



# CARDIAC ARREST: CLOSING THE (GENDER) GAP

*Boskey Patel, DO, FACC, FSCAI*

*Interventional Cardiology*

*Hartford Healthcare Heart and Vascular Institute @ Hartford Hospital*

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# OUTLINE

- Setting the scene
- Before the arrest
- During resuscitation
- Post-ROSC
- Outcomes
- Closing the gap

# Sudden Cardiac Arrest: Closing the Survival Gap

## THE REALITY OF CARDIAC ARREST



### Annual Cases

Roughly 350,000 to 358,000 people experience out-of-hospital cardiac arrest in the U.S. annually.



### Fatality Rate

Without immediate intervention, nine out of ten cardiac arrest events are fatal.



**18%**

### Occur in Public Settings

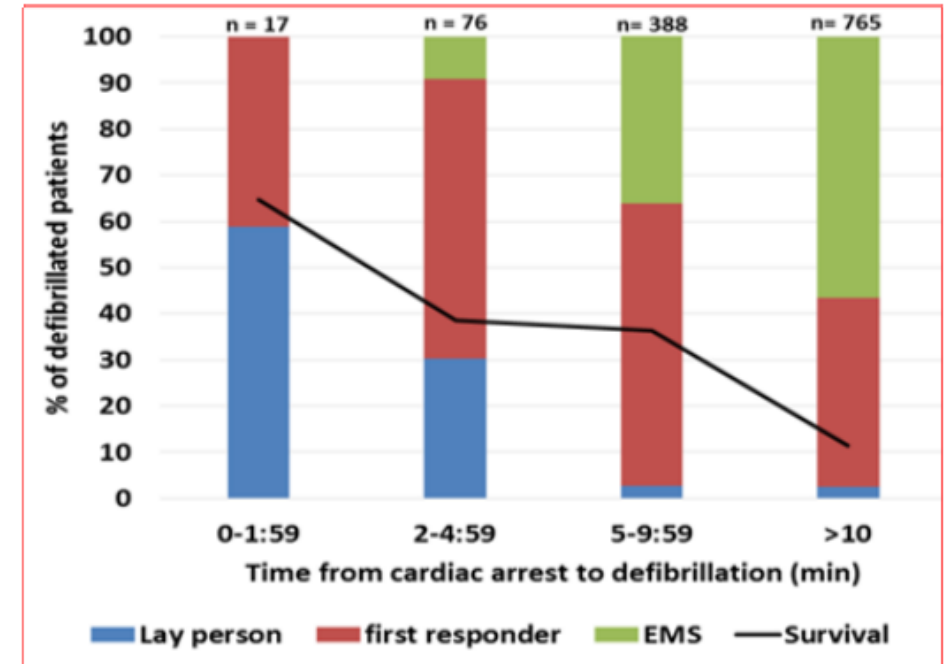
This includes workplaces, schools, gyms, and transit hubs where organizations have a duty of care.

- 430-460K cardiac arrests in the US annually
- most occur at home (70%)
- about 18% occur in public \*\*
- 12% in nursing homes/care facilities

# SETTING THE SCENE

- 24 hr survival: 29% → 30-day survival: 16%
- What improves outcomes following cardiac arrest?
  - CPR, defibrillation, TTM, immediate angiography with PCI
- Bystander CPR: doubles or triples chances of survival
  - Initiated in only 40-42% of cases
  - Higher chance of survival if witnessed (15-16%) vs unwitnessed (4%)
    - 18% if witnessed by EMS

