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PREVENTING FLOOD RELATED FATALITIES – A FOCUS ON PEOPLE DRIVING THROUGH FLOODWATER

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INTRODUCTION

Floods are the leading cause of natural disaster fatalities worldwide. In 2013, 44 per cent of natural disaster fatalities were caused by floods (International Federation of Red Cross and Red Crescent Societies, 2013). Flash floods, in particular, have the highest average mortality rate per event (Jonkman, 2005). Approximately 180 people have died in Australia over the last 15 years (Haynes, et al., 2016; Peden, 2016). A large number of these fatalities occurred when people drove their vehicles into floodwaters, ignoring road closures and warning signs.

Despite numerous campaigns on the dangers of floodwaters in recent years, people continue to put themselves at risk each year. In the June 2016 flood in New South Wales (NSW) alone, approximately 350 flood rescues occurred. Many of these rescues (approximately 50 per cent) included people stranded in or on the roofs of their cars, who may have otherwise been added to the number of fatalities. This flood event also resulted in the loss of multiple lives.

Following the major flood event on the east coast of Australia in May 2015, where several lives were also lost, the Law Crime and Community Safety Council (LCCSC) Ministers sought the Community Engagement Sub-committee (CESC) of the Australia-New Zealand Emergency Management Committee (ANZEMC) to explore the issue. A working group was established consisting of representatives from the Commonwealth, state and territory governments, and from the research industry. The project was funded by the Commonwealth Attorney-General's Department (AGD), with the resultant report prepared by the NSW State Emergency Service (SES) and the working group on behalf of ANZEMC. As at 11 July, the report has not been endorsed by ANZEMC CESC or AGD.

METHOD

A literature review analysed research on behaviour and decision-making, and how they can be influenced, drawing on examples from public health and road safety as well as flooding. Both flash flooding and slower riverine flooding were considered, given that the differences between these flood types may trigger different behaviour and decisions.

The review also surveyed Australian and international interventions targeting a reduction in the number of flood fatalities. The types of interventions considered included engagement and education, engineering, emergency management, encouragement and enforcement. Empirical evaluation of success was included where available.

The sources for the review included peer reviewed research, conference proceedings, media clips and reports, and information from government agencies.

The findings of the review were considered in a series of meetings held during the project and a workshop for the project working group in March 2016.

DISCUSSION

The literature identified the following particularly high risk trends for the period 1900-2015:

- Eastern states in coastal catchments, between Wollongong (NSW) and Maryborough (Queensland) (Coates, 1999; Fitzgerald, et al., 2010), with NSW

and Qld accounting for 74% of fatalities (Haynes, et al., 2016). These areas generally have very little warning time of flooding.

- Within 20 kilometres of home (Haynes, et al., 2016), with only 1% of flood fatalities during the period involving people who were not familiar with the area (Haynes, et al., 2016).
- Summer, particularly January to February (36%) (Haynes, et al., 2016), in the late afternoon to night (39%–45%) (Haynes, et al., 2016; Peden, 2016), and more frequently on a Friday (Peden, 2016)
- 75–80% of flood fatalities were males (Coates, 1999; Queensland University of Technology, 2010; Haynes, et al., 2016), with a similar over-representation of males fatally attempting to drive through floodwaters (Haynes, et al., 2016).
- 0–29, and over 60 (Coates, 1999; Coates & Haynes, 2008; Fitzgerald, et al., 2010; Becker, et al., 2011; Haynes, et al., 2009; Wright, et al., 2010; Drobot, et al., 2007; Haynes, et al., 2016; Peden, 2016).
- 4WD drivers, with approximately 35% of flood related fatalities associated with 4WDs (Haynes, et al., 2016).
- Workers including, emergency services personnel such as fire, police, ambulance and SES (Live Leak, 2011; Fox4, 2015), as well as doctors, utility maintenance workers, mail delivery personnel, farmers, miners and many government workers (Becker, et al., 2015; Gissing, 2015; Becker, et al., 2011) where they 'needed to get to work' and did not have the discretion to cancel their trip, even if they perceived the risk was high (Ruin, et al., 2009; Ruin, 2008).

Similar trends have been observed internationally (Ashley & Ashley, 2008; French, et al., 1983; Jonkman & Kelman, 2005; Kundzewicz & Kundzewicz, 2005; Diakakis & Deligiannakis, 2013; Doocy, et al., 2013; Petrucci & Pasqua, 2012; Coates & Haynes, 2008; Fitzgerald, et al., 2010; Coates, 1999). Contributing factors to these trends include exposure, propensity for particular occupations (Coates, 1999; Coates & Haynes, 2008; Fitzgerald, et al., 2010; Jonkman & Kelman, 2005; Jonah, 1986), greater confidence in their driving ability (Matthews & Moran, 1986), type of cars they drive, when and why they drive, identity, broader social influences such as peer and/or passenger influence, a tendency for risk-taking behaviour (Jonah, 1986; Maples & Tiefenbacher, 2009), voluntary exposure to floodwater, as well as a perception that such large vehicles are more stable and safe (Franklin, et al., 2014; Maples & Tiefenbacher, 2009; Petrucci & Pasqua, 2012; Becker, et al., 2011; League, 2009; Wilson, 2015).

