Summary: PAROS New Study Proposals

New Study Proposal 1

Proposer	Title	Objectives/Hypothesis
Ng Wei Lin (Singapore)	Trends of DA-CPR and bystander CPR rates in OHCA patients between intervention groups of DA-CPR Resuscitation Package	• Primary aim: To investigate the trends of DA-CPR and bystander CPR rates in OHCA patients between intervention groups (basic, comprehensive, control) of DA-CPR Resuscitation Package • Secondary aim: To investigate and compare the trends of survival to discharge and neurological outcomes between intervention groups • Methods: All non-traumatic OHCA cases conveyed to emergency departments, unwitnessed by EMS/ambulance that occurred between January 2009 and December 2016 will be included. All OHCA cases where resuscitation was not attempted or unknown will be excluded from this study.

New Study Proposal 2

Proposer	Title	Objectives/Hypothesis
Gayathri Devi Nadarajan (Singapore)	Universal TOR rules and health economic outcomes if TOR is applied to the OHCA patients in Asia	• Primary aim: To determine the changes in the number of ambulance transports, hospital admissions and people with poor neurological outcomes that will occur if the TOR is implemented on Asian OHCA cases. • Secondary aim: To conduct a health economic assessment and estimate the potential economic evaluation of implementing TOR in Asian EMS systems. • Significance: Help prioritize the utilization of Emergency Care resources in the Asian setting, where a proportion of the countries fall in the low or upper middle-income settings and a large proportion of the Emergency Services are still in a developing stage.

New Study Proposal 3

Proposer	Title	Objectives/Hypothesis
Hansol Chang (Korea)	Pre-hospital airway for out-of-hospital cardiac arrest	• Aim: To investigated whether pre-hospital advanced airway management (AAM) is associated with improved survival of out-of hospital cardiac arrest (OHCA) compared to conventional bag-valve-mask ventilation (BVM) • Methods: ○ Inclusion/exclusion: BVM and AAM using supraglottic, or endotracheal airway ○ Exclusion: Patient without information about prehospital airway or neurologic outcome ○ Analysis: The differences in baseline clinical characteristics will be adjusted using propensity scoring matching (PSM) or inverse probability of treatment weighting (IPTW) ○ Primary outcome: 30-day survival with neurologically favorable status defined by cerebral performance category 1 or 2

New Study Proposal 4

Proposer	Title	Objectives/Hypothesis
Kentaro Kajino (Japan)	Universal termination of resuscitation (TOR) rule predicts neurologically favorable outcome in Asian countries	• Aim: To assess the performance of the universal TOR in Asian countries related with PAROS • Population: All cardiac arrest patients who visited emergency department in the PAROS participating Asian countries. • Data source: An international, multi-area registry of cardiac arrest patients, PAROS • Outcome Variable: Prehospital ROSC, ROSC, hospital administration, one month survival, Neurologically favorable outcome with one month) • Adjusting factors: patient's characteristics (age, gender, arrest origin, PAD, witness, initial rhythm, location, etc.), EMS activities (Advanced airway management, drug administration, defibrillation etc.), country, year • Statistical analysis: χsquare test, Mann-Whitney test, Multivariable logistic regression using SPSS

New Study Proposal 5

Proposer	Title	Objectives/Hypothesis
Tatsuya Kaito, Hideharu Tanaka (Japan)	Association between drug administration and outcome after out-of-hospital cardiac arrest	• Aim: To evaluate the association between drug administration and its outcome after OHCA • Population: Patients with EMS-treated OHCA aged ≥18 years will be analyzed, exclude missing data • Primary exposure variable: Drug administration in the prehospital setting • Analysis: Patients will be divided into the Shockable and Non-shockable cohorts, stratified by country and calculated propensity scores with the logistic model. • Primary outcome: Survival to discharge. • Secondary outcome: Return of spontaneous circulation at the emergency department and a favorable neurological outcome.

New Study Proposal 6

Proposer	Title	Objectives/Hypothesis
Koshi Nakagawa, Hideharu Tanaka (Japan)	Association between advanced airway management and outcome after out-of-hospital cardiac arrest - propensity score analysis	• Primary aim: To evaluate effect of AAM on OHCA, association between AAM and outcome after OHCA, with accounting to regional differences • Secondary aim: To evaluate the association between AAM devices and outcomes after OHCA • Population: Patients with EMS-treated OHCA aged ≥18 years exclude missing data • Primary exposure variable: AAM in the prehospital setting including ETI and SGA • Analysis: Patients will be divided into the Shockable and Non-shockable cohorts, stratified by country and calculated propensity scores with the logistic model accounting domestic regional differences in each country

New Study Proposal to be presented by PI

S/N	Proposer	Title
7	Hsu, Shu-Hsien, Chiang Wen-Chu (Taiwan)	The Validation and Development of TOR rules in Patients Following OHCA in Asia Countries
8	Koshi Nakagawa, Hideharu Tanaka (Japan)	Verification of the effect of introducing DA-CPR comprehensive package – a regression discontinuity design
9	Ji woong Kim, Won Chul Cha, Hansol Chang (Korea)	Developing a Time-Adaptive Prediction Model for Out-of-Hospital Cardiac Arrest: using PARSOS data

The Validation and Development of Termination-of-Resuscitation (TOR) rules in Patients Following Out-of-Hospital Cardiac Arrest (OHCA) in Asia Countries

Name: Shu-Hsien, Hsu
Designation/Department: National Taiwan University Hospital
Country: Taiwan

Introduction

- Termination-of-resuscitation rules (TORRs) provide effective re-allocation of limited medical resource for out-of-hospital cardiac arrest (OHCA) patients under the concept of medical futility.
- The performance of TORRs in western countries has been reviewed and well validated in OHCA patients.
- However, TORRs lacked evidence of accuracy in pan-Asia.

Aims/ Hypothesis

- We aimed to validate the performance of several TORRs in mortality and unfavorable neurological outcome prediction and to explore the potential relation of suboptimal performance of TORRs.
- This study aims to develope a TORR that is suitable for Asia countries by using PAROS OHCA register data.

Methods

- **Study design and setting**
  - We used the PAROS registry to validate the performance of TORRs in OHCA patients in 13 Asian countries.
- **Study population**
  - The study population included adults, non-traumatic OHCA patients between 1 January 2013 and 31 December 2017.
  - Exclusion criteria: (1) age <18 years old, (2) non-EMS transport to the ED, (3) traumatic cardiac arrest, (4) obvious signs of death (e.g. decapitation, rigor mortis, and lividity) or having do-not-resuscitate (DNR) orders, (5) missing data.
- **Variables**
  - Patient demographics, prehospital information, and survival status.
  - Age, sex, prehospital rhythm, prehospital defibrillation, bystander cardiopulmonary resuscitation (CPR), cardiac arrest witnessed, prehospital return of spontaneous circulation ROSC and survival to discharge, etc.
- **Outcome measures**
  - Primary outcome: death to hospital discharge (DTHD).
  - Secondary outcome is unfavorable neurological outcome of discharge (CPC3,4,5).

Methods

- **Statistical analysis**
  - Validation of TORRs:
    - The performance of the TORRs were summarised by Sn, Sp, PPV, NPV with 95% CI.
    - The comparison of the variable differences between subgroups was examined using the Student t-test and chi-square test. Means and standard deviations (SD) were reported for continuous variables. Counts and percentages were calculated for categorical variables.
  - Development of a new TORR:
    - Univariate analysis to find potential factors related to the primary and secondary outcomes.
    - Data are randomly split into two subsets:
      - Derivation group: 2/3 data.
      - Validation group: 1/3 data.
    - Multivariate logistic regression to analysis the data of derivation group and construct the best regression model with the largest area under the curve (AUC) from several candidate models. Furthermore, this regression model is validated by using the data of validation group.

Significance

- Fulfil the knowledge gap of current TORRs performance in Asia countries.
- Provide series follow up information of TORRs performance in Asia for further decision or policy making.
- Developed a new TORR suitable in Asia.

Thank you for your time and attention!

Q &A

Introduction

- Current TORRs fail to reach the definition of futile medicine in predicting the death or unfavorable neurological outcome of OHCA patients in some Asia countries.

Aims/ Hypothesis

- This study aims to develope a TORR that is suitable for Asia countries by using PAROS OHCA register data.

Methods

- **Study design and setting**
  - Data are extracted from the PAROS Register from January 1, 2013 to December 31, 2017.
- **Study population**
  - The study population included adults, non-traumatic OHCA patients between 1 January 2013 and 31 December 2017.
  - Exclusion criteria: (1) age <18 years, (2) non-EMS transport to the ED, (3) traumatic cardiac arrest, (4) obvious signs of death (e.g. decapitation, rigor mortis, lividity, and decapitation) or having do-not-resuscitate (DNR) orders, (5) missing data.
- **Variables**
  - Patient demographics, prehospital information, and survival status.
  - Age, sex, prehospital rhythm, prehospital defibrillation, bystander cardiopulmonary resuscitation (CPR), cardiac arrest witnessed, prehospital return of spontaneous circulation ROSC and survival to discharge, etc.
- **Outcome measures**
  - Primary outcome: death to hospital discharge (DTHD).
  - Secondary outcome is unfavorable neurological outcome of discharge (CPC3,4,5).
- **Statistical analysis**
  - Univariate analysis was conducted to one-by-one find potential factors related to the primary and secondary outcomes.
  - Data are randomly split into two subsets:
    - Derivation group: 2/3 data.
    - Validation group: 1/3 data.
  - Multivariate logistic regression analysis for the data of derivation group was used to construct and find one best regression model with the largest area under the curve (AUC) from several candidate models. Furthermore, this regression model is validated by using the data of validation group.

Significance

- Developed a new TORR in Asia by using PAROS register and validate the performance.

Verification of the effect of introducing DA-CPR comprehensive package – a regression discontinuity design

Name: ***Koshi NAKAGAWA***, *MEM, EMT-P* *Hideharu TANAKA, MD, PhD*
Designation/Department: Kokushikan University
Country: Japan

Introduction

- ✓The DA-CPR comprehensive package was **introduced to enhance DA-CPR** as a part of PAROS 2.