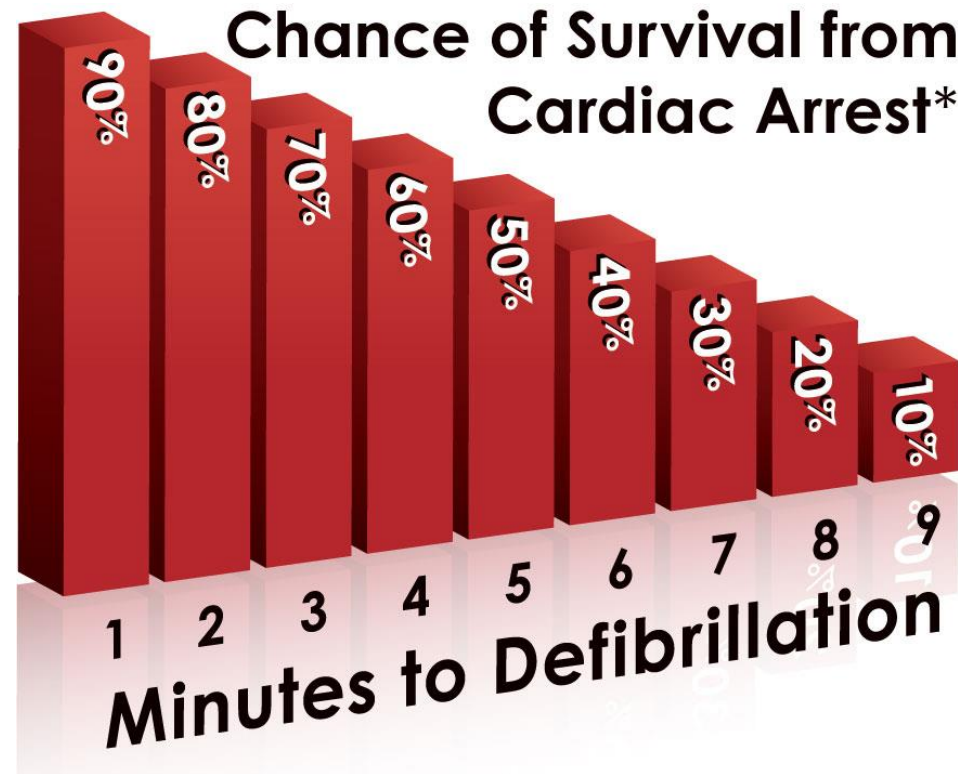
Time to defibrillation,  
who did it, and survival



Hansen C, et al. JAMA.2015;314:255-264

# SETTING THE SCENE

- Timely, successful defib: 90% chance of gross survival
- Every minute delay in defibrillation → survival chance drops by 10%

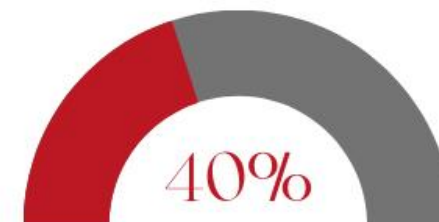




Median time from 911 call  
to paramedic arrival is  
**more than 7 minutes**



More than **70%** of  
patients **do not** receive  
timely defibrillation



Less than 40% of patients  
**receive bystander CPR**



29% of patients have an AED  
applied **prior to** paramedic arrival

There is little evidence that these  
statistics have substantially  
improved despite 30 years of work.

