FLOOD RISK COMMUNICATION RESEARCH INTO PRACTICE BRIEF 1 DECEMBER 2018

Driving into Floodwater

A systematic review of risks, behaviour and mitigation

Mozumdar Arifa Ahmed[1], Katharine Haynes[1,2], Mel Taylor[1,2] and Matalena Tofa[1,2]

1. Macquarie University
2. Bushfire and Natural Hazards CRC

Statement of purpose: The Research into practice brief series provides concise summaries of research findings for endusers and practitioners. The material for this brief is adapted from the academic journal publication: Ahmed, M.A., Haynes, K., Taylor, M. (2018). Assessing the risks of driving into floodwater: A systematic review.International Journal of Disaster Risk Reduction. 31, pp953-963

Macquarie University NSW 2109 Australia ABN 90 952 801 237

Mel Taylor: mel.taylor@mq.edu.au
Katharine Haynes: katharine.haynes@mq.edu.au

CRICOS Provider 00002J

@bnhcrc
www.bnhcrc.com.au

AIM

This review aims to compare and document the international research on driving into floodwater; identify risk factors; document theoretical models used to explain people's risky behaviours; and identify intervention strategies utilised or proposed.

METHOD

The review utilised a systematic literature review methodology. This is different to a standard literature review as it employs rigorous methods to identify, appraise and synthesise the data. A systematic review enables a complete review of all available literature and is able to be replicated by others. A systematic review protocol was prepared and registered in PROSPERO.

The protocol states the objectives, questions, inclusion and exclusion criteria, and intensive search strategies. Search terms included 'flood', 'risk', 'drowning', 'driving' and 'vehicles', and articles published before 31 August 2017 were included. A total of 968 titles, 430 abstracts and 52 full texts were reviewed. Of these, 24 peerreviewed articles met the selection criteria.

RISK FACTORS IDENTIFIED

Risk factors identified in the 24 studies were classified into seven categories:

Reasons for driving into floodwater:

- Continuing intended travel, traveling home, commuting to or from work or an appointment, visiting, evacuating, to rescue someone, to recover something.

Demographic factors:

- Gender: Majority of the fatalities are males.
- Age: Those <29, although two studies identified higher ages. USA, 20-69 (Kellar and Schmidlin 2012). Greece, 40-69 (Diakakis and Deligiannakis, 2013).

Situational factors:

- Road type and characteristics: the absence of barricades, absence of lighting, dipping road grade, lack of curb and guttering, and the inability of motorists to easily turn around (Gissing et al., 2017).
- Catchment: small upstream (increased rate of rise) (Gissing et al., 2017).
- Type of vehicle: increasing numbers of 4WD and SUV.
- Road familiarity and distance to travel: familiarity may embolden, majority of fatalities occurred within 20 km of the individual's home (Haynes et al., 2017), however one study also identified that those on a long journey were most likely to incorrectly judge levels of risk (Ruin et al., 2007).

Environmental factors:

- Time of day: most fatalities occurred at night, dawn or dusk when visibility is poor (Haynes et al., 2017).
- Seasons: in Australia, a seasonal trend is identified associated with the wet season and summer storms (Haynes et al., 2017).

Flood risk indicators:

- The influence of road signs, height or water depth indicators, barricades, and warning and education campaigns have not been well evaluated (Haynes et al., 2017).

