PAROS Singapore & previous geospatial/operation research

Andrew Ho
Chief resident (clinician-scientist track), SingHealth Emergency Medicine
Adj research fellow, Duke-NUS Medical School
Vice-chair (research), Asian Association for Emergency Medical Services

Financial disclosures: None

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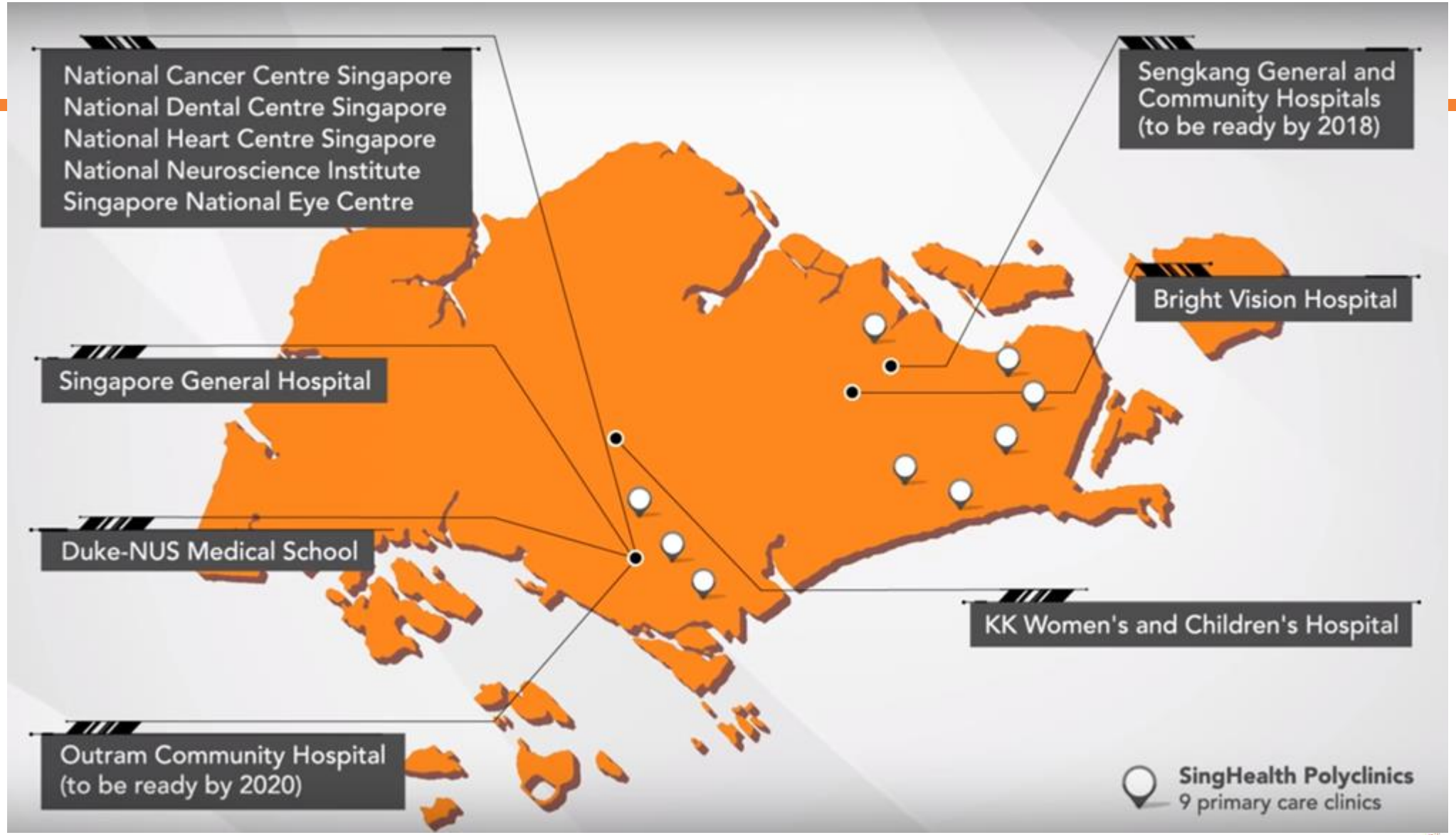

SingHealth DUKE-NUS ACADEMIC MEDICAL CENTRE

Content

- Out-of-hospital cardiac arrest (OHCA)
- Introduction to PAROS
- High quality relevant data sources in Singapore
- Previous geospatial/operations/spatiotemporal research

Out-of-hospital cardiac arrest

- The most sudden of the emergency medical conditions
- Tremendous health burden
- Not synonymous with “heart attack”
- Chain of survival
- Survival varies greatly between systems
- Ideal use-case to improve care systems

