Are We Through with CPC2?

5 Year Review of Neuroprotective CPR & & Improved Survival from Out-Of-Hospital Hospital Cardiac Arrest

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Critical Care Medicine

Original Investigation

Crit Care Med February 2024; 52: 170-181

LATE BREAKER ARTICLES

Survival for Nonshockable Cardiac Arrests Treated With Noninvasive Circulatory Adjuncts and Head/Thorax Elevation*

OBJECTIVES: Cardiac arrests remain a leading cause of death worldwide. Most patients have nonshockable electrocardiographic presentations (asystole/pulseless electrical activity). Despite well-performed basic and advanced cardiopulmonary resuscitation (CPR) interventions, patients with these presentations have always faced unlikely chances of survival. The primary objective was to determine if, in addition to conventional CPR (C-CPR), expeditious application of noninvasive circulation-enhancing adjuncts, and then gradual elevation of head and

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But…

We Were Also Seeing a New Clinical Signal …

Edmond, Oklahoma Survivors 11/9/22

>30min
CPR.

72 Minutes Continuous CPR!

More on that in a minute…

5-year experience with Head Up CPR

Comparison of 5-Year Neurologically Intact Survival Between an Automated Head Up Cardiopulmonary Resuscitation Registry and a National Cardiac Arrest Registry

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Background

Pre-clinical animal studies have demonstrated improved cerebral blood flow and neurological survival with Automated Head Up Position (AHUP) cardiopulmonary resuscitation (CPR) as compared to flat conventional (C) CPR. AHUP CPR consists of 1) Gradual automated head and thorax elevation 2) active compression decompression CPR and 3) an impedance threshold device. Subsequently, observational propensity-matched studies of out-of-hospital cardiac arrest (OHCA) patients demonstrated a time-dependent association between survival with intact neurological function (SNF) and AHUP CPR implementation. However, comparison of AHUP CPR outcomes with

Hypothesis

Use of AHUP CPR for OHCA by first responder agencies will demonstrate a higher incidence of SNF compared to C-CPR outcomes from a national registry in the United States.

Methods

- Data from 5 years (2020-2024) from an AHUP-CPR Registry comprised of OHCA patients routinely treated by first responders with AHUP CPR were compared with data from the Cardiac Arrest Registry to Enhance Survival (CARES).
- Patient demographics, arrest characteristics, ROSC, SHD, and SNF were recorded. SNF was defined as a Cerebral Performance Category 1 or 2 at

Results

- Nine AHUP registry sites (MN, FL, TN, IL, OK, VA, AL, IA, MI) were included.
- Summary 5-year demographics (Table 1) and clinical outcomes (Table 2) are shown.
- For the AHUP sites, the average time (mm:ss, SD) from 9-1-1 call to start of CPR was 9:09 (4:37) and time to start of AHUP CPR was 12:46 (5:57). The AHUP registry had a higher 5-yr incidence of SNF versus the CARES registry (difference 2.7%, 95% CI 1.8-3.7, $p < 0.0001$). This difference was consistent over years (Figure 1)
- Secondary outcomes of return of spontaneous circulation and survival to

	AHUP REGISTRY		CARES	
Date Range	2020-2024		2020-2024	
# of Cases	3700		679494	
Avg. Age (STD)	67.0	16.8	62.3	
Male % (#)	61.5%	2275	64.5%	438282
VF % (#)	20.0%	739	17.3%	117766
All Non-Shockable % (#)	75.9%	2810	82.7%	561616
Witnessed % (#)	47.6%	1760	49.7%	337916
Bystander Witnessed % (#)	35.9%	1330	37.5%	254594
EMS Witnessed % (#)	11.6%	430	12.3%	83322
Bystander CPR % (#)	42.1%	1557	38.8%	263364

Table 1 (above): Patient demographic and arrest characteristics

	AHUP REGISTRY		CARES		Difference (95% CI)	p value
Date Range	2020-2024		2020-2024			
# of Cases	3700		679494			
Sustained ROSC% (#)	29.2%	1081	26.8%	181777	2.4% (1.0-3.9)	P = 0.0007
Survival to D/C% (#)	12.9%	478	9.6%	65095	3.3% (2.3-4.4)	P < 0.0001
Survival with Good Outcome% (#)	10.3%	382	7.6%	51519	2.7% (1.8-3.7)	P < 0.0001

