

# Just follow law: Impact of legislative interventions on cardiovascular emergencies

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# Conflict of interest declaration

I have nothing to disclose.

This line of work has been supported by:

- SingHealth Duke-NUS Academic Medical Centre
- National Medical Research Council
- Singapore Heart Foundation



**JUST FOLLOW LAW**  
**我在政府部门的日子**

**A JACK NEO FILM**  
梁智强作品



# Presentation Outline

- Legislative environment determines health outcomes
- Did smoke-free legislation reduce AMI in Singapore?
- Does smoke-free legislation reduce stroke around the world?
- Do Good Samaritan Laws increase BCPR in the real world?

### Countries/Areas With Highest Law and Order Index Scores

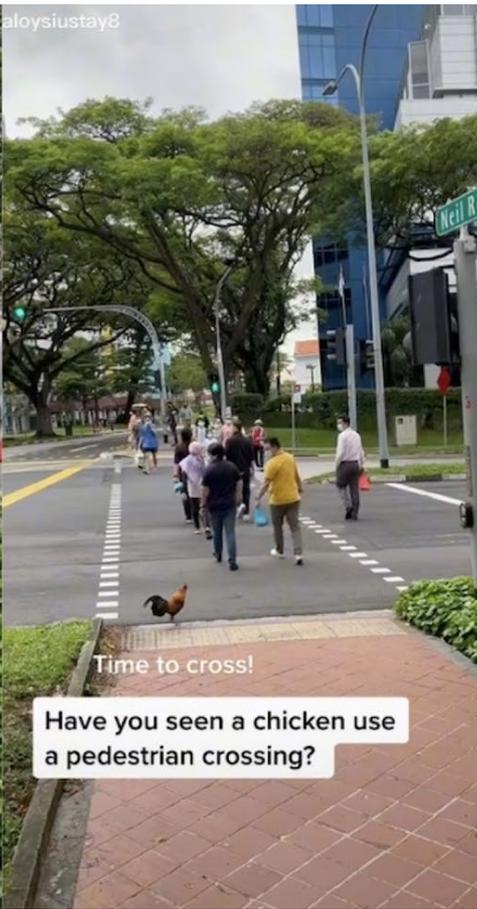
Singapore	97
Norway	93
Iceland	93
Finland	93
Uzbekistan	91
Hong Kong	91
Switzerland	90
Canada	90
Indonesia	89
Denmark	88
Slovenia	88
Luxembourg	88
Austria	88
China	88
Netherlands	88
Egypt	88

Based on Gallup World Polls, 2017

Full results for all countries available at the back of the report.



