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Protecting the future: fatal incidents on Australian farms involving children (2001 to 2017)

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Introduction

Agriculture has the second highest fatality rate of all industries in Australia.¹ Added to this, most agricultural enterprises are family owned and operated. A farm is unique in that it is a place of work and home, for many Australian children. This poses increased risks to children and visitors to the farm environment. The involvement of children in fatal incidents within the farming sector is not isolated to Australia, with similar findings being reported from North America, New Zealand and South Asia.²⁻⁴

Being raised on a farm is appreciated as a good lifestyle, but poses many potential hazards. Children under the age of fifteen are at high risk of coming in contact with farm structures (dams, water storages), farm vehicles (quads, motorcycles), mobile farm machinery (tractors) and animals (horses, cattle), all of which may cause injury.

During 2010-15 the Australian Institute of Health and Welfare (AIHW), reported over 2,000 children were hospitalised due to a farm-related injury. Motorcycles and quads (All Terrain Vehicles - ATV) predominated, with nearly half of all cases involving a child under 14 years. The leading causes were motorcycles/quads and horses, for males and females respectively.⁵

A sentinel Australian study assessing the 1989-92 period, identified that children (<15 years), were involved in almost 20% (n= 115), of all fatal on-farm cases.⁶ Since this time, there has been some dedicated action under the auspices of Farmsafe Australia via a national program of work that concluded in 2006. A national media campaign building on the earlier program and focusing specifically on the safety of toddlers around water, was also conducted in 2011-12. However, since this period there has been no consolidated planned interventions to reduce farm-related injury in children.

While child injury is both predictable and preventable,⁷ there is little current child specific data on the situation in Australia to assess progress and to determine further scope for interventions to reduce fatal incidents in this cohort. The aim of this study was to describe the non-intentional fatal

injury patterns and casual agents associated with childhood deaths in Australia (2001-17) and to assess trends over time.

Methods

A 17-year retrospective review of non-intentional farm related fatal incidents was conducted for children under 15 years of age. Data for this study were extracted from the National Coronial Information System (NCIS), which is the central repository of information about every death reported to an Australian coroner. For this study, data were available from the NCIS inception in 2001 through to 31, December 2017.⁸ For farm-related incidents, all cases are included where: (i) the person died unexpectedly and the cause of death is unknown; (ii) the person died in a violent or unnatural manner; and, (iii) a doctor has been unable to sign a death certificate giving the cause of death. For each case, preliminary information is uploaded into the NCIS and these remain 'open' until the coroner hands down a final determination and the case is then 'closed'. In each NCIS case, a cause of death is determined and recorded by a coroner, with specific cause of death details independently coded by the Australian Bureau of Statistics (ABS) against the International Classification of Disease 10 (ICD-10).⁹

Data extraction from NCIS involves two inter-related processes. Firstly, a commercial media tracking organisation (iSentia/Meltwater) is used to scan approximately 2,500 daily, weekly and monthly publications Australia wide. Publications are scanned for various designated search terms (e.g. "farm*", "property", "growers", "producers", "horticulture"). Where a potential on-farm case is identified the corresponding NCIS case file number is obtained for this 'open' case. This process has been used since 2005 and has proven to be reliable in identifying potential case events for inclusion. However, as not all cases are reported in the media, there is potential for cases to be under-enumerated. Consequently, the second approach to identifying cases of relevance relies on keyword searches of the NCIS (farm*) for each year. These are then reviewed with cases that are not farm-related and those confirmed as intentional by the coroner, being withdrawn from the dataset. The available NCIS data for farm-related cases are coded using the Farm Injury Optimal Dataset, with farm fatalities including both work and non-work related activities. The dataset provides specific codes on demographics, role in event (e.g. operator, bystander, passenger), work relatedness, adult supervision, relevant causal agents of injury (dams, quads, vehicles [utility, truck, car etc] and tractors etc.), mechanism of injury and other context specific information as applicable, such as helmet usage, loads and rollover/runover. The dataset has been widely used in other Australian farm injury studies.¹⁰

Data for all deaths on farms involving children under 15 years were extracted from the NCIS database for the period 2001-17. To ensure that case numbers are not under-enumerated, 'open' cases have been included in this review. However, these 'open' cases generally have less detail, particularly in relation to agent and mechanism of injury.