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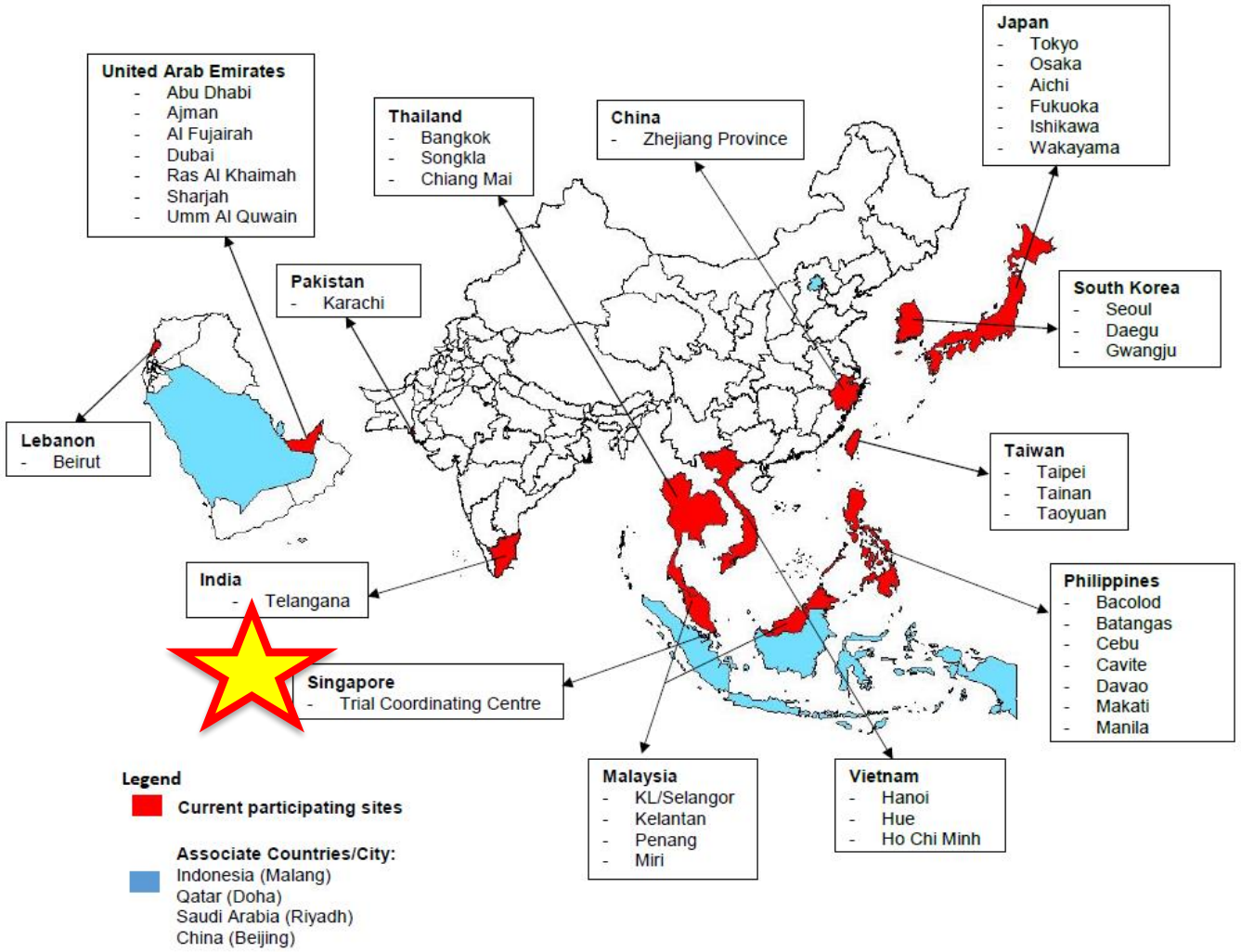
The Pan Asian Resuscitation Outcomes Study (PAROS)



SingHealth DUKE-NUS ACADEMIC MEDICAL CENTRE

Brief history

- PAROS Clinical Research Network established in 2010
- Founding sites: Japan, S.Korea, Singapore, Taiwan, Malaysia, Thailand, UAE-Dubai
- Mix of newly-developed & developing emergency medical systems (EMS)
- Report OHCA system characteristics & outcome trends
- Launching pad for EMS development in Asia

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Celebrating 20 Years of Clinical Research in Singapore

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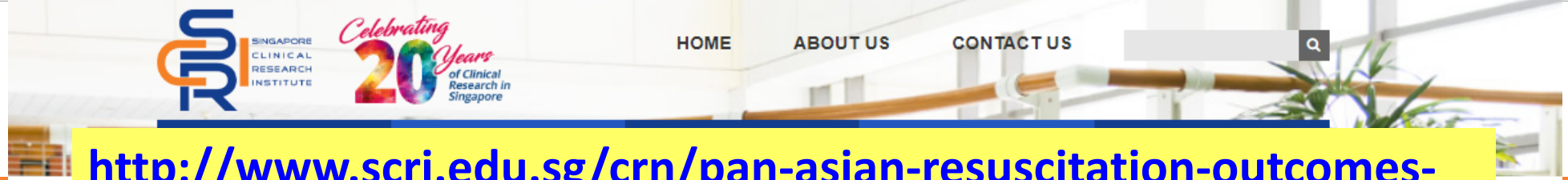

http://www.scri.edu.sg/crn/pan-asian-resuscitation-outcomes-study-paros-clinical-research-network-crn/about-paros/

CLINICAL RESEARCH NETWORKS

- Overview
- Asian Thoracic Oncology Research Group (ATORG)
- Asia-Pacific Hepatocellular Carcinoma (AHCC) Trials Group
- Family Medicine Research Network (FMRN)
- Metabolic Research Network
- Pan-Asian Resuscitation Outcomes Study (PAROS) Clinical Research Network (CRN)
  - About PAROS
  - Research
  - Members
  - PAROS Publications
  - Source Documents
  - PAROS Presentations
  - Upcoming Events
  - PAROS Newsletters
  - Event Photos
  - PAROS FAQ
  - Asian EMS Council
  - How to Reach Us

» Clinical Research Networks » Pan-Asian Resuscitation Outcomes Study (PAROS) Clinical Research Network (CRN) » About PAROS

About PAROS

The PAROS CRN is a collaborative research group formed in 2010 by dedicated Pre-hospital and Emergency Care (PEC) providers conducting PEC research in the Asia-Pacific region. It promotes collaboration by bringing together like-minded individuals to share experiences and develop joint initiatives for the betterment of PEC.

Currently, research into PEC in the Asia-Pacific region is largely inadequate and poorly coordinated owing to the marked variations in Emergency Medical Services (EMS) systems and outcomes reporting. With PEC conditions such as Out-of-Hospital Cardiac Arrest (OHCA) being one of the leading causes of death worldwide, the dearth in the understanding of trends and research in PEC underscores the urgent need for more collaborative research and good-quality intervention trials in PEC.

PAROS CRN endeavours to improve outcomes from PEC across the Asia-Pacific region through the creation of a platform to support and stimulate research into effective strategies to improve survival in PEC. The ability to reach out to countries across the Asia-Pacific region means that the Network can adopt a multi-pronged strategy that targets key stakeholders such as the community, EMS and the hospitals in its vision to improve PEC outcomes. By offering practical ways of monitoring and meaningful measurement of PEC outcomes, PAROS CRN has an enormous potential to contribute significantly to PEC research, regardless of whether they are epidemiological studies or clinical trials. As a first step, PAROS CRN has identified OHCA as one of its main thrusts. The Network will gather valuable information on OHCA and deepen the understanding of the EMS systems in the region to devise strategies that improve survival. An IRB master template of an OHCA study initiated by A/Prof Marcus Ong can be found here.

