Singapore's Out-of-Hospital Cardiac Arrest Data Report (2011-2020)

UPEC
UNIT FOR PRE-HOSPITAL EMERGENCY CARE
• SINGAPORE •
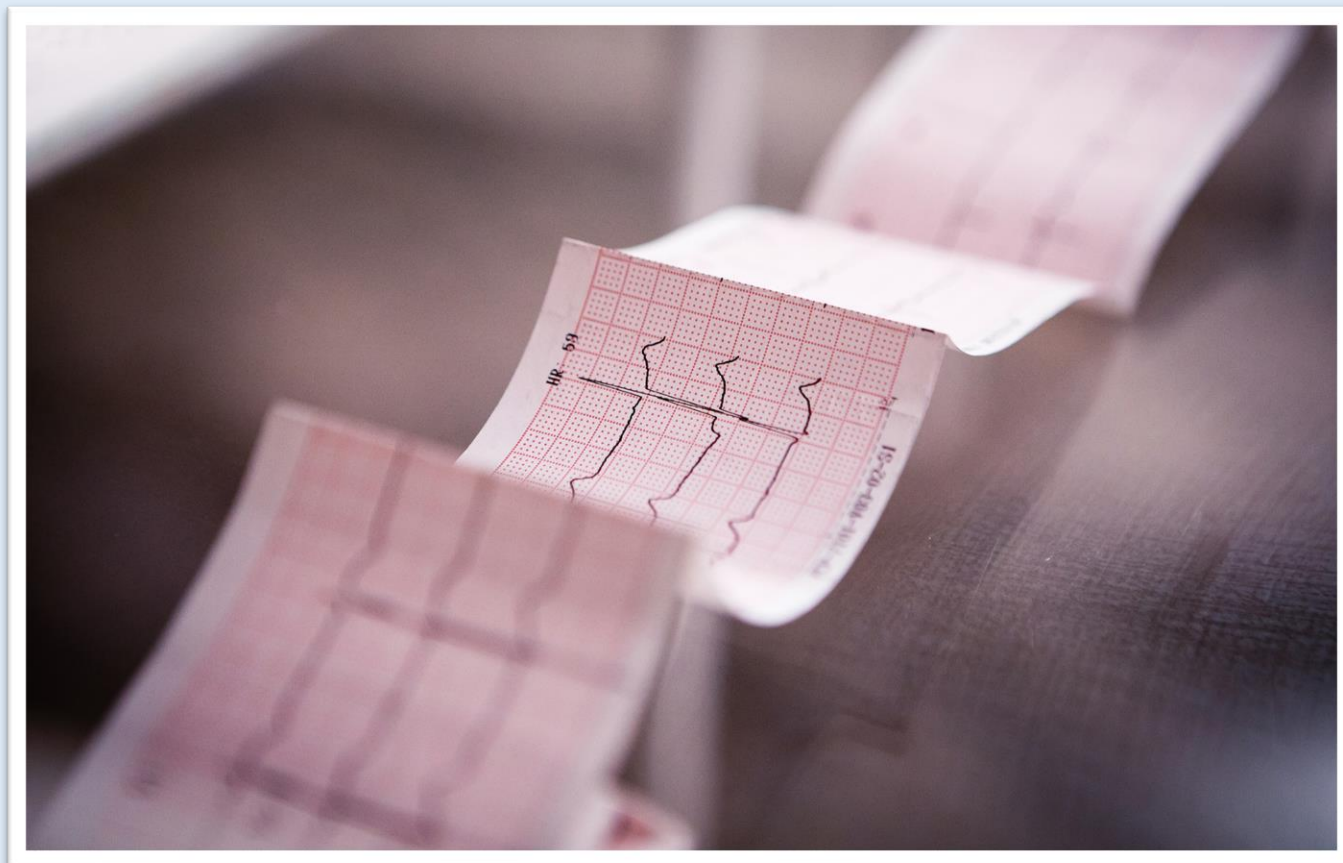
May 2022

Executive Summary

In this fifth annual report, we again accelerated the reporting of 2020 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 2020, the number of out-of-hospital cardiac arrests (OHCA) increased from 3233 in 2019 to **3432**. 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 from 60.0**%** in 2019 to **56.2%** in 2020.

- Automated External Defibrillators (AED) applied/use rates dropped from 10.5% in 2019 to **8.5%** in 2020. Despite the recent improvements in AED use rates, we suspect that the COVID-19 impact is seen here with this rate. This is drop is, in part, a result of COVID-19 protective measures such as halting of the public's myResponder OHCA alert programme for a period. The assumption is that we will see a bounce back in use rates in the coming data reports. Based on current relaxing of COVID-19 precautions, we may not see this return to a positive trend until the reporting of the 2023 data. Bystander AED use is a critical indicator to watch because early use of AEDs can more than double the survival rate.[1]

- In 2020, the Return of Spontaneous Circulation (ROSC) at scene/*en route* rate decreased to **9.8%** from 12.1% in 2019. 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 2020 was **149** compared to 200 in 2019. Also, the overall OHCA survival-to-discharge rate decreased to **4.3%** from 6.2% in 2019.

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[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 fell to **22.2%** in 2020, down from 26.2% in 2019. 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 2020, **73.8%** did so with good-to-moderate neurological function compared to 78% in 2019. Survival-to-discharge with good-to-moderate neurological functioning is the gold standard for OHCA survival.

Training the public in cardiopulmonary resuscitation (CPR) and AED use will continue with increased creativity as we steer a course through the COVID-19 recovery period. The public should remain aware that **75%** 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 that 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. Therefore, earliest use of the device after OHCA onset enables the AED's therapeutic shock to be more effective compared to delayed use.

We made progress over the recent data reporting periods, especially with increasing public access defibrillation and survival-to-discharge with good neurological function. Once we clear the impacts from COVID-19 period, we expect to see our OHCA indicators bounce back and trend upward. 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; Prof Marcus Ong Eng Hock, MBBS, FRCS (A&E), MPH.