<u>comprehensive package</u>

(Seoul, Taipei, Tainan, Singapore, Penang, Kuala Lumpur/Klang Valley, Eastern)

- ◆ DA-CPR Protocol
- ◆ Training program
- ◆ **Quality measurement tool**
- ◆ Quality improvement program
- ◆ Community education program

- ✓In primary analysis, rate of DA-CPR implementation and outcomes after OHCA was increased.
- ✓The detailed DA data collected by **Quality measurement tool** has not been evaluated yet.

Quality measurement tool

Dispatch agency	______________________________		
Date of call	☐☐ / ☐☐ / ☐☐☐☐ (dd/mm/yyyy)		
Time of call	☐☐ : ☐☐ : ☐☐ (hh:mm:ss)		
PAROS case number (Official/PAROS HQ use only)	☐☐☐☐☐☐☐☐☐☐☐☐		
Incident No/CAD	______________________________		
Was this a cardiac arrest before arrival of EMS?	☐1 Yes	☐2 No	☐3 Unknown
CPR already in progress?	☐1 Yes	☐2 No	☐3 Unknown
Did Dispatch recognize need for CPR?	☐1 Yes	☐2 No	☐3 Unknown
CPR instructions started?	☐1 Yes	☐2 No	☐3 Unknown
Chest Compressions performed?	☐1 Yes	☐2 No	☐3 Unknown
Barriers to CPR	☐1 Hang up phone	☐2 Caller left phone	☐3 Caller refuse
	☐4 Caller not with patient	☐5 Language barrier	☐6 Overly distraught
	☐7 Couldn't move patient	☐8 Patient's status changed	☐9 Difficult patie access
	☐10 Other (please specify) ______________________________		☐11 Not applicab

✓Time data and detailed DA data are collected.

Dispatch: Patient

	Conscious?	Breathing Normally?
☐1 Adult	☐1 Yes	☐1 Yes
☐2 Child	☐2 No	☐2 No
☐3 Infant	☐3 Unknown	☐3 Unknown
☐4 Unknown		

Dispatch: Time Measures

Transfer Call?	☐1 Yes	☐2 No	☐3 Unknown
If yes, time elapsed before dispatcher first addressed caller	☐☐ : ☐☐ (mm:ss)	☐3 Unknown	
Dispatcher recognizes need for CPR	☐☐ : ☐☐ (mm:ss)	☐3 Unknown	
Dispatcher began instructions	☐☐ : ☐☐ (mm:ss)	☐3 Unknown	
Time to first compression	☐☐ : ☐☐ (mm:ss)	☐3 Unknown	

Aims/ Hypothesis

Aim

✓This study will aim to evaluate the association between **introduction of comprehensive package** and **improvement of dispatcher's skills**.

Hypothesis

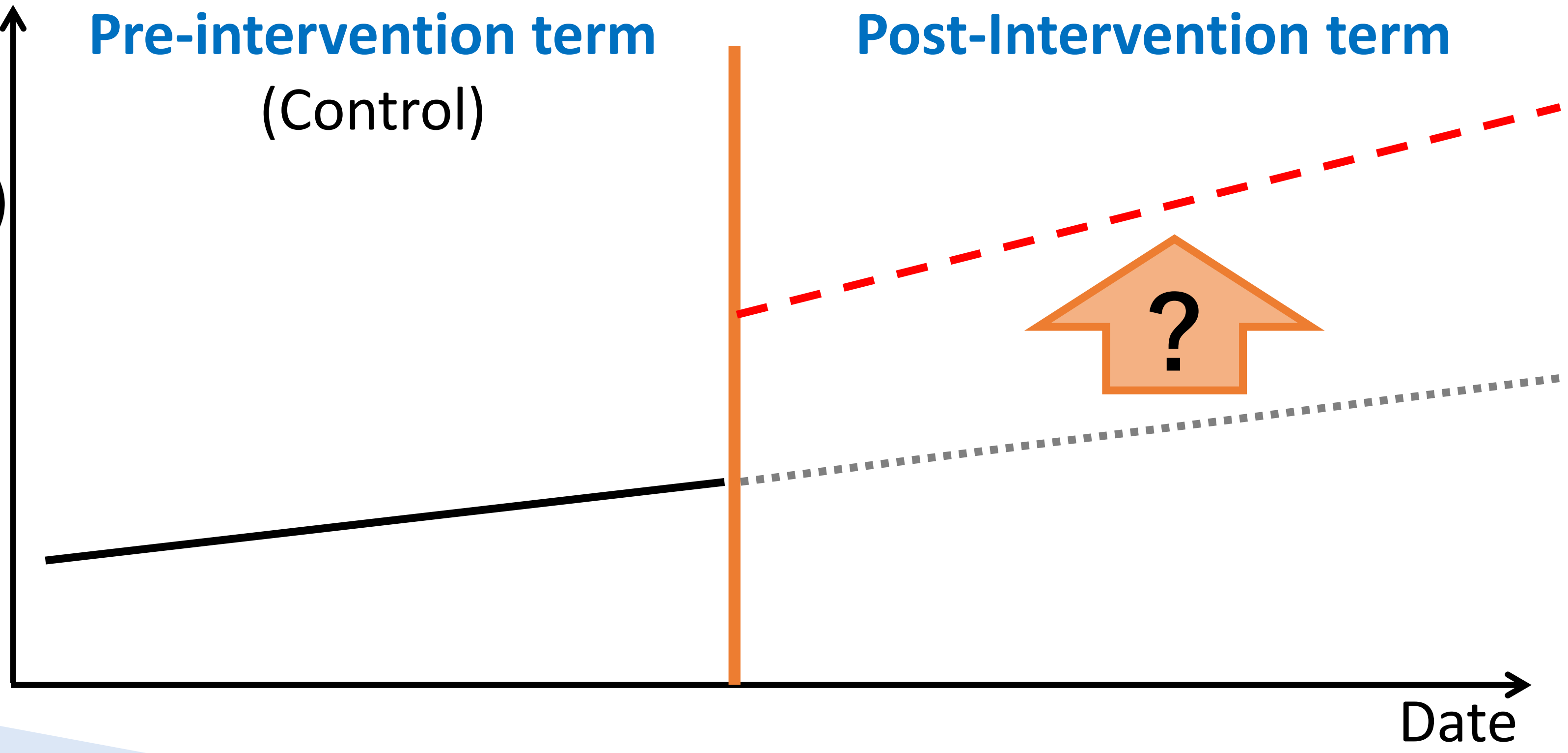
✓Dispatchers' skills were improved by introducing the comprehensive package.

Methods

- ✓**Before and after study**
- ✓**Regression discontinuity design**
- ✓Participants: OHCAs that occurred in where introduced comprehensive package. (Seoul, Taipei, Tainan, Singapore, Penang, Kuala Lumpur/Klang Valley, Eastern)

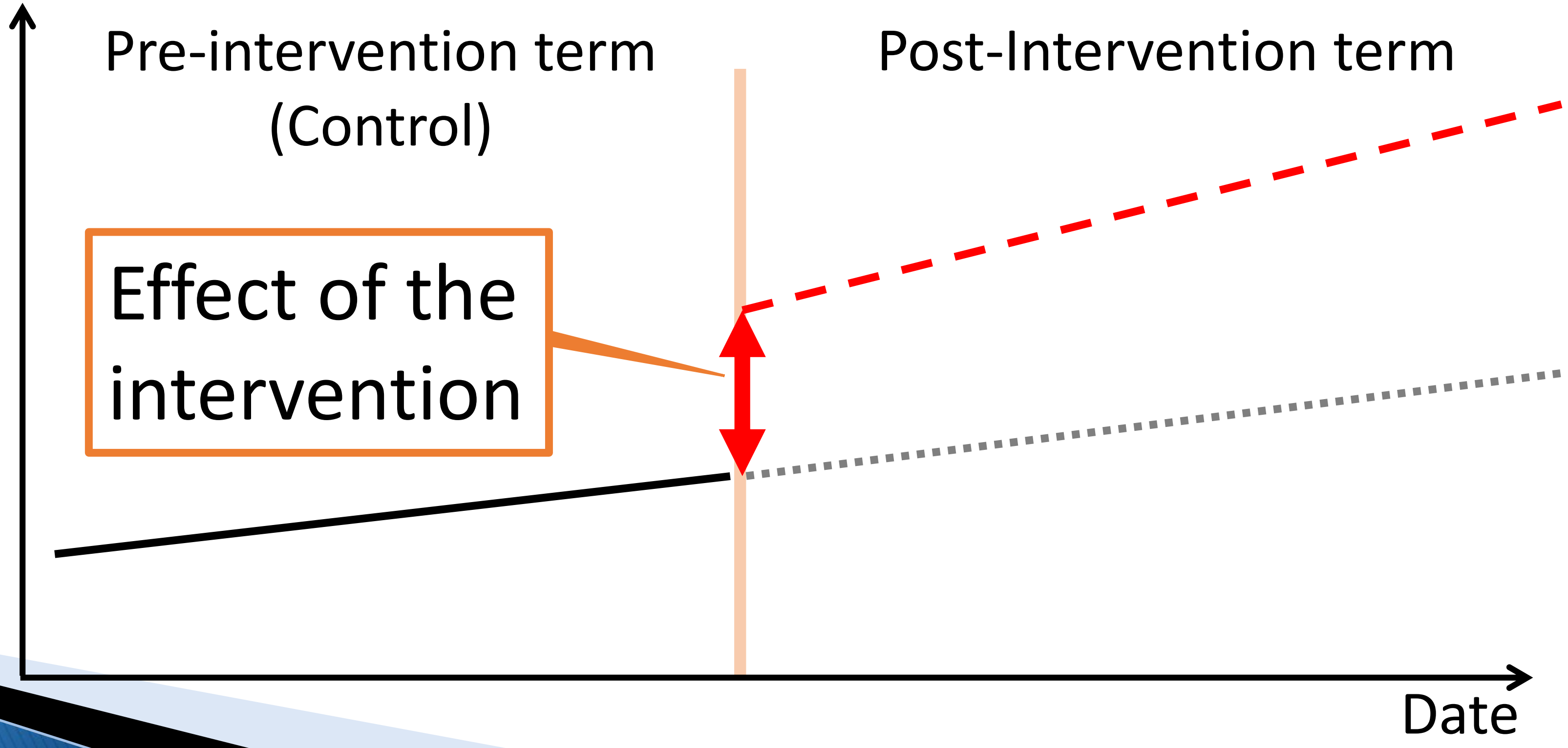
Outcomes

1. **Rate of OHCA recognition**(%)
2. Time from call to recognition
3. Time from recognition to BCPR



Regression discontinuity design

- ✓**Quasi-experimental design**
- ✓A simple before-after comparison cannot be compared in consideration of trends.
- ✓It can be compared as if the comprehensive package was randomly assigned.