Mission

To improve outcomes from Pre-hospital and Emergency Care across the Asia-Pacific region by promoting high quality research into resuscitation

Vision

Improving outcomes from Pre-hospital and Emergency Care across the Asia-Pacific region

Value to Singapore and the Region

PAROS CRN endeavours to answer important questions for the development and revisions of Pre-hospital and Emergency Care (PEC) policies. This research has a major social value as it aims to improve outcomes from

PAROS variables–EMS

Variable	Core	Non-Core
Emergency Medical Services (EMS) agency		
Mode of transport	●	
Date of incident	●	
Location of incident *(optional)*		●
Location type		●
Date of birth / Age	●	
Gender	●	
Race *(optional)*		●
Medical history		●
Time call received at dispatch centre	●	
Time first responder dispatched		●
Time ambulance dispatched		●
Time first responder arrived at scene		●
Time ambulance arrived at scene	●	
Time EMS arrived at patient side	●	
Time ambulance left scene	●	
Time ambulance arrived at ED	●	
Estimated time of arrest		●
Arrest witnessed by	●	
Bystander CPR	●	
First CPR initiated by		●
Bystander AED applied		●
Resuscitation attempted by EMS / Private ambulance	●	
First arrest rhythm	●	
Time CPR started by EMS / Private ambulance		●
Time AED applied by EMS / Private ambulance		●
Pre-hospital defibrillation	●	
Defibrillation performed by		●
Mechanical CPR device used by EMS / Private ambulance		●
Prehospital advanced airway		●
Prehospital drug administration		●
Return of spontaneous circulation at scene / en-route	●	
CPR discontinued at scene / en-route		●
Final status at scene	●	
Cause of arrest *(only for cases pronounced dead at scene by EMS)*	●	
Level of destination hospital		●
Destination hospital		●
Patient's status at ED arrival	●	

Each country would declare whether #13 and/or #14 would be core to them and they will be bound by this expectation.

PAROS variables–ED

Variable	Core	Non-Core
Hospital [Emergency Department (ED)]		
Date of arrival at ED	●	
Time of arrival at ED		●
Patient status on arrival at ED - Pulse and/or Breathing		●
Cardiac rhythm on arrival at ED		●
ED defibrillation performed		●
Mechanical CPR device used at ED		●
Advanced airway used at ED		●
Drug administered at ED		●
Return of spontaneous circulation at ED	●	
Emergency PCI performed		●
Emergency CABG performed		●
Hypothermia therapy initiated		●
ECMO therapy initiated		●
Cause of arrest	●	
Reason for discontinuing CPR at ED		●
Outcome of patient	●	
Patient status	●	
Date of discharge or death		●
Patient neurological status on discharge or at 30th day post-arrest		●
EQ-5D Health Dimensions - Mobility		●
EQ-5D Health Dimensions - Self-care		●
EQ-5D Health Dimensions - Usual activities		●
EQ-5D Health Dimensions - Pain/discomfort		●
EQ-5D Health Dimensions - Anxiety/depression		●
EQ-5D Visual Analog Scale (VAS)		●

PAROS Phases of Study

- Phase I (2010-2015): Determining the Cost-Effectiveness of Strategies to Improve Survival from OHCA
- Phase II (2013-2017): International Multi-Center Controlled Trial of Dispatcher-Assisted Cardio-Pulmonary Resuscitation (DA-CPR) Intervention Package
- Phase III (ongoing, Singapore only): Step-wedged cluster-randomized trial of ambulance-based interventions

Zoom in to Singapore

- Island city-state in Southeast Asia
- Population: 5.6 Million
- Life expectancy: 82 years
- Mixed healthcare funding
- Single national EMS provider
- 7 adult hospital, 1 pediatric
- Ideal population laboratory?

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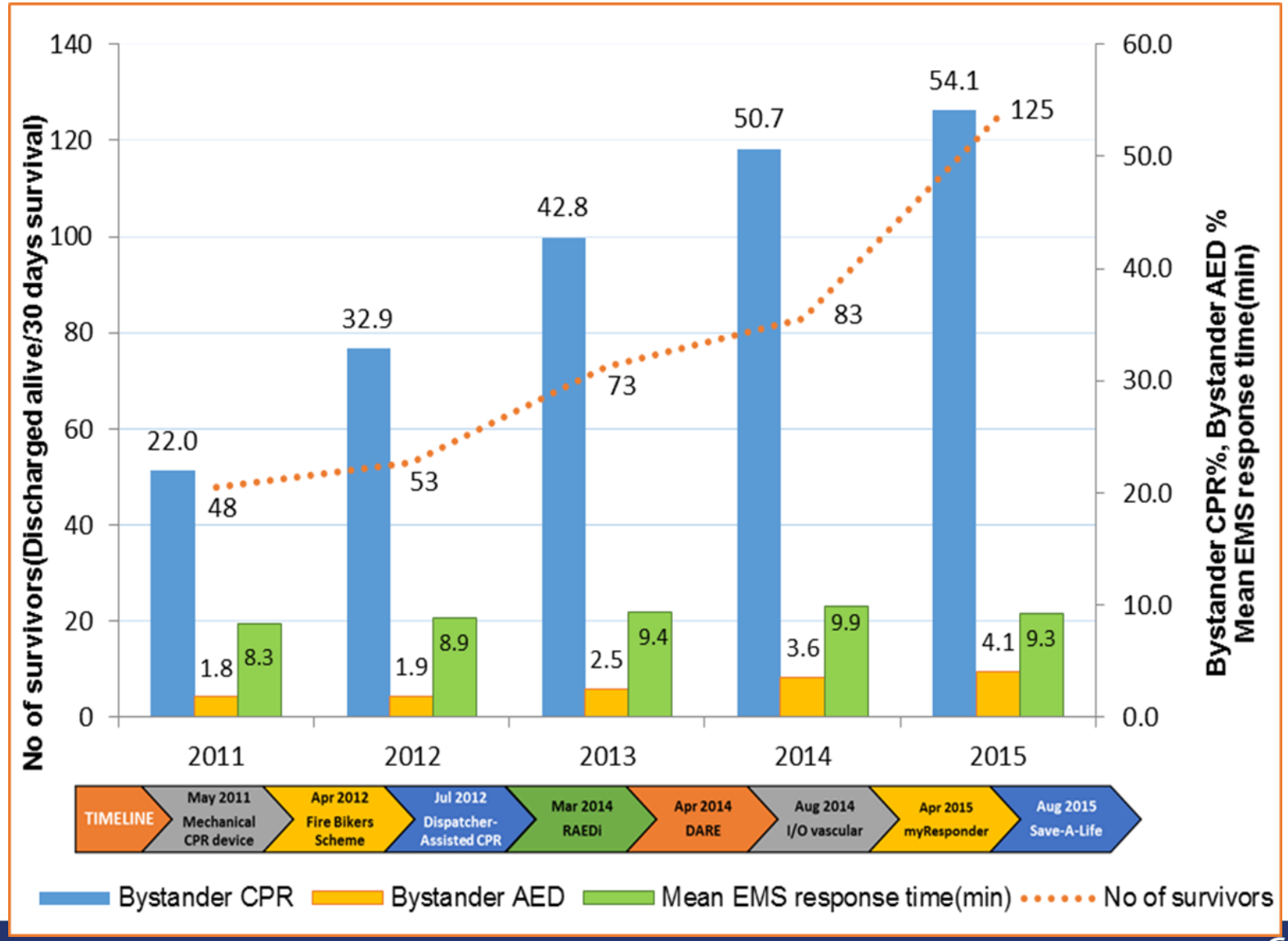
Singapore PAROS investigators