# ALMOST 20 YEARS OF DATA

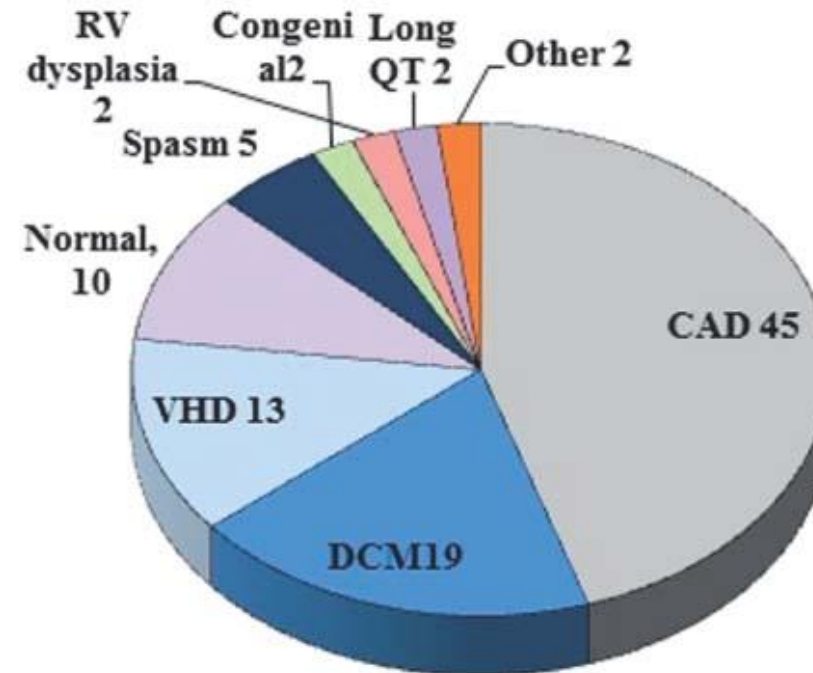
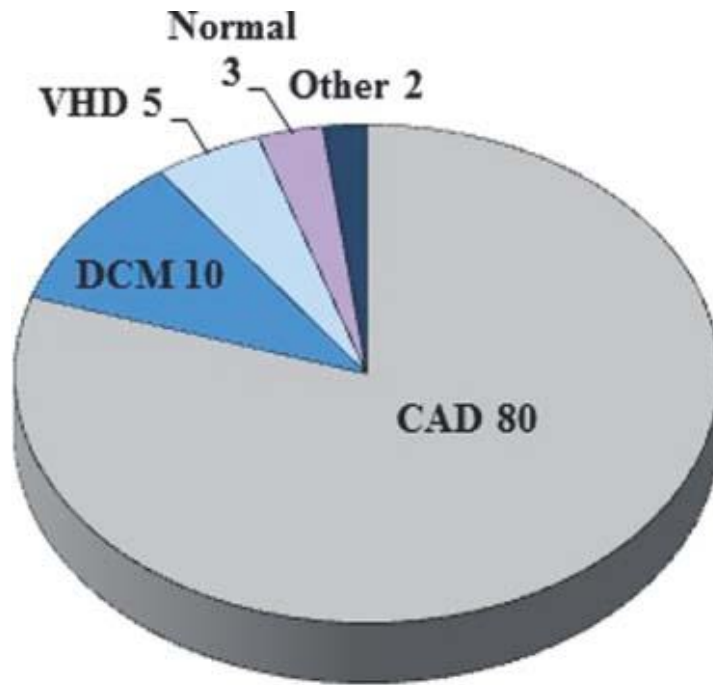
- 2025: retrospective study of European OHCA pts 2014-2023 (1128 pts)
- 2024: retrospective cohort study of 3400 Dutch pts with OHCA 2005-2017
- 2022: retrospective analysis of prospective registry, 900 pts with OHCA
- 2020: review of 2 randomized trials with 4000+ OHCA
- 2020: meta analysis of 1.2 million OHCA pts (33 studies)
- 2016: retrospective analysis of all CA pts using NIS from 2003-2012 (1.4 million)
- 2010: review of 67 studies from Europe, North America, Asia, Australia