Descriptive analyses of the data were completed including age and gender breakdown, state where incident occurred, work-relatedness, causal agents, farm resident or visitor, day of week, time of day and parental/adult supervision at time of incident. Three-year moving averages were used to smooth out annual fluctuations in case numbers and to preserve confidentiality.

To assess the trend in the number of deaths over the 2001-17 period, a Poisson loglinear regression analysis (Generalised Linear Model) was used, with year centred at the mid-point (2009). Years were centred so as to enable the investigation of potential higher level polynomial terms. All analyses were conducted using IBM SPSS Version 24, with statistical significance set at $p < 0.05$.¹¹

The study has ethics approval from the Department of Justice Human Research Ethics Committee - Approval number CF/14/1161.

Results

Of the 1,352 farm deaths in the NCIS across all age groups between 2001-17, those in the 0-14 years category ($n=202$), accounted for almost 15% of all cases. Of the 202 cases, 89.1% were closed ($n=180$). Children were predominantly fatally injured during recreational activities (84.1%). Nevertheless, children who were bystanders to farm work or being cared for while undertaking farm duties, are represented. Only 13 children (6.4%), were undertaking farm work at the time of the fatal incident.

Figure 1 shows the three-year moving average has reduced from 53 cases (17.6 cases/annum) to 24 (8 cases/annum) in the period.

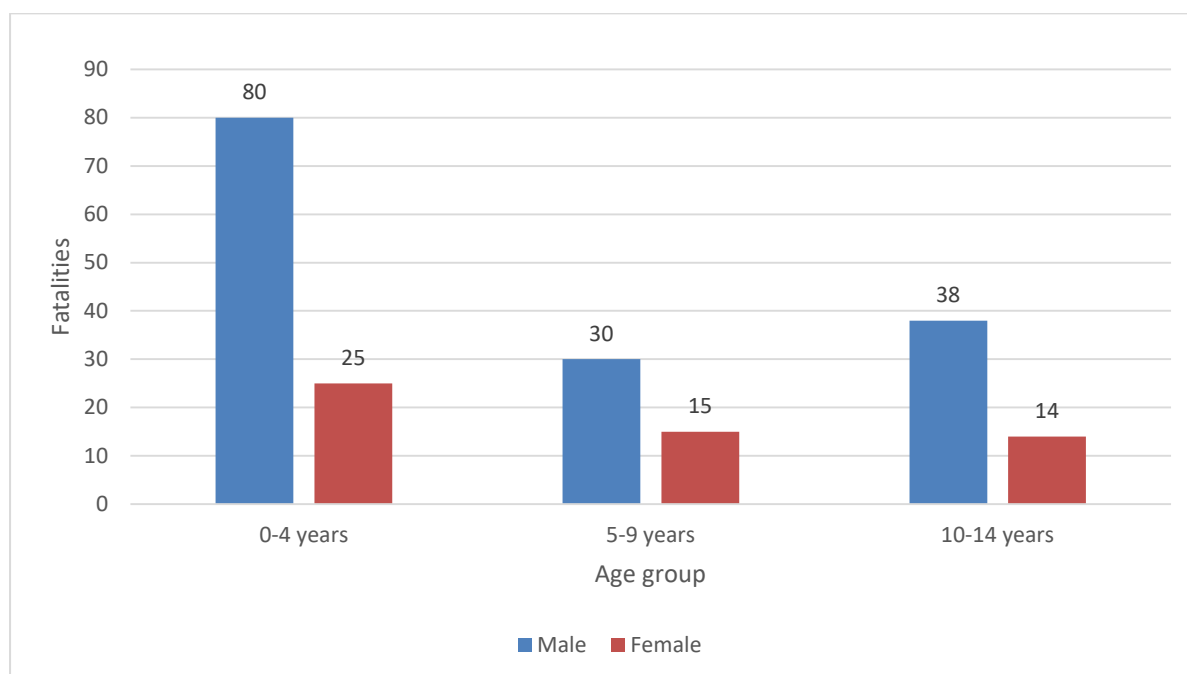
Figure 1 Child deaths on farm - 3 year moving average (2001-17)



Gender and age

Overall, males dominated (73%; n=148) in all age groups under fifteen years. As indicated in Figure 2, children aged 0-4 constituted over half of all child deaths (52%; n=105). This was followed by those 10-14 years (25.7%; n=52) and 5-9 years (22.3%; n=45).

