an early age and had little to no formal training (Aitken et al 2012). Participants' discussions on the usefulness of adopting messages that promote vehicle user age restrictions revealed the following:

- Quad bike users saw the manufacturers' guidelines on age restrictions as a way to escape liability, which effectively discredited the manufacturers' advice.
- The cost of purchasing smaller quad bikes designed for children was prohibitive for many households, so a larger-sized quad bike that may, for example, have been purchased for farm work would be more likely to be used by children anyway.
- Parental determination of maturity, in addition to age and size of the child and parental knowledge of the dangers, played a major role in controlling children's activities on quad bikes.

Overall, both adult and youth quad bike users viewed safety messages promoting age restrictions, and education messages that did not reflect understanding of quad bike use, to be ineffective (Aitken et al 2012). Therefore, to develop effective messages, it is important to include quad bike users in the development of education programmes.

While there are numerous resources in New Zealand that offer safety tips for children on farms and guidelines on planning rural safety days for children,²¹ the CYMRC would like to see more education programmes for children and their parents that are developed by and for rural communities. Box 4 (p. 40) discusses the community of Waimakariri, which engaged quad bike users in the development of its school programme, 'Down the Back Paddock'. It is important that every rural community in New Zealand develop such resources, but consideration should also be given to a national resource similar to the one developed by Farmsafe Australia called *Growing Kids on Farms: An Education Resource for Primary Schools* (Farmsafe Australia n.d.).²²

2B. Vehicle design standards and product safety: legislative and regulatory approaches

Legislative and regulatory approaches are also a component of multifaceted interventions. The CYMRC noted during the stakeholder workshop discussions for this report that there are issues in relation to product safety and vehicle design standards in New Zealand.

21 For example, see the ACC resource *Rural Safety Days: Guidelines for Planning Effective Rural Safety Days for Rural Children*, available at: www.acc.co.nz/PRD_EXT_CSMP/groups/external_ip/documents/guide/pi00202.pdf.

22 For more information on Farmsafe Australia's child safety on farms programme in general, see: www.farmsafe.org.au/content/child-safety-on-farms.

The ANSI approved the first set of product safety standards for off-road vehicles in 1990. These product standards were developed by the Specialty Vehicle Institute of America (SVIA) and have subsequently been modified to match the safety requirements needed for vehicles designed to be operated by children and young people of specific ages (SVIA 2012). The modified standards include the ANSI/SVIA 1-2010 standard for four-wheeled ATVs and the ANSI/ROHVA 1-2001 standard for recreational off-highway vehicles (and any subsequent amendments). Under the standards, size and performance specifications are provided for 'youth model' vehicles (Y6, Y10 and Y12 models) designed for children, and 'transition-model' vehicles (T model) designed for young riders aged 14 and 15 years (SVIA 2012). The standards specify major safety requirements for brakes, safety labelling and vehicle speeds. The restricted and maximum vehicle speeds are presented in Table 14.

Table 14: Maximum and restricted vehicle speeds included in the ANSI/SVIA product standard for ATVs (quad bikes) (Consumer Product Safety Commission 2010)

AGE	ANSI/SVIA 1-2007
6	Y6 models Restricted speed = 16 km/h Maximum speed = 24 km/h
7	
8	
9	
10	Y10 and Y12 models Restricted speed = 24 km/h Maximum speed = 48 km/h
11	
12	
13	
14	T models Restricted speed = 24 km/h Maximum speed = 48 km/h
15	
16+	Adult models No speed limits

Currently in New Zealand the supply of quad bikes (ATVs) and side-by-side vehicles in accordance with both of the ANSI safety standards is voluntary. However, all adult-sized quad bikes sold in New Zealand do come with a manufacturer's warning label stating that operation of the vehicle by an under-16-year-old increases the risk of injury or death, and that the vehicle should not be operated by children aged under 16 years (Safekids Aotearoa 2014).

An emerging body of literature also points to the potential for various vehicle design innovations and improved safety features, such as speed limiters/governors and improved vehicle stabilisation, to help reduce the risk of injury for children and young people (Injury Prevention Committee of the Canadian Paediatric Society 2011). Several adults in the focus groups from Aitken et al's study endorsed engineering modifications, such as speed governors, as being potentially effective in helping control or limit maximum vehicle speeds for younger-aged riders (Aitken et al 2012), but the stakeholders consulted for this CYMRC report had mixed opinions in regard to the efficacy of such modifications.

Alongside the issue of vehicle product safety, the CYMRC noted a number of legislative and regulatory issues arose during the stakeholder workshop discussions that point to a need for further discussions, as various stakeholders had differing views on when injury prevention should include legislative change. Legislative changes that may require further discussion include:

- off-road vehicle registration and warrant of fitness (to ensure ongoing vehicle maintenance and safety)
- adoption of minimum safety standards for products, including having age-specific or age-graded safety requirements (eg, speed limiters on bikes designed for children and young people)
- licensing of vehicle riders and/or compulsory training for all quad bike vehicle riders
- re-evaluation of the exemptions under the Land Transport Act 1998
- no children under 16 years of age on adult-sized quad bikes
- children riding quad bikes to wear helmets at all times.