Social factors:

- Avoiding isolation and being stranded, behaviour of other drivers; and security of others being present if rescue was needed (Pearson and Hamilton, 2014).
- Influence of others: pressure from other drivers; encouragement by passengers. In an Australian study drivers were alone in the vehicle in 58% of cases, the remaining 42% of drivers drove into floodwaters with passengers in the vehicle (Peden et al., 2017). Individual factors:
- Personal beliefs, past experience, self-efficacy, confidence, risk perceptions and drug/alcohol use

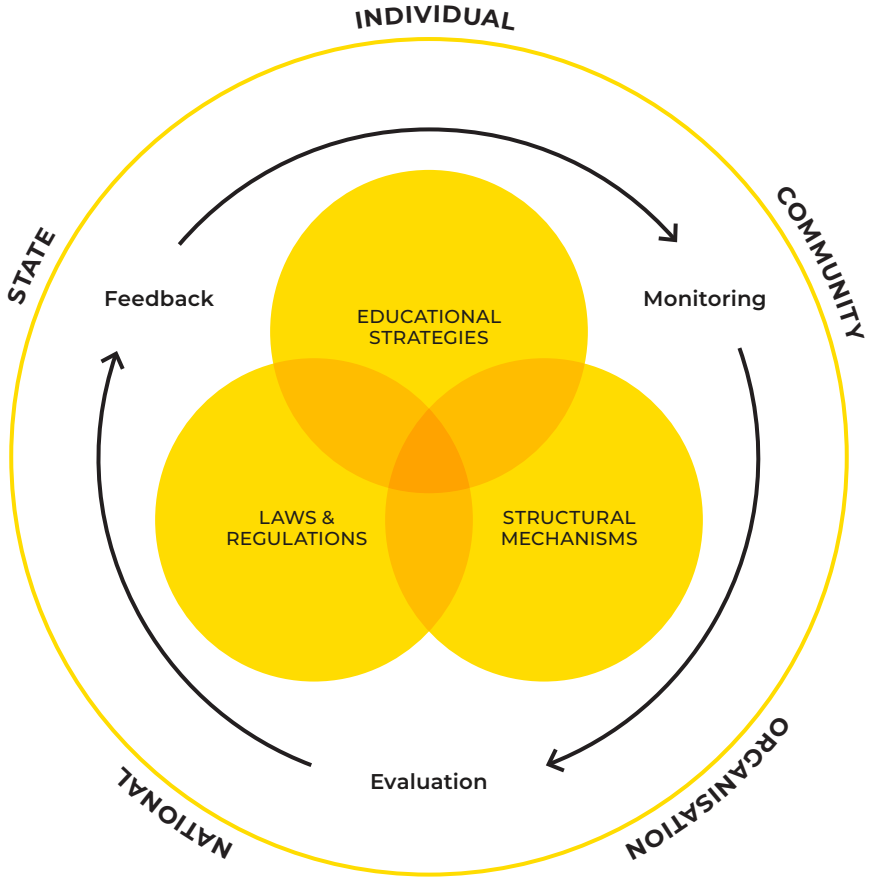

Figure 1: Proposed integrated intervention model to reduce the risk of people driving into floodwater

THEORETICAL MODELS USED

The only model used to explain risky driving behaviours in the context of flooded waterways is the Theory of Planned Behaviour (TPB) (Pearson & Hamilton, 2014; Hamilton et al., 2016). The original TPB model by Ajzen (1991) considers:

- Attitude: overall positive/negative evaluations of performing the behaviour
- Subjective Norm: perceived social pressure from important others
- Perceived Behavioural Control: perceived amount of control over performance

To these, a measure of 'willingness' to drive into floodwater from the prototype willingness model (PWM), perceptions of risk from the Health Belief Model (HBM), and past behaviour have been added (Pearson & Hamilton, 2014; Hamilton et al., 2016).

INTERVENTION STRATEGIES UTILISED OR PROPOSED

Based on this systematic review, we propose an integrated systems approach (Figure 1) to address the seven risk factors. Three major intervention strategies are used together:

- Educational initiatives for awareness building;
- Structural developments through advanced technology and equipment for improving decision accuracy; and
- Law and regulation activities.
- Monitoring and evaluation of the three strategies should occur at five levels: individuals (public, workers, employees); communities and local government (e.g. local authorities, council, community groups and clubs); organisations (e.g. corporates, insurance companies, financial institutions); state (e.g. police, state emergency services, hospitals); and national (e.g. government ministries, policy makers, implementers, and planners).