ACKNOWLEDGEMENTS

> *"Training the public in cardiopulmonary resuscitation (CPR) and AED use will continue with increased creativity as we steer a course through the COVID-19 recovery period. The public should remain aware that 75% 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."*
> *—Prof Marcus Ong*

The Big Picture – Fruits of sustained, collective efforts.

Figure 1 — Overview

Bystander CPR, AED, Utstein survival (%); Mean EMS response time (Mins)

Year	Bystander CPR	Bystander AED	Mean EMS response time (mins)	Utstein survival (%)	No of survivors
2011	22.0	1.8	8.3	11.6	48
2012	32.8	1.9	8.9	13.4	53
2013	42.9	2.5	9.4	15.2	73
2014	50.6	3.6	9.9	15.3	83
2015	54.1	4.0	9.3	21.2	124
2016	56.8	4.6	8.8	23.1	163
2017	60.3	6.5	9.1	21.0	134
2018	61.8	7.2	8.8	25.9	175
2019	60.0	10.5	8.4	26.2	200
2020	56.2	8.5	8.7	22.2	149

Timeline: 2011 Mechanical CPR device → 2012 Fire Bikers Scheme → 2012 DA-CPR → 2014 RAEDi → 2014 DARE → 2014 I/O vascular → 2015 myRspndr → 2015 Save-A-Life → 2015 DARE Community Training → 2016 DARE with CPRcard

Incidence of OHCA

Figure 2

OHCA Incidence 2011-2020

- Crude incidence increased to **60.4 per 100,000** persons in 2020 from 56.7 per 100,000 persons in 2019.

- The age-standardised incidence[2], which allows for comparisons with other locales, remained steady at **43.3 per 100,000** in 2020 compared to 43.2 per 100,000 in 2019.

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[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. (Attempted again on May 12, 2022. Link no longer active.)

Figure 3

OHCA Incidence <65 / ≥65
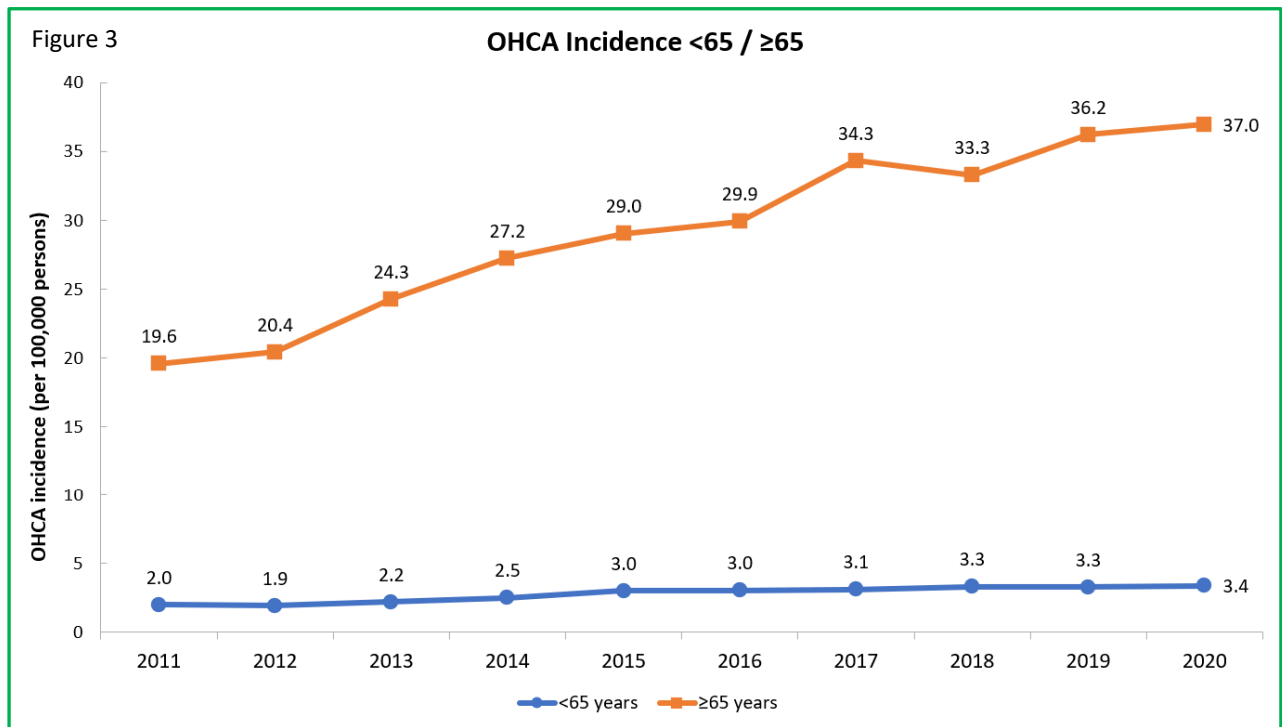
- The incidence among those aged 64 or younger remained steady at **3.4 per 100,000 persons** in 2020, compared with 3.3 per 100,000 persons in 2019.

- For those aged 65 years and older, the incidence increased to **37.0 per 100,000 persons** in 2020 compared to 36.2 per 100,000 persons in 2019.

