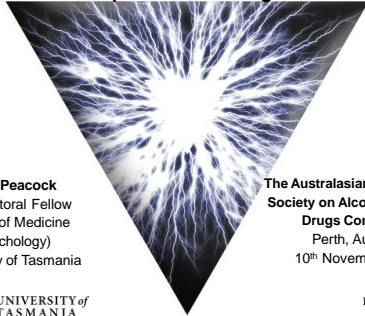


## A Mixed Hazard? Alcohol, Caffeinated Energy Drinks and the Consequences Of Co-Ingestion



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**The Australasian Professional  
Society on Alcohol and other  
Drugs Conference**  
Perth, Australia  
10<sup>th</sup> November, 2015

**FACULTY OF  
HEALTH**

## Declarations Funding

Study	Funder	Study	Funder
Peacock et al. (2012)	UTAS	Peacock et al. (2014)	ATDC (funding); Red Bull (placebo samples)
Peacock et al. (2013)	UTAS	Peacock et al. (2014)	-
Peacock et al. (2013)	-	Peacock & Bruno (2015)	UTAS
Peacock & Bruno (2013)	-	Peacock et al. (2015)	UTAS
Peacock et al. (2013)	UTAS funding	Peacock et al. (2015)	NSW Health; ARC, VicHealth
Lubman et al. (2013)	NSW Health	Peacock et al. (2015)	NSW Health; Deakin University
Peacock et al. (2013)	ATDC (funding); Red Bull (placebo samples)	Peacock et al. (2015)	Australian Government

## Energy Drinks (EDs) Background

- Functional beverages promoted as enhancing performance
- First products launched in Australia in 1997 (V® energy drink) and 1999 (Red Bull®)
- One in ten Australians report consuming EDs in the past 3 months, with 37% of 18-24 year olds reporting such use (Pennay et al. 2015)
- Research findings support marketing claims of heightened energy and enhanced performance post-consumption (Anderson, 2007; Childs & de Wit, 2008; Seidl, Payri, Nicham, & Hauser, 2000; Smit, Cotton, Hughes, & Rogers, 2004; Smit & Rogers, 2002)



## Energy Drinks (EDs) Ingredients

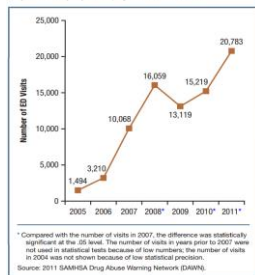
Ingredient (mg per 250mL)						
<b>Caffeine (mg)</b>	80	80	80	77.5	26	833 (207mg per 60mL)
<b>Taurine (mg)</b>	1000	1000	1000	-	-	?
<b>Glucuronolactone (mg)</b>	600	300	5	-	-	?
<b>Sugar (g)</b>	27	26	27	4	26.5	-

### Food Standards Australia and New Zealand:

- Caffeine content:** maximum of 320mg/L caffeine, or 80mg per 250mL
- Recommended maximum intake:** two standard 250mL EDs (160mg caffeine)

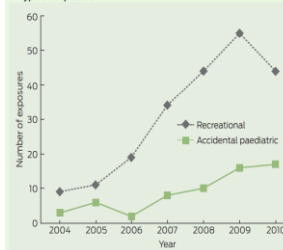
## Energy Drinks (EDs) Harms

Figure 1. Energy Drink-Related Emergency Department (ED) Visits, by Year: 2005 to 2011



SAMSHA (2011). DAWN Report

1 Annual number of energy drink exposures reported to the NSW Poisons Information Centre, Jan 2004 – Dec 2010, by type of exposure