REFERENCES AND FURTHER READING

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179-211. doi:http://dx.doi.org/10.1016/0749- 5978(91)90020-T

Ahmed, M.A., Haynes, K., Taylor, M. (2018). Assessing the risks of driving into floodwater: A systematic review. International Journal of Disaster Risk Reduction. 31, pp953-963

Diakakis, M., and Deligiannakis, G. (2013). Vehiclerelated flood fatalities in Greece. Environmental Hazards, 12(3-4), 278-290. doi:10.1080/17477891.2013.832651

Gissing, A., Tofa, M., Opper, S. & Haynes, K. (2017) Influence of road characteristics on flood fatalities in Australia. Report for the Bushfire and Natural Hazards CRC.

Hamilton, K., Peden, A. E., Pearson, M., and Hagger, M. S. (2016). Stop there's water on the road! Identifying key beliefs guiding people's willingness to drive through flooded waterways. Safety Science, 89, 308-314. doi:http://dx.doi.org/10.1016/j.ssci.2016.07.004

Haynes, K., Coates, L., van den Honert, R., Gissing, A., Bird, D., Dimer de Oliveira, F., . . . Radford, D. (2017). Exploring the circumstances surrounding flood fatalities in Australia—1900–2015 and the implications for policy and practice. Environmental Science and Policy, 76, 165-176. doi:https://doi.org/10.1016/j.envsci.2017.07.003

Kellar, D. M. M., and Schmidlin, T. W. (2012). Vehiclerelated flood deaths in the United States, 1995- 2005. Journal of Flood Risk Management, 5(2), 153-163. doi:10.1111/j.1753-318X.2012.01136.x

Pearson, M., and Hamilton, K. (2014). Investigating driver willingness to drive through flooded waterways. Accident Analysis and Prevention, 72, 382-390. doi:http://dx.doi.org/10.1016/j.aap.2014.07.018

Peden AE, Franklin RC, Leggat P, Aitken P. Causal Pathways of Flood Related River Drowning Deaths in Australia. PLOS Currents Disasters. 2017 May 18 . Edition 1. doi: 10.1371/currents.dis.001072490b201118f0f689c0 fbe7d437

Ruin, I., Gaillard, J.-C., and Lutoff, C. (2007). How to get there? Assessing motorists' flash flood risk perception on daily itineraries. Environmental Hazards, 7(3), 235-244.

KEY PAPERS PUBLISHED SINCE THE REVIEW:

Hamilton et al (2018) Changing people's attitudes and beliefs toward driving through floodwaters- Evaluation of a video infographic- Transportation Research Part F: Traffic Psychology and Behaviour, 53, Feb 2018: 50-60. https://www.sciencedirect.com/science/journal/13 698478/53/supp/C"

This study designed and evaluated a video infographic that highlights the dangers of driving through floodwaters. The study identified that the infographic was effective in reducing positive attitudes and social pressure to drive into floodwaters immediately after watching the video.

Hamilton et al (2017) Drivers' experiences during floods- Investigating the psychological influences underpinning decisions to avoid driving through floodwater. International Journal of Disaster Risk Reduction. Dec 2017: https://www.sciencedirect.com/science/journal/22 124209

This study utilised the theory of planned behaviour to explore drivers' experiences and beliefs with respect to driving through floodwater. Gender (females), attitude, subjective norm, and perceived behavioural control were identified as the most important factors in terms of making a decision not to drive through floodwater.

FLOOD RISK COMMUNICATION

This research is funded by the Bushfire and Natural Hazards CRC and is led by Dr Mel Taylor and Dr Katharine Haynes. This project will develop an understanding of the motivations, beliefs, decision making processes and information needs of at-risk groups for flood fatalities, specifically those who drive or recreate in floodwater.

For more information, please see: www.bnhcrc.com.au/research/floodriskcomms