*World Justice Project Rule of Law Index 2024*



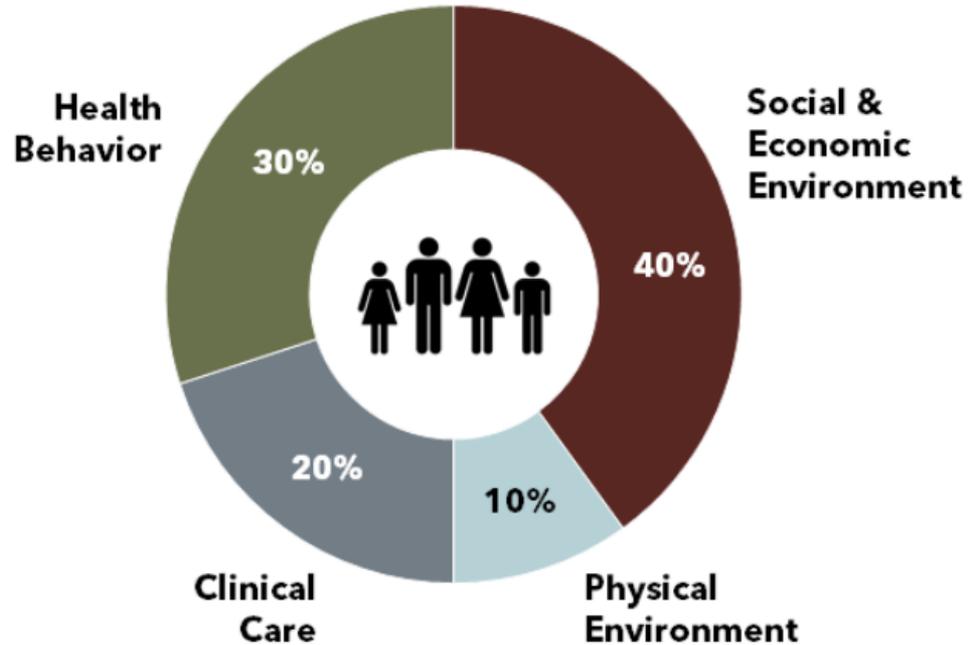
Singapore, a law-abiding nation

@aloysiustay8 on Tiktok

# Social Ecological Model



## THE DRIVERS OF HEALTH



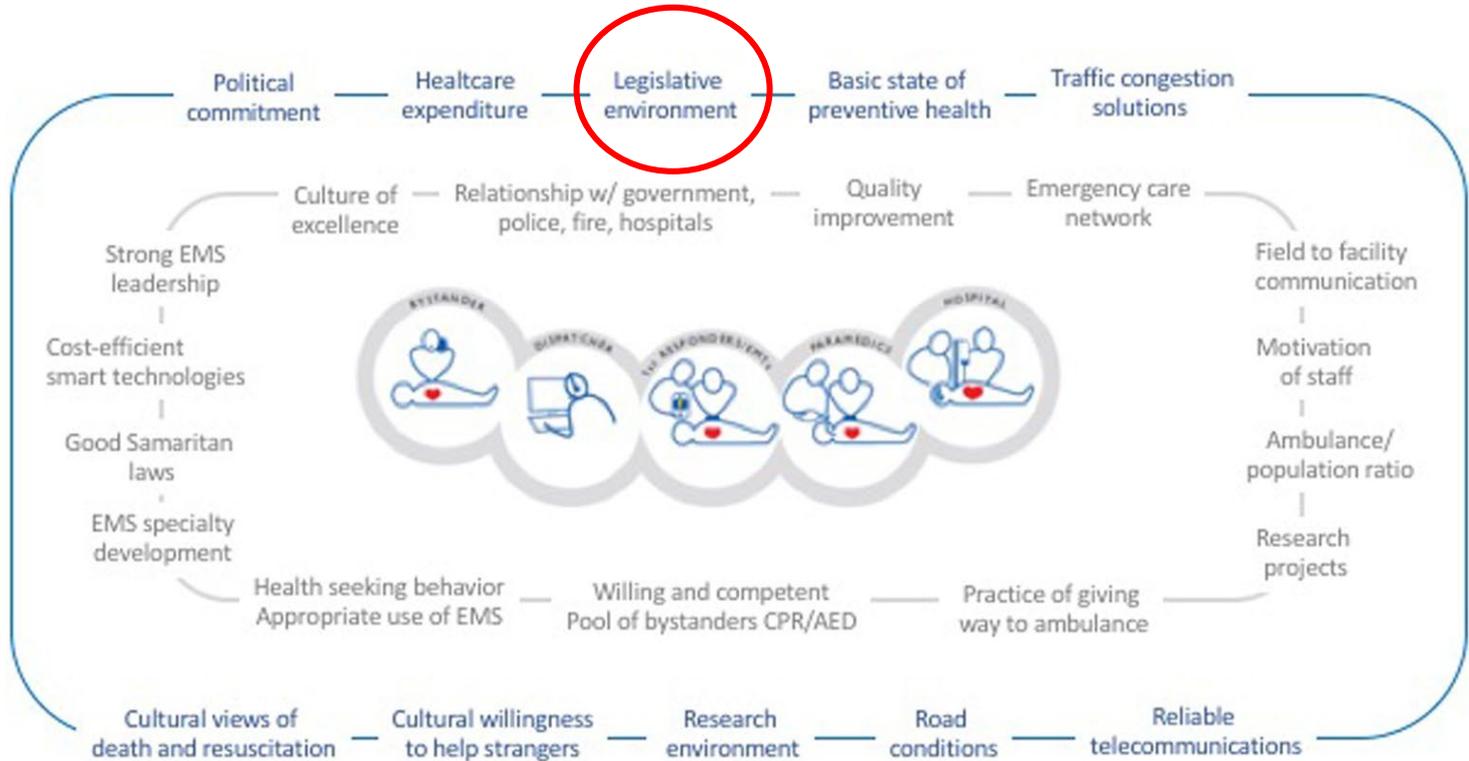
Social environment & health behaviors are the *biggest* determinants of health

# How about in emergency medical care - **cardiac arrest**?

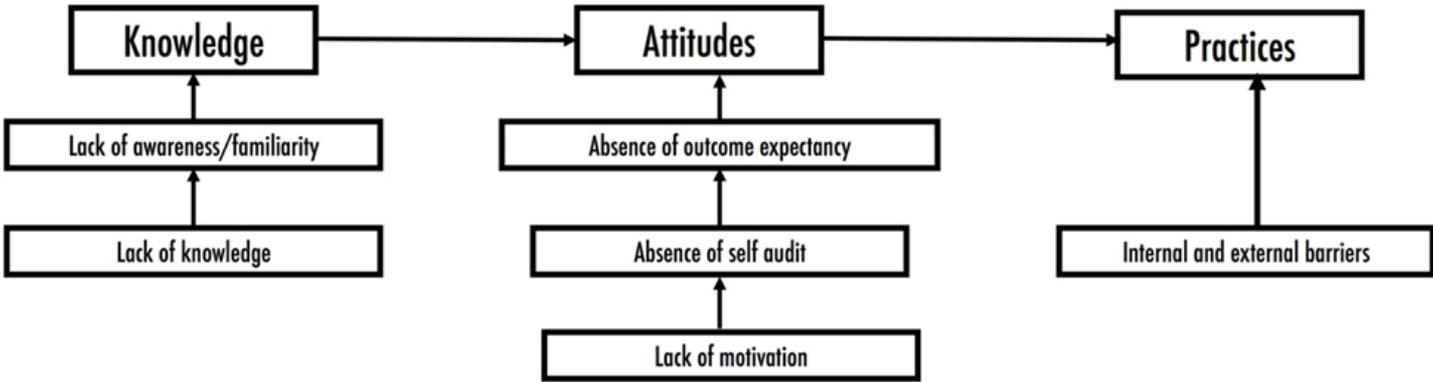


# How about in emergency medical care?

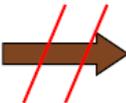
**Frame of Survival**  
for improving OHCA outcomes in developing EMS systems



# Circumventing the KAP disconnect



Example:

**Know about exercise benefits** *90%*  **exercise** *25%*

*Barriers*  
*Lack of support*  
*Lack of skills, Adverse environment*

# Study #1 of 3

Original research

BMJ Global Health

## Association between the extension of smoke-free legislation and incident acute myocardial infarctions in Singapore from 2010 to 2019: an interrupted time-series analysis

Jamie S Y Ho,<sup>1</sup> Andrew F W Ho,<sup>2,3,4</sup> Eric Jou,<sup>5</sup> Nan Liu,<sup>2</sup> Huili Zheng,<sup>6</sup> Joel Aik <sup>2,7</sup>





It is an **offence** “to inhale and expel the smoke of tobacco or any other substance and to hold any cigar, cigarette, pipe or any other form of tobacco product which is alight or emitting smoke”

Smoking (Prohibition in Certain Places) Act 1992

### List of Places Where Smoking is Prohibited

It is an offence for a person to smoke in smoking prohibited areas listed under the (Places) Regulations 2018.