Gunja & Brown (2012). MJA

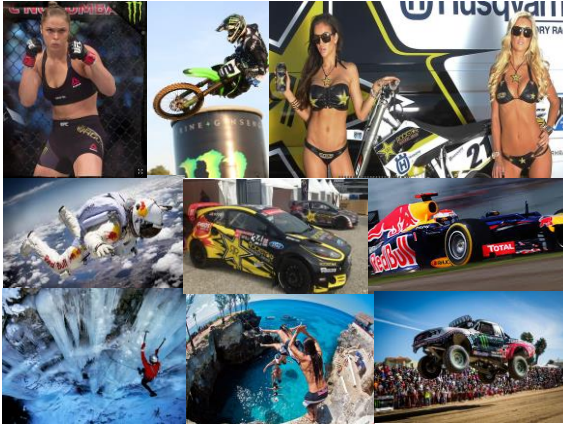
## Energy Drinks (EDs) Harms

### Primary causes:

- Excess consumption
- Concomitant with other psychoactive substances
- Use by 'vulnerable' consumers (children, pregnant women, those sensitive to caffeine)
- With pre-existing medical condition

### Presentation:

**Caffeine intoxication:** nervousness, restlessness, insomnia, gastrointestinal upset, diuresis, difficulty concentrating, muscular twitching, tachycardia or cardiac arrhythmia, and psychomotor agitation



### AmED: Alcohol Mixed with Energy Drink Definition

- Co-ingestion of alcohol with EDs in the same drinking session. For example:

1. Mixing alcohol and ED within the same beverage
2. Having a shot of spirits with an ED chaser
3. Having the alcohol and ED as separate drinks in the same session



MamaMia

### The 10 ways you know that you've truly reached your late 20s.

Sophistication in drunkenness.



Parents still searching for answers a year on

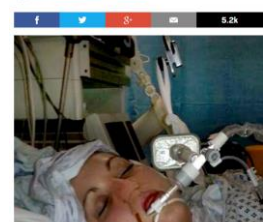
Parents still searching for answers a year on



Two 16-year-old girls wander through a suburban shopping centre, one gesturing about a party she is going to that night, the other agreeing over which shoes to buy for the school formal.

### Teenager suffered three heart attacks from energy drinks in 10 Jagerbombs

Richard Harding, Publisher for Metro.co.uk



### Briton died after downing dozens of vodka and Red Bull cocktails on holiday booze binge

18:55, 22 AUG 2014 UPDATED 18:55, 22 AUG 2014 BY JONATHAN SYMONDS

Tragic Adam Walker, 22, was found dead on his hotel bed in Malia, Crete on June 6 by his friend Damien Farmer



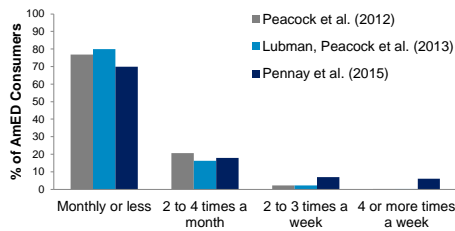
## Consumption Patterns

### AmED: Alcohol Mixed with Energy Drink Prevalence of Use

Study	N	Sample	%
			<b>Tonight</b>
Pennay et al. (2015)	4227	Australian licensed venue patrons	21
Verster et al. (2015)	913	Dutch licensed venue patrons	20
			<b>Last month</b>
Brache & Stockwell (2011)	465	Canadian university students	23
O'Brien et al. (2008)	4721	US university students	24
Oteri et al. (2007)	450	Italian university students	48
Snipes et al. (2013)	704	US university students	19
Velazquez et al. (2012)	585	US university students	15
			<b>Last 3 months</b>
Pennay et al. (2015)*	2,000	AUS population - aged 18-95	5
		- aged 18-24	20
			<b>Last 6 months</b>
Azagba et al. (2013)*	36,155	Canadian school students	20
Berger et al. (2013)	606	US university students	65
Peacock et al. (2013)	693	Australian regular ecstasy users	70
Peacock et al. (2015)	963	Australian community	42
Woolsey et al. (2010)	401	US university students	37