Member	Role	Institution
Professor Marcus Ong	Chair, PI	Singapore General Hospital
Dr Desmond Mao	Site-PI	Khoo Teck Puat Hospital
Dr Tham Lai Peng	Site-PI	KK Women's & Children's Hospital
Dr Michael Chia	Site-PI	Tan Tock Seng Hospital
Dr Cheah Si Oon	Site-PI	Ng Teng Fong General Hospital
Dr Gan Han Nee	Site-PI	Changi General Hospital
Dr Benjamin Leong	Site-PI	National University Hospital
Dr Ng Yih Yng	Site-PI	Singapore Civil Defence Force

Progress in 5 years – S'pore

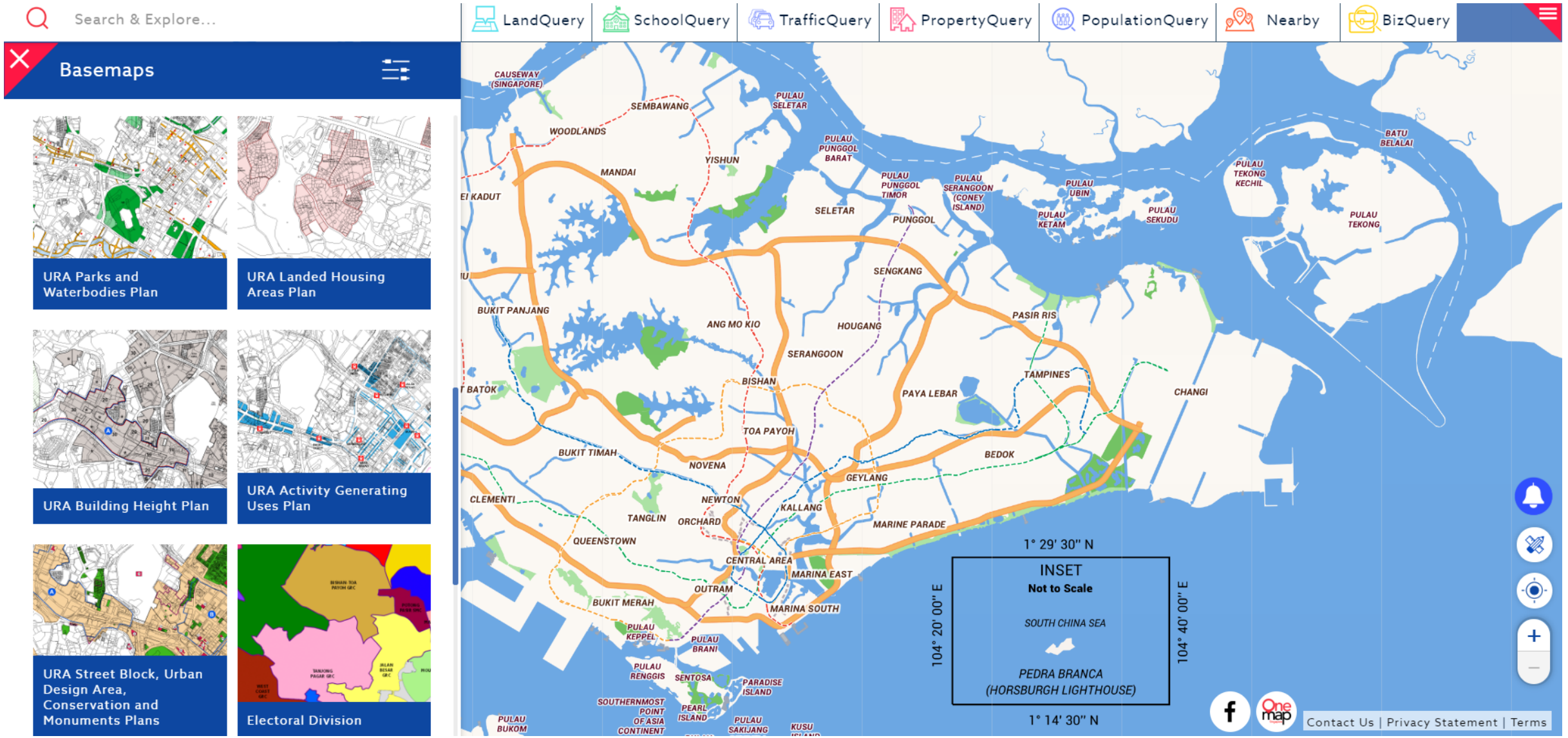


Other DISEASE data sources

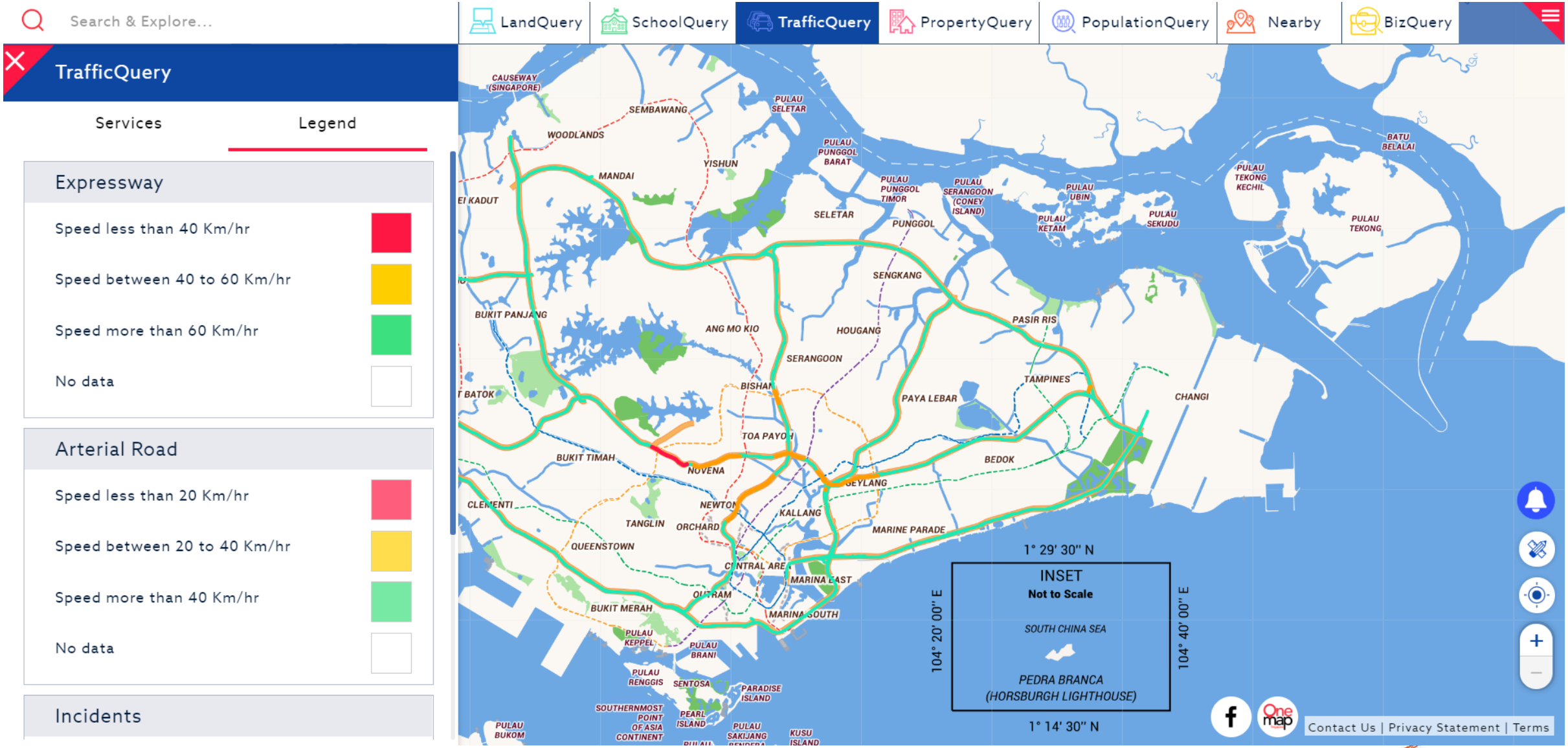
- National Registry of Diseases Office
  - Singapore Myocardial Infarction Registry
  - Singapore Stroke Registry
  - Death Registry
- National Trauma Registry
  - Contributes data to Pan-Asian Trauma Outcomes Study (PATOS)
- Administrative health services data
  - Operational/admin ambulance data (SCDF)
  - Emergency dept / inpatient (MOH, SingHealth RHS)

EXPOSURE data sources

- Census data (conducted every 10 years)
- OneMap Singapore
  - National, public-domain, API-based detailed maps of Singapore
  - Eg land, schools, traffic, population geospatial data
- Data.gov.sg
  - National, public-domain, API-based data
  - Eg, economy, education, government, finance, health, transport
- Environmental data (real time, public domain)
  - Meteorological society Singapore: eg rainfall, ambient temperature, wind direction
  - National Environmental Agency: air pollution indices



