Singapore's Out-of-Hospital Cardiac Arrest Data Report (2011-2019)

UNIT FOR PRE-HOSPITAL EMERGENCY CARE
UPEC
SINGAPORE

September 2021

Executive Summary

In this fourth annual report, we accelerated the reporting of 2019 data with the help of dedicated staff who were repurposed after COVID-19 precautions halted other facets of our operation. Highlights for this reporting period are:

- In 2019, the number of out-of-hospital cardiac arrests (OHCA) increased from 2972 in 2018 to **3233**. This increase is due to the growing proportion of the elderly population in Singapore. Age is a major risk factor for cardiac arrest.

- The bystander CPR rates dipped slightly from 61.8**%** in 2018 and to **60.0%** in 2019.

- Automated External Defibrillators (AED) use (applied) rates increased from 7.2% in 2018 to **10.5%** in 2019. This marks a milestone where Singapore has broken through to double-digit rate of AED use. The assumption is that we continue to see the benefits of the efforts by the Singapore Civil Defence Force (SCDF) and Singapore Heart Foundation (SHF) to install AEDs and make them visible to the public via the myResponder phone app. Bystander AED use is a critical indicator to watch because early use of AEDs can more than double the survival rate. [1]

- In 2019, the Return of Spontaneous Circulation (ROSC) at scene/*en route* rate decreased a bit to **12.1%** from 13.1% in 2018. ROSC is another important indicator to monitor because it is an initial, but unstable, state of recovery.

- The overall number of people who survived-to-discharge in 2019 was **200**, compared to 175 in 2018. Also, the overall OHCA survival-to-discharge rate increased to **6.2%** up from 5.9% in 2018.

[1] Holmberg MJ, Vognsen M, Andersen MS, Donnino MW, Andersen LW. Bystander automated external defibrillator use and clinical outcomes after out-of-hospital cardiac arrest: A systematic review and meta-analysis. Resuscitation. 2017 Nov 1;120:77-87.

- Utstein survival increased to **26.2%** in 2019 compared to 25.9% in 2018. The Utstein survival rate is an internationally accepted benchmark measure. We use it to monitor how well we are doing with our overall efforts to improve the entire chain of survival.

- Of those patients who survived an OHCA in 2019, **78.0%** did so with good-to-moderate neurological function compared to 67.4% in 2018. Survival-to-discharge with good-to-moderate neurological functioning is the gold standard for OHCA survival.

Once again, on many of the key indicators, we are making steady progress. We continue to see an increasing incidence of OHCA in Singapore, but it is encouraging to see sustained improvements in our public defibrillation and survival outcomes. Training the public in cardiopulmonary resuscitation (CPR) and AED use will continue with increased creativity as we steer a course through the second year of the COVID-19 pandemic. The public should remain aware that 74% of cardiac arrests occur in the home and are witnessed by a family member in the same household who will have the earliest opportunity to respond. With AEDs increasingly available in HDB blocks and elsewhere nationwide, it is important we remain prepared with knowledge and the skills to retrieve and use one immediately. Chances for a shockable rhythm are greatest when the collapse is first observed or discovered thus making the AED's therapeutic shock more effective.

We have continued to make progress, especially with increasing public access defibrillation and survival to discharge with good neurological function. Let us continue to focus on increasing the quality of CPR, resuscitation, and post-resuscitation care to improve survival with good neurological outcomes.

Sincerely,

Prof. Marcus E.H. Ong

Alexander White, JD, MPH; Nur Shahidah, BA; Nurul Asyikin, BSc; Liew LX, BSc, Pek Pin Pin, MPH; Ng Yih Yng, MBBS, FAMS, MRCS A&E (Edin), MPH; Prof Marcus Ong Eng Hock, MBBS, FRCS (A&E), MPH; and Susan Yap

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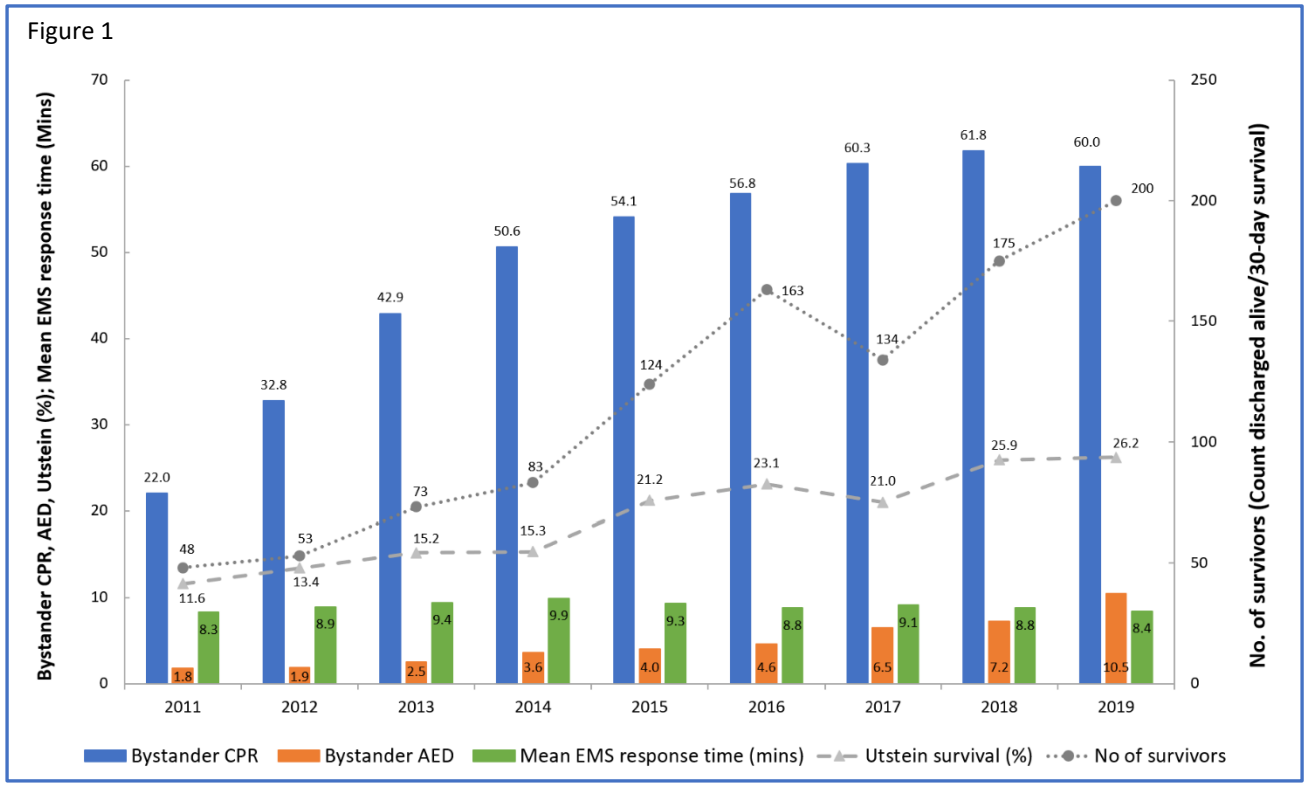
"We have continued to make progress, especially with increasing public access defibrillation and survival to discharge with good neurological function. Let us continue to focus on increasing the quality of CPR, resuscitation, and post-resuscitation care to improve survival with good neurological outcomes."
—Prof Marcus Ong