Significance

✓This study will be a large-scale study regarding DA-CPR in Pan-Asian countries using PAROS 2 CRN.

✓It can evaluate the effects of comprehensive package, and it would expand the spread of comprehensive package.

Any Questions?

Koshi NAKAGAWA, MEM, EMT-P
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Developing a Time-Adaptive Prediction Model for Out-of-Hospital Cardiac Arrest: using PAROS data

Hansol Chang[1,2], Won Chul Cha[1,2], Jiwoong Kim[2]
[1]Department of Emergency Medicine, Samsung Medical Center, Seoul, Korea
[2]Department of Digital Heath, SAHIST, Seoul, Korea

Outline of Proposal

- Introduction
- Aims/Hypotheses
- Methods
- Significance

Introduction

- Predicting the prognosis of OHCA[1] patients can assist clinicians in
    1) making decisions about the treatment of patients
    2) use of hospital resources, or
    3) termination of resuscitation
- **Decisions about the treatment of patients in real time is needed**

- Differences in EMS system and other environmental factors exists for each country
- **Development of both international and nation-specific prediction model is needed**

1 OHCA: Out-of-hospital cardiac arrest

Introduction

Developed a model that predicts clinical outcomes of OHCA patients, using Korean OHCA registry (KOHCAR) dataset

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Original Paper

Developing a Time-Adaptive Prediction Model for Out-of-Hospital Cardiac Arrest: Nationwide Cohort Study in Korea

Ji Woong Kim[1], MS; Juhyung Ha[2], MSc; Taerim Kim[3], MD; Hee Yoon[3], MD; Sung Yeon Hwang[3], MD; Ik Joon Jo[3], MD; Tae Gun Shin[3], MD; Min Seob Sim[3], MD; Kyunga Kim[1,4], PhD; Won Chul Cha[1,3,5], MD

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JMIR, 2021 (https://www.jmir.org/2021/7/e28361)

Model performance

AUROC[1] curve range

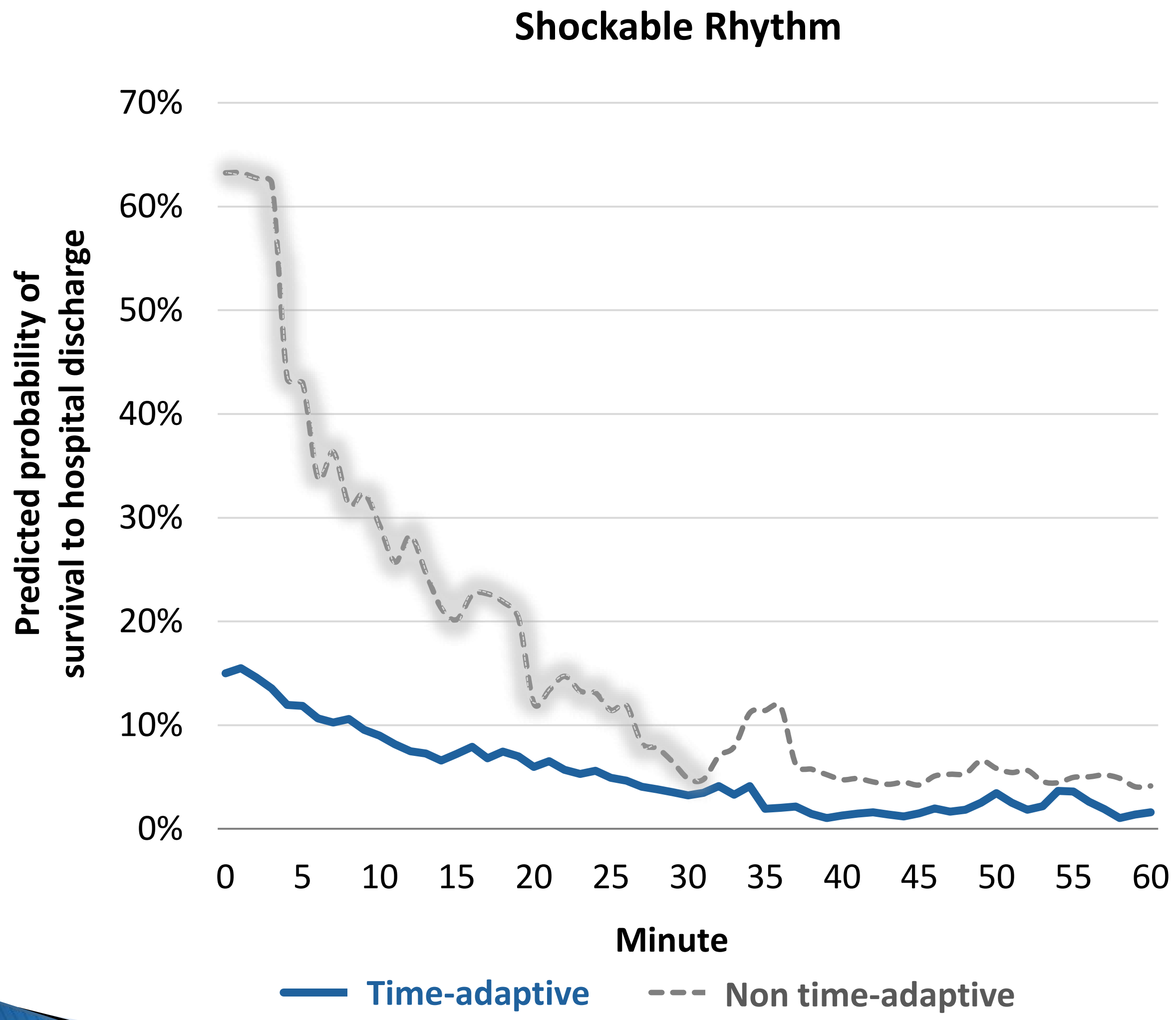
1) **Good neurological outcome (CPC[2] 1-2):**
   from **0.910** (95% CI 0.910-0.911)
   to **0.869** (95% CI 0.865-0.871)

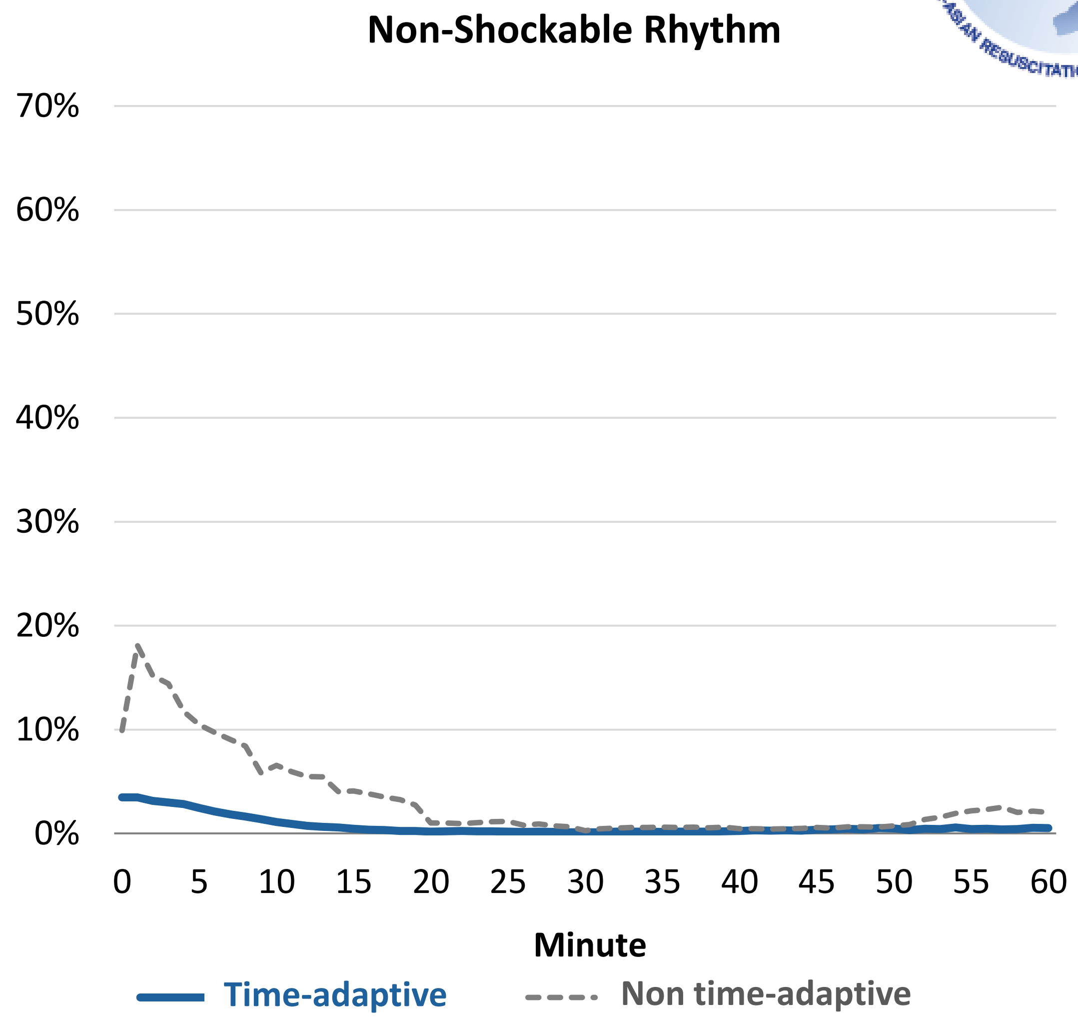
2) **Survival to hospital discharge:**
   from **0.800** (95% CI 0.797-0.800)
   to **0.734** (95% CI 0.736-0.740)

95% CIs were calculated using bootstrapping with 1000 sampling iterations with replacement.