2C. Locally coordinated approaches: Safe Communities

A key challenge for planning, implementing and monitoring multifaceted interventions, which includes motorcycle and quad bike use by children for recreation or transport purposes, is how do the necessary stakeholders configure themselves to do this? The World Health Organization's (WHO's) International Safe Community model²³ creates a mechanism for these issues to be addressed at a community level. The WHO's Safe Community concept was initiated at the First World Conference on Accident and Injury Prevention held in Stockholm, Sweden in September 1989 (WHO 2014).²⁴

The Safe Community movement can be a valuable source of support for communities seeking to improve the quality of their safety initiatives. The emphasis of the Safe Community approach is on collaboration, partnership and community capacity-building to reduce the incidence of injury and promote injury- and violence-reducing behaviours. The six criteria for community accreditation follow:

1. **Leadership and collaboration:** Demonstration of leadership by a coalition or group focused on improving community safety.
2. **Programme reach:** The range and reach of community safety programmes operating throughout the community and its region, including an indication of the extent to which they are based on proven or promising intervention strategies.
3. **Priority setting:** Demonstration of programmes that target and promote safety for high-risk vulnerable groups and environments.
4. **Data analysis and strategic alignment:** Analysis of available safety data (eg, injury, crime, violence and safety perception) for the community and its region, and how the community aligns with established national and regional priorities and action plans.
5. **Evaluation:** Outline of the impacts expected from the safety programmes, including how they will be measured or evaluated.
6. **Communication and networking:** Demonstration of community engagement with relevant sectors of the community and ongoing participation in local, national and international Safe Communities.

The Safe Community model has been used in some local New Zealand approaches to community injury prevention (Coggan et al 2000). Box 4 (p. 40) provides more information on Safe Communities in New Zealand.

²³ For more information on the WHO's International Safe Community model, see www.ki.se/csp. For information on Safe Communities in New Zealand, see www.safecommunities.org.nz.

²⁴ The premise 'all human beings have an equal right to health and safety' is a basic tenet of the WHO Health for All strategy and the WHO Global Programme on Accident Prevention and Injury Control (WHO 2014).

Box 4: Safe Communities in New Zealand

Safe Communities Foundation New Zealand (SCFNZ) is the primary organisation in New Zealand for promoting, supporting and inspiring communities wishing to become formally designated as accredited Safe Communities.²⁵

As of 30 June 2014, there are 28 New Zealand territorial authorities covering 24 accredited Safe Communities. Excellent examples of what is occurring through community engagement, problem-solving and collaboration on injury and violence prevention problems within individual communities can be found in Safe Communities applications, available on the SCFNZ website.²⁶ Auckland West became the first formally designated Safe Community in New Zealand in 1994, with Waimakariri receiving formal designation shortly thereafter.

The Waimakariri Safe Community was the first rural safe community in New Zealand. It is managed by a Waimakariri District Council Community Team that works with a wide range of partners to develop safety promotion activities. For children aged 0–14 years, safety initiatives have been developed in relation to farm safety, playground safety, medicine-related poisoning, child abuse, falls prevention, car restraints, water safety and driveway run over prevention. Other safety promotion activities have been developed for youth aged 15–24 years, elderly aged 65 years and over, natural disasters, violence prevention and suicide prevention. Programmes aimed at particularly high-risk areas include rural environments, homes, roads, water and other public spaces. All of Waimakariri's programmes are underscored by an ongoing regional data collection system and agreed measurements to evaluate the processes and outcomes of each safety initiative (WHO n.d.).

The Department of Labour commended Waimakariri for its initiatives to improve safety for rural children in the *Agriculture Sector Action Plan to 2013: Workplace Health and Safety Strategy for New Zealand to 2015*. Most notably, Injury Prevention Waimakariri had:

- surveyed about 2500 primary school children to learn more about their use of horses, ponies, quad bikes and motorcycles, and then promoted the key findings
- delivered an in-school programme, called 'Down the Back Paddock', to teach key safety messages²⁷
- organised training days and safety brochures targeted at children and their parents
- promoted a pre-purchase checklist for parents thinking about buying an off-road vehicle for their child (Department of Labour 2012).

²⁵ See: www.safecommunities.org.nz.

²⁶ See: www.safecommunities.org.nz/sc.

²⁷ See: www.downthebackpaddock.co.nz.

3. Understand barriers

At the session convened by the CYMRC with key stakeholders to discuss this draft report, there was a very strong consensus that attitudes towards safety on New Zealand farms pose one of the key barriers to change.

In an effort to include parents in the process of developing effective interventions, Cryer et al (2009) asked parents to suggest ways in which injuries to children in agriculture settings could be prevented. The most frequent suggestions were:

- high levels of supervision
- taking the safety-conscious approach, including banned or restricted access to the farm and use of farm vehicles, machinery and working with animals
- education and training
- applying common sense.

The parents also reported the following barriers to safety interventions:

- having to rush due to lack of time
- being tired and fatigued
- lack of reliable safety equipment
- pressures from neighbours, co-workers or management
- lack of access to practical information that is easy to put into practice (Cryer et al 2009).

Based on a small number (n=5) of in-depth qualitative interviews of parents, Basham et al (2009) found the following:

- The involvement of children in farming activities was often due to necessity in order to supervise children or as an opportunity for the children to grow in a diverse environment, encouraging a sense of personal responsibility for their own safety under supervised conditions, assessed by the parent.
- Helmets on quad bikes were perceived as inconvenient and impractical.
- Helmet use was required by children on two-wheeled vehicles; however, children were not often required to use helmets when driving quad bikes. The need for safety was related to the speed of the vehicle, with quad bikes perceived to not need helmets since they operate at lower speeds.
- Safety frames were considered by some to be a more practical safety addition than roll bars. Design interventions should have minimal effect on the operation of the vehicle and should not inhibit normal farming activities.
- Enforcement of legislative interventions would be impossible and would not acknowledge the context of the workplace and family environment (Basham et al 2009).