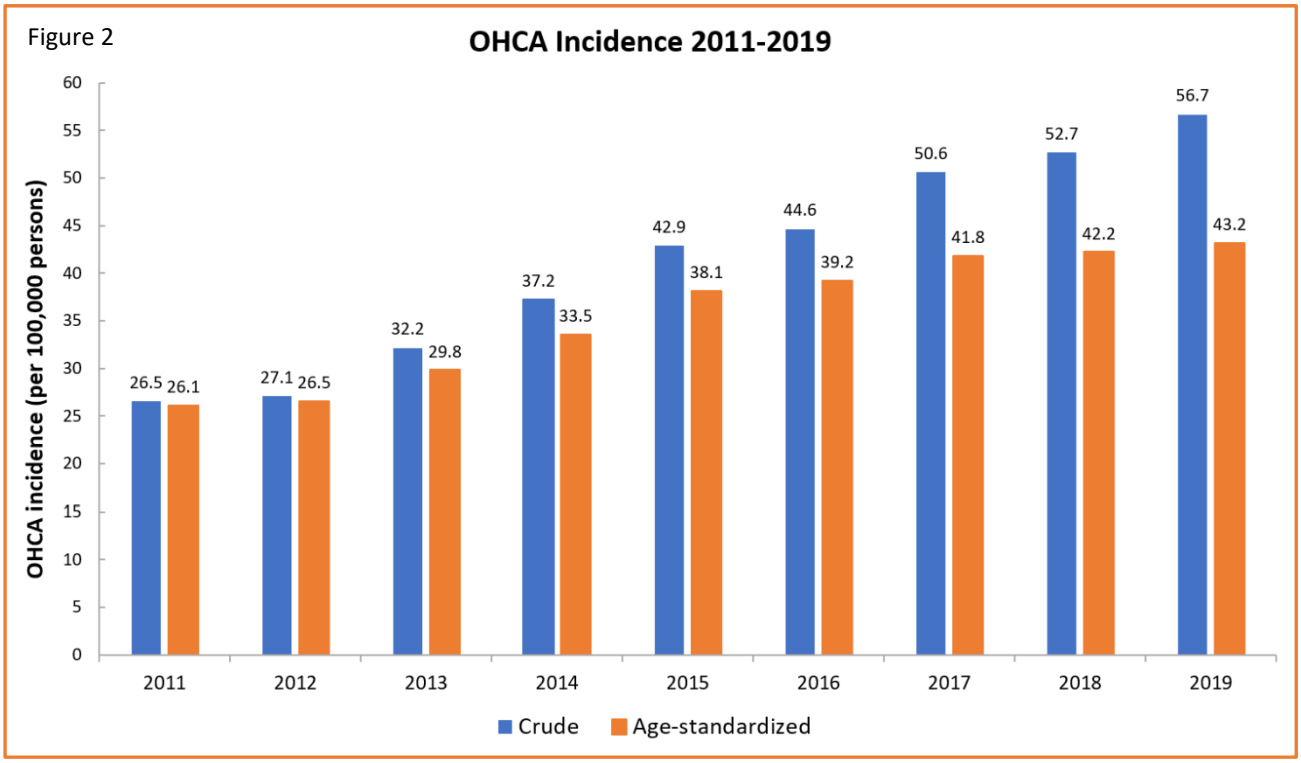
The Big Picture – Fruits of sustained, collective efforts.

Figure 1



Incidence of OHCA

Figure 2

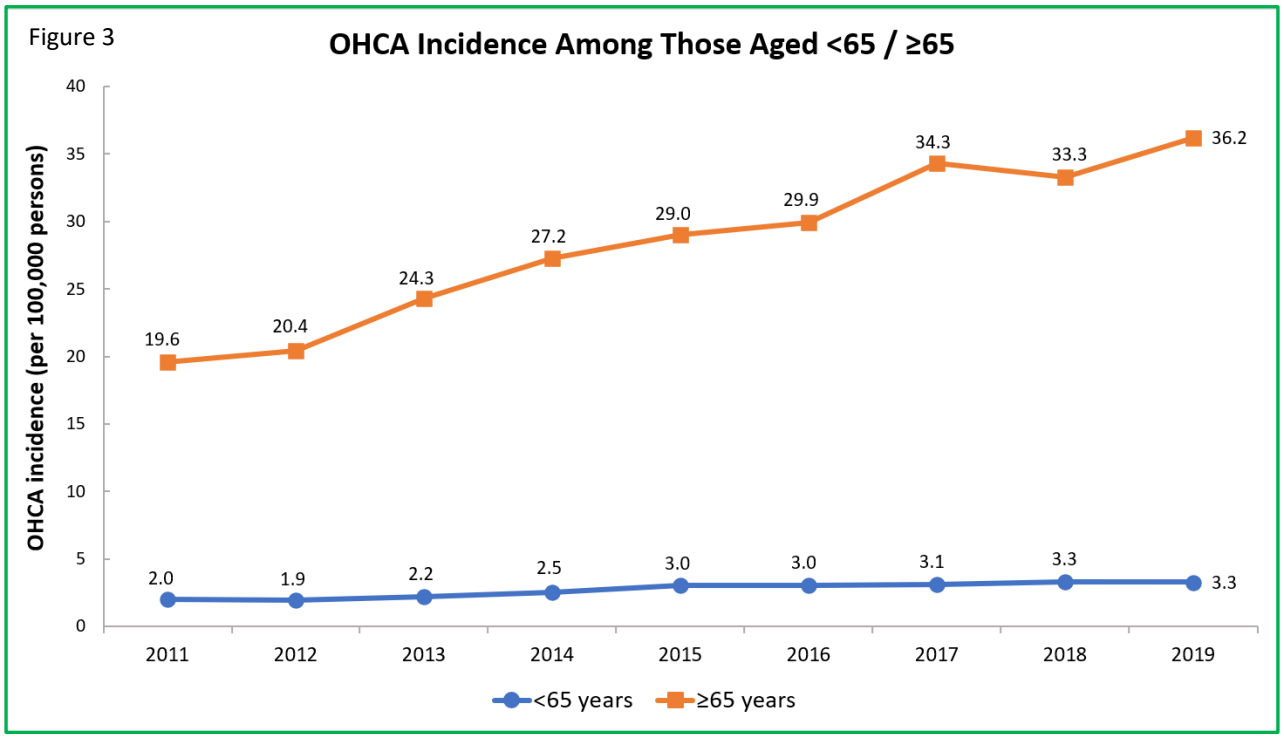


- Crude incidence increased to **56.7 per 100,000** persons in 2019 from 52.7 per 100,000 persons in 2018.

- The age-standardised incidence[2], which allows for comparisons with other locales, increased to **43.2 per 100,000** in 2019 from 42.2 per 100,000 in 2018.

[2] Age-standardized incidence figures were derived by applying the category-specific incidence of each population to the Segi World Standard population. World Health Organization 2001. Age Standardization of Rates. https://www.who.int/healthinfo/paper31.pdf Last accessed on September 15, 2021.

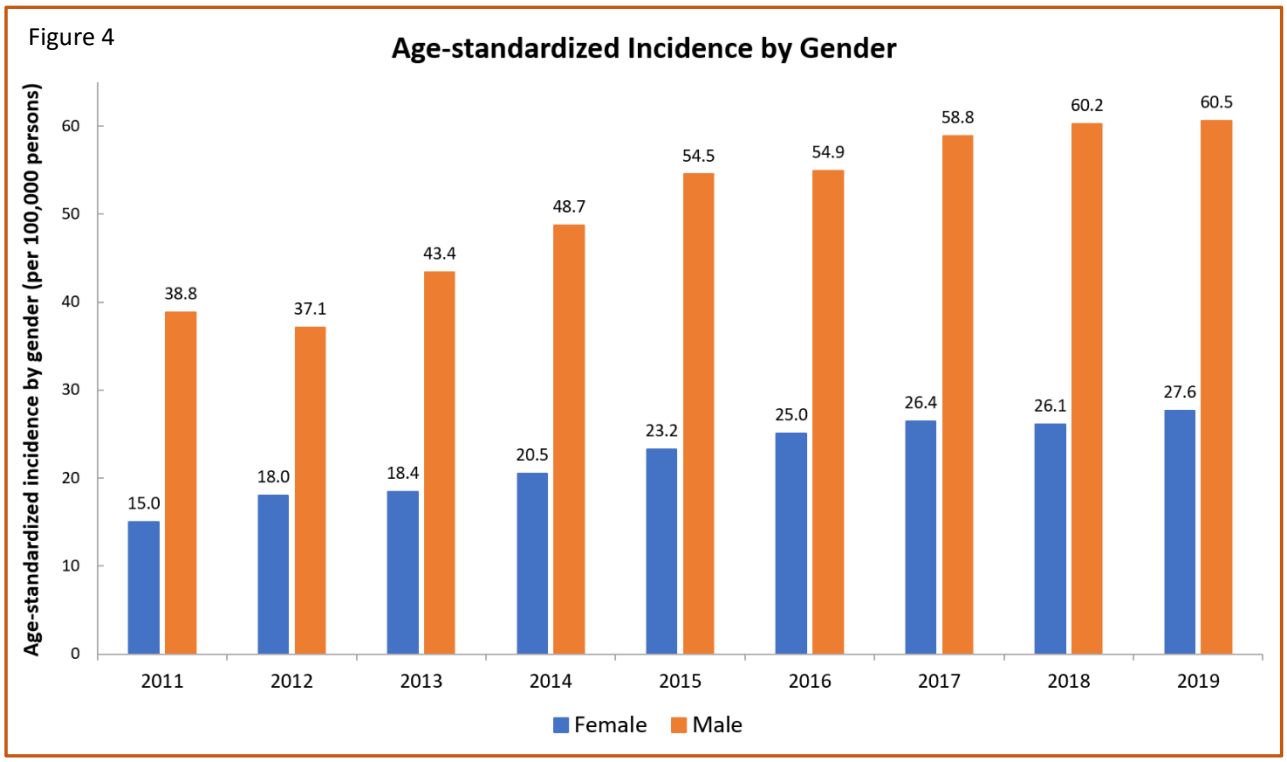
Figure 3



- The incidence among those aged 64 or younger remained steady at **3.3 per 100,000** persons in 2019, as with 2018.