Figure 2 Child farm deaths by age group and gender (2001-17)



Location and time

Around two-thirds (62.9%) of the fatalities (Table 1), occurred in Queensland (n=69) and New South Wales (n=58). Incidents most frequently involved farm residents (n=140; 69.3%), with almost half (n=91; 45%) occurring on a weekend and around one in every fourth case involving a visitor (Table 2). The peak time of injury across all age groups was 3-6pm, accounting for 41% of incidents (Table 3).

Table 1 Fatal on farm cases by State or Territory, children 0-14 years, Australia (2001-17)

| State or Territory | Total | % |
|--------------------|-------|-------|
| New South Wales | 58 | 28.7 |
| Northern Territory | * | 2.0 |
| Queensland | 69 | 34.2 |
| South Australia | 8 | 4.0 |
| Tasmania | 9 | 4.5 |
| Victoria | 34 | 16.8 |
| Western Australia | 20 | 9.9 |
| Total | 202 | 100.0 |

* Figure <5

Table 2 Fatal on farm cases by age group, incident day of week and residence, children 0-14 years, (Australia) 2001-17

| Age / residency | Day of week | | | | | | | TOTAL |
|-----------------|-------------|-----|-----|------|-----|-----|-----|-------|
| | Mon | Tue | Wed | Thur | Fri | Sat | Sun | |
| 0-4 | 12 | 14 | 9 | 12 | 19 | 25 | 14 | 105 |
| 5-9 | 8 | 5 | 5 | * | * | 9 | 12 | 45 |
| 10-14 | * | 11 | * | * | * | 20 | 11 | 52 |
| Total | 23 | 30 | 15 | 17 | 26 | 54 | 37 | 202 |
| Residents | 19 | 18 | 12 | 12 | 19 | 38 | 22 | 140 |
| Visitors | 4 | 12 | 3 | 5 | 7 | 16 | 15 | 60 |

* Figure <5

Table 3 Fatal on farm cases by age group, incident time of day and residence, children 0-14 years, Australia (2001-17)

| Time of day / residency | Age Group | | | TOTAL |
|-------------------------|-----------|-----|-------|-------|
| | 0-4 | 5-9 | 10-14 | |
| 6-<9am | 10 | * | * | 14 |
| 9-<12 noon | 21 | * | 10 | 34 |
| 12-<3pm | 20 | 10 | 12 | 42 |
| 3-<6pm | 40 | 23 | 20 | 83 |
| 6-<9pm | 7 | * | * | 13 |
| Other/ns | 7 | * | 5 | 16 |
| Total | 105 | 45 | 52 | 202 |
| Residents | 80 | 32 | 28 | 140 |
| Visitors | 25 | 13 | 24 | 62 |

* Figure <5

Causal agents

Seven agents (water bodies, quads, tractors, utes, cars, motorbikes and horses), accounted for almost 80% (n=155) of all cases (Table 4). Water bodies were responsible for over 33% (n=68) of deaths, with the majority in those aged 0-4 years. Dams were the principal locality, though other sources including pools, creeks, rivers and irrigation channels were prominent. Overall, 22% of drowning's involved farm visitors.

Quads were the next leading agent representing 15% (n=30), of cases. Those in the youngest age group were most frequently passengers, but this varied with increasing age. Children 10-14 years represented nearly half of all cases and were most likely operators. Farm visitors were involved in over 43% of these incidents and three of the cases were work-related. Rollovers occurred in 80% of cases.

Tractor cases were dominated by those aged 0-4 years (n=10). Invariably, cases involved being transported as a passenger and falling off, or being runover when around a tractor. These typically involved farm residents, with four cases being work-related.

Fatalities involving farm utes included: (1) vehicle rollovers where the child was in the cabin but not wearing a seatbelt; (2) a fall when riding in the tray of the ute and/or vehicle rollover; and (3) a slow-vehicle runaway incident. Incidents were highest in the 10-14 year age group (n=7) and most frequently involved riding in the tray of the ute. Ute-related fatalities involved mostly visitors as decedents. Similarly, car incidents involved unrestrained children in the cabin across all ages, or slow-speed runovers in those aged 0-4 years. Most cases involved farm residents.