1 AUROC: Area under the receiver operating characteristic
2 CPC: Cerebral Performance Category

Using our time-adaptive prediction model shows **a more realistic pattern of survival to hospital discharge**, compared to a non time-adaptive prediction model.





Time-adaptive model: using CPR duration to define cohorts over time

Non time-adaptive model: using CPR duration as a feature

Aims/Hypothesis

We aim to predict patients' clinical outcomes every minute during ongoing CPR[1]

- We believe that we can…

1. **Build a more generally usable international prediction model with a multi-center, multi-national database**
2. **Build a nation-specific prediction model, using transfer learning technique**
3. **Externally validate our previous model**

1 CPR: Cardio-pulmonary resuscitation

Methods

Datasets to be used:

1) Korean OHCA registry dataset and 2) PAROS dataset

Predictors:

1. **Patient demographics:**

   sex, age

2. **Occurrence-related information:**

   bystander CPR, prehospital CPR, patient's act at the time of OHCA, prehospital electrocardiography (ECG) rhythm, prehospital defibrillation, history of hypertension, diabetes, heart disease, renal disease, respiratory disease, stroke, dyslipidemia

3. **Hospital treatment information collected at ED before CPR:**

   EMS-to-ED time, initial ECG rhythm at the ED, defibrillation, place of the first defibrillation

Methods

Model development:

- **Time-adaptive prediction model:**
    - Create training datasets for each minute to only include ongoing CPR patients
- **Prediction methods:** Random forest, Light GBM, Artificial neural networks
- **Performance metrics:** Prediction probability, AUROC[1], AUPRC[2]
- Calculate 95% CIs using bootstrapping with 1,000 sampling iterations with replacement
- Compare both generalized international model and nation-specific model

1 AUROC: Area under the receiver operating characteristic
2 AUPRC: Area under precision-recall curve

Methods

2 types of models to be developed

1. **Develop a generalized international prediction model**

2. **Develop nation-specific prediction models**

    - Use **transfer learning** to increase model performance and overcome small dataset problem

    - **National characteristics** will be applied to each nation-specific model to better reflect reality

Significance

1. **We can build a generalized prediction model that has been internationally validated**

2. **We will incorporate transfer learning technique when building a nation-specific model**

    - Using existing model : easy development, high availability with low dataset by transfer learning

3. We can build a time-adaptive model

- Make cohort by time by CPR duration: Possible to show patient outcome and change of outcome in every minute

PAROS 2 Updates

International Multi-Center Controlled Interventional Trial to Increase OHCA Survival by Implementation of a Dispatcher-Assisted CPR Package (Pan-Asian Resuscitation Outcomes Study Phase 2)

Marcus Ong Eng Hock
Duke-NUS Medical School
Singapore General Hospital

DISCLOSURES

Authors

Sang Do Shin, Patrick Chow-In Ko, Cindy Xinyi Lin, Matthew Huei-Ming Ma, Hyun Wook Ryoo, Kwanhathai Darin Wong, Supasaowapak Jirapong, Chih-Hao Lin, Chan-Wei Kuo, Ramana Rao, Wenwei Cai, Faith Gaerlan, Munawar Khursheed, Do Ngoc Son, Karim Sarah, Mazen El Sayed, Saad Al Qahtani, Hideharu Tanaka

Funding

The study is supported by grants from the National Medical Research Council (Singapore) and Ministry of Health, Singapore.

BACKGROUND

- Early interventions such as cardiopulmonary resuscitation (CPR) and defibrillation can increase the odds of survival from OHCA.
- Bystander CPR and survival rates in Asia Pacific are relatively low, ranging from 10-40% and 0-31.2% (Utstein survival), respectively.
- In comparison, bystander CPR and survival rates were reported to be as high as 81.3% and 76.5% respectively, in the US.

BACKGROUND

- Dispatcher-assisted CPR (DA-CPR) has the potential to deliver early bystander CPR.
- In 2010, the PAROS network developed and implemented two levels of bundled DA-CPR package:

Basic package
DA-CPR protocol
Training package
Data collection tool

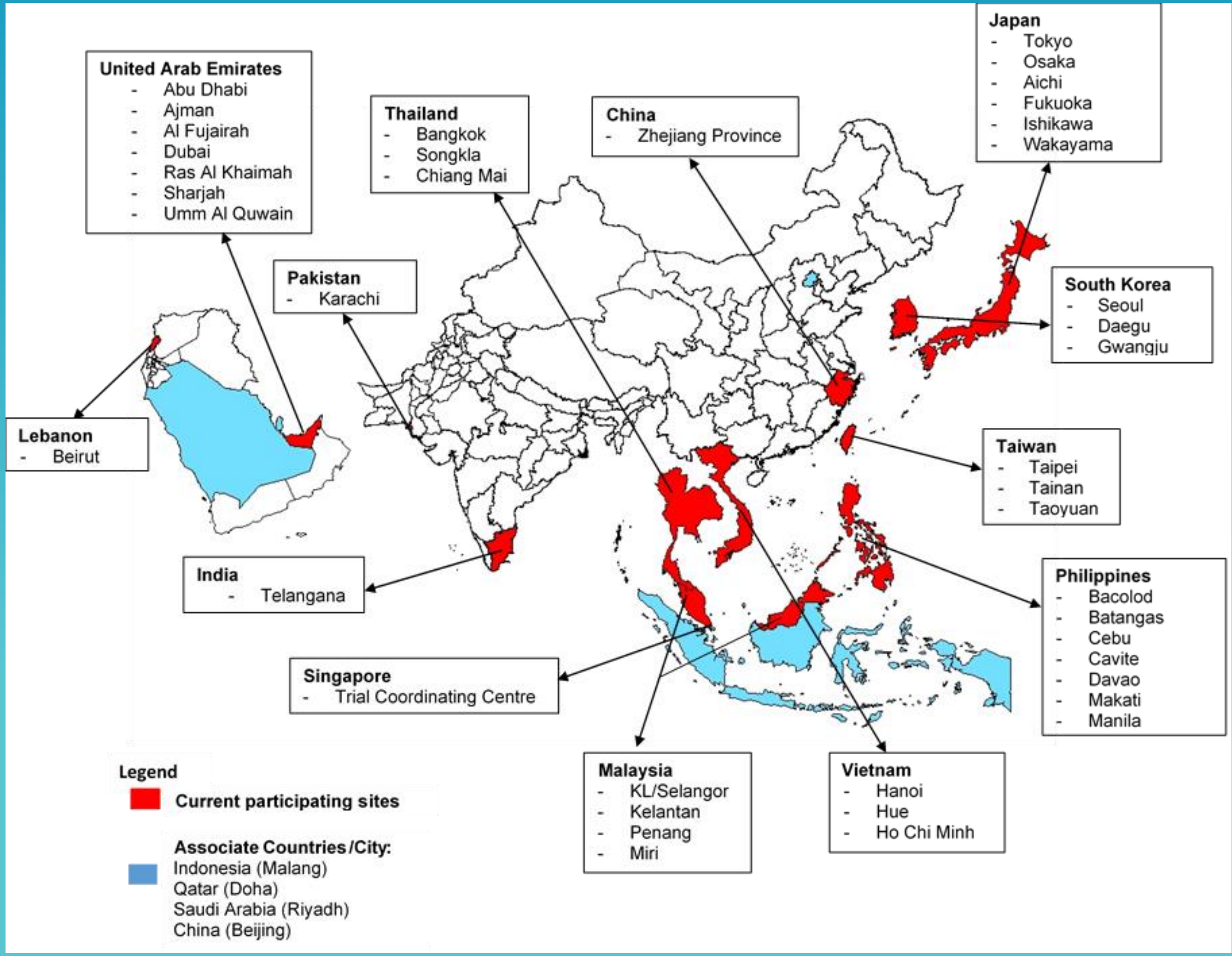
Comprehensive package
DA-CPR protocol
Training package
Data collection tool
Quality improvement tool
Community education program

STUDY AIM

- We aimed to assess the real-world impact of the bundled DA-CPR packages on bystander CPR and survival rates for OHCA in the Asia Pacific region.

METHODS

- Three-arm, prospective, multinational, implementation trial in an EMS setting in the Asia Pacific region.



- Based on their capacity, sites either implemented a comprehensive or a basic DA-CPR package
- Sites which did not implement DA-CPR served as controls.
- OHCA cases between January 2009 and June 2018 from 13 countries in the PAROS CRN were included.