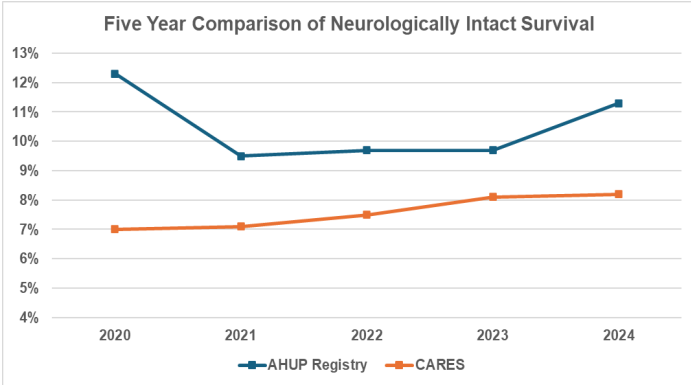


Table 2 (above): Patient clinical outcomes and comparisons

Figure 1 (left): Year by year comparison of survival with intact neurological survival between two OHCA registries

Limitations

- Data comparisons are in aggregate and unadjusted
- Data from both registries are observational and non-randomized

Conclusions

Over a 5-year period, an unadjusted analysis of aggregate data from two OHCA patient registries demonstrated that the incidence of survival with intact neurological function was higher in patients treated with AHUP CPR as part of first responder care versus patients treated with conventional CPR methods.

References

1. Moore JC et al. Resuscitation. 2017 Dec;121:195-200. PMID: 28827197.
2. Moore JC et al. Resuscitation. 2021 Jan;158:220-227. PMID: 33027619;
3. Moore JC et al. Resuscitation. 2022 Oct;179:9-17. PMID: 35933057.
4. Bachista KM et al. Crit Care Med. 2024 Feb 1;52(2):170-181. PMID: 38240504.

5-YEAR REGISTRY (Yet to be Published) RESULTS

- Jan 1, 2020 (COVID Era) and December 31, 2024:
- >3700 Pts from 10 EMS agencies across 9 states
  (MN, FL, TN, IL, OK, VA, AL, IA, MI)
- Avg age 64 yrs, 64% Men, 911 Call to CPR=9.99 min
- 391 (10.5%) Survived with CPC 1-2 (91% = CPC 1)
- Avg age of Intact Survivors was 56 yrs
- For Non-Shockables: 12% (PEA) & 2% (Asystole) survived CPC 1-2.

How were these places doing before?

Overall Neurologically-Favorable Survival

Before AHUP CPR

8.5%

246 / 2,884

p = 0.01

Statistically significant improvement in pooled results across all sites

Compared to other metrics?