Motorbikes were all being operated recreationally and were dominated by those aged 10-14 years (n=9). Of the four head injury cases, two were wearing helmets and the status was unknown for one case. Visitors accounted for over 50% of cases.

Horse-related incidents were spread across the age groups, with the majority involving females (n=8). Most were farm residents and all were recreational. Of the three head injury cases, two were wearing helmets and the status was unknown for one case. Over half were trampled by the horse, with around half of all cases occurring on a weekend period. One in every three cases involved a visitor.

Other deaths (animals, farm chemicals, farm structures, handtools, materials and powered equipment), accounted for less than 10% of cases. The majority of these involved a farm resident.

Table 4 Fatal on farm cases by agent of injury, children 0-14 years, Australia (2001-17)

| | 0-14 | Residents | Visitors |
|------------------------|-------------|------------------|-----------------|
| Animal | 15 | 11 | 4 |
| Horse | 12 | 8 | 4 |
| Farm structure | 74 | 58 | 16 |
| Water | 10 | 6 | 4 |
| Dam | 43 | 36 | 7 |
| Pool | 9 | 8 | 1 |
| Creek/River/Irrigation | 6 | 3 | 3 |
| Other farm structure | 6 | 5 | 1 |
| Farm vehicles | 76 | 43 | 33 |
| Quads | 30 | 17 | 13 |
| Motorbike | 11 | 5 | 6 |
| Ute | 11 | 7 | 4 |
| Car | 10 | 8 | 2 |
| Mobile farm machinery | 25 | 19 | 6 |
| Tractor | 13 | 12 | 1 |
| Other | 12 | 9 | 3 |

Cause of death

Most injuries occurred as the result of three mechanisms: fell and runover as a passenger on agricultural machinery or farm vehicles (36%); asphyxia due to drowning (34%); and being run over by agricultural machinery or farm vehicles as a bystander (28%). Asphyxia from drowning and major crush injuries (of the head, neck, chest and abdomen), were the most frequent mechanisms of injury causing premature death.

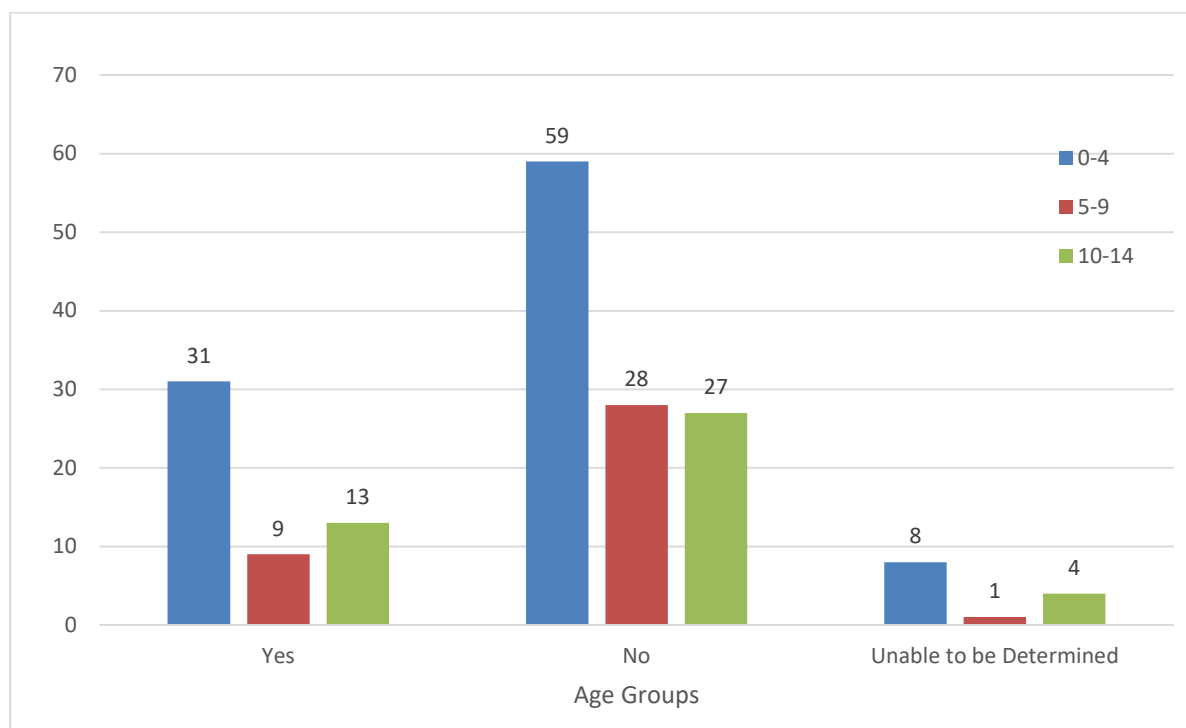
Table 5 Fatal on farm cases by cause of death, children 0-14 years, Australia, (2001-17)