1. If you are within a building or public service vehicle, it is largely not permitted to smoke in rooms and uncovered areas on the rooftops of multi-storey carparks. This includes residential building, atrium, courtyard, common corridor, lifts, lobby, void deck, and
2. If you are outside a building or public service vehicle, the following are also smoking prohibited areas:

- Everywhere around the hospital compounds
- Educational institutions and their compounds including any area within five metres of the building
- Covered linkways
- Bus stops, bus shelters, and bus poles, including any area within a five metres of the bus stop or shelter
- Parks in public housing estates managed by the respective Town Councils
- Parks under the purview of JTC Corporation
- Playgrounds and exercise areas, including adjacent amenities for users
- Reservoirs; Active, Beautiful, Clean Waters (ABC Waters) Sites; 10 Recreational Beaches
- Swimming pools, including changing and shower rooms or areas for users of the swimming pool within five metres of the swimming pool.
- Pavilions within any residential premises meant to hold functions
- Pedestrian overhead bridges, covered or underground walkways
- Washrooms, including mobile toilets
- Public areas within the Orchard Road precinct designated as a No Smoking Zone

Any area within five metres of ventilation intakes, external windows, openings, entrances, and other areas used for commercial, industrial or recreational purposes or publicly accessible where smoking is prohibited.

Please note that smoking is also prohibited at all parks, gardens and nature reserves managed by the relevant authority.

\*Smoking is prohibited at Changi Beach, East Coast Beach, West Coast Beach, Coney Island Beach, Punggol Beach, Siloso Beach, Palawan Beach, and Sentosa Beach.

### List of Areas where Smoking is Allowed\*

Smoking is allowed in the smoking facilities i.e. smoking corner, smoking room

at food retail establishments

premises, Changi Airport, public entertainment outlets.

within

s,

ew of JTC,

occupied by officers of MINDEF and

oking Zone

g is allowed:

as long as no second-hand tobacco smoke is expelled (i.e. windows are fully

wound up) in smoking prohibited places

residential estates

Unsheltered) in town centres

aces except at Orchard Road No Smoking Zone

ks except those at Orchard Road No Smoking Zone

is on the top deck of multi-storey carpark buildings except those at Orchard Road No Smoking

ways except those at Orchard Road No Smoking Zone

cept those at Orchard Road No Smoking Zone

oking is usually permitted, there are some temporary exceptions where smoking is prohibited:

per permanent or temporary

ated by manager of a place



**Correct as at 4th March 2025**

# Timeline of smoking controls (pg 1 of 2)

1992: Smoking (Prohibition in Certain Places) Act integrates previous smoking bans (buses, MRT, cinema).

1994: Smoking is banned in all air-conditioned private offices and factories.

1997: Smoking is banned on the compounds of all educational institutions - schools, junior colleges, polytechnics and covered buildings in universities.

2004: Graphic warnings on the dangers of smoking are required to be displayed on cigarette packs. Singapore ratifies the World Health Organisation Framework Convention on Tobacco Control, the first evidence-based global health treaty which came into force in 2005.

2007: Smoking is banned in all entertainment outlets including pubs, bars, dance clubs, lounges and nightclubs and their outdoor refreshment areas.

2009: All Singapore duty-paid cigarettes (SDPCs) have to be labelled with SDPC marks and vertical bars on individual sticks.

2010: Smoking cessation counselling offered in schools, with full-time nurses stationed to counsel students in secondary schools, colleges and polytechnics.

2011: Ban on sale of tobacco products in shops that sell health-related products and those that offer youth-centric products or services such as game arcades, confectioners, candy, comic and toy stores.

National anti-smoking social movement I Quit launched by Health Promotion Board (HPB). It adopts a community-based personalised approach to build a network of support for smokers to quit.

2012: Blue Ribbon initiative launched by HPB to encourage and mobilise businesses and organisations like markets, food centres and hotels to support smoke-free environments given the harm of second-hand and third-hand smoke.

# Timeline of smoking controls (pg 2 of 2)

2013: Smoke-free places expanded to include public areas in residential areas including common areas of residential buildings (common corridors, void decks, staircases, stairwells and multi-purpose halls), covered walkways and linkways, pedestrian overhead bridges, a 5m radius from the edge of bus shelters, and hospital outdoor compounds.

2014: Ban on shisha.

2015: Ban on emerging tobacco products such as smokeless cigarettes and dissolvable tobacco or nicotine.

2016: Ban on point-of-sale display, customer loyalty programmes and promotional schemes involving tobacco products.

2017: Ban on smoking in private hire cars, trishaws and excursion buses, and compounds of autonomous universities, private educational institutions and within 5m of all educational institutions; food and beverage outlets no longer allowed to apply for new smoking corners.

Ministry of Health announces plan to increase minimum legal age for smoking from 18 to 21 by 2021.

2018: Ban on e-cigarettes and vaporisers; 10 per cent increase in excise duty for all tobacco products, including clove cigarettes, and other cigarettes containing tobacco and tobacco substitutes, which are now subjected to excise duty of 42.7 cents for every gram or part thereof of each cigarette, up from 38.8 cents previously. This came after cigarette and manufactured tobacco levies went up by 10 per cent in 2014.

2019: Smoking in all public areas within Orchard Road precinct prohibited, but there are more than 50 designated smoking areas.

# Did expansion of smoking control reduce AMI 2010-2019?

- Countries that enacted smoke-free laws have reported respiratory health benefits
- Majority of studies examined *indoor* smoking bans
- Our previous studies found that air quality triggered AMI within 4 days
- Did the series of smoking controls in Singapore reduce AMI incidence?
- Did certain subpopulations benefit more?