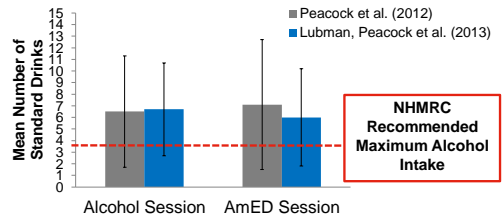
\*representative sample

### AmED: Alcohol Mixed with Energy Drink Frequency of AmED Use



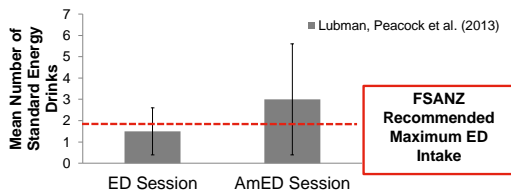
\*AmED consumers typically use alcohol (without ED) fortnightly to 2-3 times a week.

### AmED: Alcohol Mixed with Energy Drink Typical Alcohol Intake



- International research contradictory as to whether intake is **greater** in AmED sessions (Brache & Stockwell, 2011; Price et al., 2010) or **lower** in AmED sessions (de Haan et al., 2012; Johnson et al., 2015; Woolsey et al., 2010)
- Two-thirds (66%) typically have AmED during perceived 'heavy drinking sessions'

### AmED: Alcohol Mixed with Energy Drink Typical Energy Drink Intake

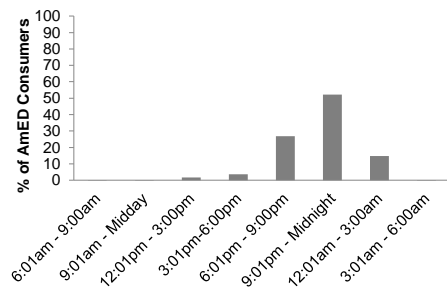


- Guideline awareness is associated with **greater** likelihood of exceeding intake guidelines
- Strongest correlates of exceeding intake guidelines are:
  - Greater frequency of use, and
  - Exceeding NHMRC alcohol intake guidelines

**Guideline knowledge does not predict compliance with intake guidelines**

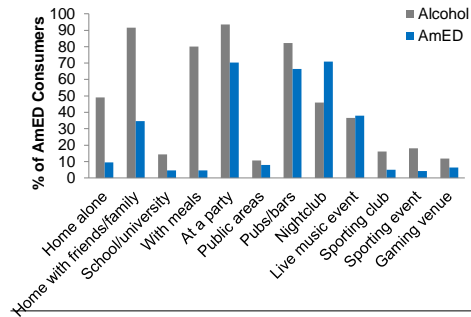
Peacock et al. (under review)

### AmED: Alcohol Mixed with Energy Drink Typical Time Commence AmED Use



Peacock et al. (2013). Psych of Addict Behav

### AmED: Alcohol Mixed with Energy Drink Settings for AmED Use



Lubman, Peacock et al. (2013). NSW Report.

## Motivations for Use

### AmED: Alcohol Mixed with Energy Drink Consumption Patterns: Summary

- Small proportion of Australian population report recent AmED use
- Higher rates of use amongst groups characterised by heavier alcohol consumption (e.g., university students, people who use illicit drugs)
- Lower frequency of use than alcohol but excess ED consumption when combined
- Awareness of intake guidelines does not necessarily translate into healthier decisions in regards to ED intake
- Consume AmED late at night in risky settings

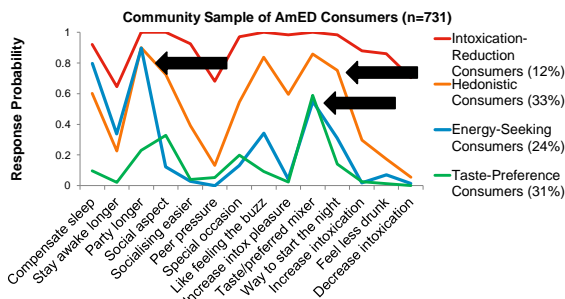
### AmED: Alcohol Mixed with Energy Drink Motivations for Use

#### Main types of motivations include:

1. Hedonistic: sensation- or pleasure-seeking
  - Like the taste
  - Increase pleasure/intensity of intoxication
2. Social: peer relations and group norms
  - Peer pressure
  - Special occasion
3. Energy/endurance: functional outcomes
  - To party for longer
  - Compensate for fatigue
4. Intoxication-reduction: control of intoxication experience
  - To feel less drunk
  - To reduce intoxication

Droste et al. (2014). ACER.