The authors also noted that mothers placed a greater emphasis on the age of the child when considering the child's access to quad bikes compared with fathers.

Many organisations, such as WorkSafe New Zealand and Landcorp Farming Limited, are working hard to develop a culture of safety in the workplace. (See Box 5 (p. 42) on Landcorp's current safety programmes.)

Landcorp's 'Play It Safe' programme is a good example of an occupational health and safety programme for farmers and farm owners. And, as the example of Waimakariri's 'Down the Back Paddock' programme suggests, there are also a number of programmes geared towards educating children about how to stay safe on farms that include information on motorcycle, quad bike and farm vehicle safety.

While there are some who argue the success of such education programmes has not yet been proven, a change in attitudes, beliefs and behaviours in relation to safety on New Zealand farms is most likely to begin with education programmes directed to a number of different audiences. Culture change is difficult to achieve and it might be quite some time before the success rates of such campaigns can be accurately assessed.

Box 5: 'A safe place to farm'



Landcorp Farming Limited has developed and is currently running a campaign called **100% Safety** as an occupational health and safety programme especially suited to its farming operations.²⁸

The 100% Safety programme motto is '**Play It Safe**'. The campaign is fronted by ex-All Black and farmer Richard Loe. This campaign is designed to build safety into the organisational DNA, where all staff are empowered to speak up about safety concerns and routinely think about their own safety, the safety of their colleagues and the safety of any children or adults who live on, or visit, the farms.

The management system that underpins Play It Safe includes clear guidelines for the identification and management of common hazards, as well as hazards that are specific to each individual farm. New farm employees have multiple days of safety training within their first three months, with a focus on the significant hazards of farming, including livestock handling, agrichemicals, tractors, ATVs and chainsaws. They are also instructed in first aid and hazard identification. The training is delivered by Farmsafe under the Primary Industry Training Organisation framework, and in some instances leads to NZQA qualifications.

To ensure safety on each Landcorp property, external auditors carry out safety and quality assurance audits annually. These audits are seen as an integral part of having a safe work environment.

Since 2000, Landcorp has held 'Tertiary' status under ACC's Workplace Safety Management Practices programme, and in 2012 moved to become part of the Partnership Programme. This externally audited status, the highest available, reflects the commitment of Landcorp's staff to working safely every day.

4. Use behaviour change theory in intervention design

Successful injury prevention initiatives must be grounded in appropriate behaviour change theory. Gielen and Sleet (2003) noted that, historically, injury prevention interventions were based on the assumption that increasing people's awareness would change their behaviours. Today we understand, however, that behaviour change is not so simple. The complex nature of injuries require behavioural models and theories to identify all the components contributing to the injury development (eg, risk behaviours and protective behaviours), and to delineate how the components work together to result in injury. These 'behaviour change theories' help to understand the causes of the injury problem and identify potential mechanisms that can be used to guide prevention programme design (Gielen and Sleet 2003).

Winston and Jacobsohn (2010) recognised that developing multifaceted interventions is a process that brings together injury epidemiologists, engineers and a range of other disciplines and perspectives. They highlight the importance of behavioural scientists in this process, to help create a full picture of the often-fragmented injury puzzle between interventions and changing human behaviours.

Gielen and Sleet (2003) presented a summary of well-known individual- and community-level health behaviour change theories that have been applied to injury prevention problems. Individual-level theories, such as the Stages of Change model (also termed the Transtheoretical model),²⁹ focus on how the individual's health-related behaviours change over time, whereas community-level models focus on how communities and community members organise themselves to solve health and social problems.

²⁸ See: www.landcorp.co.nz/play-it-safe.

²⁹ The Stages of Change ('Transtheoretical') model conceptualises human behaviour change as a dynamic process that typically includes five stages: 1. pre-contemplative, or not thinking about changing behaviour; 2. contemplative, which is being aware and considering changing behaviour; 3. preparation, or taking steps towards behaviour change; 4. action, or making the change; and 5. maintenance, or retaining the behaviour change over time (Gielen and Sleet 2003).

The literature review by Lilley et al (2004) found that very few interventions were based on established theories of behaviour change, a finding supported by Gielen and Sleet (2003) for injury prevention approaches as a whole. The Ag DARE programme, which was designed for adolescents to improve farm safety behaviour, provides an example of a programme based on individual-level behaviour change theory (Reed et al 2003; Lilley et al 2004). In the Ag DARE programme, the Stages of Change model was used to assess the adolescent's stages of adopting safety behaviour change.

While individual- and community-level behaviour change models are sufficient for many issues, for those issues where cultural factors have a strong impact on behaviour, it is important to consider both classic behaviour change and culture change approaches (Cabinet Office Strategy Unit 2008). Culture will influence attitudes, values and aspirations, thus affecting the decisions individuals and communities make. Culture change must be driven by a suite of initiatives targeted at families, communities, organisations (including schools and workplaces) and society. Local and national policy makers can support this process in a number of ways, including:

- supporting people through the most immediate influences to them, such as interventions that promote parenting, peers and role models
- supporting people through wider social influences, such as the role of national dialogue or government leading by example
- enabling people through providing capacity and alternatives for different choices alongside support, guidance and advice
- encouraging people through incentives, recognition of success or use of legislation and regulation.

All of the issues for prevention identified in this report are generated from a safety culture in the New Zealand context, which could be improved upon at every level of society. Once the risks have been prioritised, the barriers to adopting evidence-based safety practices identified, and the uptake to interventions better understood, then multifaceted interventions can be designed accordingly, using the most appropriate behaviour change models to achieve each desired outcome.