Fatalities are not isolated to the areas of Australia listed above, with Northern Territory having a heightened risk per capita (Haynes, et al., 2016).

Additionally, it is important to note that near misses are usually absent from statistics, with the exception of recorded flood rescues, self-reports and insurance records where available. This may mean the potential risks associated with flooding are underestimated, and may also skew the groups identified as most at risk.

Why are people driving through flood water?

The majority of people who died attempting to drive through floodwater were 'en-route' (Haynes, et al., 2016). It is easy to feel safe inside a vehicle and not fully appreciate the risks of floodwater (Diakakis & Deligiannakis, 2013; Jonkman &

Kelman, 2005). The following excerpts demonstrate some of the misconceptions about driving through floodwater (Footprints Market Research, 2015):

- 'I'm a local, I know the roads and how they flood.'
- 'My vehicle can handle the water – It's a 4WD, heavy, has high clearance and snorkel.'
- 'It's the small cars and soccer mums that don't know what they're doing.'
- 'If I can walk through it, I can drive through it.'
- 'The car manual says it can handle this depth.'
- 'I'll follow in the wake of a truck.'

Behaviour and decision-making during natural disasters is complex—it involves interaction between environmental information, social processes and individual factors, including beliefs, knowledge, willingness, attitudes, perceptions and skills (Lindell & Perry, 1992; Grothmann & Reusswig, 2006; Sorensen, 2000; Bandura, 1997; Tobin & Montz, 1997; Pearson & Hamilton, 2014). Blood alcohol level, which impairs judgment, is obviously another factor (Diakakis & Deligiannakis, 2013), with an estimated 37 per cent of vehicle-related flood fatalities involving alcohol (Peden, 2016). Higher-order thinking is influenced by conscious intentions and can be disengaged through distraction, or high or very low levels of arousal (Kahneman, 2012; Strack & Deutsch, 2004). Arousal can be triggered by stressful situations, for example, a flooded road (Tobin & Montz, 1997; Benight, et al., 2007; MacLean, 1990; Thomas, 2012). This helps to explain contradictions between how people think they might behave and how they actually behave (Wright, et al., 2010). When higher-order thinking is disengaged, the number of potential actions considered by a person is reduced (Lambert, et al., 2003; Baumeister & Heatherton, 1996). Appealing to rationality is generally not a successful way to intervene in this situation; instead, a person's motivational system needs to be considered (Redshaw, 2004), which is developed well before the decision about driving through floodwater (Dufty, 2014).

Motivations include internal, external, social, situational and organisational influences (Bearman, et al., 2009), such as attachment, reputation (good or rebellious), control, desire for pleasure and avoidance of pain (Darnton, 2008), the need for self-enhancement, identity (Grawe, 2007; Freud, 1922), social norms, values, experience and understanding (Andreasen, 1995; O'Neill, 2004; Abraham, et al., 2011; Michie, et al., 2011; Triandis, 1977; Ajzen, 1991). While there is unlikely to be a single psychological theory or behavioural model that explains why people drive through floodwater, the research shows that the timing of interventions is particularly important—both in targeting the motivational system and enabling the brain to process concepts.

Changing risky behaviour

Trying to ensure safe behaviour in disasters is a challenging and long-term pursuit which, ultimately, is about minimisation rather than eradication. People still smoke, eat junk food and speed, and realistically, they are also likely to continue to enter floodwater. However, there have been dramatic changes in attitudes and perceptions towards these kind of behaviours as a consequence of successful interventions and enforced regulation.

Behaviour change literature and campaigns, including health behaviour and road safety, show that a holistic approach to changing risky behaviours, using multiple

intervention techniques and targeting different audiences, is more effective than using an intervention in isolation. The goal is to make the decision *not* to drive through floodwater the easiest decision.

Education and engagement

Communication generally occurs through a spectrum of education and engagement activities, ranging from mass media campaigns to locally based community engagement activities. Message consistency is a critical component of successful education and engagement interventions. In the context of driving through floodwater, this may mean working with the media, vehicle manufacturers, schools, workplaces (including emergency service workplaces), driver education and advertising bodies to ensure that the messages and imagery used by these different sources support the desired overall messaging, and work collaboratively towards the development of a safe social norm (Goode, et al., 2011; Gissing, et al., 2015).