Figure 4

Age-standardized Incidence by Gender
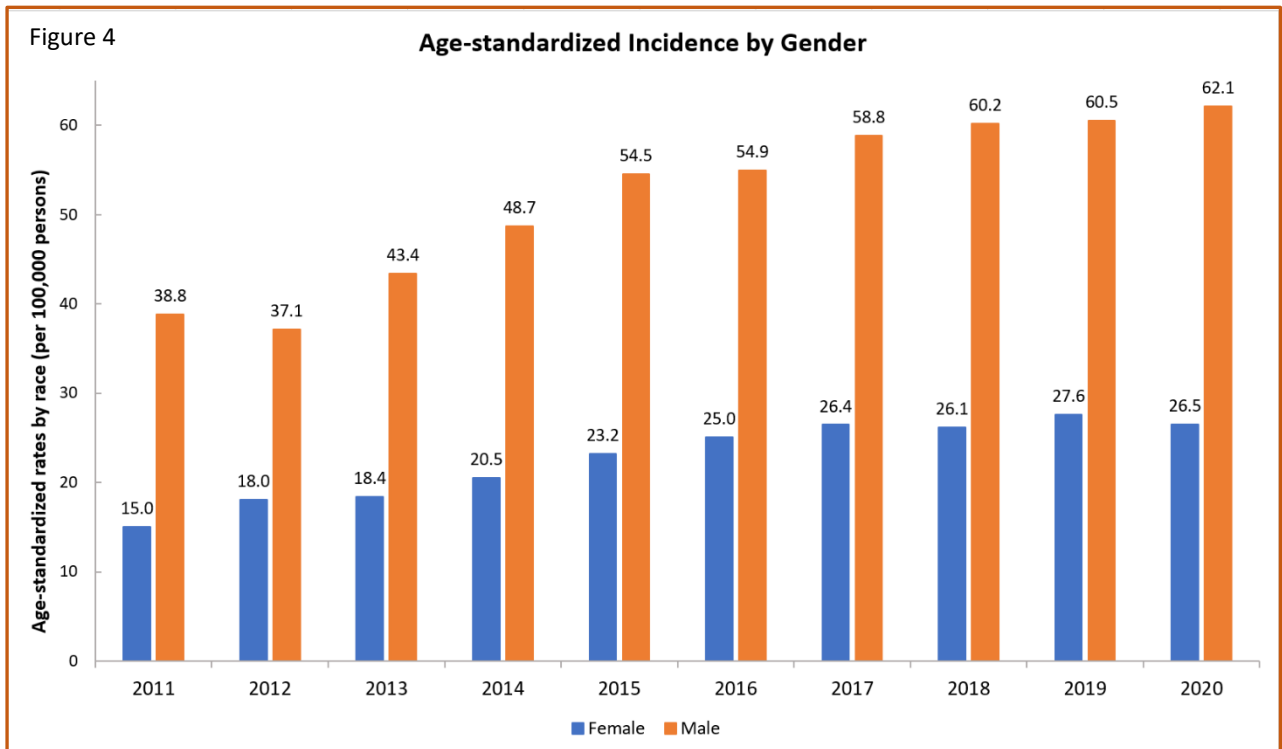
- Age-standardized incidence among females decreased to **26.5 per 100,000** persons in 2020, down from 27.6 per 100,000 persons in 2019.

- Age-standardized incidence among males increased to **62.1 per 100,000** persons in 2020 compared to 60.5 per 100,000 persons in 2019.

Figure 5

Age-standardized Incidence by Race
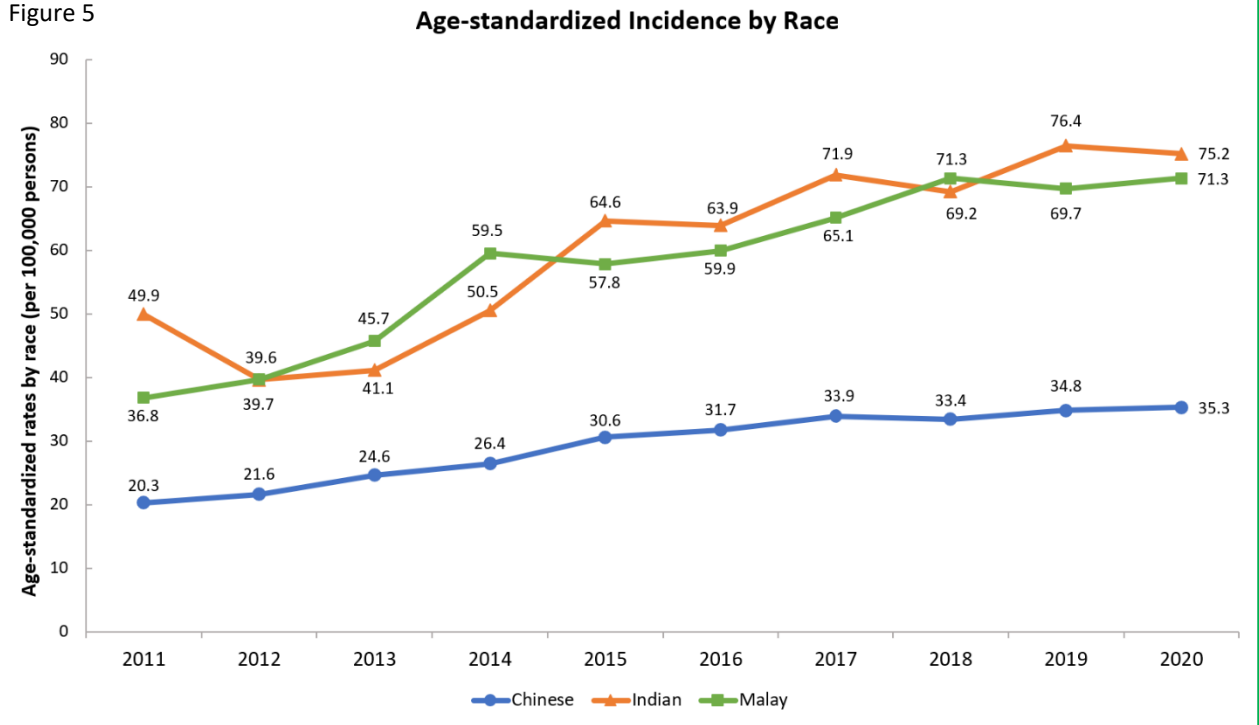
Incidence among:

- Chinese increased slightly to **35.3 per 100,000** persons in 2020, up from 34.8 per 100,000 persons in 2019.

- Indians decreased to **75.2 per 100,000** persons in 2020, down slightly from 76.4 per 100,000 persons in 2019.

- Malays increased slightly to **71.3 per 100,000** persons in 2020, up from 69.7 per 100,000 persons in 2019.