Limitations of this report

Crash scene investigation and vehicle assessment

Interpreting the data reviewed for this report should be done with caution. When a child or young person dies in these circumstances, there may be an investigation by the New Zealand Police Serious Crash Unit or WorkSafe New Zealand, depending on whether the location was a road or whether the vehicle was being used for work. The use of a motorcycle or quad bike by a child under 15 years of age, either for recreational driving as a non-farm-work mode of transport across the farm or on the roads adjacent to the farm, reduces the likelihood a full scene investigation of the death will take place. This then biases the amount of information available from which to identify issues for prevention.

The CYMRC's view is that all deaths related to motor vehicles, regardless of vehicle type or location of death, require an extensive incident scene and vehicle assessment. The expertise to conduct such reviews currently exists within the New Zealand Police Serious Crash Unit, but its focus and funding is aimed mostly at on-road crashes. The unit is, however, variably engaged with the types of deaths described in this report as police districts decide locally how their Serious Crash Unit will work. The extent of scene and vehicle assessment and analysis is, therefore, variable and rendered more complex by the involvement of WorkSafe New Zealand in some scene assessments where the incident occurred in the workplace. Coroners have an important role to ensure everything possible is learnt from each fatality by requesting death scene assessment and analysis.

Systematic data collection and reporting

Although the information within the CYMRC database on the 33 child cases in this report is extensive and from sources including LCYMRCs, police, post-mortem findings and coroners' reports, the information available in relation to helmet use, vehicle type and cc rating was not reported in a systematic way. Without systematic information collection, gaps exist in our understanding of these deaths, which impacts our ability to influence system changes following such tragedies.

In the data reviewed for this report, the total number of children driving or riding on vehicles was not known; therefore, the burden of deaths among child drivers in proportion to their exposure could not be calculated. Furthermore, for the 12 children under 15 years of age who died from a quad bike accident, information on the size of the bike was only available for five cases. Of those five, only one child was riding a small quad bike below 90cc. Anson et al encountered similar issues with recording and reporting of vehicle size, and could classify ATV size in only 42 of the 218 (19 percent) ATV-related hospitalisations in New Zealand between 2000 and 2006 (Anson et al 2009).

The issue of the size and power of a motorcycle or quad bike was a theme common to all types of bikes and ages included in this review. Without improved recording of make, model and cc rating, it is not possible to determine the full extent of the problem of the safety of the vehicle and its appropriateness for the age of the driver. Recording the make, model and cc rating of the quad bike should be improved before deciding whether children should be prohibited from operating quad bikes.

Issues for consideration in developing recommendations

Recent emphasis in New Zealand on safe quad bike use and design may be allowing the burden of two-wheeled mortality to go unnoticed. This report identified that the depth of the investigation into the child's death was dependent on whether it was a road or a workplace and, if at a workplace, whether the death was work-related. This review of national mortality data and the reviews from the LCYMRGs were not constrained by the location of the death or whether it was work-related, thus allowing for a broader overview, helping to bring the whole picture into focus.

Children and their parents who are living on or visiting rural properties are a key audience for the findings of this review. Even when all care is in place to protect child drivers on rural properties, unexpected changes in speed or misjudged decisions can result in their death. Although exemptions for licences may be granted for young farmers using vehicles on the roads, having child drivers operating motorised vehicles on the road is against current legislation. The New Zealand Transport Agency states: 'We will not grant an exemption... if you want to apply for a licence and are less than 16 years old' (New Zealand Transport Agency 2013).

In jurisdictions overseas, product manufacturers may be liable for injury or death related to the product they manufacture for sale. In New Zealand, such liability is reduced because of the role of ACC. It might be suggested that this results in less focus on reviewing cases and developing safer equipment. It is therefore critical that all cases undergo a detailed review and there is a system for reporting back to manufacturers about vehicle improvements.

The following issues were identified from the review undertaken for this report. These were considered by the CYMRC when developing the set of recommendations that follow (p. 46):

- mismatch in the power of the vehicle and the rider's age
- rider inexperience and the need to promote safety awareness, including having appropriate spaces to learn rider skills
- excess speed on vehicles and the need to include a speed restrictor on smaller off-road vehicles being used by younger people
- difficult terrain and conditions associated with off-road, rural and farm environments
- mechanical defects, especially brakes and throttle, and a lack of regular maintenance and vehicle safety checks
- poor visibility associated with head-on crashes
- need for safety promotion and injury prevention campaigns to focus on behaviour change
- unrestrained passengers falling off, being run over by trailers or being thrown into objects
- parents not always recognising the dangers these machines can pose for small children, the developmental level required to use these machines safely and the time needed to develop skills for safe use.