https://www.onemap.sg/



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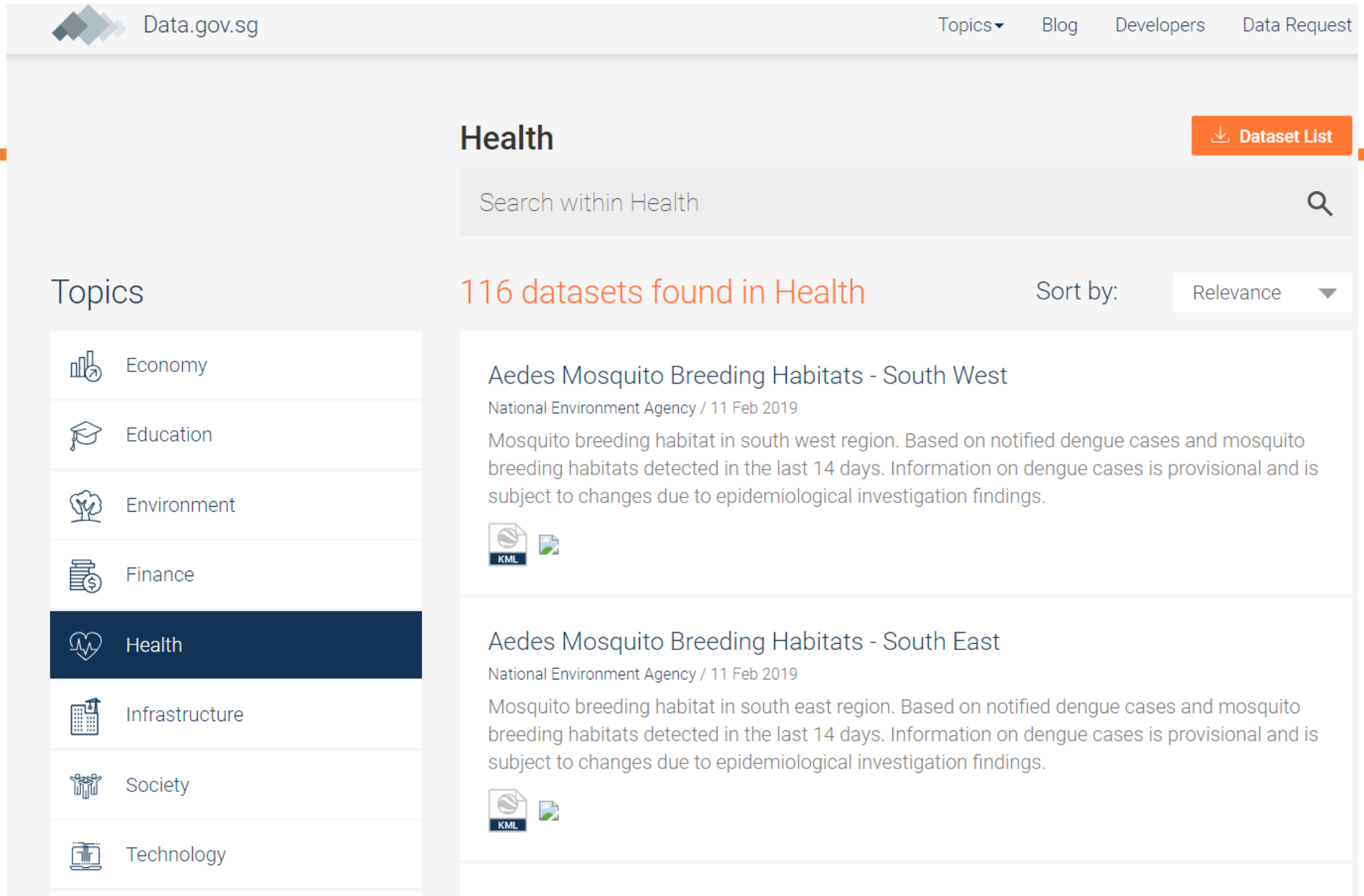

https://data.gov.sg/

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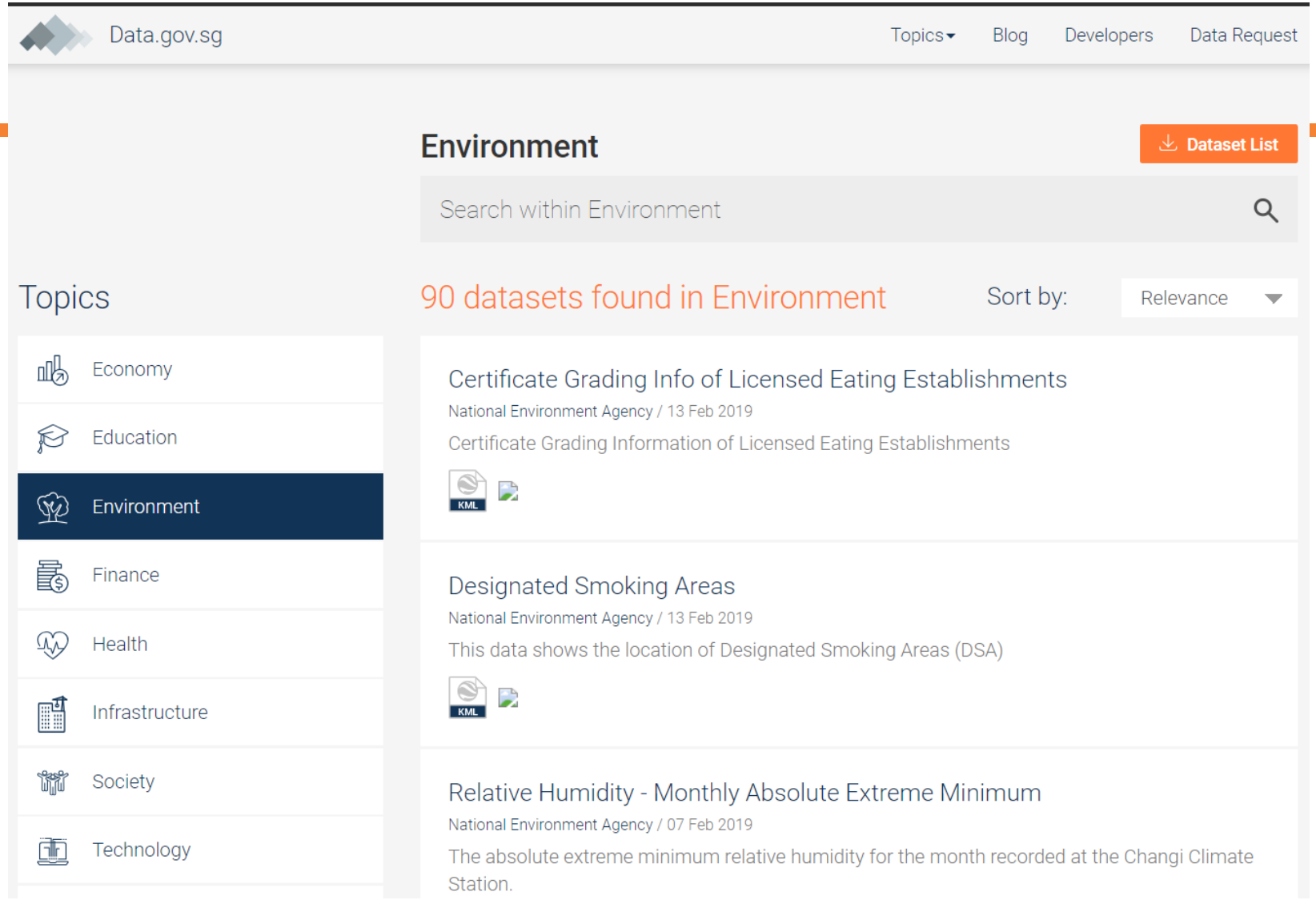