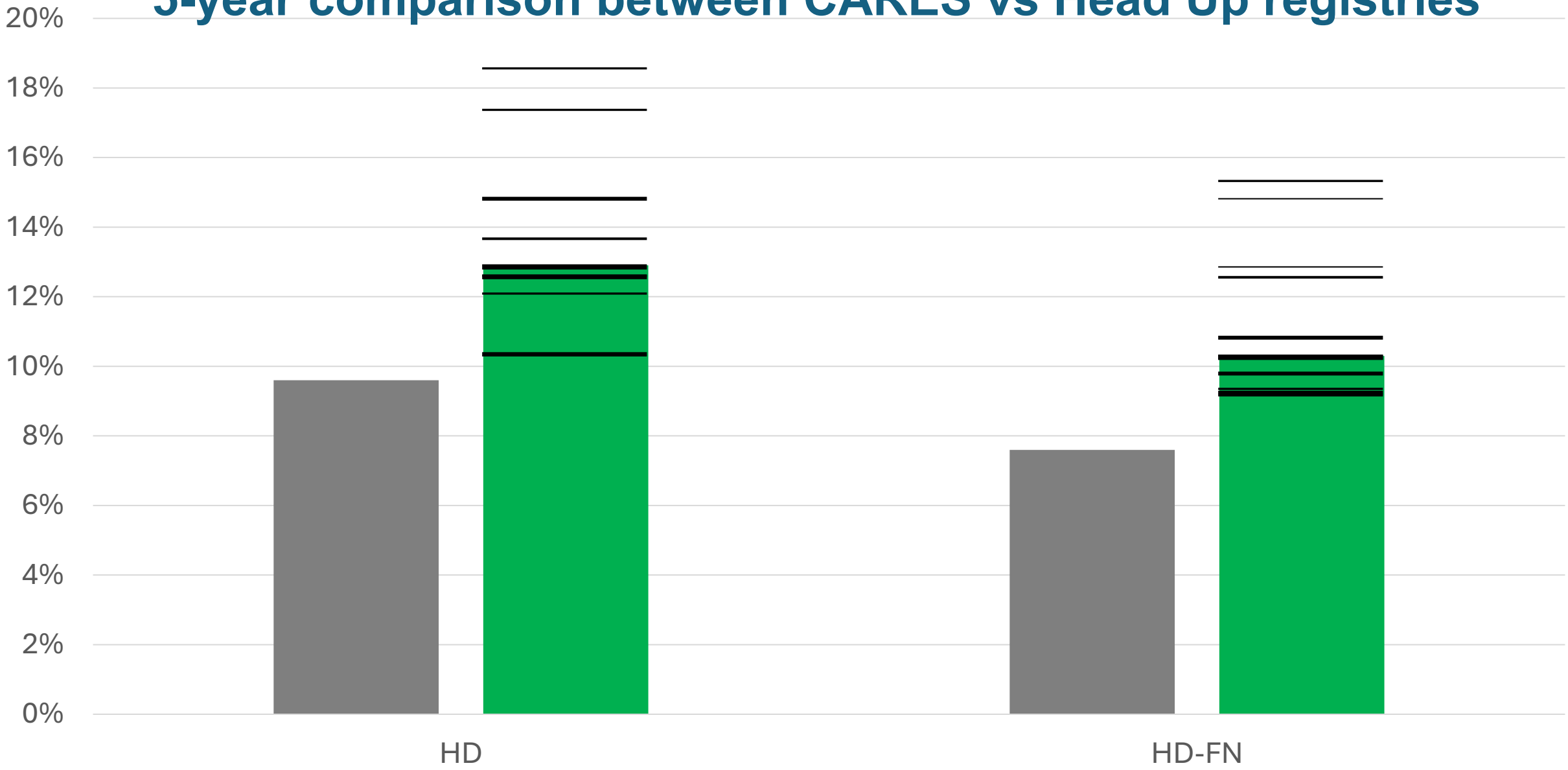
5-Year AHUP Registry vs CARES

	2020-2024		
	AHUP Registry	**CARES**	**p-value**
% Sustained ROSC	**29.3% (1091/3721)**	**26.8% (181,777/679,474)**	**0.0004**
% Hospital D/C	**13.0% (483/3721)**	**9.6% (65,095/679,474)**	**<0.00001**
% Neuro Intact Survival	**10.5% (379/3721)**	**7.6% (51,519/679,474)**	**<0.00001**

Participating Sites: Edina, MN, St Johns County, FL, Germantown, TN, Edmond, OK, Tuscaloosa, AL, Peoria, IL, Chesapeake, VA, Des Moines, IA, Canton, MI