Recommendations

A) National policy and practice recommendations

1. When serious injuries or fatalities involving off-road vehicles occur, an extensive, high-quality incident scene and vehicle assessment as well as analysis should take place regardless of the location of the event or the activity at the time.
 - a. The role of the New Zealand Police Serious Crash Unit should be reviewed with a view to ensuring it is involved with all deaths related to motor vehicles.
 - b. Coroners should be seeking analysis from the New Zealand Police Serious Crash Unit with regard to all deaths related to motor vehicles.
 - c. Information about the details and themes related to fatalities should be systematically shared with others, including the lead agency for injury prevention (see recommendation 2 below), vehicle manufacturers and distributors, and other relevant community organisations.
2. A single agency should take responsibility for child and youth injury prevention by facilitating the cross-sector planning, implementation and evaluation of interventions that address child and youth safety around the use of all off-road vehicles (motorcycles, quad bikes and motorised agricultural vehicles) in the wider contexts of work, home and recreation. This broad approach to injury prevention should be led by the Accident Compensation Corporation (ACC) and form part of its current work on injury prevention. A detailed review of all injuries sustained by children and young people from using off-road vehicles should be included in the scope of this injury prevention work.
3. The Ministry of Business, Innovation and Employment (MBIE) should continue to consider the implications of adopting the American National Standards Institute's (ANSI's) safety standards for quad bikes and side-by-side vehicles³⁰ so all off-road vehicles entering New Zealand are built to minimum construction standards.
4. Given the increasing number of international recommendations advising that children younger than 16 years of age should not operate quad bikes of any size, parents and caregivers should be made aware of these overseas recommendations through clear, consistent and coordinated messaging from lead agencies.
5. For children who ride motorcycles, risks may be reduced by training programmes on bike safety. Training on off-road vehicles should be widely available to children and young people, and training should be encouraged **before** any child or young person ever rides these vehicles. Training programmes need to teach all vehicle users how to ride safely and strengthen awareness of the specific risks associated with riding off-road vehicles.³¹ These programmes should be targeted to the rural, farming and agricultural sectors, be multifaceted, include school-based education approaches, consider the developmental attributes of children and be guided by established behaviour change theories.
6. The CYMRC's *Ninth Data Report* shows a statistically significant decrease in road traffic deaths between 2008 and 2012 (CYMRC 2014). For young people aged 16 years and older, there has been a substantial reduction in road traffic fatalities in part due to graduated motor vehicle use. A similar approach should be adopted for off-road use.
7. Some of the current exemptions for farmers under the Land Transport Act 1998 should be re-evaluated. These exemptions include: on-road use of farm bikes, registration and ongoing maintenance requirements, helmet use and the implications for employers. While these exemptions apply to riders over 15 years of age, children aged under 15 years will be influenced by their older role models.

³⁰ These standards include the ANSI/SVIA 1-2010 standard for four-wheeled ATVs and the ANSI/ROHVA 1-2001 standard for recreational off-highway vehicles (and any subsequent amendments). The supply of ATVs (quad bikes) and side-by-side vehicles in accordance with both of these standards is currently voluntary in New Zealand.

³¹ In New Zealand, recent emphasis has been placed on improving safety on quad bikes through programmes such as WorkSafe New Zealand's quad bike harm reduction project. The findings from this review suggest there should also be equal emphasis placed on motorcycle harm reduction and injury prevention, particularly for children and young people using these vehicles for recreational purposes.

B) Local recommendations

1. Local rural non-governmental organisations, local government and district health boards should, with advice from national groups such as Federated Farmers, develop skills and education programmes specifically for parents, children and young people who live rurally on or near farms and are users of quad bikes. These programmes should:
 - a. be school- and community-based
 - b. include training on 'active' bike-riding skills (including how to distribute one's weight safely while riding the vehicle)
 - c. include education on injury prevention and harm minimisation (eg, helmet and protective clothing use)
 - d. identify safe recreation areas and no-go zones for children on farms
 - e. be appropriately designed for the cognitive and physical developmental level of the child or young person.
2. District health board public health services and local governments, in partnership with other agencies and health services, including emergency departments and trauma services, should participate in international Safe Communities activities to address local motorcycle and quad bike injuries, as appropriate to their populations.

C) Best practice for vehicle design and safe use

1. Design engineers and manufactures are encouraged to consider including various vehicle safety mechanisms on quad bikes made for children and young people that prevent sudden accidental surges of power,³² children from using vehicles outside the manufacturer's weight recommendations, and crushing and asphyxia injuries caused by quad bike rollover.³³
2. Children, young people and parents who operate quad bikes should ensure they are familiar with and actively using the safety practices and guidelines recommended by the manufacturer, and other government agencies such as WorkSafe New Zealand and ACC. These include the following:
 - a. Children under the age of 16 years should not ride adult-sized motorcycles, quad bikes or any other off-road vehicle built specifically for an adult (see Appendix 1).
 - b. Children and young people should only drive age-appropriate bikes in accordance with the ANSI standards and as recommended in the manufacturer's guidelines for safe vehicle use.
 - c. Children should never be carried as a passenger on a motorcycle or quad bike unless it is specifically designed to carry two people. Children or inexperienced adults carrying passengers is especially dangerous.
 - d. Helmets should be worn at all times.
 - e. Safety belts should be worn when travelling in side-by-side vehicles.

³² For example, a 'safety catch throttle restrictor' set up so that full power is automatically inactivated unless deliberately engaged, thereby protecting inexperienced users, and those manoeuvring at low speeds and in difficult situations.

³³ Note that there is still ongoing research being conducted on the safety performance of quad bike ROPS, and currently no consensus has been reached with regard to the overall safety of ROPS. Some ROPS may impede the rider's ability to dismount from the vehicle in situations where control over the vehicle is lost.

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Appendix 1: Discussion document – Ages and stages safety chart for comparing different settings

The Land Transport Act 1998 does not permit drivers aged under 16 years to drive any vehicles on a public road. Presumably, this is because it is understood that, for children, physical abilities are often not matched by cognitive abilities. As a result, children can lack the knowledge, skills, concentration and reliable judgement to manage the road environment. Similar issues and risks arise in off-road settings but no legislation provides clarity for parents and families.

A wide range of skills is needed to operate an off-road vehicle. It is important that further resources are developed to assist families, parents and caregivers to support the safety of their children and young people.