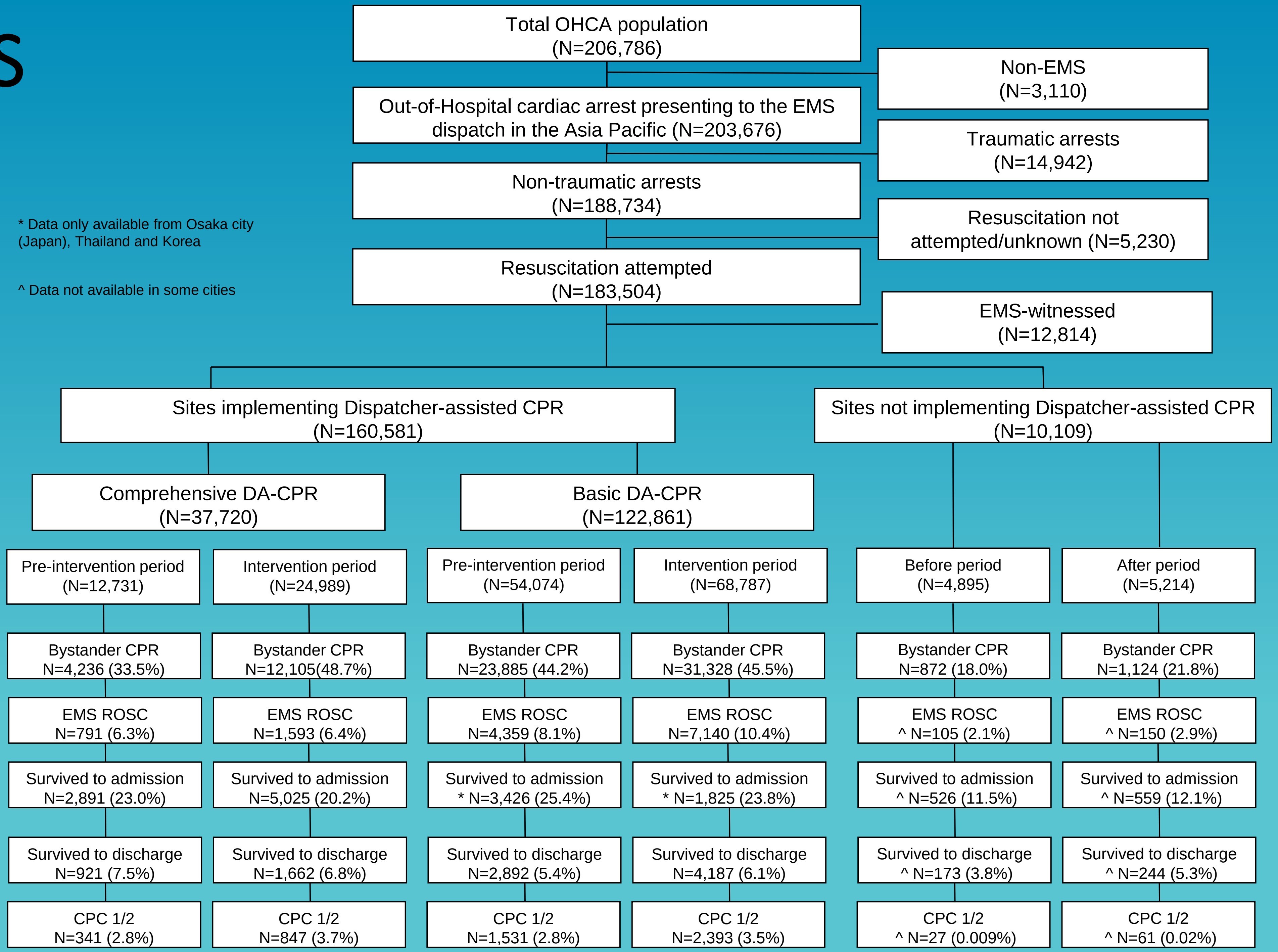
METHODS

- Primary outcome: survival-to-discharge or 30th day post-arrest, if not discharged.
- Secondary outcomes: bystander CPR, Utstein survival, and neurological outcome on discharge or 30th day post-arrest, if not discharged.
- Logistic regression was used to model the before-after change within each country and intervention arm, and between intervention arms. We adjusted for country/site if the sample size for that country is large enough.
- For control sites, data were categorized into before-after periods with approximately equal time period.
- Statistical significance was set at $p<0.05$

RESULTS

* Data only available from Osaka city (Japan), Thailand and Korea

^ Data not available in some cities



RESULTS

Summary Statistics	Comprehensive DA-CPR countries							
	Korea.Seoul (n=17,284)		Malaysia (n=3,482)		Singapore (n=12,546)		Taiwan.TaipeiTainan (n=12,505)	
	Pre (n=7,990)	Post (n=9,294)	Pre (n=494)	Post (n=2,988)	Pre (n=3,028)	Post (n=9,518)	Pre (n=4,175)	Post (n=8,330)
Age, years, Median (IQR)	66.5 (26)	68 (25)	61 (25)	59 (26)	65 (24)	68 (25)	74 (26.5)	74 (25)
Gender (n, %)								
Male	5243 (65.6)	5915 (63.6)	344 (69.9)	2024 (67.8)	1992 (65.8)	6133 (64.4)	2679 (64.2)	5304 (63.7)
Arrest witnessed by (n, %)								
Not witnessed	3158 (46.7)	3735 (46.9)	254 (55.1)	942 (32.7)	1303 (43)	3741 (39.3)	2400 (62.9)	4261 (54.4)
Bystander	3144 (46.5)	3611 (45.4)	185 (40.1)	1774 (61.6)	1483 (49)	4947 (52)	1069 (28)	3351 (42.8)
EMS	459 (6.8)	611 (7.7)	22 (4.8)	164 (5.7)	242 (8)	830 (8.7)	346 (9.1)	224 (2.9)
First arrest rhythm (n, %) [a, b, c, d]								
VT, VF, unknown shockable	1226 (16.3)	1300 (14.7)	8 (3.8)	85 (5)	554 (18.6)	1640 (17.4)	381 (9.2)	877 (10.6)
Unknown unshockable	247 (3.3)	321 (3.6)	81 (38.9)	199 (11.6)	24 (0.8)	474 (5)	56 (1.4)	122 (1.5)
Asystole	4283 (56.8)	5592 (63.3)	52 (25)	1225 (71.7)	1590 (53.4)	4517 (48)	2289 (55.3)	4447 (53.8)
Pulseless electrical activity	1103 (14.6)	1466 (16.6)	4 (1.9)	78 (4.6)	806 (27.1)	2714 (28.8)	799 (19.3)	1793 (21.7)
Unknown	678 (9)	149 (1.7)	63 (30.3)	122 (7.1)	5 (0.2)	75 (0.8)	613 (14.8)	1024 (12.4)
Prehospital intervention (n, %)								
Bystander CPR	2854 (35.7)	4399 (47.3)	76 (16.5)	604 (21)	677 (22.4)	4800 (50.4)	1103 (27.2)	2782 (34.2)
Bystander AED applied [a, b]	71 (0.9)	326 (3.5)	0 (0)	108 (3.8)	54 (1.8)	345 (3.7)		
Prehospital defibrillation [a, b, c, d]	1801 (23.9)	1878 (21.3)	8 (3.8)	111 (6.5)	699 (23.5)	2503 (26.6)	461 (11.2)	972 (11.9)
Prehospital drug administration [a, b, c, d]	59 (0.8)	11 (0.1)	45 (21.6)	612 (35.8)	1419 (47.6)	5187 (55.1)	618 (14.9)	896 (10.8)
Prehospital advanced airway [a, b, c, d]	1181 (19)	1927 (21.8)	83 (39.9)	757 (44.3)	2393 (80.3)	8172 (86.8)	1866 (45.2)	5778 (70.4)
DA CPR performed (n, %) [f]								
Yes		3773 (40.6)		115 (6.3)		2550 (75.3)		661 (14.9)

ED ROSC	2667 (35.4)	3422 (36.8)	11 (2.3)	118 (4)	895 (29.6)	3114 (32.7)	1214 (30)	2155 (26.4)
Any ROSC [a]	2917 (36.6)	3442 (37)	18 (3.6)	128 (4.3)	913 (30.2)	3256 (34.2)	1305 (31.3)	2230 (26.8)
Survived to admission	1938 (24.9)	2332 (25.1)	13 (2.7)	89 (3)	522 (17.2)	1764 (18.5)	983 (23.7)	1724 (21)
Survived to discharge	710 (9.5)	840 (9.4)	5 (1)	8 (0.3)	97 (3.2)	481 (5.1)	292 (7.1)	659 (8.1)
Post arrest CPC 1/2	238 (3.2)	409 (4.6)			54 (1.8)	307 (3.2)	127 (3.1)	309 (3.9)

RESULTS

Summary Statistics	Basic DA-CPR countries					
	Japan (n=135,966)		Thailand (n=1,679)		Korea.DaeguGwangju (n=5,419)	
	Pre (n=63,773)	Post (n=72,193)	Pre (n=1,318)	Post (n=361)	Pre (n=1,705)	Post (n=3,714)
Age, years, Median (IQR)	76 (22)	77 (20)	60 (32)	61 (31)	68 (27)	68 (27)
Gender (n, %)						
Male	36840 (57.8)	41164 (57)	857 (65)	243 (67.3)	1061 (62.2)	2391 (64.4)
Arrest witnessed by (n, %)						
Not witnessed	37758 (59.2)	41267 (57.2)	402 (30.7)	170 (47.1)	559 (41.1)	1401 (46)
Bystander	21444 (33.6)	25703 (35.6)	875 (66.9)	176 (48.8)	664 (48.9)	1376 (45.2)
EMS	4571 (7.2)	5223 (7.2)	31 (2.4)	15 (4.2)	136 (10)	269 (8.8)
First arrest rhythm (n, %) [a, b, c, d]						
VT, VF, unknown shockable	4767 (7.5)	4783 (6.6)	78 (8.7)	35 (9.8)	221 (14.6)	512 (15)
Unknown unshockable	13889 (21.8)	4941 (6.8)	7 (0.8)	1 (0.3)	143 (9.4)	262 (7.7)
Asystole	34065 (53.4)	43443 (60.2)	737 (81.9)	287 (80.6)	841 (55.5)	2067 (60.6)
Pulseless electrical activity	10527 (16.5)	15803 (21.9)	69 (7.7)	33 (9.3)	114 (7.5)	476 (13.9)
Unknown	525 (0.8)	3223 (4.5)	9 (1)	0 (0)	195 (12.9)	96 (2.8)
Prehospital intervention (n, %)						
Bystander CPR	25683 (40.3)	30295 (42)	215 (16.4)	115 (31.9)	363 (21.3)	1330 (35.8)
Bystander AED applied [a, b]	340 (0.7)	931 (1.4)	21 (2.1)	5 (1.4)	35 (2.1)	108 (2.9)
Prehospital defibrillation [a, b, c, d]	6660 (10.4)	9987 (13.8)	141 (15.7)	58 (16.3)	272 (18)	669 (19.6)
Prehospital drug administration [a, b, c, d]	5124 (8)	8747 (12.1)	691 (76.8)	262 (73.6)		6 (0.2)
Prehospital advanced airway [a, b, c, d]	24430 (38.3)	26158 (36.2)	687 (76.3)	261 (73.3)	239 (16.2)	893 (26.2)
DA CPR performed (n, %) [f]						
Yes		35257 (48.8)		134 (37.1)		1022 (27.5)
EMS ROSC [a, b, c, d]	5426 (8.5)	8104 (11.2)	175 (19.4)	75 (21.1)	57 (3.9)	217 (6.4)
ED ROSC			359 (27.2)	78 (21.6)	405 (24.6)	1170 (31.5)
Any ROSC [3]			407 (30.9)	111 (30.7)	450 (26.5)	1181 (31.8)
Survived to admission			293 (22.3)	62 (17.2)	283 (16.6)	641 (17.3)
Survived to discharge	3633 (5.7)	4865 (6.7)	47 (3.6)	2 (0.6)	70 (4.5)	196 (5.7)
Post arrest CPC 1/2	1959 (3.1)	2859 (4)	11 (0.9)	0 (0)	36 (2.3)	119 (3.5)