- For those aged 65 years and older, this incidence increased to **36.2 per 100,000** persons in 2019 compared to 33.3 per 100,000 persons in 2018.

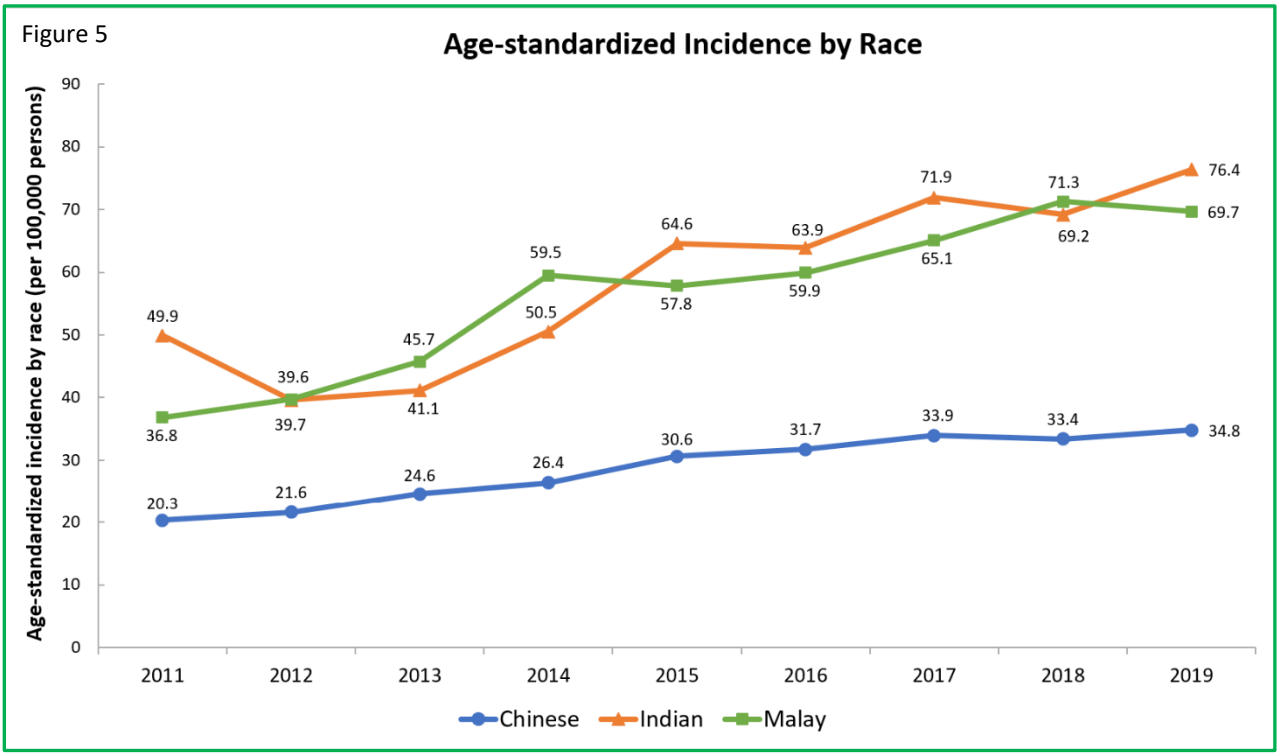
Figure 4



- Age-standardized incidence among females increased to **27.6 per 100,000** persons in 2019, up from 26.1 per 100,000 persons in 2018.

- Age-standardized incidence among males remained stable at **60.5 per 100,000** persons in 2019 compared to 60.2 per 100,000 persons in 2018.

Figure 5



Incidence among:

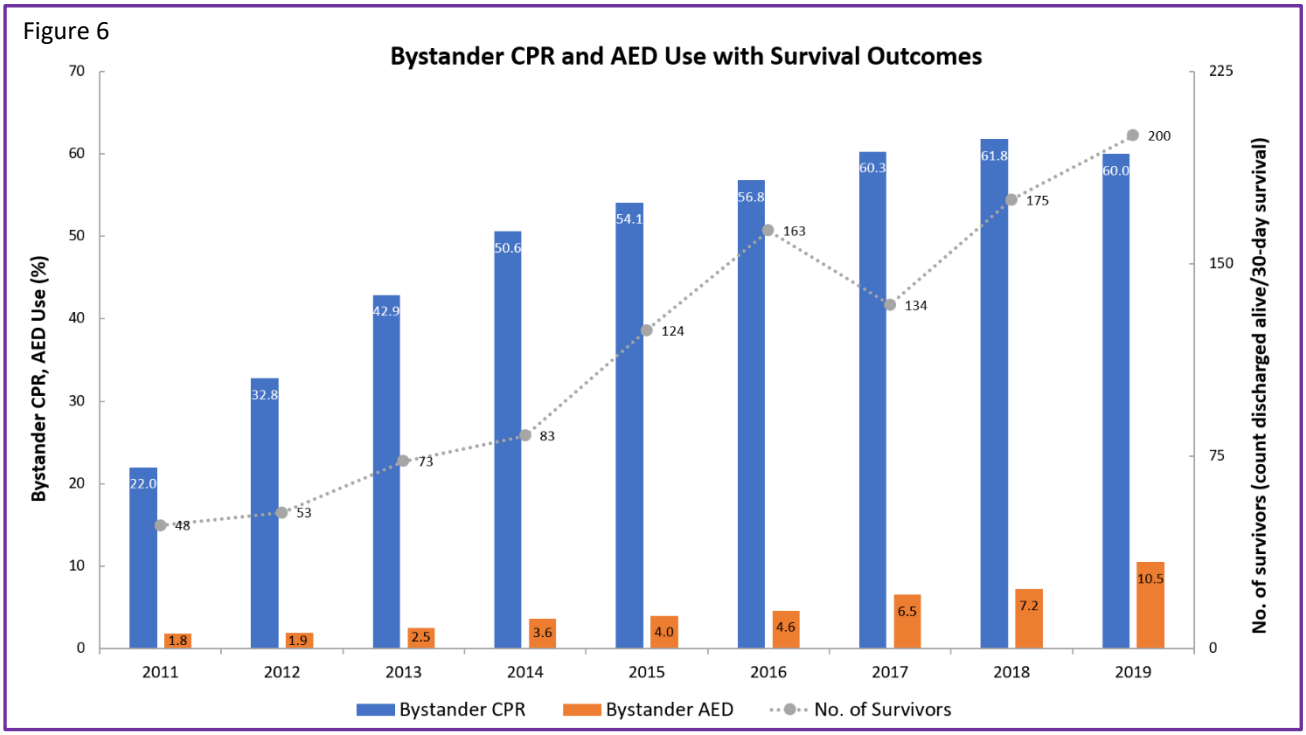
- Chinese increased slightly to **34.8 per 100,000** persons in 2019, up from 33.4 per 100,000 persons in 2018.

- Indians increased to **76.4 per 100,000** persons in 2019, up from 69.2 per 100,000 persons in 2018.

- Malays decreased slightly to **69.7 per 100,000** persons in 2019, down from 71.3 per 100,000 persons in 2018.

Bystander CPR and AED use

Figure 6



- Bystander CPR decreased to **60.0%** in 2019, down from 61.8% in 2018.