For a child to interact safely with traffic, a wide range of fundamental skills are required and the child must learn to deploy these skills strategically at the roadside (Thomson et al 1996). The skills required include abilities to:

- **detect the presence of risk**, which requires ability to maintain focused attention, be resistant to distractions, conduct a full visual scan of the environment, coordinate visual and auditory information, anticipate ground conditions and anticipate interaction with other vehicles
- **make timing judgements**, which requires ability to determine other vehicles' directions and speeds, and identify any potential deviations from the expected
- **coordinate information from different directions**, which requires ability to divide attention, hold information in memory, and coordinate and integrate information that is being drawn simultaneously from multiple sources
- **coordinate perception and action**, which necessitates linking time available to action required, motor precision and strength, and familiarity with controls to react precisely even under stress.
(Adapted from Thomson et al 1996).

Risks will be mitigated by:

- helmet use at all times
- a well-maintained vehicle
- the size, power and speed of the vehicle matched to the rider
- no alcohol
- a vehicle with safety features
- rider training
- no passengers
- safe terrain
- supervision and support.

While safety guidance is generally well established and agreed for water and public road settings, there is less agreement in off-road settings, particularly for children between 5 and 15 years of age.

Table A1: Ages and stages safety chart for comparing different settings

AGE	Water	Road	Quad bike/Motorcycle
0–12 mths	<ul style="list-style-type: none"> • Small volumes of water can kill (eg, buckets and ponds) • An adult always needs to supervise in the bath 	<ul style="list-style-type: none"> • Always in an approved safety restraint, appropriately fitted 	<ul style="list-style-type: none"> • Never operate any off-road vehicle • Never ride any off-road vehicle as a passenger
1–4 yrs	<ul style="list-style-type: none"> • Direct supervision by an adult – child should always be within an arm’s reach and practising water safe behaviour • Pool and spa fences must be maintained • Wear correctly fitted lifejackets 	<ul style="list-style-type: none"> • Always in approved safety restraint • Hold hand near road • Separate play areas from vehicle areas 	<ul style="list-style-type: none"> • Do not leave child alone inside the vehicle, even when stationary
5–9 yrs	<ul style="list-style-type: none"> • Active supervision at all times in water • Growing water confidence • Learning to swim • Water safety skills training • Wear correctly fitted lifejackets 	<ul style="list-style-type: none"> • Approved safety restraint to 148cm then correctly secured safety belt • Supervised road crossing using designated crossing places • Cycle/Skateboard/Scooter with helmet 	<p><i>No consensus has been reached on safety guidance for these age ranges (see pages 33–34)</i></p>
10–15 yrs	<ul style="list-style-type: none"> • Supervised swimming in groups • Water safety skills training • Swim between the flags • Wear correctly fitted lifejackets 	<ul style="list-style-type: none"> • Approved safety restraint to 148cm then correctly secured safety belt • No driving on roads • Road crossing skills developing using designated crossing places • Cycles on roads in good conditions with helmet 	
16+ yrs	<ul style="list-style-type: none"> • Minimise risks taken by swimmers • Swimmers should know and recognise their limits • May supervise a younger child • Learn CPR • Never drink alcohol and swim • Wear correctly fitted lifejackets 	<ul style="list-style-type: none"> • Graduated driver licence programme starts • Crosses roads • Cycles in traffic with helmet • Zero tolerance for alcohol 	

Appendix 2: ICD-10-AM categories

The initial ICD-10-AM categories used to search the National Mortality Database were V10–V99, W24, W30, W31, X81, X82, Y03, Y32 Y85 (underlying cause of death only). Cases from these categories were then reviewed and the initial dataset refined. The final categories used in the report are in Table A2 below.

Table A2: ICD-10-AM categories

ICD CODE	ICD description
V2041	Motorcycle rider injured in collision with pedestrian or animal, driver, traffic accident, motorcycle designed primarily for on-road use
V220	Motorcycle rider injured in collision with two- or three-wheeled motor vehicle, driver, nontraffic accident
V2201	Motorcycle rider injured in collision with two- or three-wheeled motor vehicle, driver, nontraffic accident, motorcycle designed primarily for on-road use
V2202	Motorcycle rider injured in collision with two- or three-wheeled motor vehicle, driver, nontraffic accident, motorcycle designed primarily for off-road use
V2241	Motorcycle rider injured in collision with two- or three-wheeled motor vehicle, driver, traffic accident, motorcycle designed primarily for on-road use
V2242	Motorcycle rider injured in collision with two- or three-wheeled motor vehicle, driver, traffic accident, motorcycle designed primarily for off-road use
V230	Motorcycle rider injured in collision with car, pick-up truck or van, driver, nontraffic accident
V2302	Motorcycle rider injured in collision with car, pick-up truck or van, driver, nontraffic accident, motorcycle designed primarily for off-road use
V231	Motorcycle rider injured in collision with car, pick-up truck or van, passenger, nontraffic accident
V234	Motorcycle rider injured in collision with car, pick-up truck or van, driver, traffic accident
V2340	Motorcycle rider injured in collision with car, pick-up truck or van, driver, traffic accident, motor-scooter, moped or motorised bicycle
V2341	Motorcycle rider injured in collision with car, pick-up truck or van, driver, traffic accident, motorcycle designed primarily for on-road use
V2342	Motorcycle rider injured in collision with car, pick-up truck or van, driver, traffic accident, motorcycle designed primarily for off-road use
V2349	Motorcycle rider injured in collision with car, pick-up truck or van, driver, traffic accident, unspecified motorcycle
V235	Motorcycle rider injured in collision with car, pick-up truck or van, passenger, traffic accident
V244	Motorcycle rider injured in collision with heavy transport vehicle or bus, driver, traffic accident
V2441	Motorcycle rider injured in collision with heavy transport vehicle or bus, driver, traffic accident, motorcycle designed primarily for on-road use
V2450	Motorcycle rider injured in collision with heavy transport vehicle or bus, passenger, traffic accident, motor-scooter, moped or motorised bicycle
V2451	Motorcycle rider injured in collision with heavy transport vehicle or bus, passenger, traffic accident, motorcycle designed primarily for on-road use
V270	Motorcycle rider injured in collision with fixed or stationary object, driver, nontraffic accident
V2702	Motorcycle rider injured in collision with fixed or stationary object, driver, nontraffic accident, motorcycle designed primarily for off-road use
V274	Motorcycle rider injured in collision with fixed or stationary object, driver, traffic accident
V2741	Motorcycle rider injured in collision with fixed or stationary object, driver, traffic accident, motorcycle designed primarily for on-road use
V275	Motorcycle rider injured in collision with fixed or stationary object, passenger, traffic accident