### AmED: Alcohol Mixed with Energy Drink Motivations for Use



Peacock et al. (2015). ACER.

### AmED: Alcohol Mixed with Energy Drink Motivations for Use

#### Hedonistic motives associated with:

- Heavy alcohol consumption ( $\geq 6$  and  $11+$  drinks) in AmED sessions
- Heavy ED consumption ( $\geq 3$  and  $5+$  drinks) in AmED sessions
- Increased risk of hazardous drinking (AUDIT-C score  $\geq 4$ )
- Experience of physical/verbal/sexual aggression
- Experience of alcohol-related accident or injury

#### Intoxication-reduction motives associated with:

- Experience of alcohol-related accident or injury

Droste et al. (2014). ACER.

## AmED: Alcohol Mixed with Energy Drink

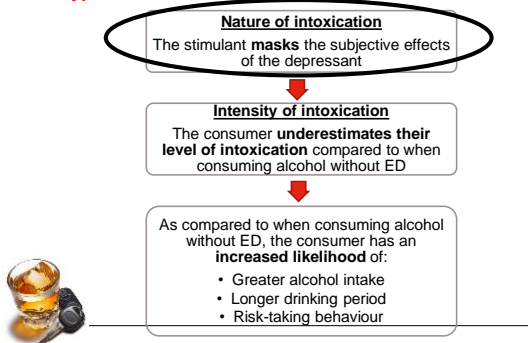
### Motivations: Summary

- Primary motivations for use revolve around taste and functional outcomes (i.e., seeking energy)
- A smaller proportion of consumers report hedonistic and intoxication-reduction motives (i.e., use to enhance/decelerate intoxication)
- Hedonistic and intoxication-reduction motives associated with heavier drinking and harms
  - Role of the individual
  - Based on assumption of interactive effects of substances

## Consequences of Use

## AmED: Alcohol Mixed with Energy Drink

### Hypothesised Effects: 'Wide-Awake Drunkenness'



### Within-Subject Retrospective Self-Report of Outcomes in AmED Versus Alcohol Sessions (Survey)

	de Haan et al. (2012)	Peacock et al. (2012)	Woolsey et al. (2010)
Tremors		↑	
Irregular heartbeat		↑	
Rapid heartbeat		-	↑
Increased speech		↑	
Inability to sleep		↑	↑
Agitation		↑	
'Jolt and crash episode'		↑	
Nausea	↓	↓	
Alterations in vision		↓	
Alteration in walking		↓	
Speech slurred		↓	
Dizziness		=	↓
Vomiting		=	
Perspiration		=	
Salivation		=	
Headache		=	

Intoxication Cues

↑ more likely in AmED sessions; ↓ less likely in AmED sessions Peacock et al. (2014). *Addiction*

### Within-Subject Self-Report of Outcomes after Blinded AmED Versus Alcohol Administration (Lab)

	Alford (2012)	Ferreira (2006)	Marczinski (2011)	Marczinski (2012)	Marczinski (2013)	Peacock (2013)	Benson (2014)
<b>Stimulatory Mood</b>							
Stimulation			=	↑	↑	↑	
Alert	↓						=
Energetic	↓						=
<b>Sedation Mood</b>							
Sedation				=	=	=	
Fatigue	↑	=		↓		=	=
Clumsy	↑						
Confused	↓						=

↑ higher ratings after AmED administration; ↓ lower ratings after AmED administration