Bystander CPR and AED use

Figure 6

Bystander CPR and AED Use with Survival Outcomes
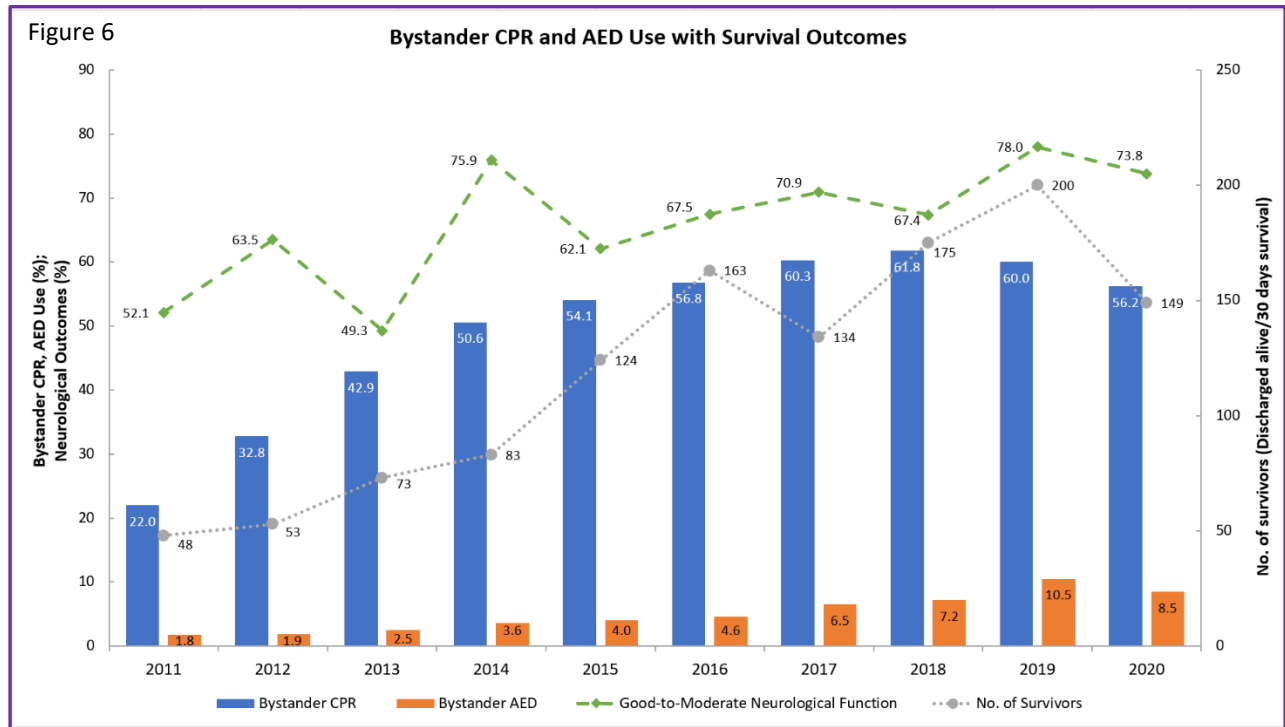
- Bystander CPR decreased to **56.2%** in 2020, down from 60.0% in 2019.

- Automated External Defibrillators (AED) applied/use rate decreased to **8.5%** in 2020, down from 10.5% in 2019.

- The number of survivors dropped to **149** in 2020 from 200 in 2019.

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, i.e., "potentially survivable". As a subset of the overall OHCA cases, reported Utstein survival rates are larger percentages than overall survival rates.*

Figure 7

Various Survival Measures
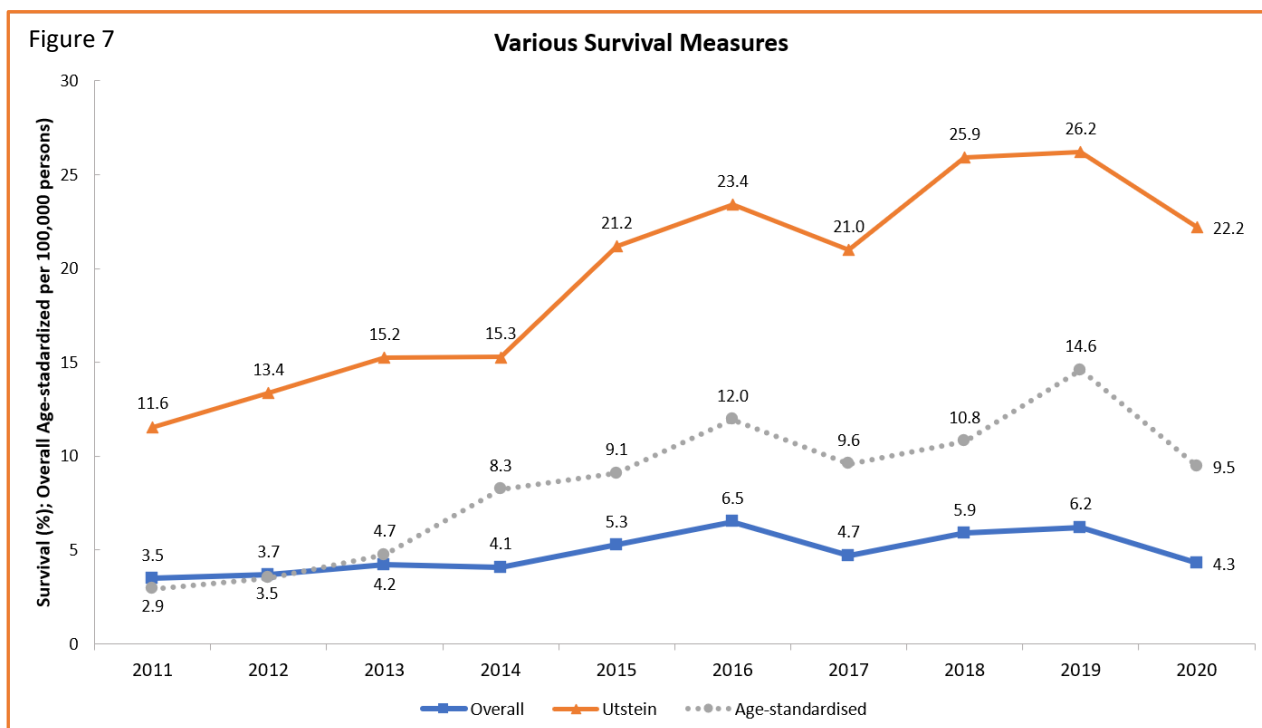
- Overall OHCA survival rate dropped to **4.3%** in 2020 compared to 6.2% in 2019.