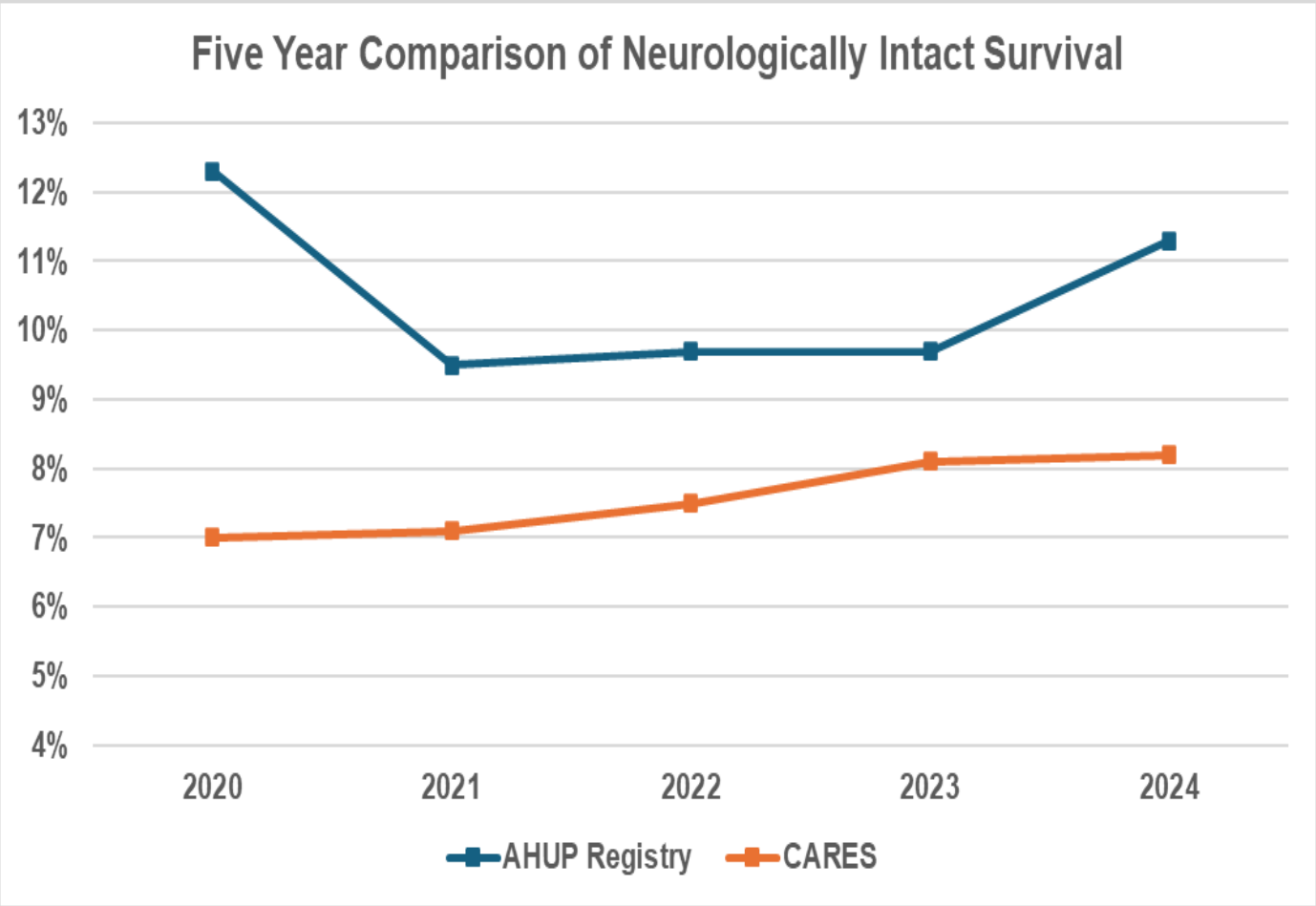
Presented at the AHA Nov 2025

5-year comparison between CARES vs Head Up registries



HD=hospital discharge
FN=favorable neurological survival

Trends?


Five Year Comparison of Neurologically Intact Survival
13%
12%
11%
10%
9%
8%
7%
6%
5%
4%
2020
2021
2022
2023
2024
AHUP Registry
CARES

Are We Through with CPC2? Neuroprotective CPR & Improved Survival from Out-Of-Hospital Cardiac Arrest