| Cause of death | Total | % |
|--------------------|-------|--------|
| Head injuries | 66 | 32.7 |
| Drowning | 69 | 34.2 |
| Multiple injuries | 14 | 6.9 |
| Asphyxia | 11 | 5.4 |
| Chest injuries | 11 | 5.4 |
| Neck injuries | 6 | 3.0 |
| Abdominal injuries | 6 | 3.0 |
| Other | 6 | 3.0 |
| Unknown | 13 | 6.4 |
| Total | 202 | 100.00 |

Supervision

Of the closed cases (n=180), more than half (63.3%; n=114) had no active supervision by an adult. In 13 cases, supervision was not able to be determined.

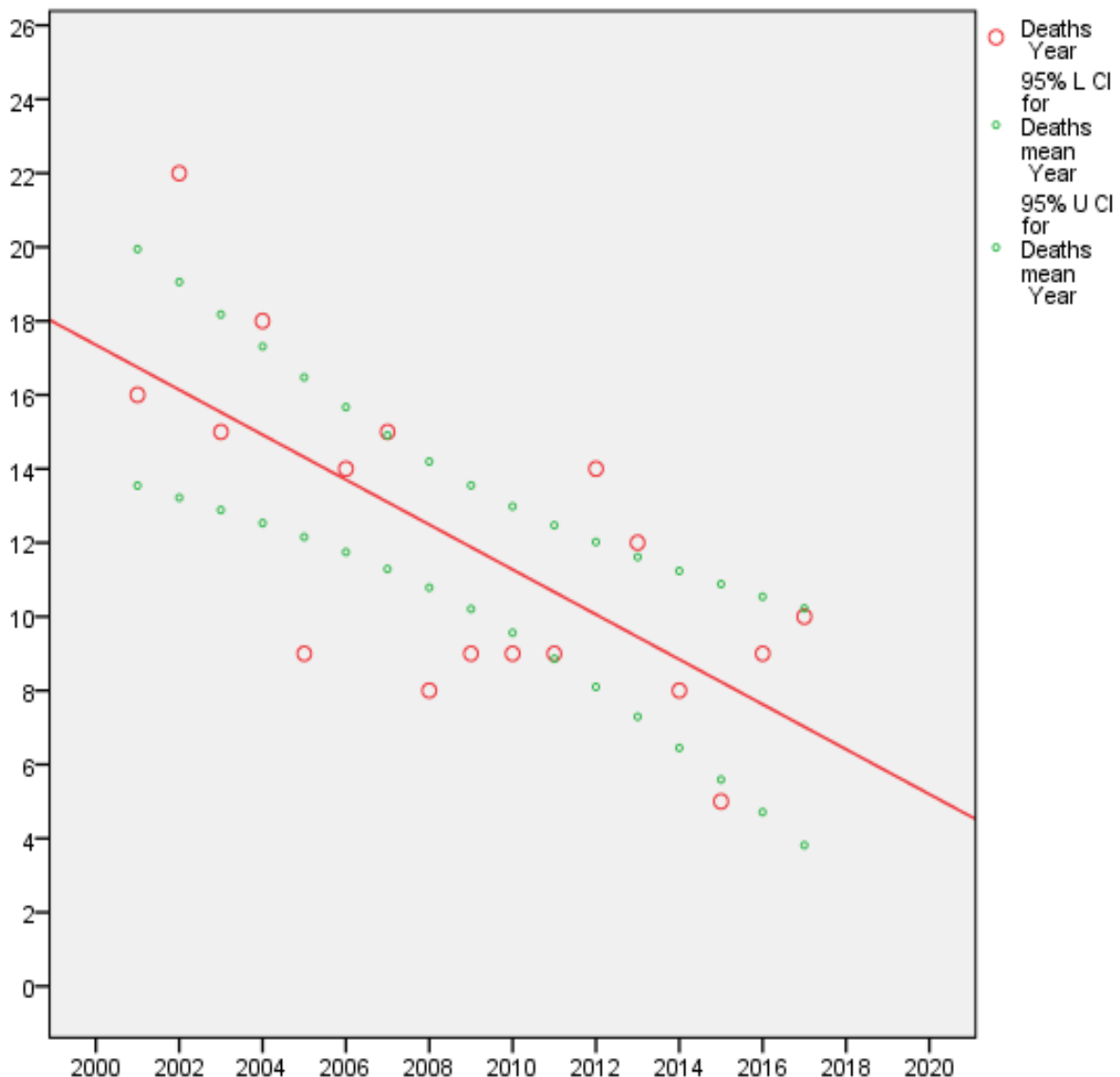
Figure 3 Adult supervision at time of incident by age group (2001-17)