Peacock et al. (2014). *Addiction*

## AmED: Alcohol Mixed with Energy Drink

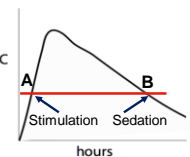
### Experimental Research

- Generalisation of doses administered to real-world consumption (Peacock et al., 2013; 2014)



- Generalisation of testing points to real-world drinking experience

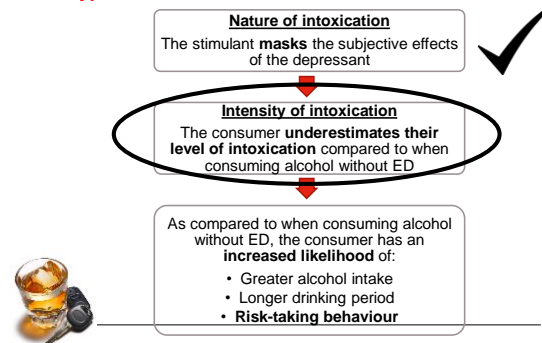
- Stimulant effects at low BAC on the ascending limb; sedative effects at higher BACs and on the descending limb



### AmED: Alcohol Mixed with Energy Drink Summary: Nature of Intoxication

- Generally, support for a change in the nature of intoxication via increased stimulation
- Energy drink as the driver of increased stimulation at high doses?
  - Small magnitude difference between alcohol administered alone and in combination with ED ingredients
- Great likelihood of adverse stimulation-based side effects?
  - Dose threshold at which these occur is unknown

### AmED: Alcohol Mixed with Energy Drink Hypothesised Effects

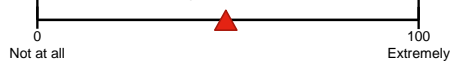


### AmED: Alcohol Mixed with Energy Drink Perceived Intensity of Intoxication

- Inferred based on early findings of Ferreira et al. (2006):
  - Lower 'headache' ratings
  - Lower 'dry mouth' ratings
  - Lower 'alterations in motor co-ordination' ratings
- \*similar ratings on 15 other indices

- Subsequent research assessing subjective intoxication involves:

How intoxicated are you right now?



Please indicate your perceived maximum of level of intoxication by indicating the total number of standard alcoholic drinks you estimate were contained in the beverage(s) you have been administered.



Study name	Statistics for each study						Std diff in means and 95% CI
	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value p-Value	
Filmore & Vogel-Sprott (1999)	0,010	0,378	0,143	-0,731	0,751	0,027 0,978	
Filmore et al. (2002)	0,307	0,538	0,289	-0,747	1,360	0,570 0,568	
Marciniak & Filmore (2006)	-0,618	0,307	0,095	-1,121	0,084	-1,686 0,092	
Marciniak et al. (2011)	-0,180	0,379	0,143	-0,922	0,562	-0,476 0,634	
Howland et al. (2011)	0,500	0,257	0,066	-0,005	1,005	1,942 0,052	
Marciniak et al. (2012)	-0,169	0,334	0,112	-0,823	0,486	-0,506 0,613	
Marciniak et al. (2013)	-0,563	0,322	0,104	-1,195	0,069	-1,746 0,081	
Heitz et al. (2013)	-0,346	0,169	0,028	-0,616	-0,016	-2,053 0,040	
Peacock et al. (2013)	-0,129	0,193	0,037	-0,250	0,508	0,667 0,505	
	-0,105	0,126	0,016	-0,351	0,141	-0,835 0,404	

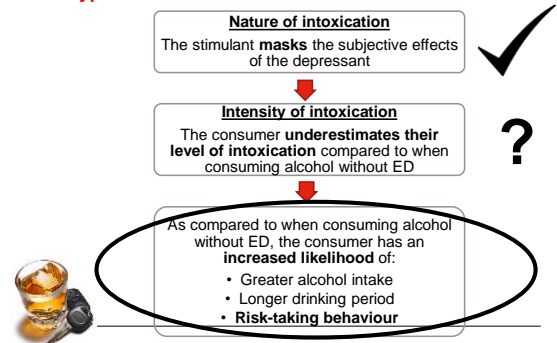


Benson et al. (2014). *Neuroscience and Biobehavioral Reviews*

### AmED: Alcohol Mixed with Energy Drink Summary: Perceived Intensity of Intoxication

- Currently no evidence of reduced intensity of intoxication at low ED doses (~ one 250mL ED)
- Sugar as the driver of reduced intoxication at higher doses similar to those consumed in the real world (i.e., three 250mL ED)
- Evident for other sugar-sweetened beverages commonly mixed with alcohol (eg. soft-drinks, fruit-juice)?