RESULTS

Summary Statistics	Countries which did not implement DA-CPR							
	Taiwan.Taoyuan (n=10,057)		China (n=1,583)		India (n=2,780)		Lebanon (n=225)	
	Pre (n=4,790)	Post (n=5,267)	Pre (n=343)	Post (n=1,240)	Pre (n=1,630)	Post (n=1,150)	Pre (n=116)	Post (n=109)
Age, years, Median (IQR)	68 (32)	68 (32)	59 (31.75)	60 (28)	50 (30)	55 (26)	75 (22.5)	73 (25)
Gender (n, %)								
Male	3313 (69.2)	3698 (70.2)	255 (74.3)	876 (70.6)	1148 (70.4)	791 (68.8)	77 (67)	75 (68.8)
Arrest witnessed by (n, %)								
Not witnessed	2771 (61.5)	3170 (64.4)	40 (11.7)	268 (21.8)	1515 (92.9)	1012 (88)	26 (26)	23 (23.7)
Bystander	1503 (33.4)	1462 (29.7)	301 (87.8)	935 (76)	5 (0.3)	3 (0.3)	69 (69)	70 (72.2)
EMS	230 (5.1)	291 (5.9)	2 (0.6)	28 (2.3)	110 (6.7)	135 (11.7)	5 (5)	4 (4.1)
First arrest rhythm (n, %) [a, b, c, d]								
VT, VF, unknown shockable	251 (6.7)	205 (5.3)	19 (8.2)	75 (7.9)	0 (0)	0 (0)	-	3 (8.6)
Unknown unshockable	1193 (31.9)	621 (16.1)	2 (0.9)	5 (0.5)	5 (0.3)	2 (0.2)	-	0 (0)
Asystole	746 (19.9)	870 (22.6)	103 (44.2)	593 (62.6)	2 (0.1)	0 (0)	-	17 (48.6)
Pulseless electrical activity	236 (6.3)	258 (6.7)	30 (12.9)	93 (9.8)	0 (0)	0 (0)	-	0 (0)
Unknown	1315 (35.2)	1904 (49.4)	79 (33.9)	181 (19.1)	1621 (99.6)	1147 (99.8)	-	15 (42.9)
Prehospital intervention (n, %)								
Bystander CPR	936 (20)	1182 (23.2)	56 (16.3)	159 (12.9)	1 (0.1)	0 (0)	8 (38.1)	7 (7.1)
Bystander AED applied [a, b]			24 (8.2)	31 (2.9)	9 (0.6)	2 (0.2)	0 (0)	1 (1.1)
Prehospital defibrillation [a, b, c, d]	204 (5.5)	204 (5.3)	22 (9.5)	87 (9.2)	0 (0)	0 (0)	0 (0)	6 (17.1)
Prehospital drug administration [a, b, c, d]	172 (4.6)	248 (6.4)	122 (53)	289 (30.7)	27 (1.7)	24 (2.1)	0 (0)	0 (0)
Prehospital advanced airway [a, b, c, d]	2607 (69.7)	3235 (83.9)	114 (49.6)	274 (29)	1 (0.1)	0 (0)	0 (0)	0 (0)
DA CPR performed (n, %) [f]								
Yes								
Response time								
Median (IQR)	7.5 (3.4)	7.5 (3)	12 (12.9)	12 (8.8)	14.1 (12.5)	13.3 (11.9)	15 (10)	20 (24.5)
Outcomes (n, %)								
EMS ROSC [a, b, c, d]	87 (2.3)	135 (3.5)	31 (13.5)	43 (4.6)	11 (0.7)	0 (0)		
ED ROSC	729 (15.4)	811 (15.7)	73 (21.9)	166 (13.9)	10 (0.6)	2 (0.2)	16 (13.8)	25 (22.9)
Any ROSC [3]	744 (15.5)	835 (15.9)	84 (24.7)	186 (15)	11 (0.7)	2 (0.2)		
Survived to admission	626 (13.2)	665 (12.8)	63 (18.7)	152 (12.3)	9 (0.6)	1 (0.1)	15 (12.9)	18 (16.7)
Survived to discharge	219 (4.6)	301 (5.8)	18 (5.4)	70 (5.6)	3 (0.2)	0 (0)	7 (6.1)	4 (3.7)
Post arrest CPC 1/2	38 (0.8)	80 (1.6)	3 (0.9)	7 (0.6)				

RESULTS

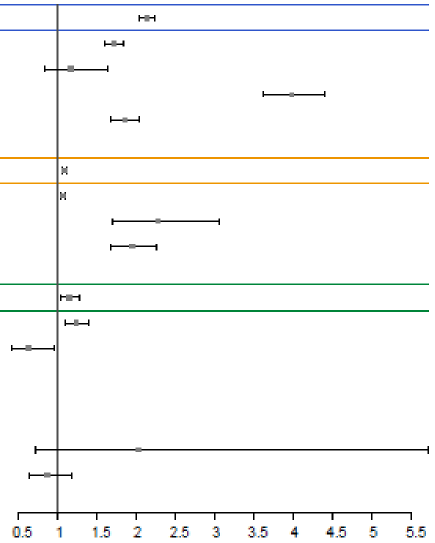
Summary Statistics	Countries which did not implement DA-CPR							
	Pakistan (n=781)		Philippines (n=868)		UAE (n=911)		Vietnam (n=700)	
	Pre (n=514)	Post (n=267)	Pre (n=781)	Post (n=87)	Pre (n=325)	Post (n=586)	Pre (n=243)	Post (n=457)
Age, years, Median (IQR)	58 (29.5)	60 (20)	57 (24)	52 (27)	53 (31)	52 (30.25)	57 (29)	53 (27)
Gender (n, %)								
Male	328 (63.8)	172 (64.4)	516 (66.1)	61 (70.1)	237 (73.1)	448 (76.5)	184 (75.7)	340 (74.6)
Arrest witnessed by (n, %)								
Not witnessed	16 (3.1)	12 (4.5)	264 (33.8)	54 (62.1)	123 (38.1)	208 (35.5)	86 (36.4)	62 (14.5)
Bystander	489 (95.1)	252 (94.4)	496 (63.6)	33 (37.9)	174 (53.9)	328 (56)	115 (48.7)	296 (69)
EMS	9 (1.8)	3 (1.1)	20 (2.6)	0 (0)	26 (8)	50 (8.5)	35 (14.8)	71 (16.6)
First arrest rhythm (n, %) [a, b, c, d]								
VT, VF, unknown shockable	5 (9.1)	4 (23.5)	3 (2.4)	4 (14.3)	61 (18.9)	82 (14)	7 (20.6)	40 (29.4)
Unknown unshockable	0 (0)	0 (0)	3 (2.4)	13 (46.4)	79 (24.5)	72 (12.3)	2 (5.9)	8 (5.9)
Asystole	4 (7.3)	2 (11.8)	26 (21)	1 (3.6)	115 (35.7)	375 (64.2)	8 (23.5)	8 (5.9)
Pulseless electrical activity	0 (0)	0 (0)	4 (3.2)	0 (0)	16 (5)	19 (3.3)	4 (11.8)	10 (7.4)
Unknown	46 (83.6)	11 (64.7)	88 (71)	10 (35.7)	51 (15.8)	36 (6.2)	13 (38.2)	70 (51.5)
Prehospital intervention (n, %)								
Bystander CPR	52 (10.1)	27 (10.1)	50 (6.4)	10 (11.5)	97 (29.8)	156 (26.6)	39 (17)	127 (29.4)
Bystander AED applied [a, b]	1 (0.3)	4 (2.2)	1 (0.5)	1 (3.2)	14 (4.3)	13 (2.2)	3 (3.4)	16 (6.2)
Prehospital defibrillation [a, b, c, d]	1 (1.8)	3 (17.6)	2 (1.6)	5 (17.9)	159 (49.4)	301 (51.5)	7 (20.6)	44 (32.6)
Prehospital drug administration [a, b, c, d]	22 (40)	4 (23.5)	19 (15.3)	12 (42.9)	88 (27.3)	59 (10.1)	29 (85.3)	129 (94.9)
Prehospital advanced airway [a, b, c, d]	38 (69.1)	7 (41.2)	13 (10.5)	2 (7.1)	268 (83.2)	529 (90.6)	22 (64.7)	112 (82.4)