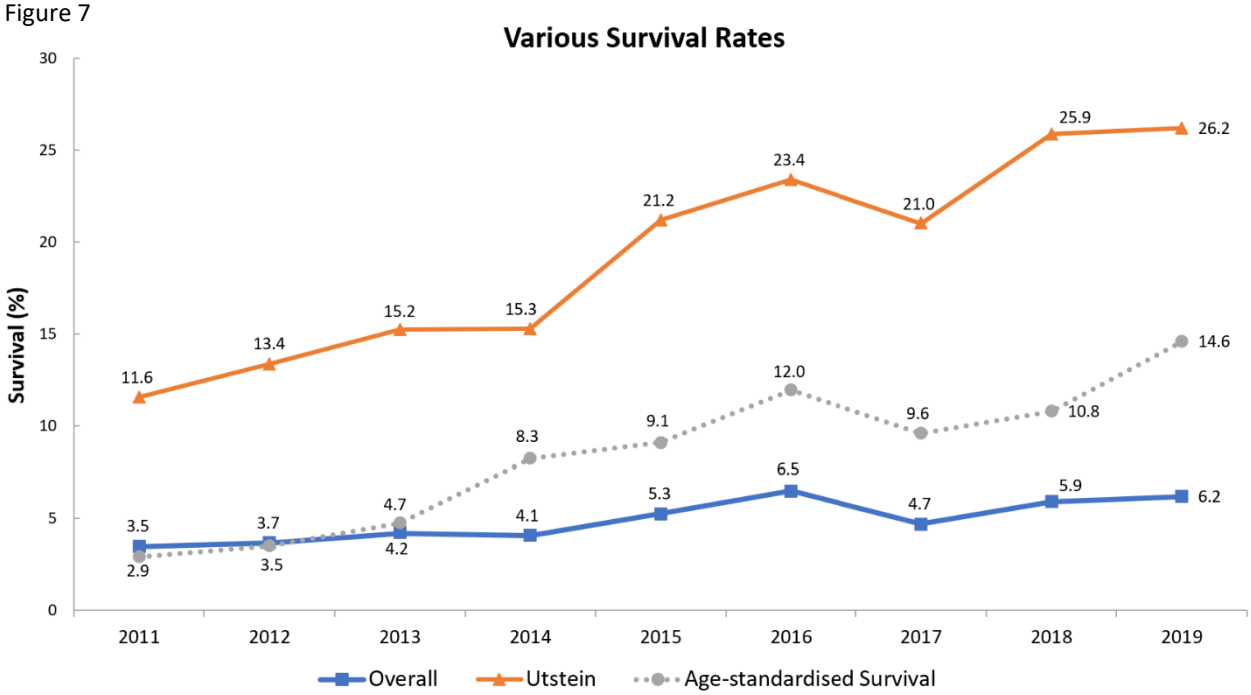
- Automated External Defibrillators (AED) use (applied) increased to **10.5%** in 2019, up from 7.2% in 2018.

- Collective efforts have resulted in **200** survivors in 2019, up from 175 in 2018.

Various survival rates: Overall, Utstein, age-standardised, and those aged </≥65 years

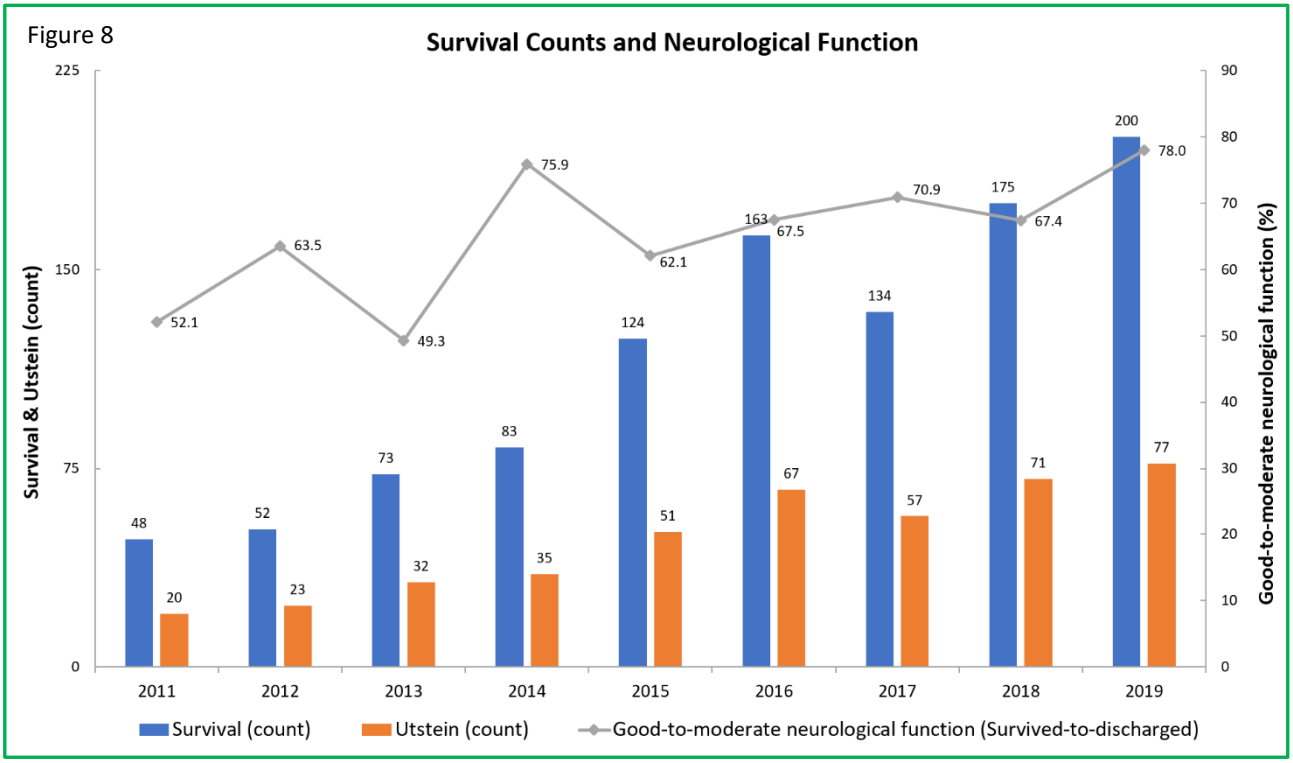
Utstein rates *are a reporting of OHCA cases that were witnessed, had a shockable heart rhythm, and were caused by some heart problem, i.e., not trauma. These are the cases where resuscitation efforts (CPR+AED) have the highest success rates. As a subset of the overall OHCA cases, reported Utstein survival rates are larger percentages than overall survival rates.*

Figure 7



- Overall survival rate remained stable at **6.2%** in 2019 compared to 5.9% in 2018.
- Utstein survival rate remained stable at **26.2%** in 2019 compared to 25.9% in 2018.
- Age-standardized survival rate increased to **14.6%** in 2019 from 10.8% in 2018.