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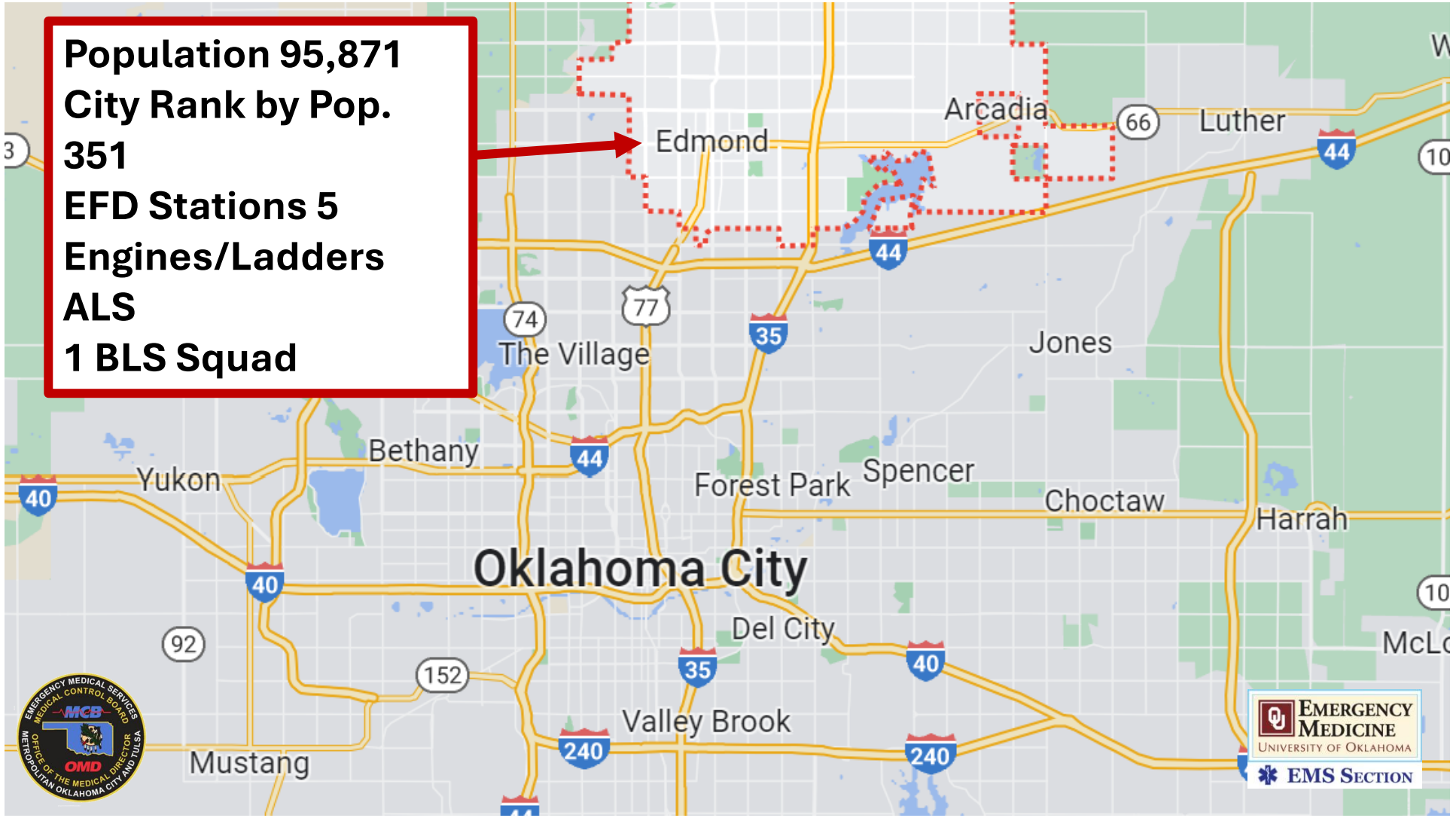
Population 95,871
City Rank by Pop.
351
EFD Stations 5
Engines/Ladders
ALS
1 BLS Squad
Edmond