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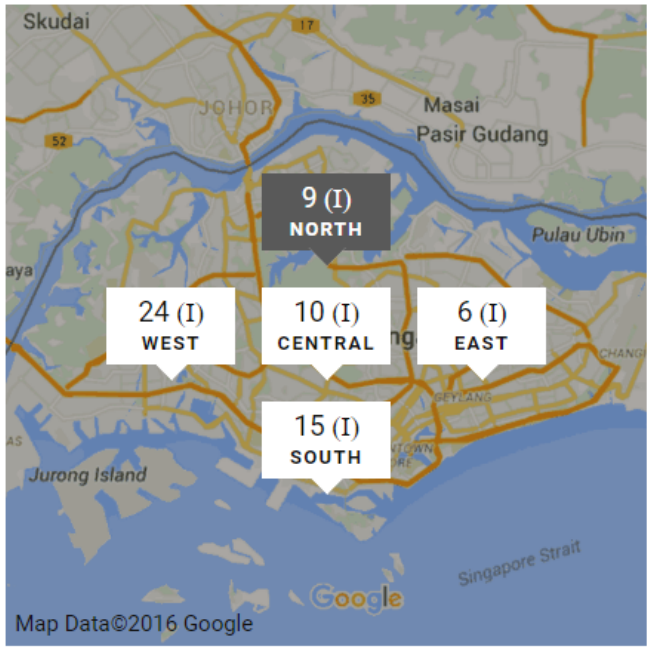
LATEST UPDATE | AIR QUALITY | HOTSPOTS | HEALTH ADVISORY | MEDIA

24-hr PSI | 1-hr PM2.5

AIR QUALITY



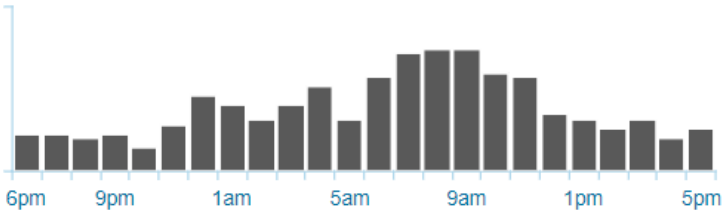
9 µg/m³

Normal

1-hr $PM_{2.5}$ reading (µg/m³)
At 5pm on 12 Feb 2019

1-hr $PM_{2.5}$ reading (µg/m³)	Band	Descriptor
0 - 55	I	Normal
56 - 150	II	Elevated
151 - 250	III	High
Above 250	IV	Very High

1-hr $PM_{2.5}$ reading (µg/m³)



Min 5 | Max 26 | Current 9

https://www.haze.gov.sg/

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4 Selected published work

Ann Emerg Med. 2011 Oct;58(4):343-51. doi: 10.1016/j.annemergmed.2010.12.014. Epub 2011 Jan 15.

Spatial variation and geographic-demographic determinants of out-of-hospital cardiac arrests in the city-state of Singapore.

Ong ME[1], Earnest A, Shahidah N, Ng WM, Foo C, Nott DJ.

Resuscitation. 2014 Sep;85(9):1153-60. doi: 10.1016/j.resuscitation.2014.06.006. Epub 2014 Jun 21.

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Acad Emerg Med. 2010 Sep;17(9):951-7. doi: 10.1111/j.1553-2712.2010.00860.x.

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Ong ME[1], Chiam TF, Ng FS, Sultana P, Lim SH, Leong BS, Ong VY, Ching Tan EC, Tham LP, Yap S, Anantharaman V; Cardiac Arrest Resuscitation Epidemiology (CARE) Study Group.

Int J Cardiol. 2018 Nov 15;271:352-358. doi: 10.1016/j.ijcard.2018.04.070.

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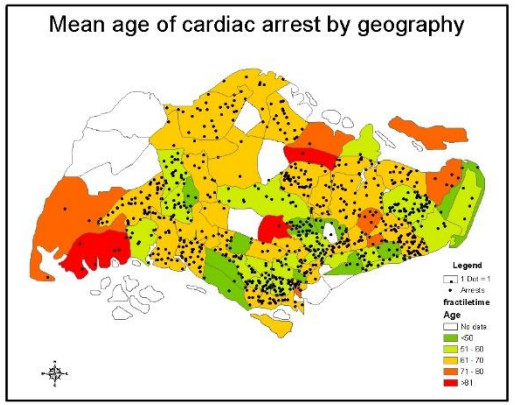
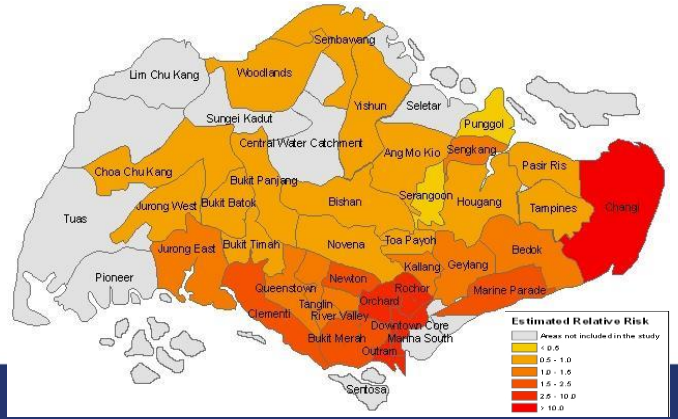
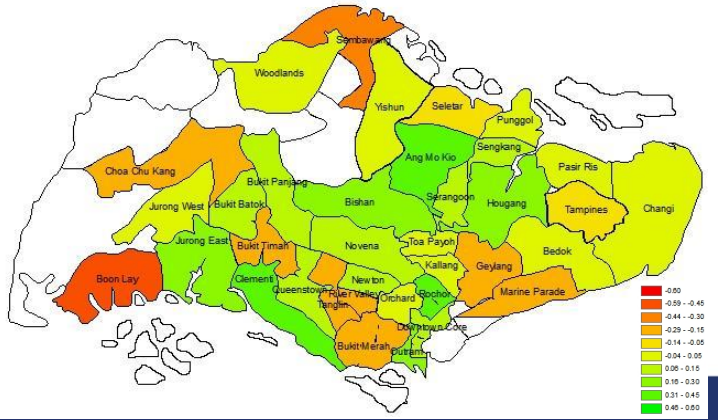
Ong ME[1], Earnest A, Shahidah N, Ng WM, Foo C, Nott DJ.