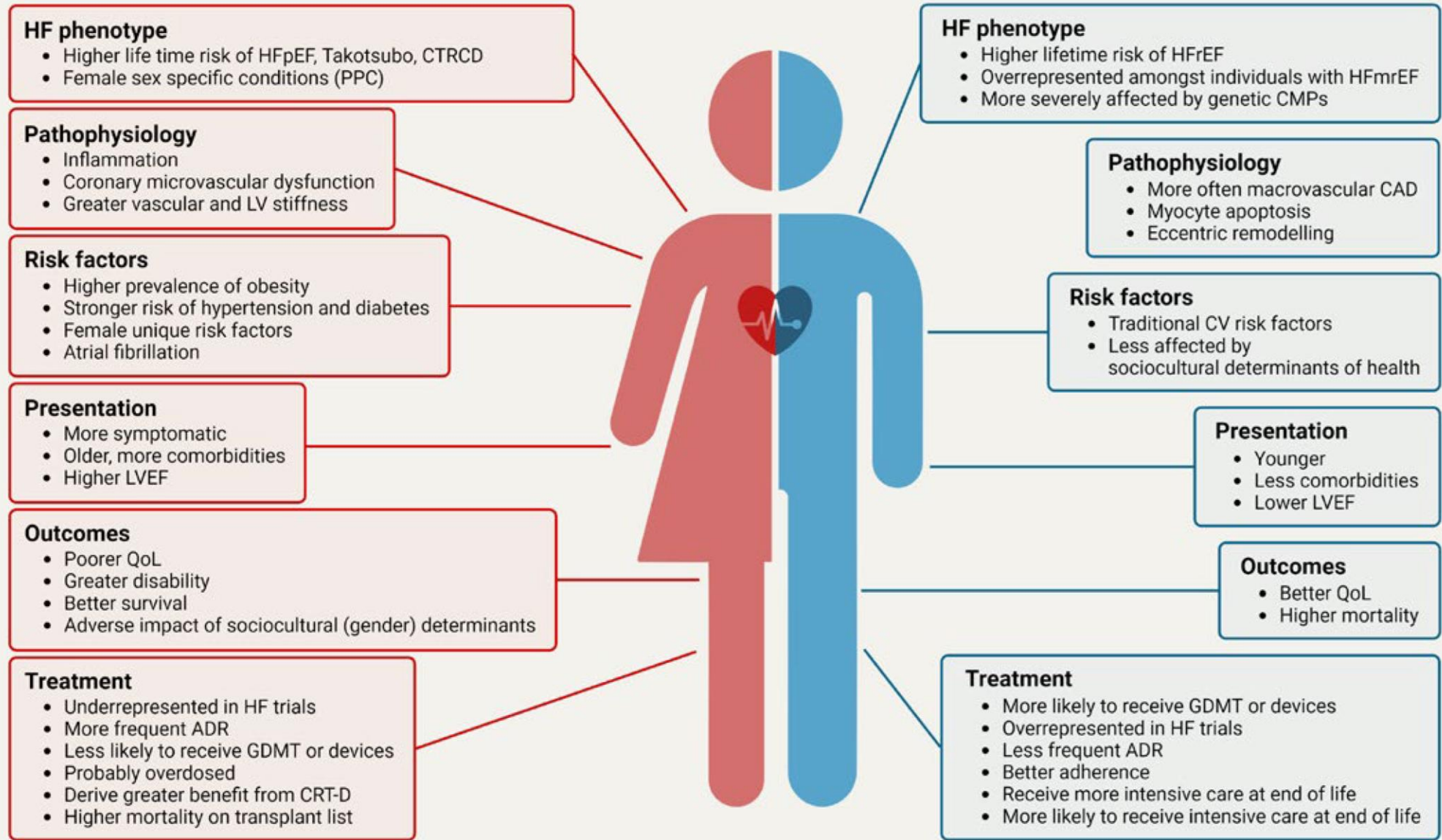
# THE GENDER GAP: BEFORE THE ARREST

## *PATHOPHYSIOLOGY MATTERS*

- Estrogen: natural shield
  - Pre-menopause estradiol vs post-menopause estrone: act via different receptors, different outcomes
- The substrate differs
  - Fibrosis and ion-channel genes in women → hypertrophy, non-arrhythmic
  - Inflammatory/cytokine pathways in men → chronic CAD

- Men's and women's hearts fail for different reasons





# THE GENDER GAP: PUTTING IT TOGETHER

## FEMALES

- Older (70)
- More likely to be unwitnessed
- Not in public: more common in women vs men
- *More often non-cardiac etiology*
- *More often non-shockable rhythm*