- Utstein survival rate dropped to **22.2%** in 2020 compared to 26.2% in 2019.

- Age-standardized survival rate decreased to **9.5%** in 2020 from 14.6% in 2019.

Figure 8

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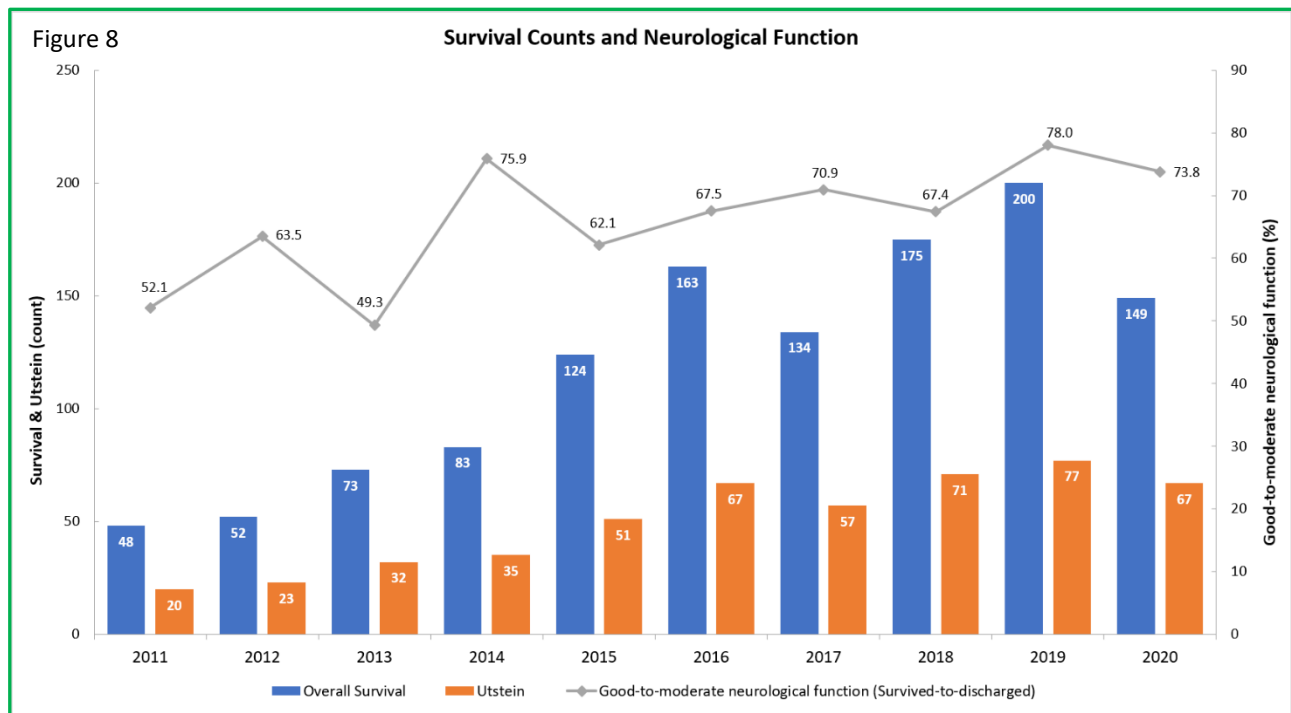
- Neurological function is measured by use of the Cerebral Performance Categories (CPC) scale. The score tells us about the survivor's neurological status and is an indication of how well survivors are recovering.

- 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 decreased to **73.8%** in 2020, down from 78.0% in 2019.

Figure 9

Survival Among Those Aged <65 / ≥65 Years with ≥65-Age Trend

Legend: <65 years | ≥65 years | % pop. >65 years
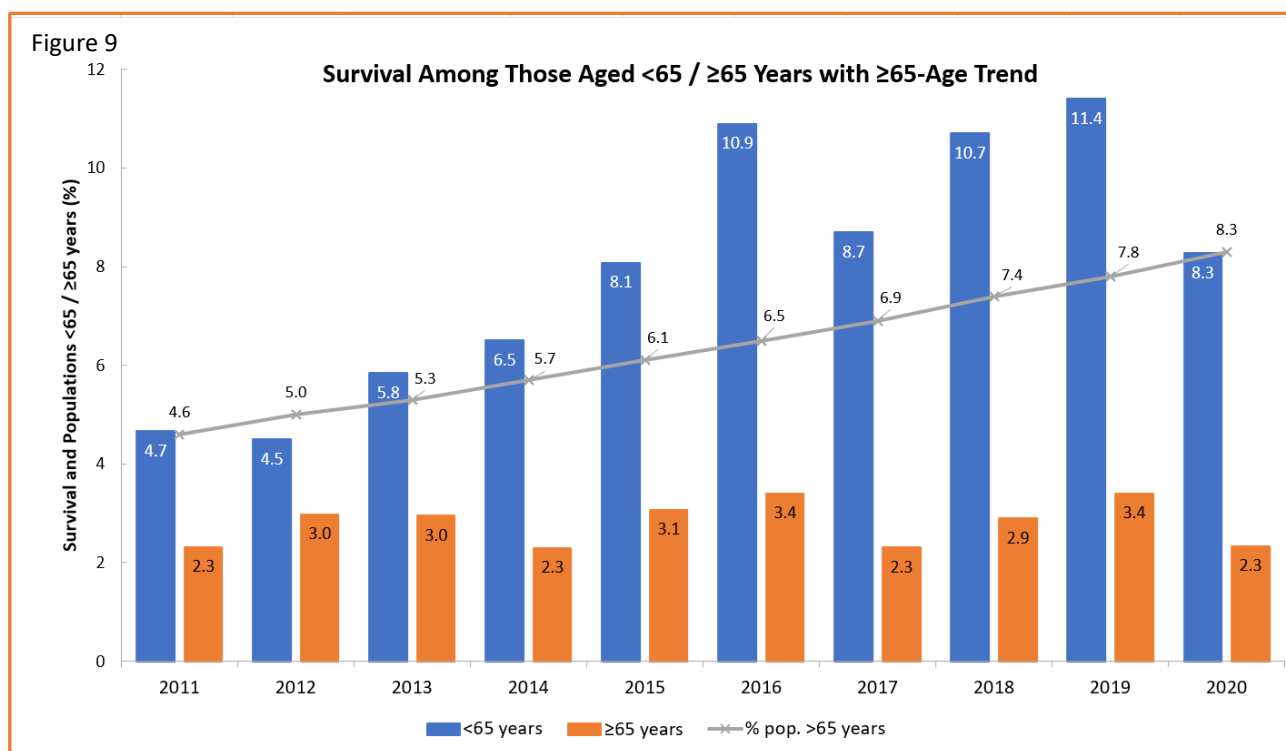
- Survival among those younger than age 65 decreased to **8.3%** in 2020 from 11.8% in 2019.