EMS ROSC [a, b, c, d]	6 (10.9)	0 (0)	5 (4)	2 (7.1)	14 (4.3)	31 (5.3)	17 (50)	100 (73.5)
ED ROSC	37 (7.2)	9 (3.4)	107 (15)	10 (11.5)			49 (20.2)	209 (46)
Any ROSC [3]	42 (8.2)	9 (3.4)	111 (14.2)	10 (11.5)			50 (20.6)	222 (48.6)
Survived to admission	21 (4.1)	5 (1.9)	53 (6.8)	4 (4.6)			34 (14.2)	107 (23.9)
Survived to discharge	7 (1.4)	2 (0.7)	6 (0.8)	1 (1.1)			18 (7.5)	64 (15)
Post arrest CPC 1/2	5 (1)	1 (0.4)	1 (0.1)	1 (1.1)			10 (4.2)	14 (3.6)

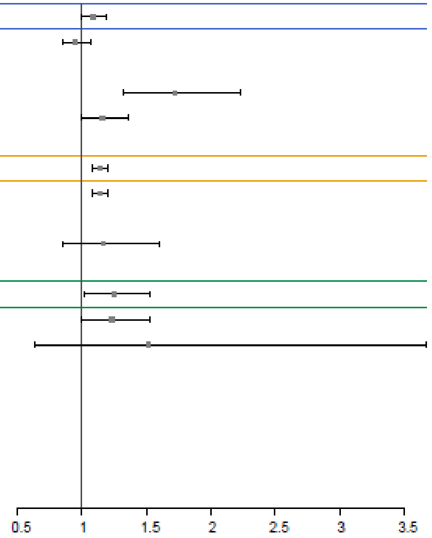
RESULTS

Before-After Outcomes Comparison within country and Intervention Arm

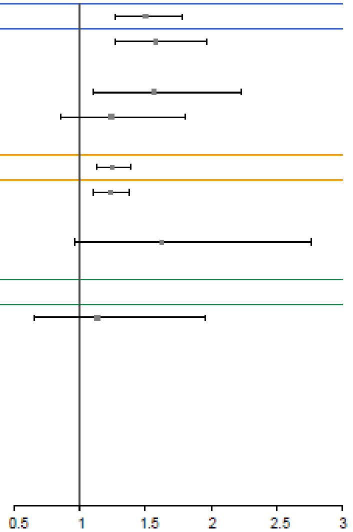
Bystander CPR	OR	95% CI	P
Comprehensive	2.14	2.04 – 2.25	< 0.001
Korea (Seoul)	1.72	1.61 – 1.84	< 0.001
Malaysia	1.17	0.84 – 1.63	0.36
Singapore	3.98	3.61 – 4.39	< 0.001
Taiwan (Taipei, Tainan)	1.85	1.69 – 2.03	< 0.001
Basic	1.09	1.06 – 1.11	< 0.001
Japan	1.06	1.04 – 1.09	< 0.001
Thailand	2.28	1.7 – 3.05	< 0.001
Korea (Daegu, Gwangju)	1.95	1.68 – 2.25	< 0.001
Control	1.15	1.03 – 1.28	0.0096
Taiwan (Taoyuan)	1.24	1.1 – 1.39	< 0.001
China	0.62	0.41 – 0.95	0.029
India			
Lebanon			
Pakistan			
Philippines	2.03	0.72 – 5.72	0.18
UAE	0.86	0.64 – 1.17	0.35
Vietnam			



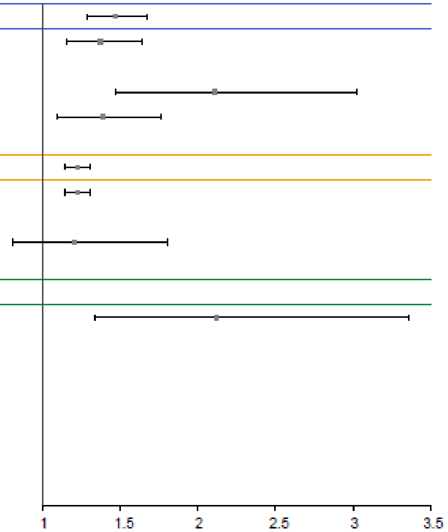
Survived to discharge	OR	95% CI	P
Comprehensive	1.09	1 – 1.19	0.051
Korea (Seoul)	0.95	0.85 – 1.06	0.38
Malaysia			
Singapore	1.72	1.33 – 2.23	< 0.001
Taiwan (Taipei, Tainan)	1.16	0.99 – 1.36	0.063
Basic	1.14	1.08 – 1.2	< 0.001
Japan	1.14	1.08 – 1.2	< 0.001
Thailand			
Korea (Daegu, Gwangju)	1.17	0.85 – 1.6	0.34
Control	1.25	1.02 – 1.53	0.034
Taiwan (Taoyuan)	1.23	1 – 1.53	0.052
China	1.52	0.63 – 3.67	0.35
India			
Lebanon			
Pakistan			
Philippines			
UAE			
Vietnam			



Survived to discharge (Utstein)	OR	95% CI	P
Comprehensive	1.5	1.27 – 1.78	< 0.001
Korea (Seoul)	1.58	1.27 – 1.96	< 0.001
Malaysia			
Singapore	1.57	1.1 – 2.24	0.014
Taiwan (Taipei, Tainan)	1.24	0.85 – 1.8	0.27
Basic	1.25	1.12 – 1.39	< 0.001
Japan	1.23	1.11 – 1.37	< 0.001
Thailand			
Korea (Daegu, Gwangju)	1.63	0.96 – 2.76	0.072
Control			
Taiwan (Taoyuan)	1.13	0.65 – 1.96	0.66
China			
India			
Lebanon			
Pakistan			
Philippines			
UAE			
Vietnam			



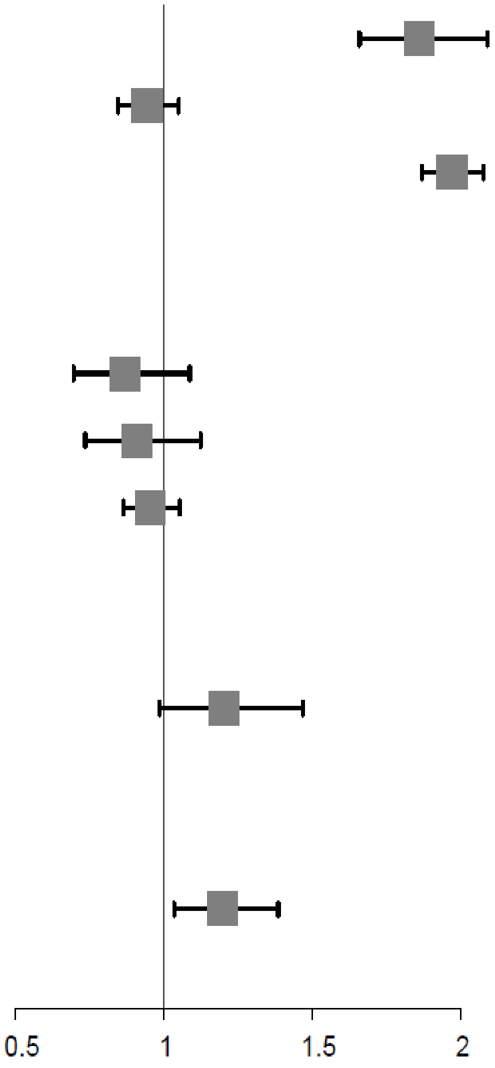
Post arrest CPC 1/2	OR	95% CI	P
Comprehensive	1.47	1.29 – 1.68	< 0.001
Korea (Seoul)	1.38	1.15 – 1.64	< 0.001
Malaysia			
Singapore	2.11	1.47 – 3.02	< 0.001
Taiwan (Taipei, Tainan)	1.39	1.1 – 1.76	0.0061
Basic	1.23	1.15 – 1.31	< 0.001
Japan	1.23	1.15 – 1.31	< 0.001
Thailand			
Korea (Daegu, Gwangju)	1.21	0.81 – 1.81	0.36
Control			
Taiwan (Taoyuan)	2.12	1.34 – 3.36	0.0014
China			
India			
Lebanon			
Pakistan			
Philippines			
UAE			
Vietnam			



RESULTS

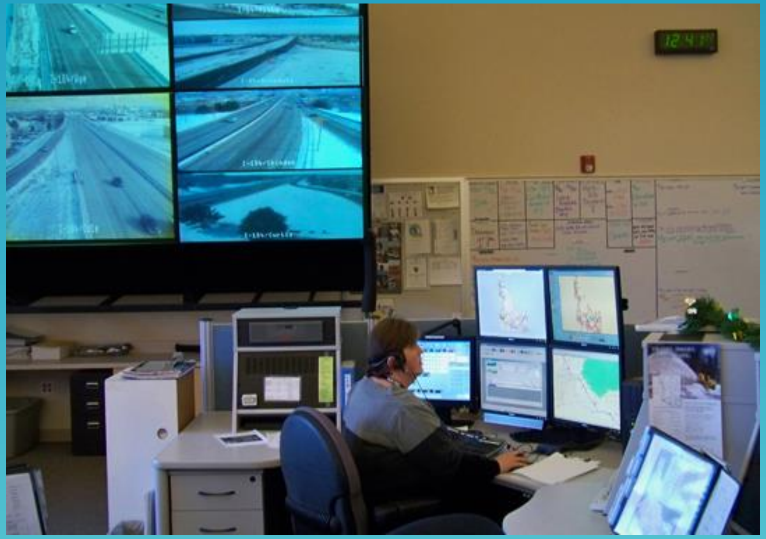
Outcomes Comparison between Intervention Arms

	Ratio of OR	95% CI	P
Bystander CPR			
Comprehensive vs. Control	1.86	1.66 – 2.09	< 0.001
Basic vs. Control	0.94	0.85 – 1.05	0.3
Comprehensive vs. Basic	1.97	1.87 – 2.08	< 0.001
Survived to discharge			
Comprehensive vs. Control	0.87	0.7 – 1.09	0.23
Basic vs. Control	0.91	0.74 – 1.13	0.39
Comprehensive vs. Basic	0.96	0.87 – 1.06	0.38
Survived to discharge (Utstein)			
Comprehensive vs. Basic	1.21	0.99 – 1.47	0.065
Post arrest CPC 1/2			
Comprehensive vs. Basic	1.2	1.04 – 1.39	0.015



DISCUSSION

- Compared to a basic DA-CPR program and no DA-CPR program, a comprehensive DA-CPR program had the most impact on BCPR rate and survival with favorable neurological outcomes.
- Bobrow et al. similarly found an increase in bystander CPR and favorable neurological outcome, comparing a comprehensive DA-CPR package to DA-CPR protocol only.
- Song et al. implemented DA-CPR protocol only and observed fluctuations in bystander CPR rates, which was in part due to low OHCA recognition rates by dispatchers.