Arcadia
Luther
The Village
Jones
Bethany
Yukon
Forest Park
Spencer
Choctaw
Harrah
Oklahoma City
Del City
Valley Brook
Mustang
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EMERGENCY MEDICINE
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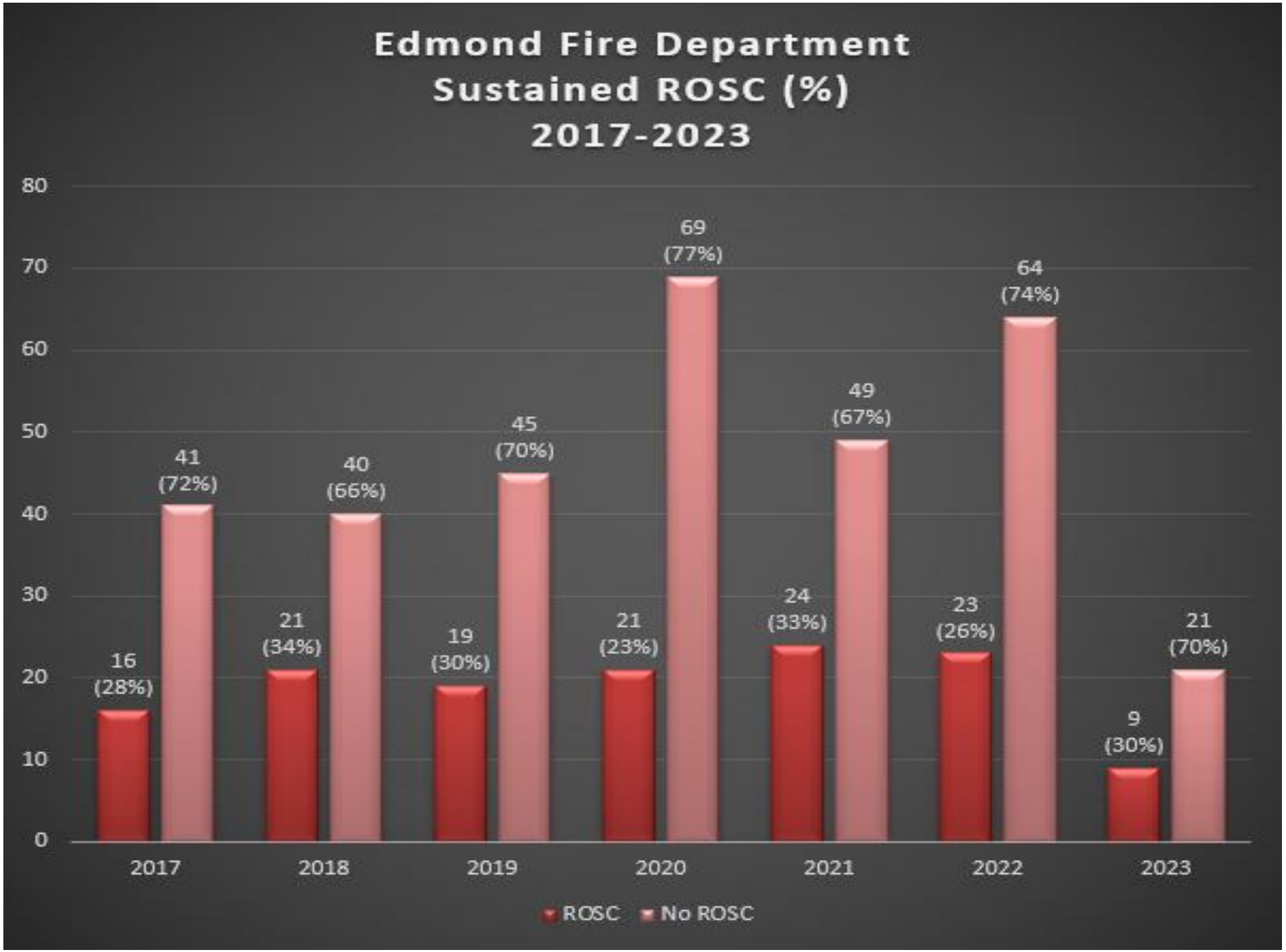
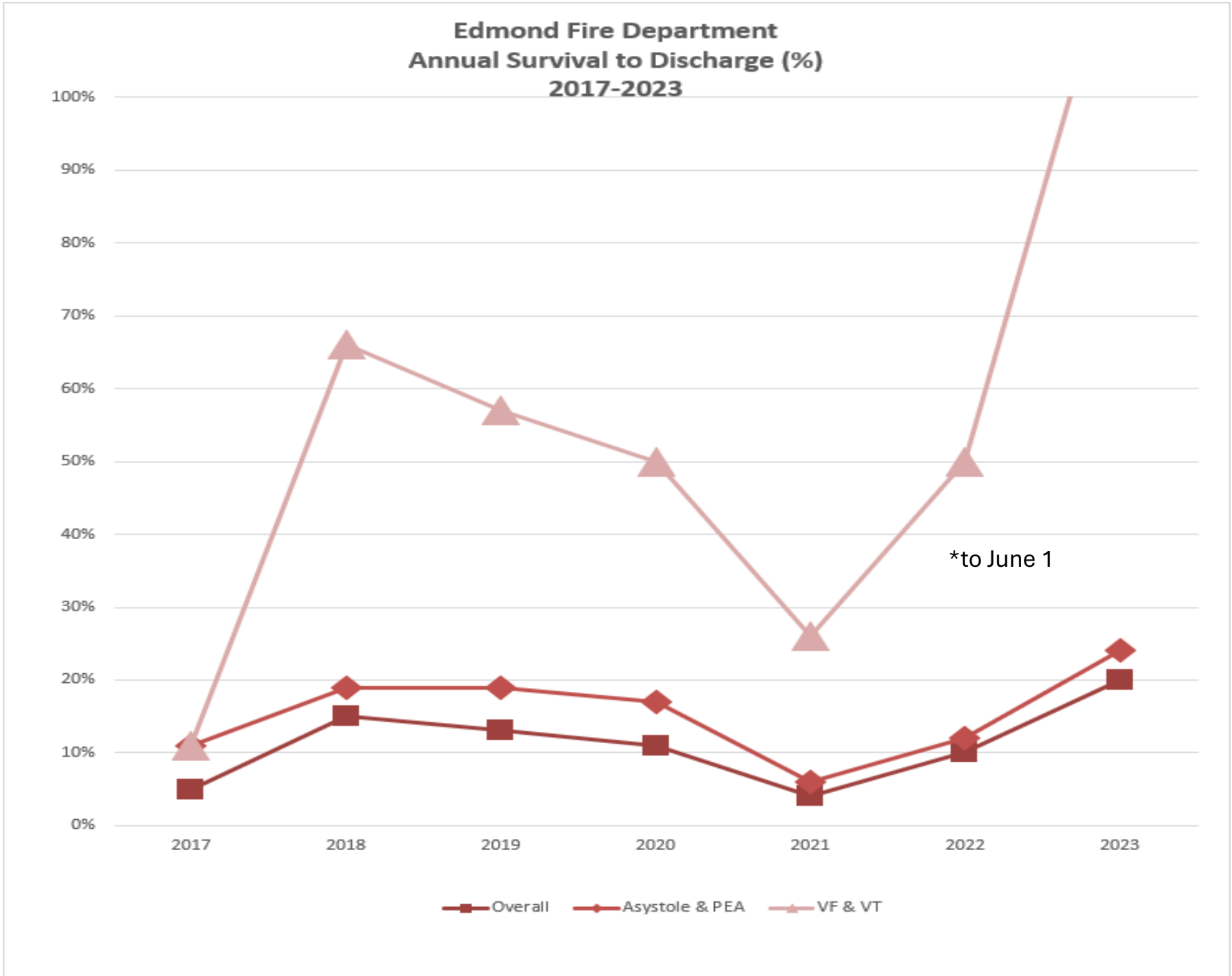
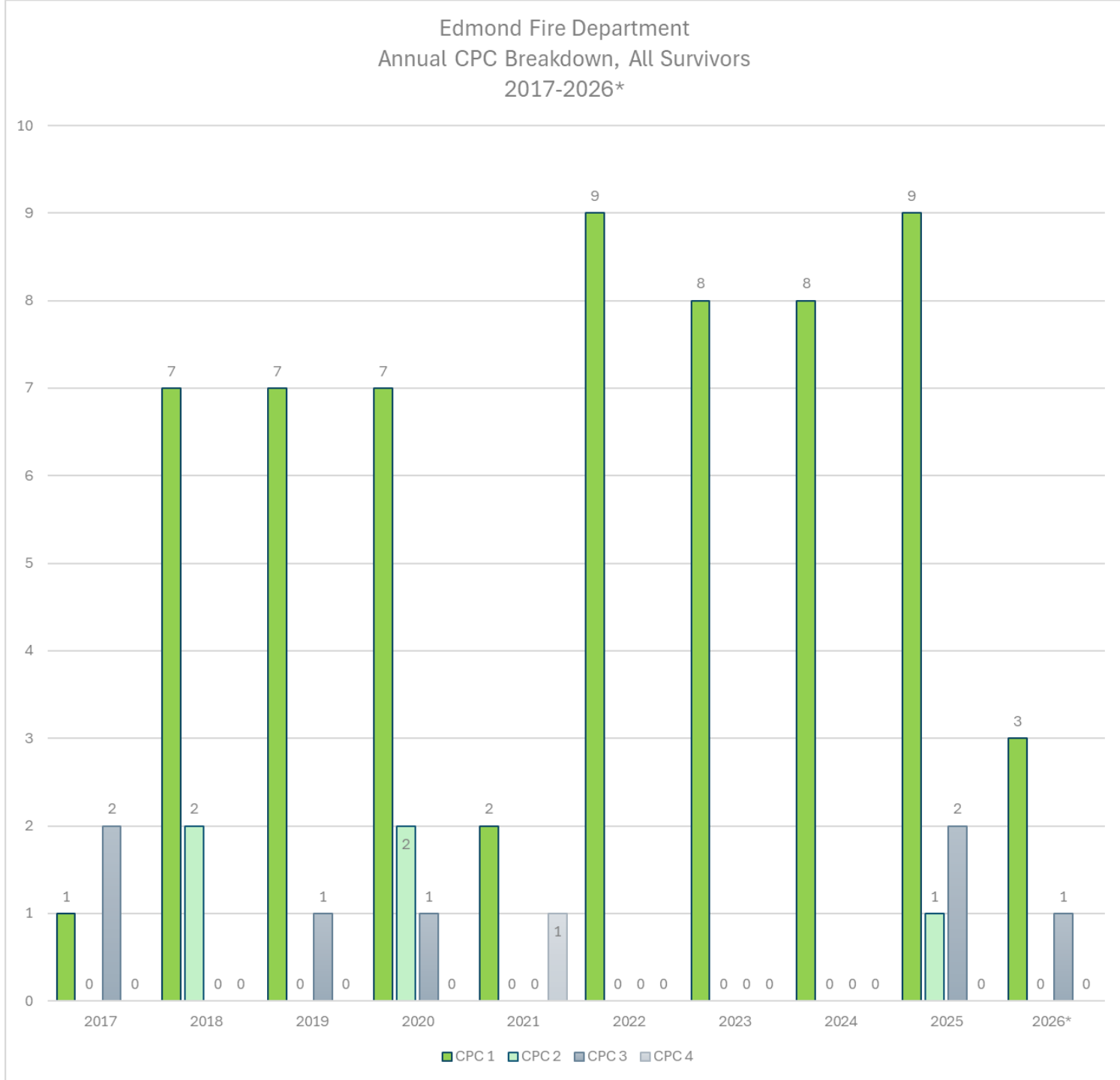