- Among those aged 65 and older, the survival rate decreased to **2.3%** in 2020, from 3.4% in 2019.

- For context, the proportion of Singaporean residents[3] aged 65 and above has steadily increased year over year, and in 2020 they made up **15.2%** of the population. In 2019, those aged 65 and above made up 14.4%.[4]

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[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. Methodology and tools have been updated and the previous figures have changed. This document reflects updated data for 2011-2020 obtained from **https://tablebuilder.singstat.gov.sg/table/TS/M810011**. Last accessed on May 12, 2022.

Return of spontaneous circulation (ROSC)
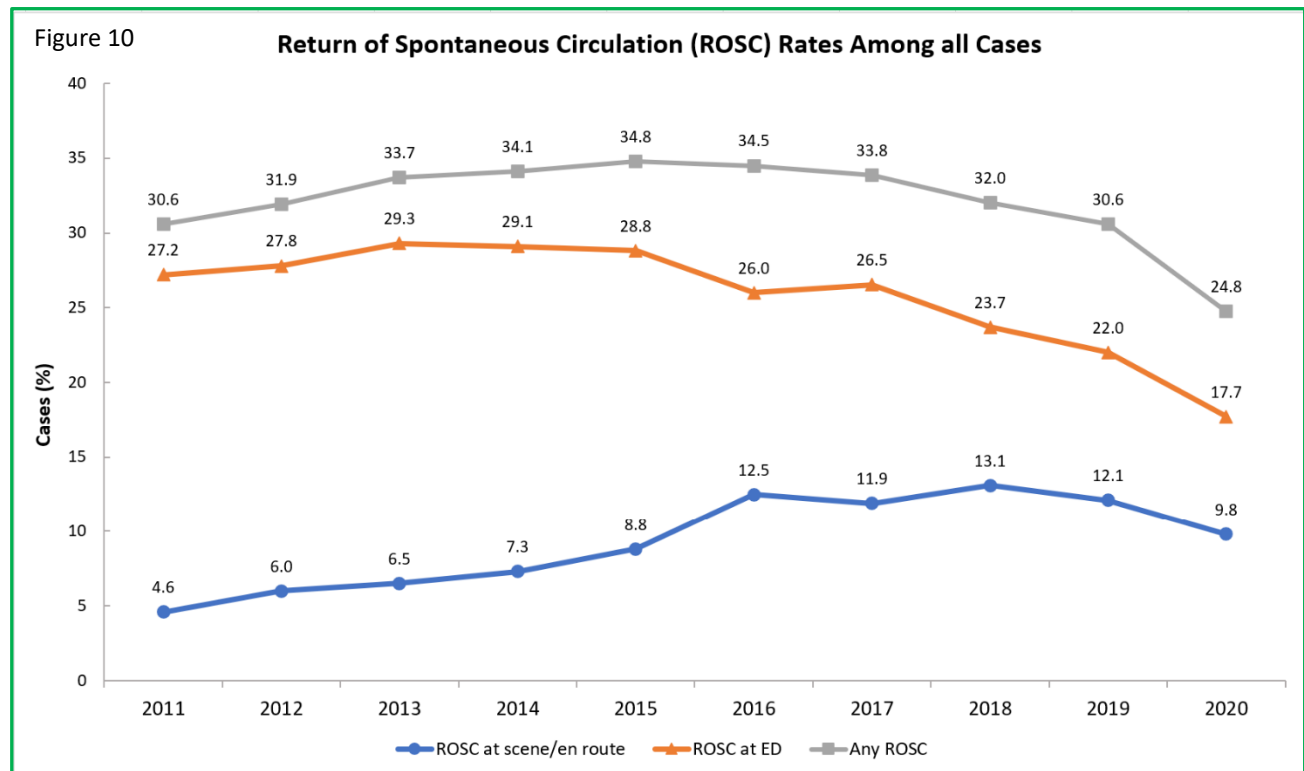
Figure 10

Return of Spontaneous Circulation (ROSC) Rates Among all Cases

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

- In 2020, the Return of Spontaneous Circulation (ROSC) at scene/en route rate decreased to **9.8%** from 12.1% in 2019.

- In 2020, ROSC achieved in the emergency department dropped to **17.7%** from 22.0% in 2019.

- The rate of ROSC achieved at any point dropped to **24.8%** in 2020 compared to 30.6% in 2019.