ICD CODE	ICD description
V2751	Motorcycle rider injured in collision with fixed or stationary object, passenger, traffic accident, motorcycle designed primarily for on-road use
V280	Motorcycle rider injured in noncollision transport accident, driver, nontraffic accident
V2801	Motorcycle rider injured in noncollision transport accident, driver, nontraffic accident, motorcycle designed primarily for on-road use
V2802	Motorcycle rider injured in noncollision transport accident, driver, nontraffic accident, motorcycle designed primarily for off-road use
V2808	Motorcycle rider injured in noncollision transport accident, driver, nontraffic accident, other specified motorcycle
V284	Motorcycle rider injured in noncollision transport accident, driver, traffic accident
V2841	Motorcycle rider injured in noncollision transport accident, driver, traffic accident, motorcycle designed primarily for on-road use
V290	Motorcycle driver injured in collision with other and unspecified motor vehicles in nontraffic accident
V299	Motorcycle rider [any] injured in unspecified traffic accident
V321	Occupant of three-wheeled motor vehicle injured in collision with two- or three-wheeled motor vehicle, passenger, nontraffic accident
V375	Occupant of three-wheeled motor vehicle injured in collision with fixed or stationary object, driver, traffic accident
V481	Car occupant injured in noncollision transport accident, passenger, nontraffic accident
V581	Occupant of pick-up truck or van injured in noncollision transport accident, passenger, nontraffic accident
V587	Occupant of pick-up truck or van injured in noncollision transport accident, person on outside of vehicle, traffic accident
V835	Driver of special industrial vehicle injured in nontraffic accident
V840	Driver of special agricultural vehicle injured in traffic accident
V841	Passenger of special agricultural vehicle injured in traffic accident
V843	Unspecified occupant of special agricultural vehicle injured in traffic accident
V845	Driver of special agricultural vehicle injured in nontraffic accident
V860	Driver of all-terrain or other off-road motor vehicle injured in traffic accident
V863	Unspecified occupant of all-terrain or other off-road motor vehicle injured in traffic accident
V865	Driver of all-terrain or other off-road motor vehicle injured in nontraffic accident
V8650	Driver of all-terrain or other off-road motor vehicle injured in nontraffic accident, two-wheeled special all-terrain or other off-road motor vehicle
V8652	Driver of all-terrain or other off-road motor vehicle injured in nontraffic accident, four-wheeled special all-terrain or other off-road motor vehicle
V866	Passenger of all-terrain or other off-road motor vehicle injured in nontraffic accident
V8662	Passenger of all-terrain or other off-road motor vehicle injured in nontraffic accident, four-wheeled special all-terrain or other off-road motor vehicle
V869	Unspecified occupant of all-terrain or other off-road motor vehicle injured in nontraffic accident
W24	Contact with lifting and transmission devices, not elsewhere classified
W308	Contact with other specified agricultural machinery
W318	Contact with other specified machinery

Appendix 3: Statistical significance testing

Introduction

Inferential statistics are used when it is necessary to use a sample to draw conclusions about the population as a whole (eg, weighing 1000 newborn babies to estimate the average birth weight of all babies in New Zealand). Any measurement based on a sample, however, will always differ from that of the underlying population, simply because of chance. Similarly, in assessing whether the risk of a particular condition (eg, sudden infant death syndrome) is different between two groups (eg, babies whose mothers smoked or did not smoke during pregnancy), the possibility that any differences seen arose simply by chance must always be considered (Craig et al 2008).

Statisticians have developed a range of measures to try to quantify the role chance plays when samples are used to make inferences about the population as a whole. Of these, one that is used in this report is the confidence interval (CI). A 95% CI suggests that if you were to randomly sample from the same population 100 times, in 95 times out of 100 the CI would include the true value. In general, if the 95% CIs of two samples overlap, there is no statistically significant difference between them. If the 95% CIs do not overlap, they are thought to be statistically different (Webb et al 2005).

The use of statistical significance testing in CYMRC reports

Descriptive statistics: The data presented in this report are derived from administrative data sets (eg, Mortality Collection, Birth Registration data set) which capture information on all of the events (eg, deaths, births) occurring during a particular period. Such data sets can thus be viewed as providing information on the entire population, rather than a sample. As a consequence, 95% CIs are not required to quantify the precision of the estimate (eg, the number of electrocution deaths in 2003–2012, although small, is not an estimate, but rather reflects the total number of deaths from electrocution during this period). Therefore, 95% CIs are not provided for any of the data presented in this report where the intention is purely to describe the number of deaths occurring in a particular category (eg, number of deaths, rates over time), on the basis that the numbers presented reflect the total population under study.