2013



2016

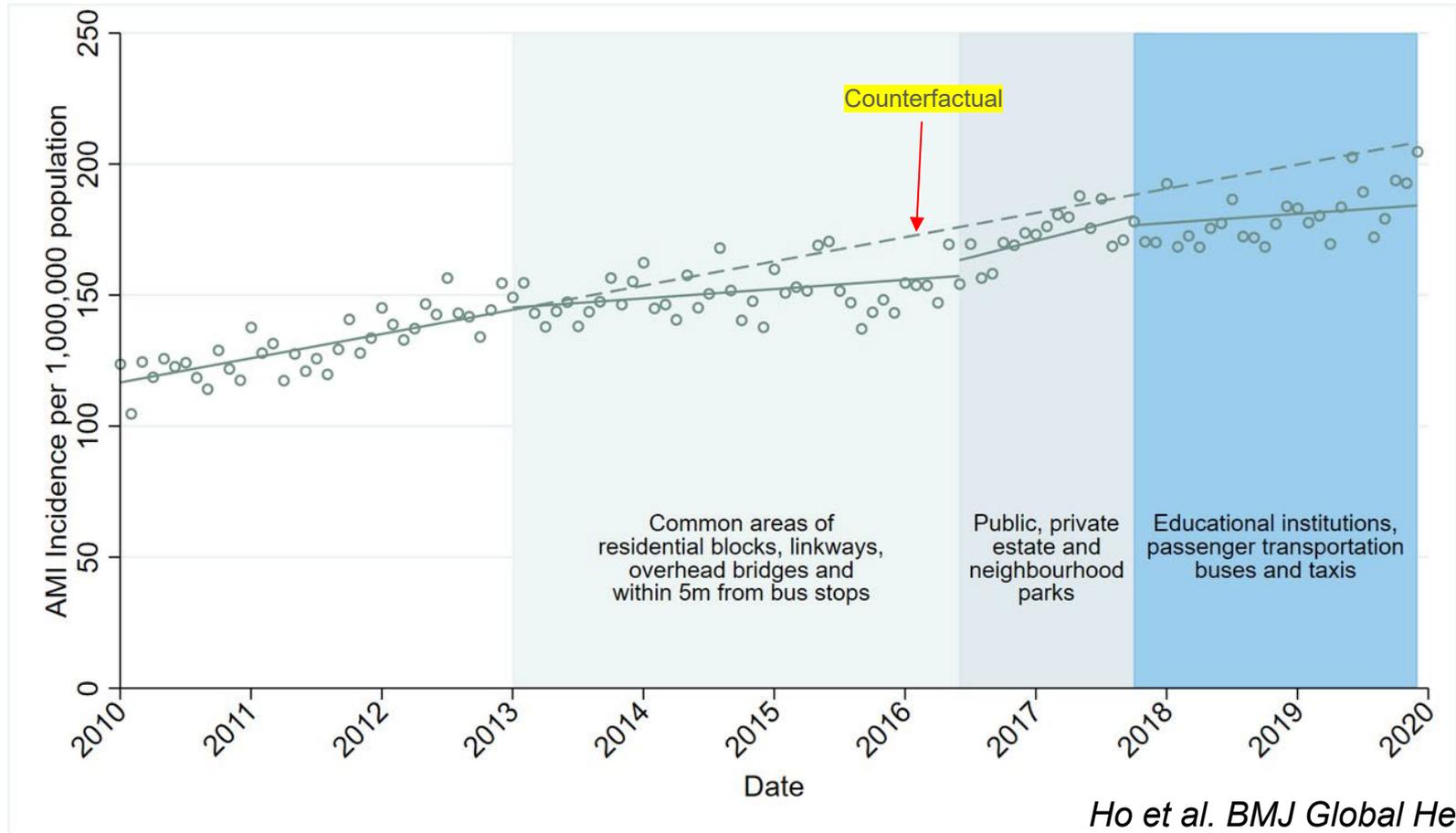


2017

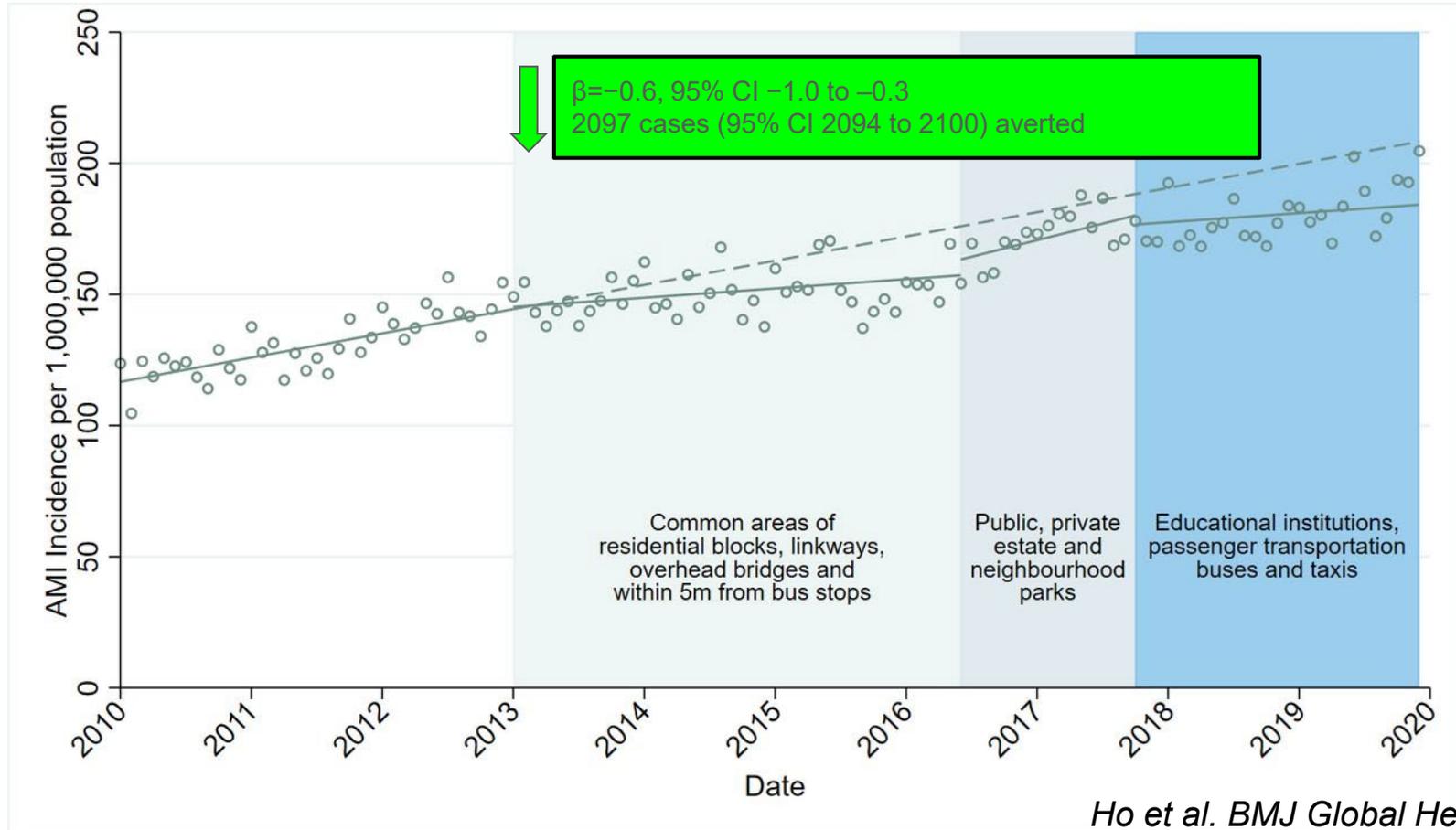
# Methods

- Singapore MI registry (2010-2019)
  - Mandatory notification by law
- Interrupted time-series, with SARIMA models
- Accounted for monthly population size (from mid-year estimate)
- Accounted for prevalence of obesity, hypertension, diabetes, hyperlipidemia
- Accounted for prevalence of smoking (eg 13.9% in 2010, 10.1% in 2020)
- Accounted for tobacco retail prices
- Assessed effect modification by age & sex

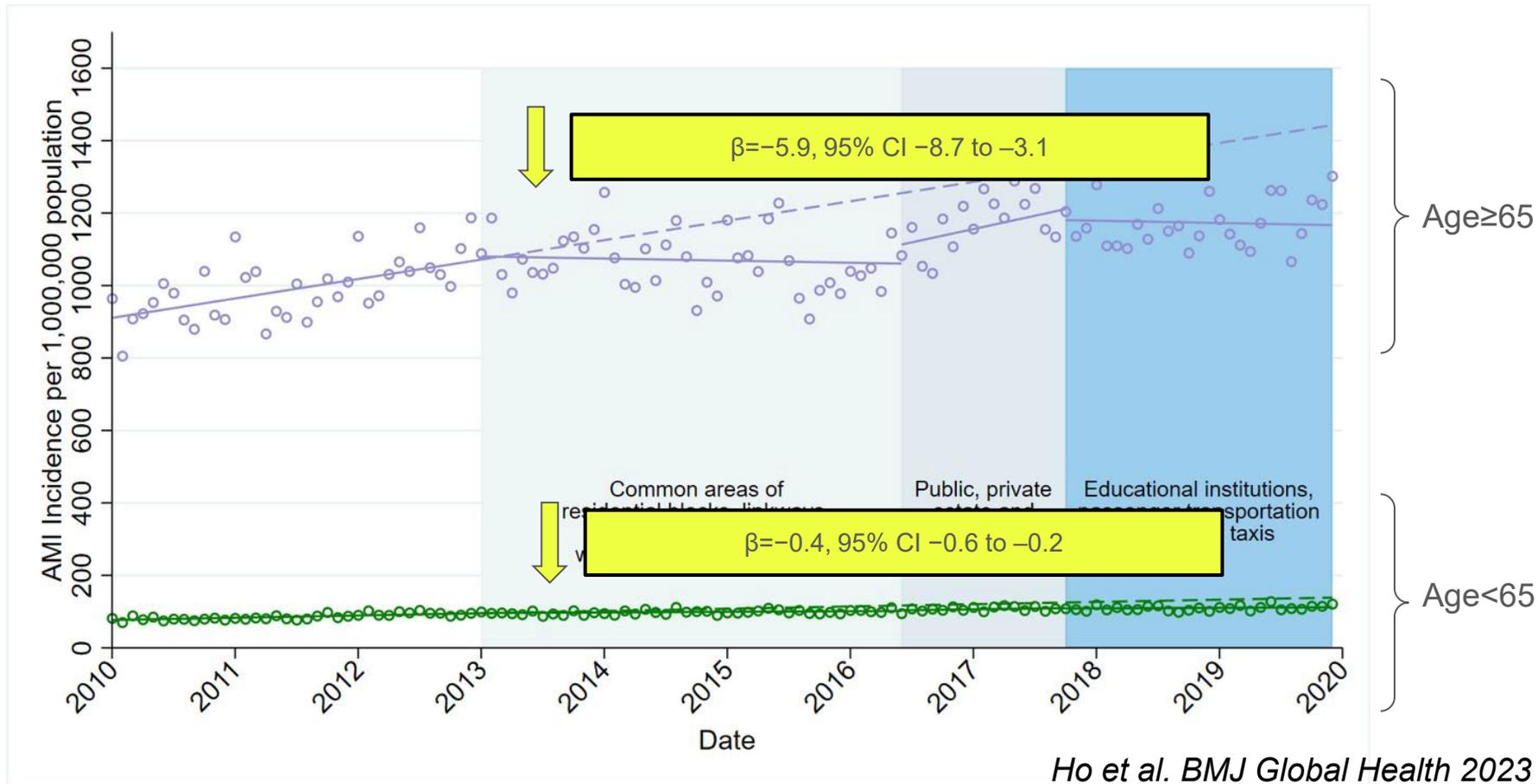
# Interrupted time series (1)



## Interrupted time series (2)



# Effect modification by age



# Findings

- AMI incidence fell following the 2013 smoking ban to housing estates (common areas, pedestrian linkways, overhead bridges, bus stops)
- Averted 2097 (95% CI 2094 to 2100) cases over 10 years
- Further expansion to parks, schools, buses and taxis did not show further protection
- Non-significant increase in AMI in 2016 was unexpected (related to hs-TnT assay rolled out in 2014?)
- Elderly much more likely to benefit
- Limitation: causality

# Cohort smoking ban?



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## Singapore 'open to the idea' of cohort smoking ban, will study how New Zealand implements ban



File photo of a person smoking. (Photo: AFP)



Jalelah Abu Baker

11 Jan 2022 02:35PM

(Updated: 11 Jan 2022 09:42PM)