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

Figure 11

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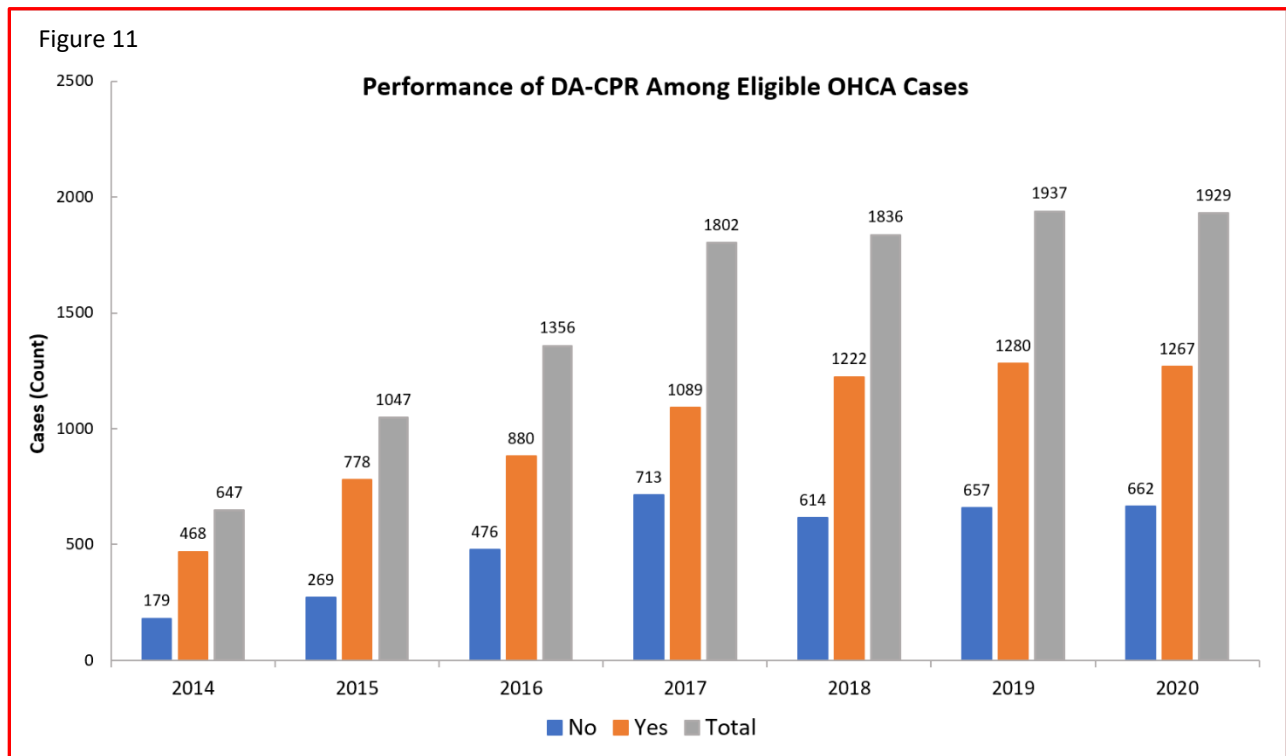
- This chart shows the number of DA-CPR included cases where: 1) no DA-CPR was performed, 2) where DA-CPR was performed, and 3) total eligible cases.

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

- In 2020, **1267 out of 1929** (65.7%) eligible cases involved DA-CPR. In 2019, 1280 out of 1937 (66.1%) 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]

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[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

Post-resuscitation interventions *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 — Aggregate Hospital-based Post-Resuscitation Interventions by Year
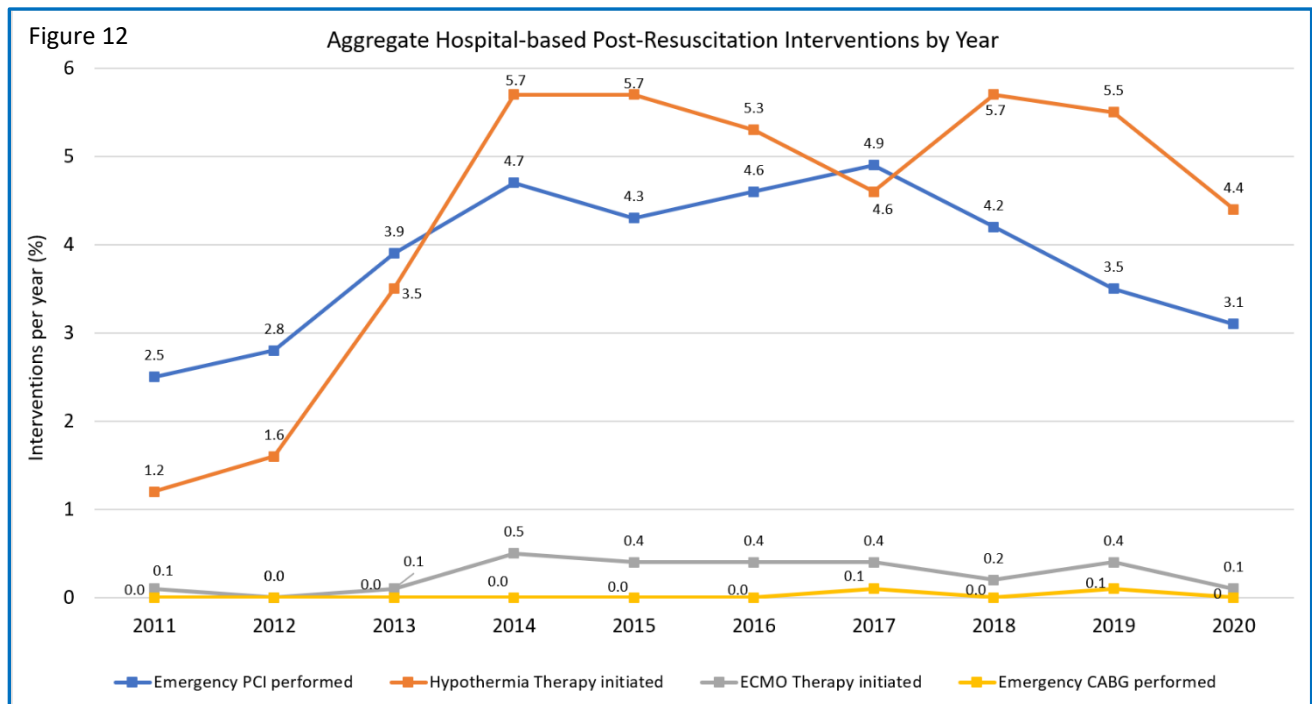
- The graph shows the aggregated rates for each of four post-OHCA hospital interventions from 2011-2020.

- Only public hospitals are included.

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

- Rates of all interventions have continued to dip.