Figure 8



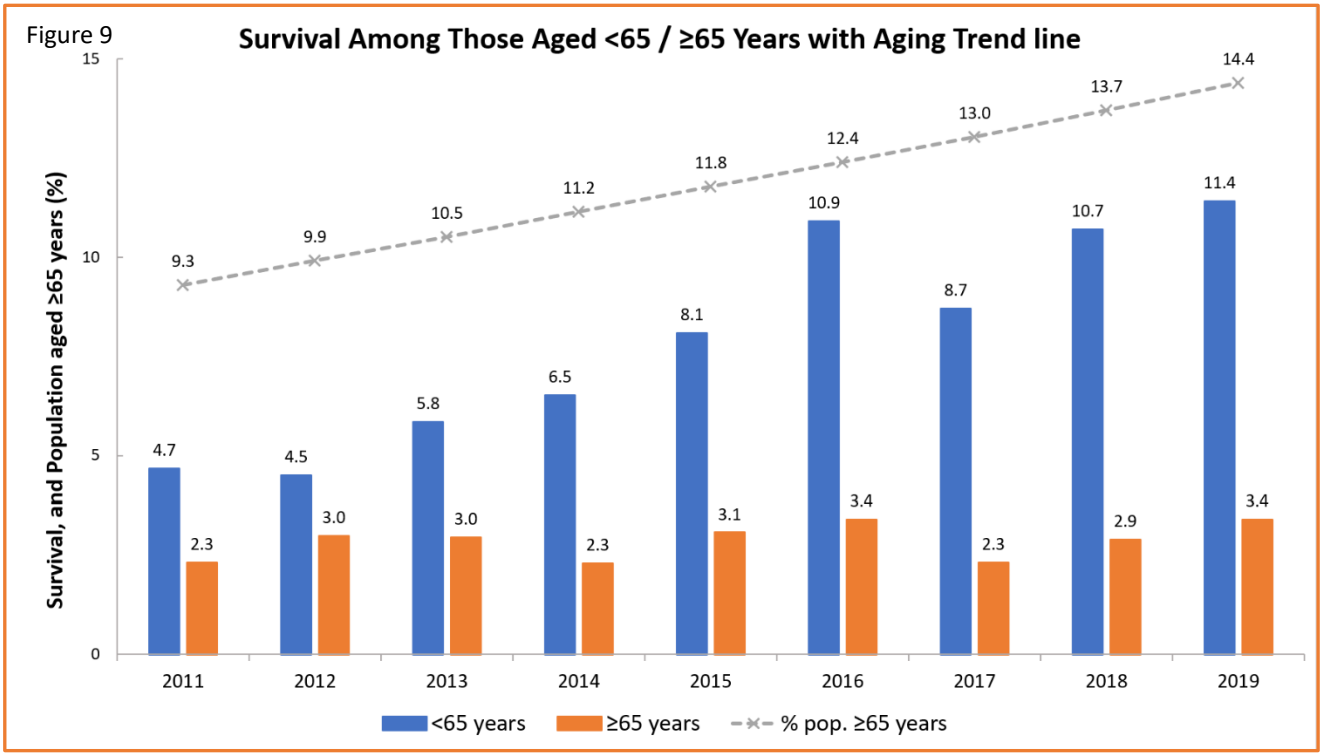
- Neurological function is measured by use of the Cerebral Performance Categories (CPC) scale. The score tells us about the survivor's neurological status and is an indication of how well survivors are recovering.

- Patients who survive OHCA are assigned a CPC score of 1 to 4 with CPC 1 being the best outcome.

- Good-to-moderate entails a CPC score of 1 or 2.

- The rate of survivors with good-to-moderate neurological function increased to **78.0%** in 2019, up from 67.4% in 2018.

Figure 9



- Survival among those younger than age 65 years increased to **11.4%** in 2019 from 10.7% in 2018.

- Among those aged 65 and older, the survival rate increased to **3.4%** in 2019, from 2.9% in 2018.

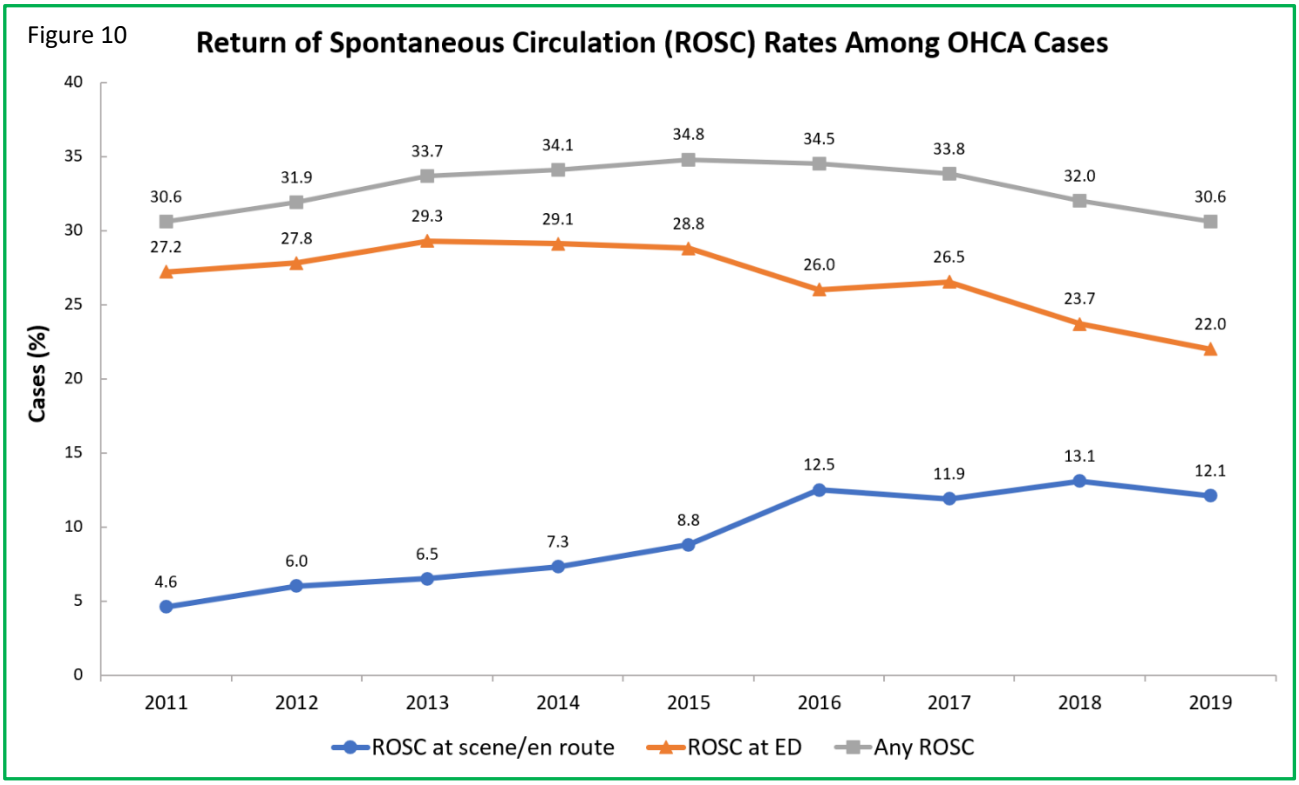
- For context, the proportion of Singaporean residents[3] aged 65 and above has steadily increased year over year, and in 2019 they made up **14.4.%** of the population. In 2018, those aged 65 and above made up 13.7%.[4]

[3] Singapore residents comprise both citizens and permanent residents. From 2003 onwards, data excludes residents who are overseas for a continuous period of 12 months or longer as at the reference period.

[4] Population data set was accessed from the SingStat website of the Department of Statistics (DOS), a department of the Ministry of Trade and Industry in the Government of Singapore. https://www.singstat.gov.sg. Last accessed on July 23, 2021.

Return of spontaneous circulation (ROSC)

Figure 10



- ROSC is another important indicator to monitor because it is an initial, but unstable, state of recovery.

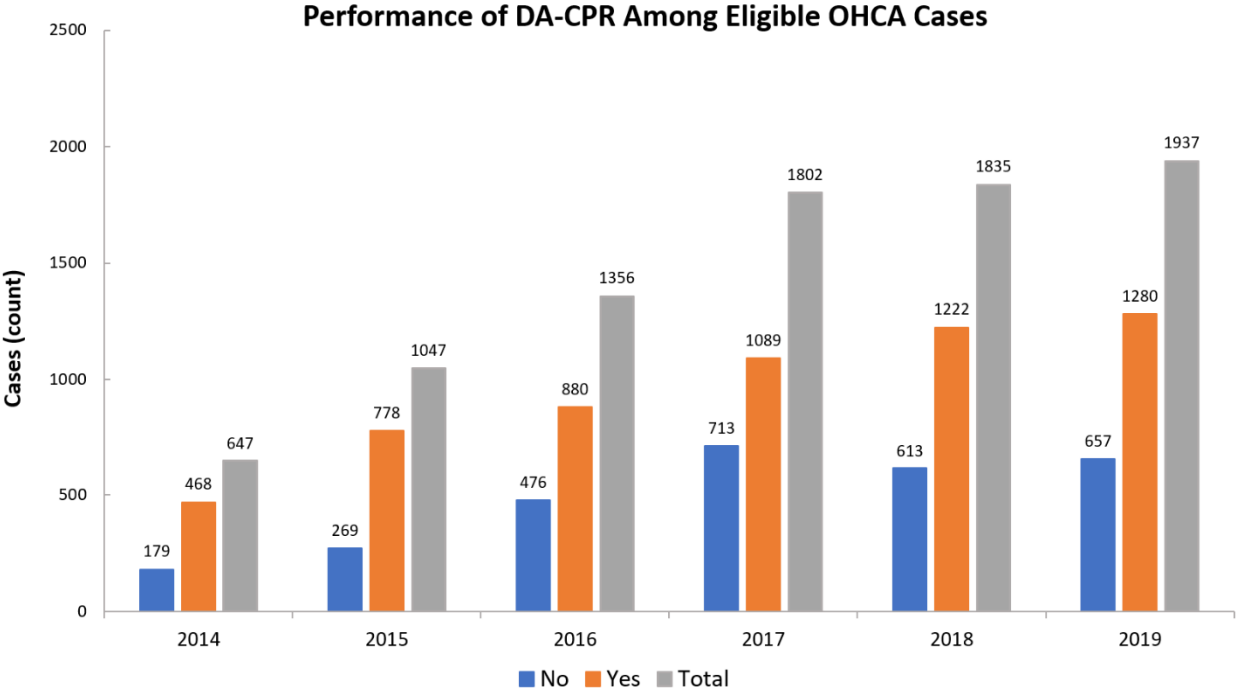
- In 2019, the Return of Spontaneous Circulation (ROSC) at scene/en route rate decreased to **12.1%** from 13.1% in 2018.