Also important is helping people to develop alternatives to driving into floodwater (e.g. using alternative routes or re-scheduling travel plans), rather than simply warning them against risky behaviour. In addition, research shows that involving the public in the development of interventions (e.g. development of messaging) produces benefits, including the fostering of trust, social norms, and ownership of choices made (Burningham, et al., 2008; Parker & Handmer, 1998; Parker, 2000; Handmer, 2000; Covello & Allen, 1988; CSIRO, 2000).

Media campaigns and community engagement are more effective when used together, and in conjunction with other types of interventions, and are most successful where they target a number of different audiences using a variety of methods (e.g. Montague, et al., 2001; McGuire, 1985; Australian Institute of Criminology, 2014). Evaluation is critical if organisations are to make a greater impact by learning from their successes and mistakes.

Engineering interventions

The range of engineering interventions implemented in Australia and internationally to prevent people driving through floodwater includes barricades and signage, vehicle design and lighting, road design to enhance the safety of motorists (e.g. road surfaces, fences and vegetation to prevent cars being washed off causeways), vehicle design with mechanisms to avoid the threat, and appropriate land-use planning to avoid the 'need' of people to drive through floodwater (VicRoads, 2003; Main Roads Western Australia, 2006; Department of Transport and Main Roads, 2010; Australian Standard 1742.2, 2009; Austroads, 2015). The scope of such engineering interventions is expanding rapidly, in line with new technologies. For example, some organisations (including Melbourne Water and Toowoomba Regional Council) have installed advanced warning systems that, when activated, communicate information to approaching vehicles and pedestrians, trigger road closure barriers and assist remote site monitoring,.

The high cost of many engineering interventions is clearly an issue, particularly where the effectiveness is uncertain. The success has been varied, partly because barricades may be removed and warnings ignored by motorists, even while flooding is still occurring. However, in certain high-risk locations, engineering solutions may be determined as most appropriate through a floodplain risk management process (Commonwealth of Australia, 2013). This process can also assist in avoiding risk in the future.

Enforcement

Examples of effective interventions using engagement and education in combination with enforcement include speeding, seat belts and drink driving. There are a number of provisions in each jurisdiction of Australia that would allow for penalties for disobeying flood signs or barriers in order to drive through floodwater, with penalties ranging from small fines to imprisonment (Eburn, 2016). The effectiveness of these penalties relies on the extent to which they can be enforced (e.g. not all signage is enforceable – 'water over road'). The presence of police, official personnel (e.g. SES) and penalties have been identified as strong deterrents to driving through floodwater. However, while enforcement may appear to offer a reliable way of influencing behaviour, it may be accompanied by high financial and political costs. In the USA there is legislation to allow for charging for flood rescue. However this may cause resistance and discourage people from seeking assistance due to fear of costs, placing those in need of rescue at greater risk (Eburn, 2016).

Work health and safety legislation (e.g. Work Health and Safety Act 2011) and policy have been effective in supporting behavioural change, which could target the substantial number of workers who drive through floodwater. Change may be achieved, for example, by workplaces acknowledging flood threats and allowing employees to arrive late or arrange alternative workplaces.

Encouragement

Positive reinforcement is often more effective than punishment in shaping decision-making and behaviour. In relation to floodwater, this may include reduced insurance premiums for safe driving, acknowledgement or reward in the workplace for flood safe behaviours, and monetary reward and community involvement through competitions (Federal Emergency Management Agency, 2016; Lahrmann, et al., 2012).

Emergency planning and response

Emergency planning can help eliminate the need for sudden and stressful fleeing and facilitate safe road use (Kelman, 2005). Involvement of the community in the development and implementation of planning can increase its benefits (Mostert & Junier, 2009; World Health Organisation, 2014; Comrie, 2011; Webber & Rae, 2015).

Emergency services generally use rescue as a response when other mechanisms fail. There are differing levels of flood rescue capability across Australia but, regardless of which state or territory, flood fatalities often occur before rescuers can respond. Rescuers cannot be everywhere at all times—they are a finite resource, conditions do not always allow rescue, and rescuers are placed at risk. Therefore, increasing rescue capability is not the simple solution.

CONCLUSION

People entering floodwater is a national issue. More than 180 people died in floods in Australia during the past 15 years. Driving a motor vehicle into floodwater was the leading cause of these fatalities and, in many cases drivers ignored road closure and warning signs when entering the water. There are a number of trends associated with those at higher risk.

Research shows that people's willingness to drive into floodwater, even after receiving warnings not to, is the result of a number of factors including attitudinal belief, social norms, past behaviour and risk perception.

Long-term behaviour change is required to achieve reduction of flood fatalities from driving into water. This may involve collaboration with key national stakeholders and ongoing coordination and collaboration between Australian jurisdictions on flood safe behaviour, as well as consistent and longitudinal evaluation of measures put in place or piloted – beyond general metrics of 'hits, likes and shares' – to strengthen the evidence base to support flood safe behaviour.

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