- Examined areal-level predictors of increased risk of OHCA at DGP level (equivalent to census tract)
- Bayesian Conditional autoregressive (CAR) spatial models
- 2001-2004 OHCA events + 2000 Census
- Results: Strong spatial correlation. Areal-level associations of Age>65, race, small household size with OHCA relative risk







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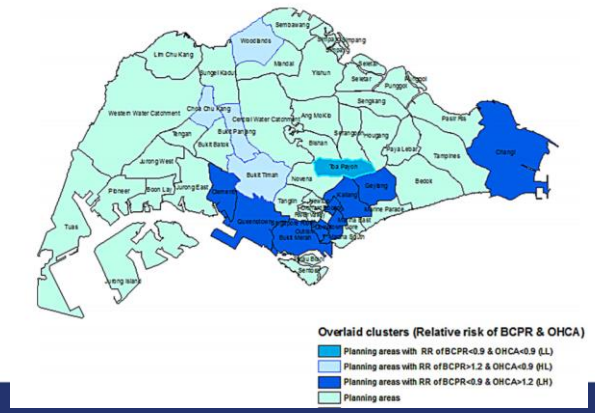
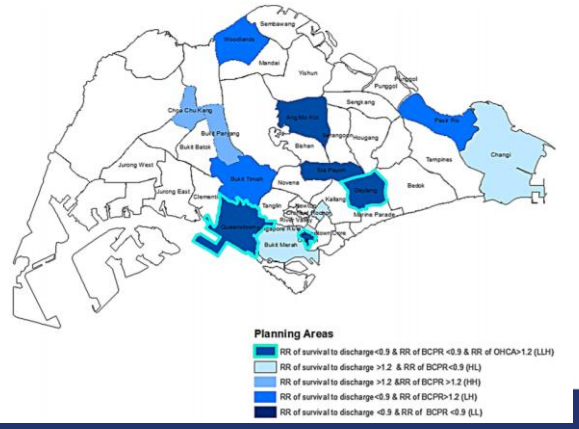
- Examined areal-level predictors of Bystander CPR (BCPR) and high risk areas for OHCA
- 2001-2011 OHCA + 2010 Census
- Bayesian CAR modelling, multilevel mixed-effects LR
- Results: BCPR rate associated with household size. 10 high-rise residential areas identified (high RR for OHCA but low RR for BCPR)





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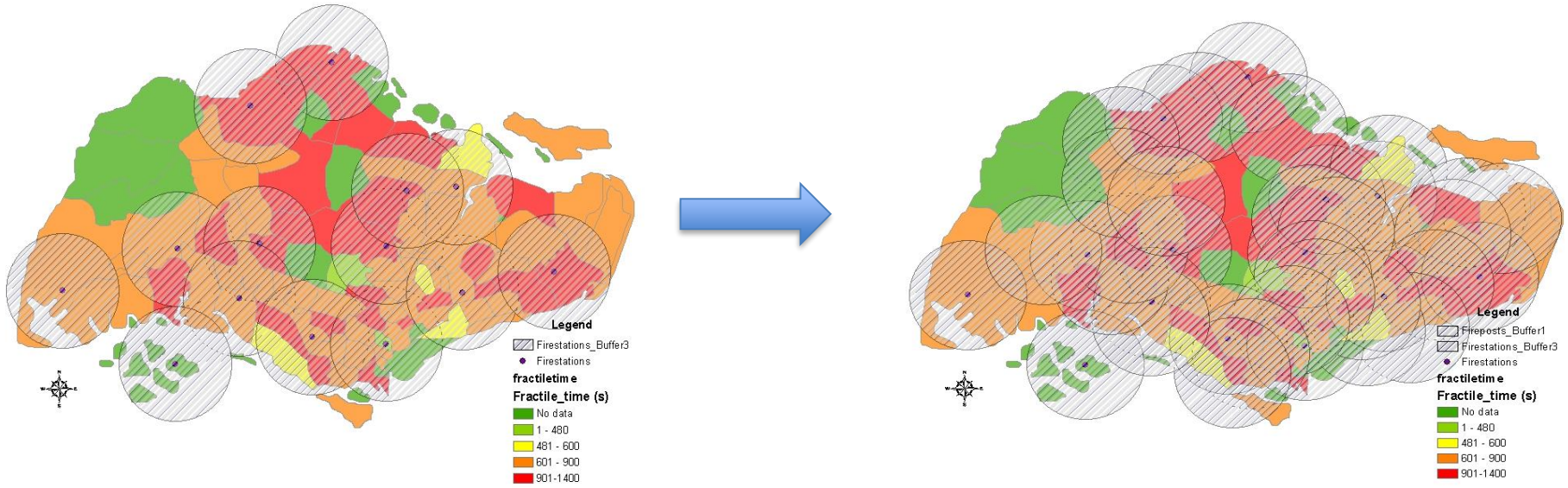
- Prospectively evaluated response time after progress strategy of increasing ambulance bases from 17 (2001) to 32 (2004)
- Ambulances redistributed according to geographic demand, but number of ambulance/crew/shifts remained constant
- Monthly mean response time reduced from 10.1 min to 7.1 min



deployment

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- Time-stratified case cross-over design
- Conditional Poisson regression model applied to daily OHCA counts, with factors such as daily temperature, rainfall, wind speed, Pollutant Standards Index (PSI)
- 2010-2015, used public domain environmental data, and PAROS Singapore data
- Results:
  - Moderate PSI days: IRR 1.1, 95%CI 1.07-1.15
  - Unhealthy PSI days: IRR 1.37, 95%CI 1.2-1.56
  - Elderly more affected
  - Risk elevated for subsequent 5 days
- Ongoing work: spatial refinement of effect?

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Questions?

sophronesis@gmail.com