# Study #2 of 3

European Stroke Journal



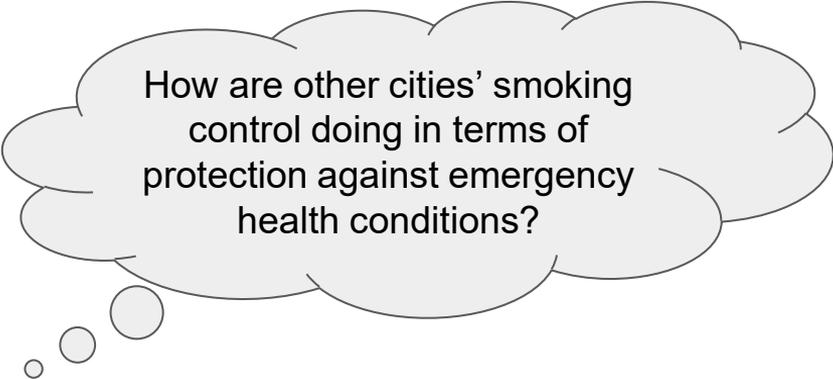
Impact Factor: 5.9  
5-Year Impact Factor: 5.9

 Free access | Review article | First published online October 30, 2024

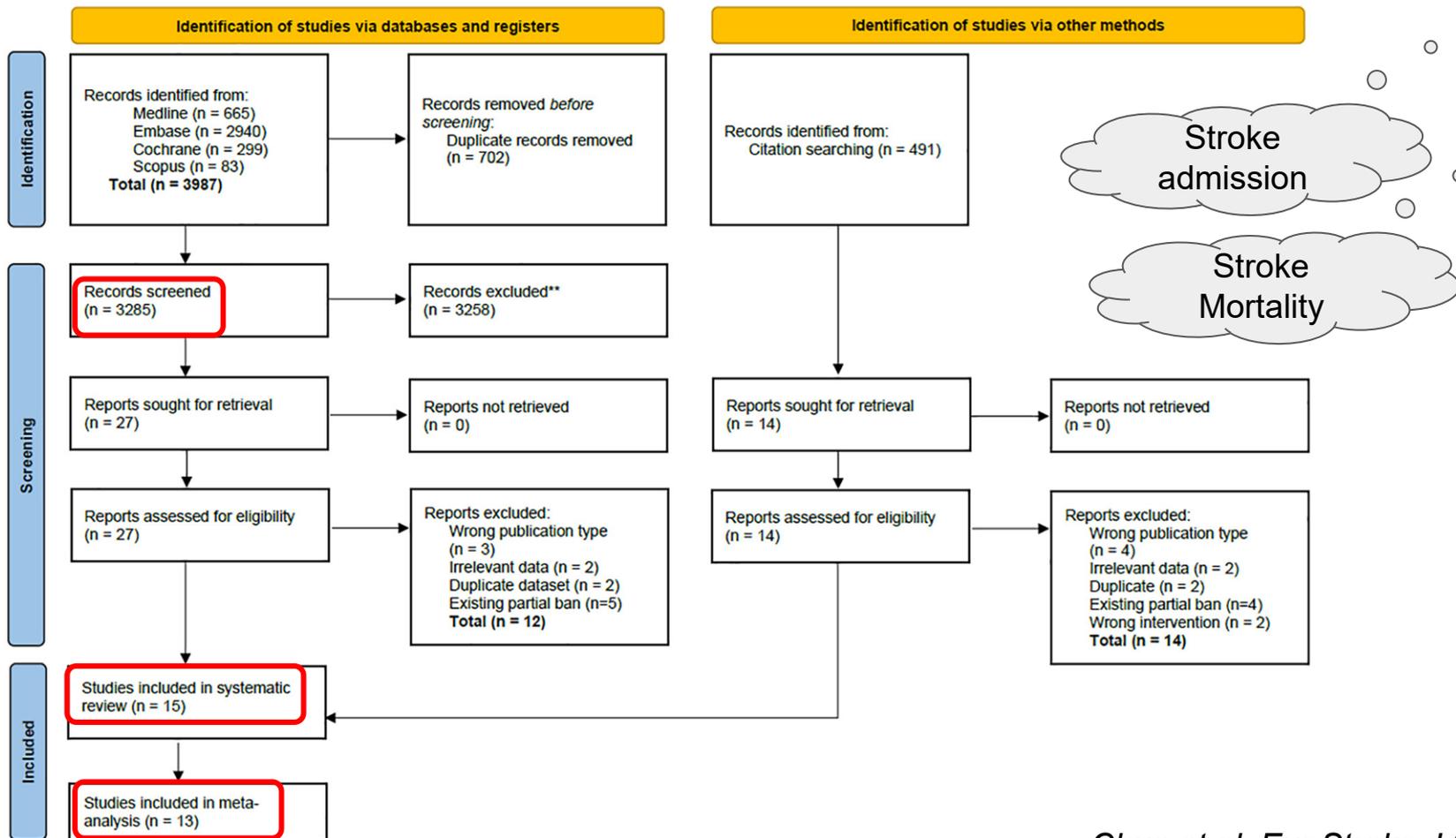
Impact of smoke-free legislation on stroke risk: A systematic review and meta-analysis

[Zhuo Xun Chua](#) , [Chern Yeh Lai Amanda](#), [...], and [Andrew Fu Wah Ho](#)   [View all authors and affiliations](#)