- In 2019, ROSC achieved in the emergency department dipped further to **22.0%** from 23.7% in 2018.

- The rate of ROSC achieved at any point continued to fall, dipping to **30.6%** in 2019 compared to 32.0% in 2018.

Cases involving Dispatcher-assisted CPR (*Eligible cases only)

Figure 11



- This chart shows the number of DA-CPR included cases where: 1) no DA-CPR was performed, 2) where DA-CPR was performed, and 3) total eligible cases.

- *Excluded cases are SCDF-witnessed collapses and non-EMS cases.

- In 2019, **1280 out of 1937** (66.1%) eligible cases involved DA-CPR. In 2018, 1222 out of 1835 (66.6%) eligible cases involved DA-CPR.

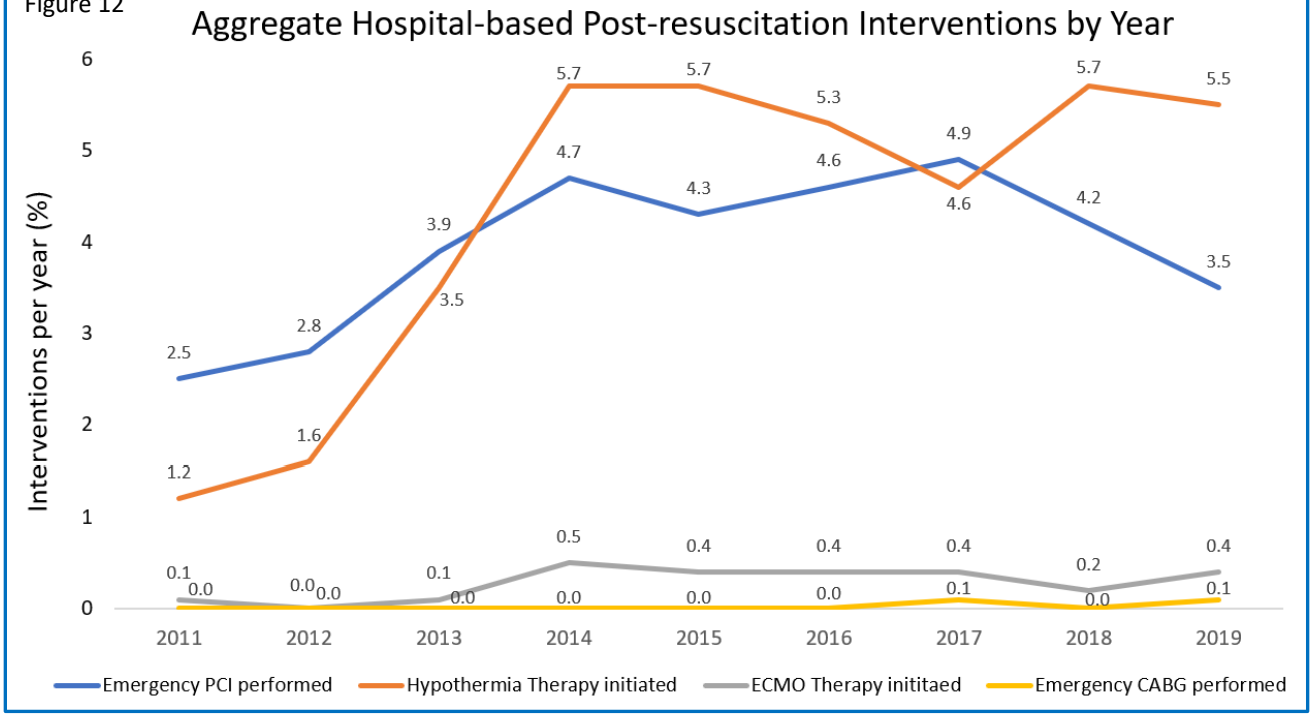
- DA-CPR would not have been done if callers could not move the patient; refused to start CPR; or if SCDF arrived before dispatcher instructions began. Other reasons include caller declined instructions (e.g., already knew how to do CPR/AED); left or hung-up phone before dispatcher instructions were given; no one answered upon call back; caller too distraught; change in patient status; caller not with patient; patient cold and hard.[5]

[5] Ho AF, Sim ZJ, Shahidah N, Hao Y, Ng YY, Leong BS, Zarinah S, Teo WK, Goh GS, Jaafar H, Ong ME. Barriers to dispatcher-assisted cardiopulmonary resuscitation in Singapore. Resuscitation. 2016 Aug 1;105:149-55.

Post-resuscitation interventions for OHCA

<u>Post-resuscitation interventions</u> *are an important link in the chain of survival. We are including these measures in our reporting for the first time. Our hope is to provide information on all links so that each one can be strengthened. The intervention included here are: Coronary artery bypass grafting (CABG), Extracorporeal membrane oxygenation (ECMO), Percutaneous coronary intervention (PCI), and Targeted temperature management (TTM).*

Figure 12

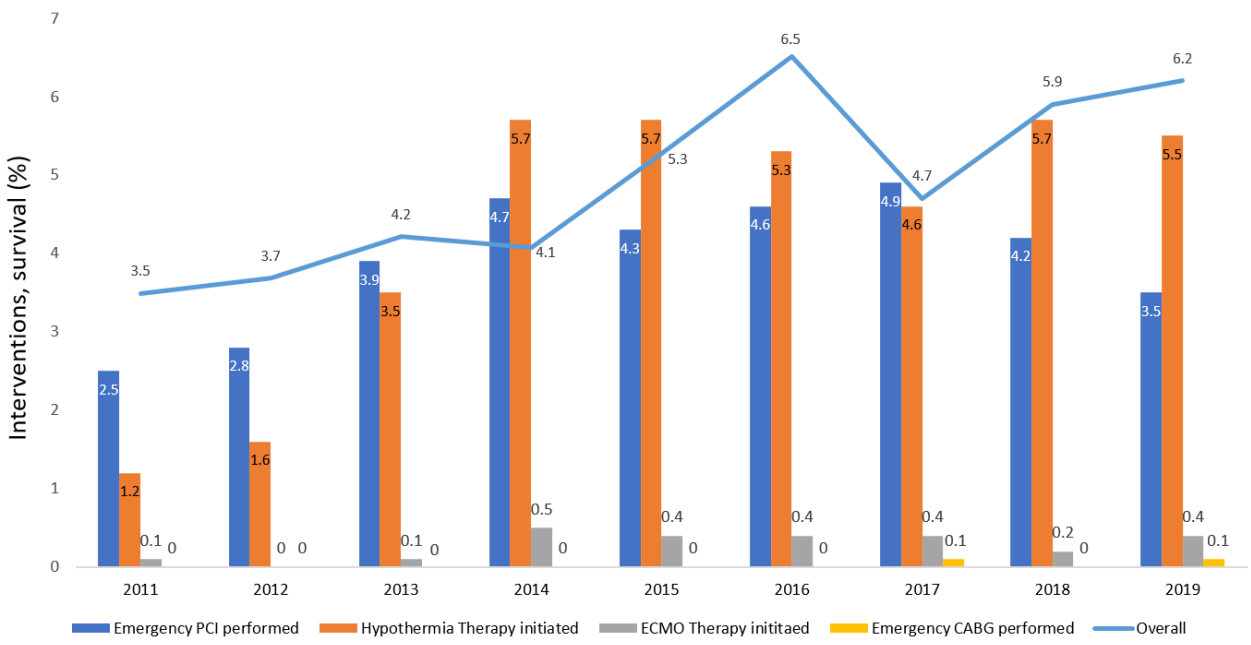


- The graph shows the aggregated rates for each of four post-OHCA hospital interventions from 2011-2019.