Edmond Fire Department
Sustained ROSC (%)
2017-2023
80
70
60
50
40
30
20
10
0
16 (28%)
41 (72%)
21 (34%)
40 (66%)
19 (30%)
45 (70%)
21 (23%)
69 (77%)
24 (33%)
49 (67%)
23 (26%)
64 (74%)
9 (30%)
21 (70%)
2017
2018
2019
2020
2021
2022
2023
ROSC
No ROSC


Edmond Fire Department
Annual Survival to Discharge (%)
2017-2023
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2017
2018
2019
2020
2021
2022
2023
*to June 1
Overall
Asystole & PEA
VF & VT


Edmond Fire Department
Annual CPC Breakdown, All Survivors
2017-2026*
10
9
8
7
6
5
4
3
2
1
0
1 0 2 0
7 2 0 0
7 0 1 0
7 2 1 0
2 0 0 1
9 0 0 0
8 0 0 0
8 0 0 0
9 1 2 0
3 0 1 0
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026*
CPC 1
CPC 2
CPC 3
CPC 4

CY2025 Metro OKC & Tulsa

Witnessed, bystander CPR, VF on arrival = “Utstein”

42%

N=21

CPC1 = 100%

What about all the others?

- 1559 OOHCA resuscitations in 2025
- Survival from all variables:

N=102

CPC1 or CPC2 = 88%

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