[OnlineFirst](#) | <https://doi.org/10.1177/23969873241293566>



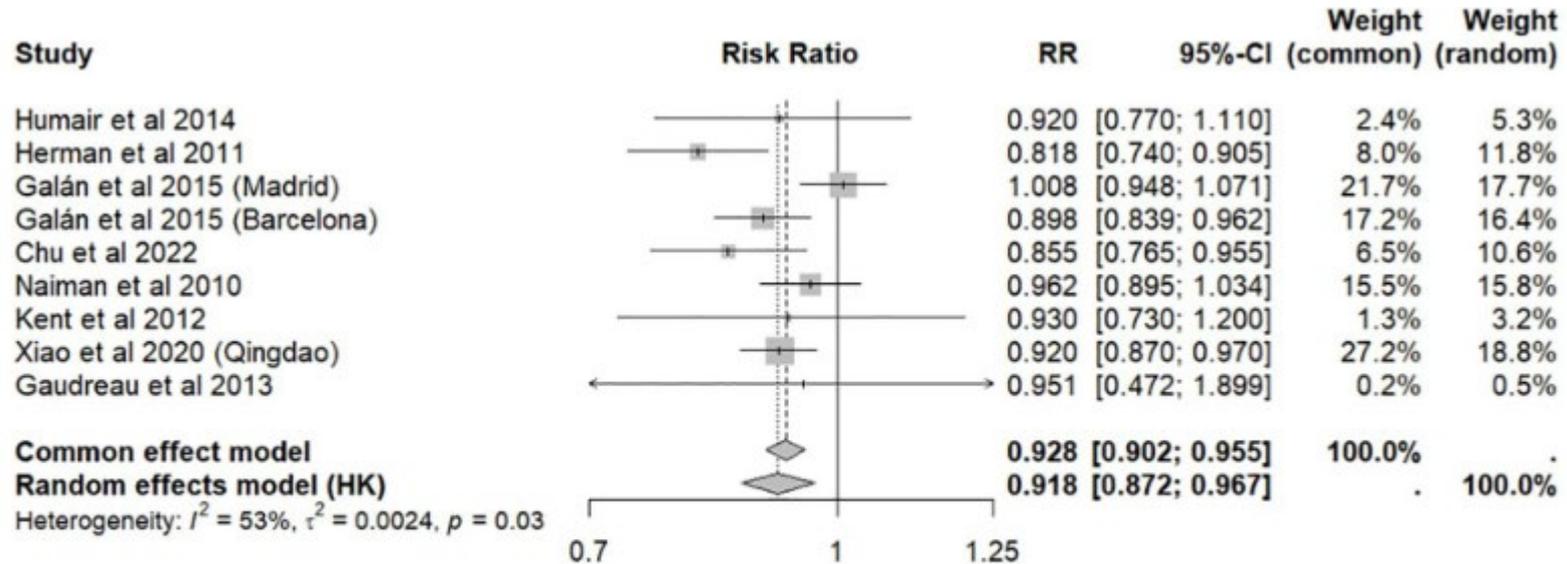
How are other cities' smoking control doing in terms of protection against emergency health conditions?



# Results

- Included 15 studies, of which 13 meta-analyzed
- Conducted between 2010 to 2023
- 6 Europe, 5 North America, 4 East Asia
- 6 studies analyzed country-wide bans, 4 state/province-wide, 5 city-wide
- 9 studies used ITS, 4 before-after with control, 2 before-after without control
- All were *indoor* bans
- Extent of ban:
  - Workplace, restaurants and bars (WRB): 12 studies
  - Workplace and restaurants (WR): 1 study
  - Workplace only (W): 1 study

# Effect of smoke-free legislation (WRB) on stroke admissions



**Figure 2.** Meta-analysis of smoke-free legislation in workplaces, restaurants and bars (WRB) on stroke hospital admissions.

# Effect of smoke-free legislation (WRB) on **stroke mortality**

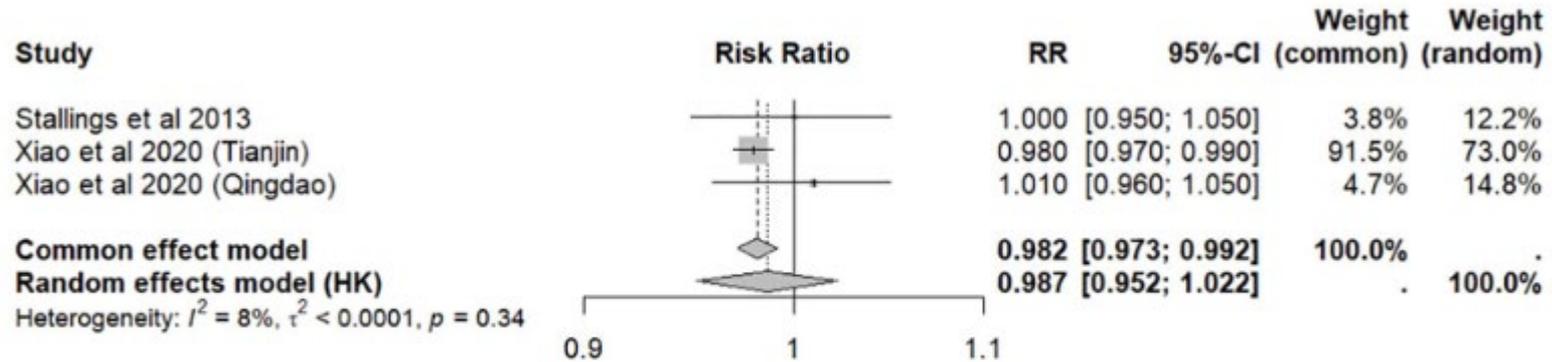


Figure 3. Meta-analysis of smoke-free legislation in workplaces, restaurants and bars (WRB) on stroke mortality.