DISCUSSION

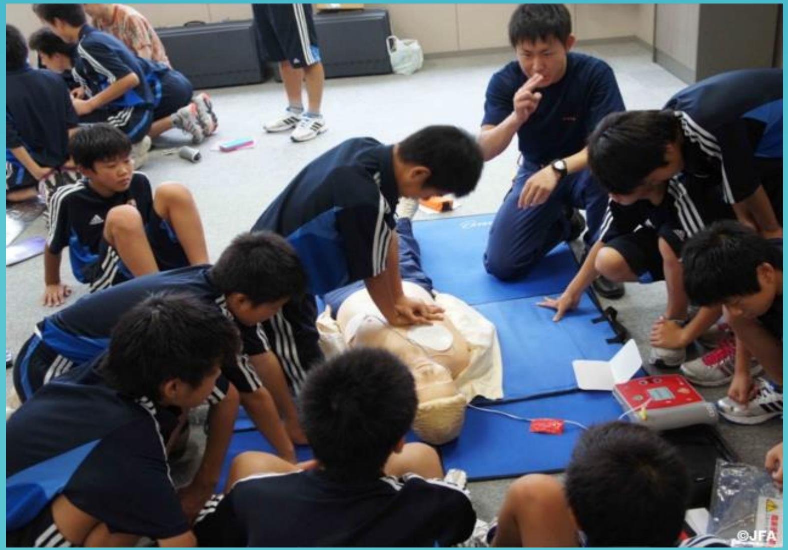
- Absence of a continuous quality improvement program could have contributed to the low recognition rates.
- Importance of a continuous quality improvement tool for DA-CPR to be effective and to ensure maintenance of performance of dispatchers over time.

LIMITATIONS

- Possible selection bias - inherent system differences between sites that had the capacity to implement the interventions and those that were unable to implement any intervention
- Adherence rate to DA-CPR intervention varies between sites from 6.3-75.3% in the comprehensive arm and 27.5-48.8% in the basic arm.
- Wide variation in sample sizes between sites - some findings were largely driven by sites with bigger cohorts.
- Unable to account for secular trends, policy changes, intervention compliance rate, sample size differences, and other interventions that could have occurred during the study period.

CONCLUSIONS

- We demonstrated the feasibility and generalizability of DA-CPR package implementation in highly heterogeneous EMS systems
- Comprehensive DA-CPR program had the most impact on BCPR and survival with favorable neurological outcome.
- Importance of a continuous quality improvement tool for DA-CPR to be effective.



Questions?

Summary: PAROS Studies Update

Proposals Withdrawn

- due to timeline and lack of progress/ request by PI

Study Title	Date of Approval	First Author	Status updates_ 2021	Topic Status
Arrest to first compression time and survival outcome in witness OHCA.	Aug 2016	Dr Yu Jin Lee	Request to withdraw 2020	Open to all
The influence of cancer on post-resuscitation treatments among out-of-hospital cardiac arrest patients	Feb 2018	Dr Joyce Kong	Request to withdraw 2020	Open to all
The effects of cancer on outcomes after out-of-hospital cardiac arrest	Feb 2018	Dr Joyce Kong	Request to withdraw 2020	Open to all
The difference of on-scene resuscitation according to initial rhythm in patient with out-of-hospital cardiac arrest	Feb 2018	Dr Won Chul Cha, Dr Taerim Kim	Request to withdraw 2020	Open to all
Prehospital Advanced Airway and Outcomes in OHCA	Feb 2018	Dr Tae Han Kim Dr Sang Do Shin	Request to withdraw 2020	Open to all

Proposals Withdrawn

- due to timeline and lack of progress/ request by PI

Study Title	Date of Approval	First Author	Status updates_ 2021	Topic Status
Time Interval between Collapse and Return of Spontaneous Circulation between Various Outcomes in OHCA	June 2014	Dr Andrew Ho	Withdrawn	Open to all
Epidemiology of OHCA between developing and developed countries	Aug 2016	Dr Takahiro Hara	Withdrawn	Open to all
The Outcomes of Traumatic or Injured OHCA and Ventricular Fibrillation	Aug 2016	Dr Patrick Ko Dr Yen-Pin Chen, Dr Sot Shih-Hung Liu	Withdrawn	Open to all
Gender difference in out-of-hospital cardiac arrest survival by region in Asian countries	Feb 2018	Dr Lee Sun Young	Withdrawn	Open to all

Study Updates

Study Title	Approval	First Author	Status updates_2021
Predictive performance of Termination-Of-Resuscitation (TOR) rules in Asia: Are They Accurate Enough?	April 2014	Dr Huang Yu-Sheng Dr Chiang Wen-Chu	Submitted an extension of the study to include PAROS 2 data
Factors Influencing Bystander Cardiopulmonary Resuscitation and the Related Outcomes across PAROS Communities	Nov 2015	Dr Jonathan Lu	Data cleaning completed, currently under data analysis. Target to submit manuscript by Dec 2021
Resuscitation Academy (RA) 10-Step Implementations in the Pan-Asian Resuscitation Outcomes Study (PAROS) group	Aug 2016	Dr Marcus Ong	Ongoing
Percutaneous coronary intervention provision and outcomes among cardiogenic OHCA in Asian countries	July 2017	Dr Takashi Tagami	
Environmental exposure as a risk factor for out-of-hospital cardiac arrest	Feb 2018	Dr Andrew Ho	Analysis in progress

Study Title	Approval	First Author	Status updates_2021
Interaction effect of bystander CPR on the association between time from call to first rhythm analysis and shockable presenting rhythm after out-of-hospital cardiac arrest	Feb 2018	Dr Jeogn Ho Park	Ongoing
The effect of initial ECG rhythm on the association between bystander cardio-pulmonary resuscitation (CPR) and outcomes after out-of-hospital cardiac arrest (OHCA)	Feb 2018	Dr Jung Eujene	
Basic versus Advanced Life Support in Out-of-Hospital Cardiac Arrest: A Retrospective Study of the Pan-Asian Resuscitation Outcomes Study (PAROS) Registry Population	Feb 2018	Dr Mazen El-Sayed	
Utstein Factors and Outcomes in Traumatic Out-of-Hospital Cardiac Arrests	Feb 2018	Dr Chia Yih Chong Michael	Manuscript completed, “Characteristics and outcomes of traumatic cardiac arrests in the Pan Asian Resuscitation Outcomes Study”. Pending acceptance of the main PAROS 2 paper.

Study Title	Approval	First Author	Status updates_2021
Pre-hospital Advanced Airway and Survival Outcomes after Paediatric Out-of-Hospital Cardiac Arrests.	Feb 2018	Dr Tham Lai Peng	Manuscript in progress
The impact of early coronary angiography on clinical outcomes in out-of-hospital cardiac arrest	Feb 2018	Dr Lim Shir Lynn	Manuscript submitted, pending review
Monitoring the brain after cardiac arrest	Feb 2018	Dr Lim Shir Lynn	Data available from NUH, await TTSH data
Variability of a first responder dispatch after out-of-hospital cardiac arrest among Asian countries	Jun 2019	Dr Sattha Riyapan	Ongoing
Emergency department factors and outcomes of adult and paediatric out-of-hospital arrests in Pan-Asian Countries	Jun 2019	Dr Gene Ong	
Development and Validation of a Predictive Model for Early Neuro-Prognostication after OHCA	Jun 2019	Dr Liu Nan	Ongoing

Study Title	Approval	First Author	Status updates_2021
Comprehensive Prehospital Intervention for Heat Wave Victims	Jun 2019	Prof Marcus Ong, Dr Gayathri Nadarajan, Dr Ramana Rao, Dr Keshav Reddy	
Protocol development for Video-Call based DACPR	Jun 2019	Dr Tae Han Kim	
Gender Disparities Among Recipients of Bystander CPR and AED in Pan-Asian Communities	Oct 2019	Dr Liu nan	ongoing
Development and Validation of the Pan-Asian ROSC After Cardiac Arrest (PA-RACA) Score	Aug 2020	Dr Liu Nan	ongoing
Use Artificial Intelligence and Deep Learning to Predict Clinical Outcomes for Out-of-Hospital Cardiac Arrest Patients	Aug 2020	Dr Liu Nan	ongoing

Study Title	Approval	First Author	Status updates_2021
Outcomes of OHCA patients stratified by mode of transport to the ED in Asia	Aug 2020	Dr Ivan Chua	ongoing
Descriptive comparison of OHCA survival and predictors amongst the geriatric age group in Asia	Aug 2020	Dr Gayathri	
Proposal for GRA Assessment Tool study	Aug 2020	Dr Gayathri	
Adult OHCA during COVID-19	Aug 2020	Dr Lim Shir Lynn	This will be merged with the international OHCA collaboration led by EuReCA
Paediatric OHCA during COVID-19	Aug 2020	Dr Kenneth Doya G. Nonesa	Data collection ongoing
Early vs Late Endotracheal Intubation among Out-of-Hospital Cardiac Arrest Patients in Pan-Asian Countries in the time of COVID-19 Pandemic	Aug 2020	Dr Daniel Unno H. Hiquiana	
Temporal trends of non-shockable out-of-hospital cardiac arrest in Asia	Dec 2020	Dr Lim Shir Lynn	Yet to be initiated, will be using both PAROS 1 and PAROS 2 data.