### AmED: Alcohol Mixed with Energy Drink Hypothesised Effects



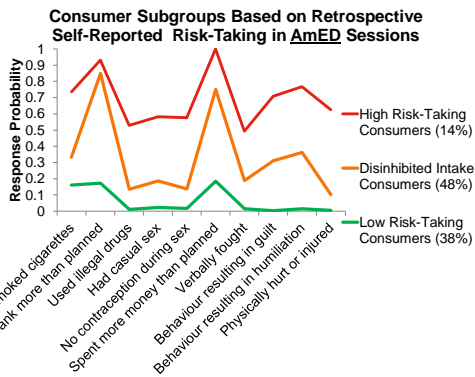
### AmED: Alcohol Mixed with Energy Drink Risk-Taking Behaviour

*"Drank too much at a mate's birthday party. Was drinking energy drink and spirits mixed. Couldn't remember some of night. Woke up in a bucket."*

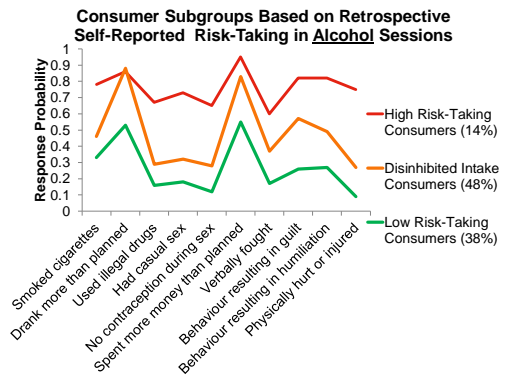
	de Haan et al. (2012)	Peacock et al. (2012)	Woolsey et al. (2010)
Drove after drinking	↓	↓	↓
Had sex with someone recently met		↓	
Got into sexual situation later regretted	↓		
Spent more money than planned		↓	
Gambled		↓	
Verbally fought	↓	↓	
Acted aggressively			↓
Physically fought	=	↓	=
Cautioned by police		↓	
Smoked cigarettes		↓	
Drank more alcohol than planned		↓	
Used illegal drugs		↓	
Passed out		↓	
Physically hurt/injured	↓	↓	=
Behaved in way that caused guilt	↓	↓	
Behaved in way that caused humiliation	↓	↓	

↓ less likely during AmED versus alcohol sessions

Peacock et al. (2014). *Addiction*



Peacock et al. (2015). *Addictive Behaviours*



Peacock et al. (2015). *Addictive Behaviours*

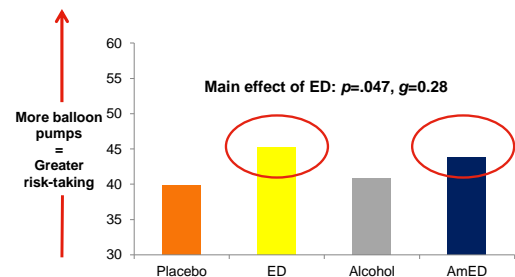
### Correlates of Retrospectively Self-Reporting Risk-Taking Behaviour after AmED Use (Controlled for Frequency AmED/Alcohol Use)