## Study #3 of 3 [*Work in progress*]

### **Research question:**

1. Do **Good Samaritan Laws** impact **bystander CPR**?
2. If so, which features do that?

# BCPR doubles survival in OHCA but barriers remain

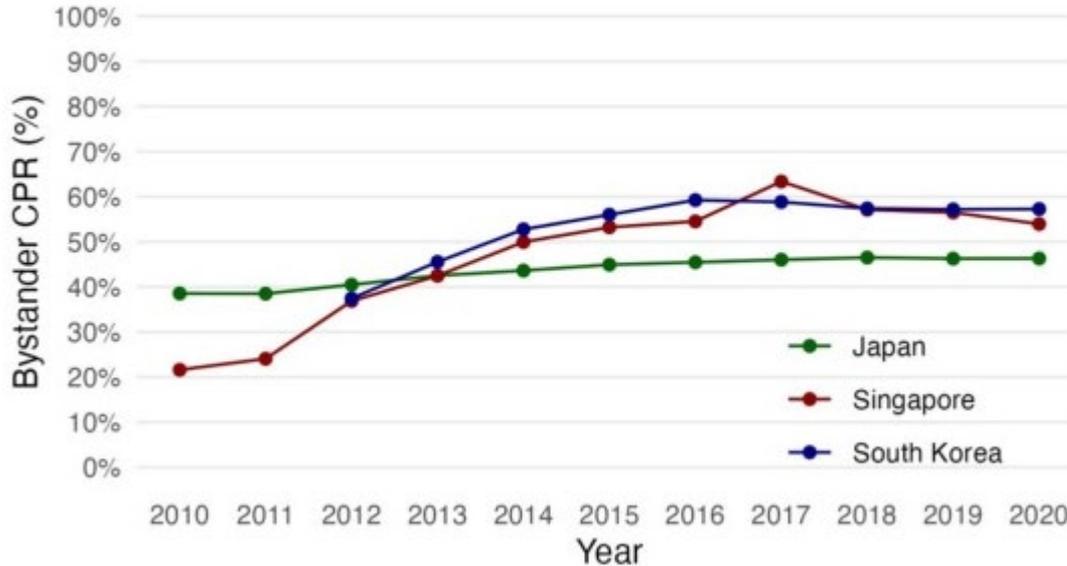
Willingness



Family mem  
/relative

CPR	85%	(78% in 2020)	(60% in 2020)	(49% in 2020)
AED	79%	(65% in 2020)	(60% in 2020)	(49% in 2020)

Bystander CPR among witnessed Adult OHCA



CPR:



CPR may not be helpful: 12%

Okada et al. Resuscitation 2025

# Good Samaritan Laws

- Review of GSLs in USA found substantial variations across states & time, as applied to drug overdose (*Reader et al 2022*)
- A before-after study in Shenzhen found that BCPR rates increased after Emergency Medical Aid Act, which has GSL components and more (*Li et al 2024*)
- Review off Westlaw legal database 1989-2019 found many cases alleging battery & negligence in OHCA scenarios (*Murphy et al 2019*)

Plaintiff		Defendant		
Victim	Relative	Lay	Trained	Business/School
18	153	12	85	76
Location				
Hospital/Nursing Home		Business	Other (street, pool, fitness center, etc)	
54		51	65	
Motivation for Case		Ruling		
Battery	Negligence	Plaintiff	Settlement	Defendant
3	167	47	47	76
Distribution of Cases				
Lay		Trained		
Negligence	Battery	Negligence	Battery	
88	0	79	3	

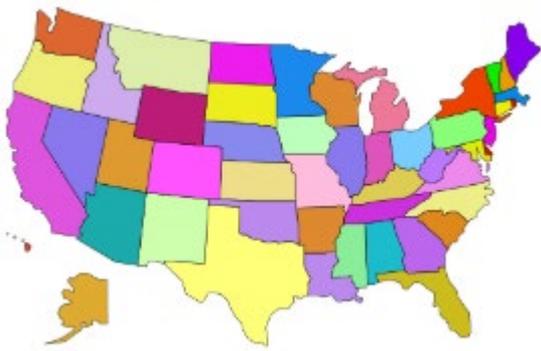
*Murphy et al.  
Resuscitation 2019*

# How might we study the impact of GSLs on BCPR?

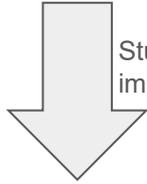


- Covers a catchment area of more than 179 million
- 37 statewide registries
- 32 additional communities in 11 states
- More than 2,300 EMS agencies
- More than 2,500 hospitals

*A natural experiment* exploiting inter-state legal heterogeneity in USA



**CARES**  
Cardiac Arrest Registry  
to Enhance Survival



Study wording &  
implementation of GSL

**Legal Protection Index**  
(0-100)  
[Main exposure]



**Individual-level BCPR**  
[Main outcome]

Mixed model accounting  
for clustering in states  
Adjusted for individual &  
group confounders

# Legal Protection Index - a novel approach

<b>Dimension</b>	<b>Description</b>
<b>1. Legal clarity</b>	How clear the provision is to the layperson
<b>2. Scope of coverage</b>	How broad the provision covers - types of medical situations, bystanders, actions bystander can render
<b>3. Exceptions</b>	How easy to prove exception to the legal protection
<b>4. Exclusions</b>	Legal protection is limited by what exclusions
<b>5. Duty to rescue</b>	Whether there is a mandatory duty to rescue

# Example: Louisiana

A. No person who in good faith gratuitously renders emergency care, first aid or rescue at the scene of an emergency, or moves a person receiving such care, first aid or rescue to a hospital or other place of medical care shall be liable for any civil damages as a result of any act or omission in rendering the care or services or as a result of any act or failure to act to provide or arrange for further medical treatment or care for the person involved in the said emergency; provided, however, such care or services or transportation shall not be considered gratuitous, and this Section shall not apply when rendered incidental to a business relationship, including but not limited to that of employer-employee, existing between the person rendering such care or service or transportation and the person receiving the same, or when incidental to a business relationship existing between the employer or principal of the person rendering such care, service or transportation and the employer or principal of the person receiving such care, service or transportation. This Section shall not exempt from liability those individuals who intentionally or by grossly negligent acts or omissions cause damages to another individual.

C. For purposes of this Section, rendering emergency care, first aid, or rescue shall include the use of an automated external defibrillator as defined by R.S. 40:1236.12.

Dimension	Score
Legal clarity	FERT score = -43.14
Scope	Bystander = 2 Beyond cardiac arrest = 2 Type of assistance = 3 (inclu. Move pt)
Exception	1
Exclusion	1
Duty to rescue	YES = 0 (see s 14:503 failure to seek assistance)



Stay tuned for results

# Final thoughts

- Examined 3 CV emergencies, in 3 populations, using 3 methods
- Legislative environment impacts population-level health behaviors & outcomes
- Current challenges include how to scope legislation to balance effectiveness with intrusiveness
- Creating an evidence base helps us to move towards this ideal

Thank you for your attention!



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