- Only public hospitals are included.

- Of the four hospital interventions charted, **hypothermia** and **emergency PCI** are the most used treatments.

Figure 13



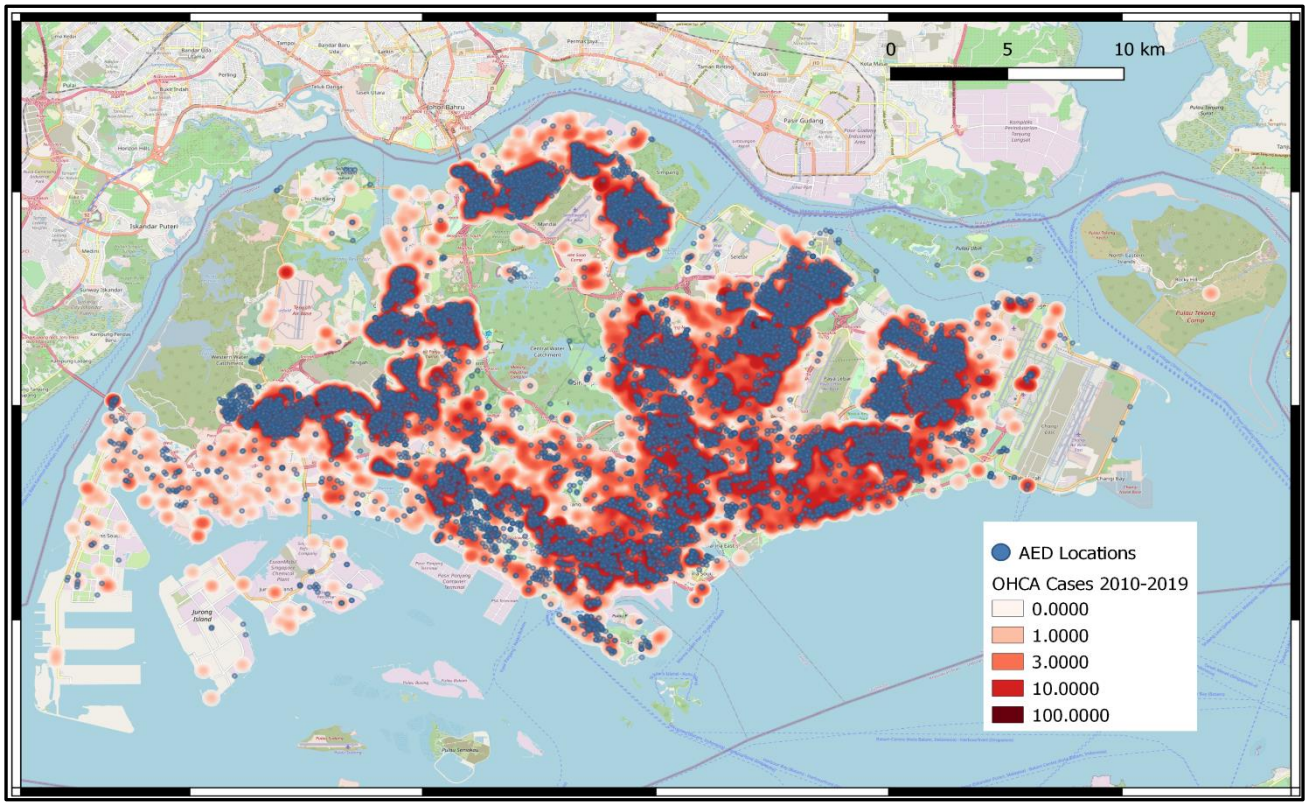
- This graph shows an overlay of the overall rate of survival atop the four aggregated hospital interventions.

- Several parameters are overlaid here for convenience, however no conclusions regarding temporality, causal associations or clinical significance should be drawn.

- Such conclusions should be drawn after a proper and thorough analysis of case data.

Automated External Defibrillator (AED) installations with OHCA locations (2010 to 2019)

Figure 14



Data sources: Pan-Asian Resuscitation Outcomes Study (PAROS) and Singapore Heart Foundation.

- In an OHCA case, the AED is the key therapeutic device that detects a shockable heart rhythm and delivers a shock to restore normal heart rhythm.

- Reducing the time to first AED shock is the key to saving more lives, on average.

- AED coverage at 400M distance from OHCA cases for all of 2010-2019 OHCAs is about 96%.

- AED coverage at 400M distance for all buildings in Singapore (based on postal codes) is nearly 90%.

- SCDF's myResponder app can inform community-based responders about AED locations.