Fatality trends

There was a significant decrease in the number of deaths over the 2001-17 period. A reduction of 0.61 (se 0.16) per year was identified with an intercept of 11.9 (se 0.79) for year=0 (i.e. 2009), [r=0.70, R² =0.490, p=0.002]. Standardised residuals satisfied the condition of normality (one sample Kolmogorov test mean=0 sd=0.97, p=0.20), even though the outcome of number of deaths followed a Poisson distribution of mean=11.882 (one sample Kolmogorov test p=0.396). Higher level polynomial terms were investigated, but none were significant.

Figure 4 Trend analysis of fatal farm cases by year, children 0-14 years, Australia (2001-17)



Discussion

This descriptive study has defined a reduction in the annual number of on-farm child injury fatalities from an average of 28.7 deaths per year (1989-92) to 11.9 per year (2001-17). Despite this improvement, the pattern and agents of fatal injury remain largely similar to the earlier 1989-92 data. Males dominate the fatal cases with those aged 0-4 years making up over half of all cases. Incidents involving drowning and specifically dams, were the major agent of injury. Around half of all

incidents occurred over weekend periods and while fatalities occurred to farm residents on all days of the week, deaths to visitors were unsurprisingly more pronounced on weekend periods.

As indicated in this assessment seven agents (water bodies, quads, tractors, motorbikes, utes, cars and horses), accounted for almost 80% of all fatal child cases. These numbers remain a cause for concern given that effective evidence-based solutions to control risks have been promulgated since 2003 (Table 6).¹² Further, while these cases reflect the mortality patterns, there will nonetheless also be a very considerable number of non-fatal cases involving these agents.

Table 6 Evidence based solutions for child safety

| Causal agent | Control measure |
|--------------|---|
| Water bodies | Construction of Safe Play Areas for toddlers to reduce access to water and pool fencing |
| Quads | No children riding any size quads given physiological and cognitive limitations, or being carried as passengers ¹³ |
| Tractors | Not be carried as passengers on tractors/implements and Safe Play Areas |
| Motorbikes | Helmet usage and other PPE |
| Farm utes | No riding in tray or without seatbelt in cabin and Safe Play Areas |
| Cars | Use of seatbelts and Safe Play Areas |
| Horses | Helmet usage and other PPE |

Adapted from Fragar et al, Evidence based solutions for child injury on Australian farms, 2003.

The high proportion of cases in the 0-4 age group and the dominance of water-related incidents, highlights the necessity for greater attention to the construction of safe play areas on farms. Safe Play Areas (SPAs) serve as an engineering control that will isolate young children from potential water hazards. In addition, SPAs would also assist in limiting access to moving tractors, farm machinery, utes and cars - which are all involved in low speed runovers of young children.¹⁴

Although quad related cases are distributed across all age groups, the 10-14 year olds constitute 50% of cases. Furthermore, the one major variation to the distribution of cases from the 1989-92 data, is the considerable impact of quad incidents. While quads appear easy to utilise and this may account for some of the visitor usage, children should not be using or be carried as a passenger on adult quads under any circumstance.¹⁵ These are practices that must continue to be discouraged. Significantly, child-sized quads are also present in these data and with weights up to 125kg, become virtually impossible for children to extricate themselves from under in the event of a rollover (noting 80% of cases involved a rollover).