	ED Intake (AmED sessions)	Alcohol Intake (AmED sessions)	Engaged in the behaviour after alcohol
Smoked cigarettes	=	=	Y
Drank more alcohol than planned	=	Y	Y
Used illegal drugs	=	Y	Y
Did not use contraception	Y	=	Y
Drove after drinking	Y	=	Y
Passenger with drunk driver	Y	=	Y
In vehicle speeding	=	=	Y
Spent more money than planned	=	=	Y
Gambled	=	=	Y
Verbally fought	Y	=	Y
Physically fought	=	=	Y
Passed out	=	=	Y
Physically hurt/injured	Y	=	Y
Behaved in way > guilt	=	=	Y
Behaved in way > humiliation	=	=	Y

Y=significant correlate; **bold**=largest magnitude association

Peacock et al. (2015). *ACER*

- Placebo = soda water and syrup
- ED = 250mL energy drink
- Alcohol = .050% BrAC
- AmED = .050% BrAC + 250mL energy drink



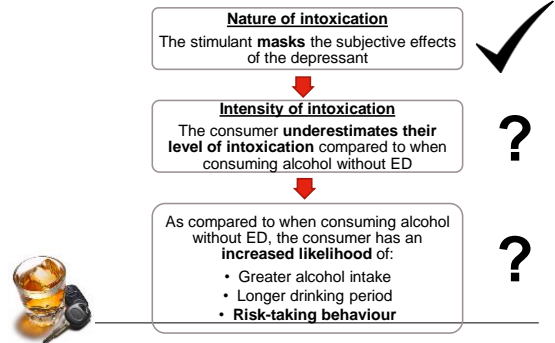
Peacock et al. (2013). *ACER*

### AmED: Alcohol Mixed with Energy Drink Summary: Risk-Taking Behaviour

- Small proportion of consumers report engaging in high-risk behaviours post-consumption
- People who engage in risky behaviours when drinking alcohol are more likely to engage in risky behaviours when using AmED (even after controlling for intake)
- Greater typical ED intake during AmED sessions associated with likelihood of some risk behaviours

Potential interaction of individual characteristic and beverage consumption effects?

### AmED: Alcohol Mixed with Energy Drink Hypothesised Effects



## Where to from here?

### AmED: Alcohol Mixed with Energy Drink Where to from here?

1. Move beyond retrospective surveys and the laboratory into the field
2. Establish whether AmED is unique in regards to risk profile relative to other sugar-sweetened and/or caffeinated alcohol mixers
3. Establish a dose-threshold at which the risk of stimulation-based negative side-effects increases substantially

### AmED: Alcohol Mixed with Energy Drink Where to from here?

#### Statement of Concern

THE 1<sup>st</sup> INTERNATIONAL ENERGY  
DRINKS CONFERENCE

6 - 7 November 2014 | Deakin University Waterfront, Geelong VIC

Conference Handbook

### AmED: Alcohol Mixed with Energy Drink Potential policy options?

1. Further regulation of the product composition (e.g., pre-mixed alcohol and caffeine beverages)
2. Limits on access and availability
3. Further requirements regarding product labelling (i.e., explicit warnings against co-consumption with alcohol)
4. Marketing restrictions

## AmED: Alcohol Mixed with Energy Drink

### What we do (tentatively) know?

1. AmED consumers are ingesting these beverages late at night in high-risk settings for harm and awareness of intake guidelines is not associated with more judicious use
  2. A proportion of consumers are using these beverages with the intent of enhancing/controlling intoxication
  3. AmED most likely alters the nature of intoxication, increasing stimulation (and increasing risk of negative stimulation-based side-effects)
  4. AmED may reduce perceived intoxication following excess ED intake due to the sugar content, suggesting a similar effect for other sugar-sweetener mixers
  5. AmED consumers are a high-risk subgroup of alcohol consumers, and there may be some interplay between individual (e.g., risk-taking propensity) and pharmacological (ED intake) factors in determining behaviour.
- 

## AmED: Alcohol Mixed with Energy Drink

### Acknowledgements

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- Peter Miller (Deakin)
- Amy Pennay (Latrobe)
- Dan Lubman (Turning Point)
- David Newcombe (Auckland)
- Frances Martin (Newcastle)



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