Measures of association: In considering whether statistical significance testing is ever required when using total population data, Rothman (2002) notes that if one wishes only to consider descriptive information (eg, rates) relating to the population in question (eg, New Zealand during 2002–12), then statistical significance testing is probably not required (as per the argument above). If, however, one wishes to use total population data to explore causal associations more generally, then the same population can be considered a sample of a larger super-population, for which statistical significance testing may be required. For example, the fact that mortality from drowning is three times higher for children from the most deprived New Zealand Deprivation Index (NZDep) areas might be used to draw conclusions about the impact of the socioeconomic environment on drowning more generally. Similarly, the strength of any observed associations is likely to vary over time (eg, in updating five-year suicide data from 2005–2011 to 2006–2012, rate ratios for Māori young people are likely to fluctuate in line with variations in the underlying rates, even though the data include all deaths for the seven-year period).

Therefore, whenever measures of association (ie, rate ratios) are presented, 95% CIs are provided, so that the reader can assess the extent to which the associations presented may have arisen by chance (Rothman 2002).

Appendix 4: Deaths of children and young people from motorcycles, quad bikes and motorised agricultural vehicles in all settings by DHB of residence and DHB of death

Table A3: Deaths of children and young people (number of deaths, rates per 100,000 and rate ratios) from motorcycles, quad bikes and motorised agricultural vehicles in all settings by DHB of residence, New Zealand 2002–12

DHB OF RESIDENCE	Off-road deaths	On-road deaths	Total deaths	Off-road rates	On-road rates	Total rates	Rate ratio (off-road/on-road)
Northland	4	2	6	0.67	-	1.01	-
Waitemata	1	13	14	-	0.64	0.69	-
Auckland		3	3	-	0.18	0.18	-
Counties Manukau	3	7	10	0.14	0.33	0.48	0.43
Waikato	8	9	17	0.55	0.62	1.18	0.89
Lakes	5	3	8	1.22	0.73	1.95	1.67
Bay of Plenty	3	10	13	0.4	1.32	1.71	0.3
Tairāwhiti	1	1	2	-	-	-	-
Hawke's Bay	2	1	3	-	-	0.51	-
Taranaki	4	4	8	0.99	0.99	1.99	1.00
MidCentral	4	7	11	0.61	1.06	1.67	0.57
Whanganui	2		2	-	-	-	-
Capital & Coast		8	8	-	0.73	0.73	-
Hutt Valley	1	2	3	-	-	0.53	-
Wairarapa	2		2	-	-	-	-
Nelson Marlborough	3	2	5	0.66	-	1.09	-
West Coast	1	2	3	-	-	2.73	-
Canterbury	3	12	15	0.16	0.66	0.82	0.25
South Canterbury	1	3	4	-	1.63	2.18	-
Otago*	9	4	13	1.24	0.55	1.8	2.25
Southland	2	4	6	-	1	1.5	-
Total	59	97	156	0.36	0.58	0.94	0.61

* Although Otago and Southland DHBs merged in 2010, they are kept separate in this table due to the time period covered by this report.

Note: Rates are not calculated for numbers less than three. Deaths in overseas residents are excluded.

Source:

Numerator: Mortality Review Database.

Denominator: New Zealand Mortality Review Data Group Estimated Resident Population 2002–12.

Table A4: Deaths of children and young people (number of deaths, rates per 100,000 and rate ratios) from motorcycles, quad bikes and motorised agricultural vehicles in all settings by DHB of death, New Zealand 2002–12

DHB OF DEATH	Off-road deaths	On-road deaths	Total deaths	Off-road rates	On-road rates	Total rates	Rate ratio (off-road/on-road)
Northland	3	3	6	0.51	0.51	1.01	1.00
Waitemata	1	12	13	-	0.59	0.64	-
Auckland	4	7	11	0.24	0.41	0.65	0.57
Counties Manukau	3	7	10	0.14	0.33	0.48	0.43
Waikato	8	7	15	0.55	0.49	1.04	1.14
Lakes	5	3	8	1.22	0.73	1.95	1.67
Bay of Plenty	3	10	13	0.4	1.32	1.71	0.30
Tairāwhiti	1	1	2	-	-	-	-
Hawke's Bay	2	1	3	-	-	0.51	-
Taranaki	4	4	8	0.99	0.99	1.99	1.00
MidCentral	3	8	11	0.46	1.21	1.67	0.38
Whanganui		2	2	-	-	-	-
Capital & Coast	1	5	6	-	0.46	0.55	-
Hutt Valley				-	-	-	-
Wairarapa	1	1	2	-	-	-	-
Nelson Marlborough	3	3	6	0.66	0.66	1.31	1.00
West Coast	1	2	3	-	-	2.73	-
Canterbury	4	12	16	0.22	0.66	0.87	0.33
South Canterbury	1	1	2	-	-	-	-
Otago*	9	5	14	1.24	0.69	1.94	1.80
Southland	2	3	5	-	0.75	1.25	-
Total	59	97	156	0.36	0.58	0.94	0.61

* Although Otago and Southland DHBs merged in 2010, they are kept separate in this table due to the time period covered by this report.

Note: Rates are not calculated for numbers less than three. Deaths in overseas residents excluded.

Source:

Numerator: Mortality Review Database.

Denominator: New Zealand Mortality Review Data Group Estimated Resident Population 2002–12.



**Child and Youth
Mortality Review
Committee**

“...Unuhia i te rito o te harakeke...”
“...taken away too early...”



Child and Youth Mortality Review Committee

“...Unuhia i te rito o te harakeke...”
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