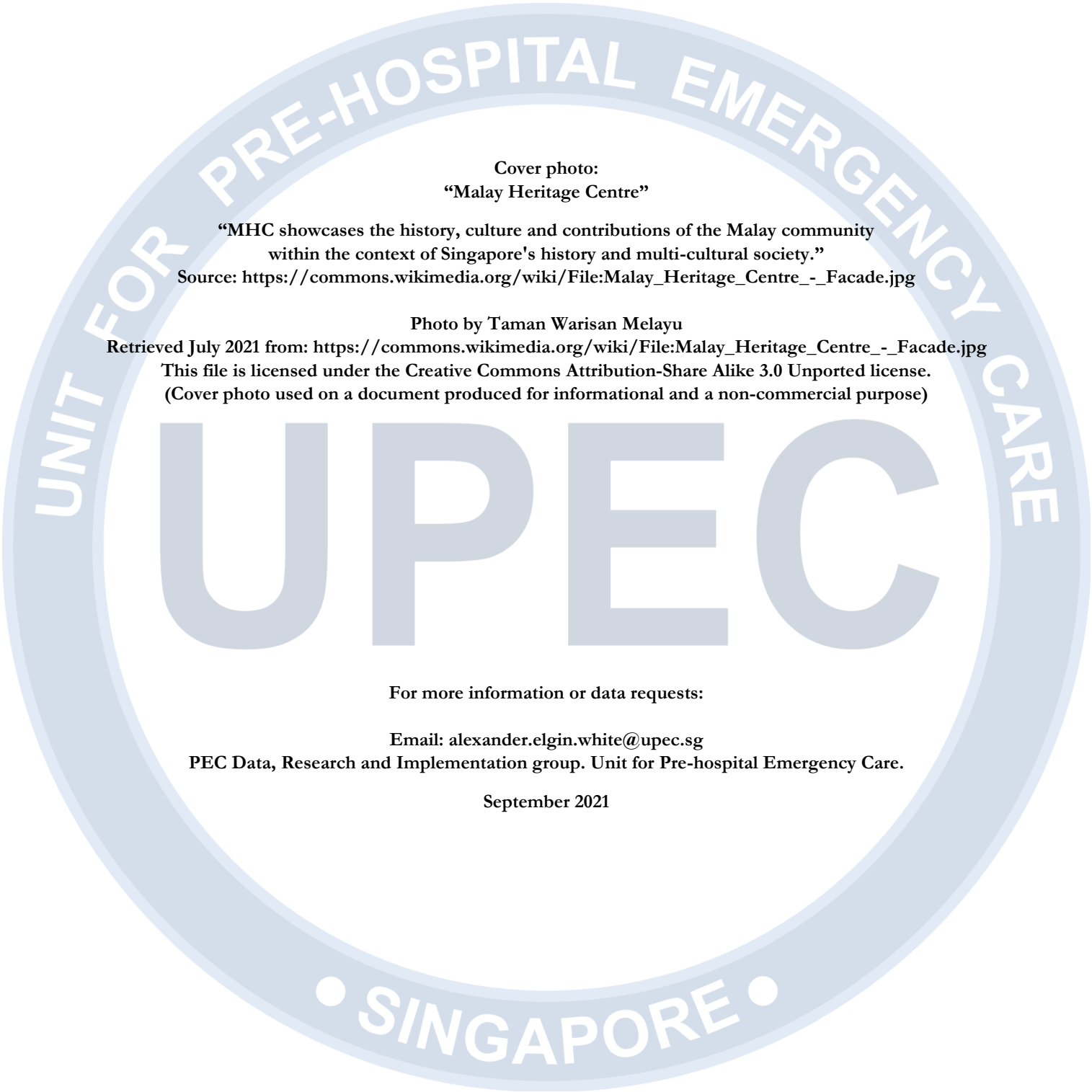
Table 1: OHCA Results, 2011-2019

	2011 n=1377	2012 n=1440	2013 n=1736	2014 n=2037	2015 n=2372	2016 n=2503	2017 n=2841	2018 n=2972	2019 n=3233
Age (yrs), Mean (Median)	63.5 (65.0)	64.1 (66.0)	65.9 (65.9)	65.9 (68.0)	65.5 (67.0)	66.0 (69.0)	67.8 (70.0)	68.0 (70.0)	69.1 (71.0)
Gender n(%)									
Female	442 (32.1)	528 (36.7)	605 (34.9)	721 (35.4)	826 (34.8)	912 (36.4)	1063 (37.4)	1075 (36.2)	1209 (37.4)
Male	935 (67.9)	912 (63.3)	1131 (65.2)	1316 (64.6)	1546 (65.2)	1591 (63.6)	1778 (62.6)	1897 (63.8)	2024 (62.6)
Location Type n(%)									
Home residence	985 (71.6)	990 (68.8)	1246 (71.8)	1481 (72.7)	1658 (69.9)	1837 (73.4)	2117 (74.5)	2164 (72.8)	2390 (73.9)
Healthcare facilities	100 (7.3)	102 (7.1)	107 (6.2)	139 (6.8)	157 (6.6)	164 (6.6)	213 (7.5)	227 (7.6)	260 (8.0)
Public setting	260 (18.9)	308 (21.4)	320 (18.4)	387 (19.0)	458 (19.3)	446 (17.8)	451 (15.9)	501 (16.9)	514 (15.9)
Bystander Intervention n(%)									
Bystander CPR	302 (22.0)	472 (32.8)	744 (42.9)	1031 (50.6)	1284 (54.1)	1422 (56.8)	1714 (60.3)	1836 (61.8)	1937 (60.0)
Bystander CPR - Witnessed arrest	214 (27.6)	304 (42.5)	423 (48.0)	615 (56.8)	779 (61.3)	808 (63.8)	1165 (72.1)	882 (69.9)	849 (67.1)
Bystander CPR - Not witnessed	88 (18.0)	168 (27.9)	321 (44.8)	416 (52.0)	505 (57.1)	614 (62.3)	549 (56.8)	954 (68.1)	1088 (65.1)
* DA-CPR performed	-	54 (18.6)	252 (34.0)	468 (72.3)	778 (74.3)	880 (64.9)	1089 (60.4)	1222 (66.6)	1280 (66.1)
DA-CPR performed - Witnessed arrest	-	29 (4.1)	129 (16.4)	244 (22.6)	421 (33.1)	450 (35.5)	698 (43.2)	532 (42.2)	505 (39.9)
DA-CPR performed - Not witnessed	-	25 (4.1)	123 (17.2)	224 (28.0)	357 (40.3)	430 (43.7)	391 (40.4)	690 (49.3)	775 (46.4)
Bystander AED	25 (1.8)	27 (1.9)	43 (2.5)	73 (3.6)	96 (4.0)	116 (4.6)	185 (6.5)	214 (7.2)	340 (10.5)
Arrest Witnessed by n(%)									
Bystander - Family	481 (34.9)	414 (28.8)	526 (30.3)	729 (35.8)	808 (34.1)	779 (31.1)	1063 (37.4)	714 (24.0)	700 (21.6)
Bystander - Healthcare professional	65 (4.7)	69 (4.8)	70 (4.0)	79 (3.9)	113 (4.8)	110 (4.4)	201 (7.1)	111 (3.7)	106 (3.3)
Bystander - Layperson	229 (16.6)	232 (16.1)	284 (16.4)	275 (13.5)	350 (14.8)	377 (15.1)	352 (12.4)	437 (14.7)	460 (14.2)
EMS/Private ambulance	112 (8.1)	122 (8.5)	139 (8.0)	154 (7.6)	216 (9.1)	252 (10.1)	258 (9.1)	309 (10.4)	296 (9.2)
Not witnessed	490 (35.6)	603 (41.9)	717 (41.3)	800 (39.3)	885 (37.3)	985 (39.4)	967 (34.0)	1401 (47.1)	1671 (51.7)

* Calculations based on valid cases.

	2011 n=1377	2012 n=1440	2013 n=1736	2014 n=2037	2015 n=2372	2016 n=2503	2017 n=2841	2018 n=2972	2019 n=3233
Initial Rhythm n(%)									
Shockable rhythm	251 (18.4)	280 (19.7)	304 (17.8)	347 (17.4)	378 (15.9)	435 (17.7)	422 (14.8)	451 (15.2)	503 (15.6)
Non-shockable rhythm	1114 (80.9)	1144 (80.3)	1405 (82.2)	1651 (82.6)	1941 (81.8)	2021 (82.3)	2360 (83.0)	2481 (83.5)	2717 (84.0)
Outcomes n(%)									
ROSC at scene	63 (4.6)	86 (6.0)	113 (6.5)	148 (7.3)	209 (8.8)	312 (12.5)	339 (11.9)	389 (13.1)	392 (12.1)
ROSC at ED	374 (27.2)	400 (27.8)	509 (29.3)	593 (29.1)	684 (28.8)	650 (26.0)	754 (26.5)	704 (23.7)	712 (22.0)
Emergency PCI performed	35 (2.5)	41 (2.8)	68 (3.9)	96 (4.7)	101 (4.3)	116 (4.6)	138 (4.9)	125 (4.2)	114 (3.5)
Hypothermia Therapy initiated	17 (1.2)	23 (1.6)	61 (3.5)	117 (5.7)	135 (5.7)	132 (5.3)	132 (4.6)	168 (5.7)	179 (5.5)
ECMO Therapy inititaed	1 (0.1)	0 (0.0)	1 (0.1)	11 (0.5)	9 (0.4)	9 (0.4)	11 (0.4)	7 (0.2)	12 (0.4)
Emergency CABG performed	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	2 (0.1)	0 (0.0)	2 (0.1)
Survival to admission	251 (18.2)	249 (17.3)	303 (17.5)	358 (17.6)	453 (19.1)	497 (19.9)	542 (19.1)	550 (18.5)	567 (17.5)
Survival to discharge	48 (3.5)	52 (3.7)	73 (4.2)	83 (4.1)	124 (5.2)	163 (6.5)	134 (4.7)	175 (5.9)	200 (6.2)
Good-to-moderate neurological function (Overall)	25 (1.8)	33 (2.3)	36 (2.1)	63 (3.1)	77 (3.2)	110 (4.4)	95 (3.3)	118 (4.0)	156 (4.8)
** Good-to-moderate neurological function (Survived-to-discharged)	25 (52.1)	33 (63.5)	36 (49.3)	63 (75.9)	77 (62.1)	110 (67.5)	95 (70.9)	118 (67.4)	156 (78.0)
Utstein survival	20 (11.6)	23 (13.4)	32 (15.2)	35 (15.3)	51 (21.2)	67 (23.1)	57 (21.0)	71 (25.9)	77 (26.2)
Missing hospital outcomes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.1)	1 (0.03)	0 (0.0)
Unknown hospital outcomes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.03)	0 (0.0)

**Calculations based on available data.



Cover photo:
"Malay Heritage Centre"

"MHC showcases the history, culture and contributions of the Malay community within the context of Singapore's history and multi-cultural society."
Source: https://commons.wikimedia.org/wiki/File:Malay_Heritage_Centre_-_Facade.jpg

Photo by Taman Warisan Melayu
Retrieved July 2021 from: https://commons.wikimedia.org/wiki/File:Malay_Heritage_Centre_-_Facade.jpg

For more information or data requests:

Email: alexander.elgin.white@upec.sg
PEC Data, Research and Implementation group. Unit for Pre-hospital Emergency Care.

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