Figure 13

Aggregate OHCA Hospital-based Post-resuscitation Interventions with overall survival rates, 2011-2020
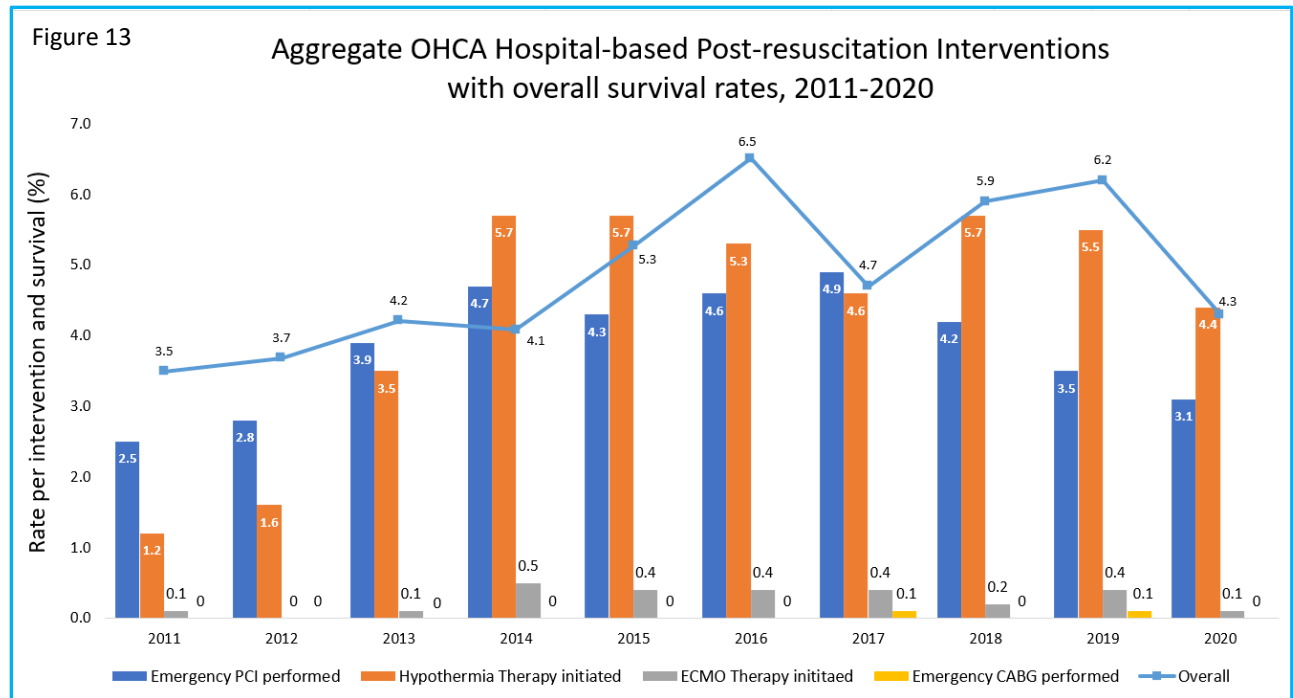
- This graph shows an overlay of the overall rate of survival atop the four aggregated hospital interventions.

- 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.

Table 1: OHCA Results, 2011-2020

	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	2020 n=3432
Age, 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)	69.9 (72.0)
Gender (%)										
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)	1244 (36.2)
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)	2188 (63.8)
Location Type (%)										
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)	2570 (74.9)
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)	318 (9.3)
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)	484 (14.1)
Bystander Intervention (%)										
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)	1929 (56.2)
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)	831 (64.2)
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)	1098 (60.4)
* 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)	1267 (65.7)
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)	500 (38.6)
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)	767 (42.2)
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)	291 (8.5)
Arrest Witnessed by (%)										
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)	783 (22.8)
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)	133 (3.9)
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)	378 (11.0)
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)	319 (9.3)
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)	1819 (53.0)
Initial Rhythm (%)										
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)	516 (15.0)
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)	2908 (84.7)
Outcomes (%)										
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)	335 (9.8)
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)	608 (17.7)
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)	107 (3.1)
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)	150 (4.4)
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)	4 (0.1)
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)	0 (0.0)
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)	446 (13.0)
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)	149 (4.3)
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)	110 (3.2)
** 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)	110 (73.8)
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)	67 (22.2)

Missing hospital outcomes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.1)	1 (0.03)	0 (0.0)	1 (0.03)
Unknown hospital outcomes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.03)	0 (0.0)	0 (0.0)
Non-shockable rhythm bystander witnessed survival	7 (1.2) n = 585	9 (1.7) n = 523	15 (2.3) n = 651	12 (1.5) n = 819	31 (3.1) n = 994	30 (3.2) n = 942	31 (2.4) n = 1306	30 (3.1) n = 966	29 (3.0) n = 955	32 (3.3) n = 974
Good-to-moderate neurological function (non-shockable rhythm, bystander witnessed overall)	1 (1.7)	6 (1.1)	3 (0.5)	9 (1.1)	16 (1.6)	15 (1.6)	19 (1.4)	16 (1.6)	15 (1.6)	15 (1.5)
Good-to-moderate neurological function (non-shockable rhythm bystander witnessed survival)	1 (14.3)	6 (66.7)	3 (20.0)	9 (75.0)	16 (51.6)	15 (50.0)	19 (61.3)	16 (53.3)	15 (51.7)	15 (46.9)
Non-cardiac origin bystander witnessed survival	6 (4.0) n = 148	6 (3.4) n = 176	9 (3.7) n = 242	8 (2.8) n = 287	19 (5.0) n = 378	28 (8.4) n = 331	18 (3.5) n = 508	28 (8.5) n = 329	21 (7.5) n = 279	21 (7.4) n = 284
Good-to-moderate neurological function (non-cardiac origin, bystander witnessed overall)	2 (1.3)	4 (2.3)	1 (0.4)	5 (1.7)	12 (3.2)	16 (4.8)	10 (2.0)	15 (4.5)	13 (4.7)	9 (3.2)
Good-to-moderate neurological function (non-cardiac origin, bystander witnessed survival)	2 (33.3)	4 (66.7)	1 (1.1)	5 (62.5)	12 (63.1)	16 (57.1)	10 (55.5)	15 (53.6)	13 (61.9)	9 (42.9)
* Calculations based on valid cases.										
**Calculations based on available data.										

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May 2022