The majority of the child fatality burden is borne by those that reside on farms, however visitors are present across all causal agents. The involvement of visitors is particularly prevalent with motorbike, ute, quad and drowning cases. Importantly, the same control approaches outlined (Table 6), are equally applicable to residents or visitors.

While there are increases in corporate agriculture in Australia, the dominant pattern continues to be family owned and operated farms.¹⁶ This is likely to be maintained for many years into the future and given the generational nature of farming, further consideration of the culture underpinning safety practices appears warranted. Child safety is a highly emotive issue and the reduction in child-related incidents points to positive progression in safety in recent years. However, it is not

infrequent to hear concerns regarding “wrapping kids in cotton wool” from some sectors of the farming community.¹⁷ Despite these concerns, the underlying culture and practices need to evolve, as has been illustrated in other areas of safety in Australian society e.g. road safety and drink driving.

Longstanding guidelines to assist parents in determining developmentally appropriate and safe farm tasks for children aged 7-16 have been available since 1999 (North American Guidelines for Children’s Agricultural Tasks).¹⁸ Australia also has existing farm specific materials available on these issues, which on the basis of the data in this study, continue to be relevant.¹⁹⁻²⁰ While the effectiveness of the Australian materials have not been widely assessed, the implementation and adherence to the North American guidelines has been shown to be less than optimal and there is no reason to suggest that the situation would be any different in Australia.²¹ Additionally, the guidelines fail to acknowledge the significant impost for children six years and under - also reflected in our Australian data in this study.

International research has indicated that parents tend to overestimate their children’s physical, social and cognitive capacity to undertake farm tasks or related activities.²²⁻²³ While specific Australian data are not available on this issue, it is improbable that farmers are not aware of risks associated with agricultural production. Indeed the data in this study, reflect the burden of recreational incidents (84% of cases) as opposed to work-related incidents. Hence, part of the key to further reductions in child fatalities must consider how to not only impart information, but how to drive genuine changes in culture and practices inclusive of recreational activities.

Children of a young age have natural curiosity, which leads to exploring around the farm, but they do not recognise potentially dangerous and hazardous situations. Education is important for parents and caregivers to realise young children will not always remember, understand, or follow rules, so they cannot be relied upon to do so consistently. While supervision is an important element for this cohort, the efficacy of such practices is not uniform and subject to human error, sometimes leading to fatal consequences. These findings reinforce a previous American study illustrating that further research into the role of supervision in injury prevention is necessitated.²⁴

Limitations to this current study include the inability to accurately determine rates of fatal injury in relation to the population exposed and the real world exposure to hazards. Additionally, there was a small percentage of cases (10%) that remained open and hence the available data were restricted.

The National Injury Prevention and Safety Promotion Plan expired in 2014,²⁵ however consultation to establish a new plan has commenced in 2019. This may provide an opportunity to reinvigorate focus on this area. Although children are obviously vulnerable and account for 15% of fatal cases in this study, there is currently an absence of funded programs addressing farm safety for children. At a time when Australia is experiencing a boom in agricultural production in conjunction with increased potential demand for exports from the rapidly expanding Asian markets,²⁶ this lack of investment in farm safety where there are known effective controls, is unacceptable.

On a positive note, this study indicates a reduction in the number of unintentional child deaths, however a re-energised effort linked with the evolving national injury plan to systematically support child farm safety is required. Such an approach must build on earlier initiatives involving a range of sectors - farm, medical, media and governmental.

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Presenter

Kerri-Lynn Peachey is the Farm Safety Research Officer at the AgHealth Australia, School of Rural Health, The University of Sydney. For many years at AgHealth she has worked with the agricultural and horticultural sectors on translation into policy and practice, though in 2016 moved to the area of farm safety research. Currently she is involved with monitoring all fatal and non-fatal incidents that occur on a farm in Australia. It is this monitoring services that enables her to maintain a national database of all fatal incidents and direct research opportunities. Combined with directing research, her aspiration is to continue providing advice on farm safety and wellbeing to the broader farming community. In addition, she operates a mixed cropping and livestock enterprise with her husband, and therefore recognises and acknowledges the necessity to enhance farming families and communities on the importance of protecting every person in the farm environment.