## MALES

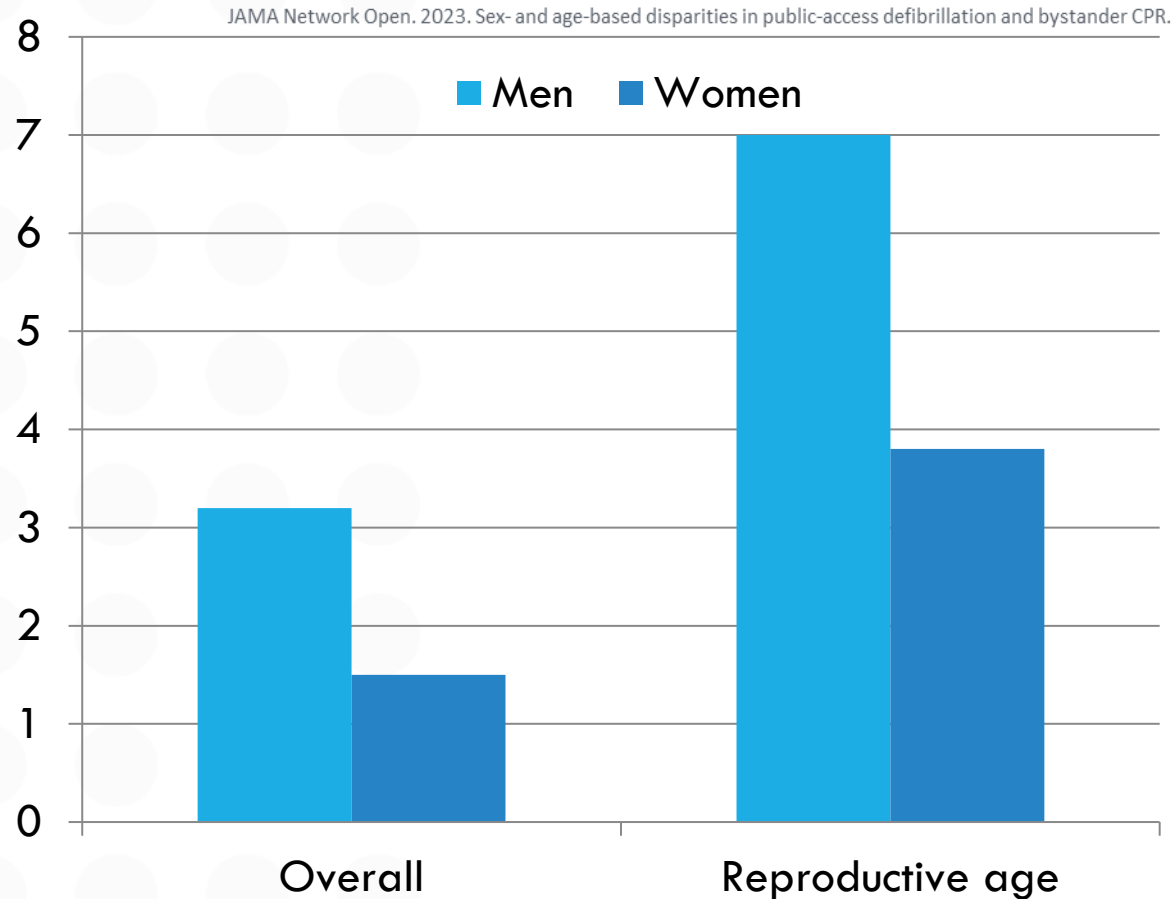
- Younger (65)
- More likely to be witnessed
- Out of hospital: more common in men
- *More often ischemic*
- *More often p/w shockable rhythm (VF/VT vs PEA/asystole)*

# THE GENDER GAP: DURING RESUSCITATION

- 67.9% vs 72.7%
  - Women vs men who get bystander CPR in Dutch population (2019)
- 39% vs 45%
  - Women vs men who get bystander CPR in public locations in the USA (2022 AHA)
- Why:
  - Failure to recognize CA
  - Concern about inappropriate touching
  - Reluctance to expose chest
  - Uncertainty or lack of knowledge about where to place AED pads



# PUBLIC AED ACCESS/USE

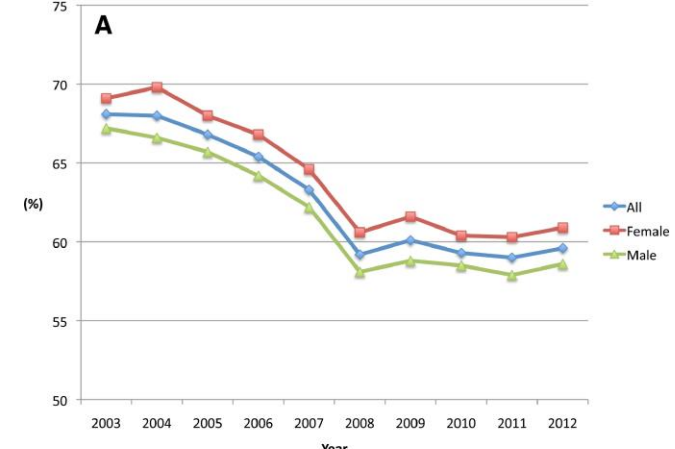
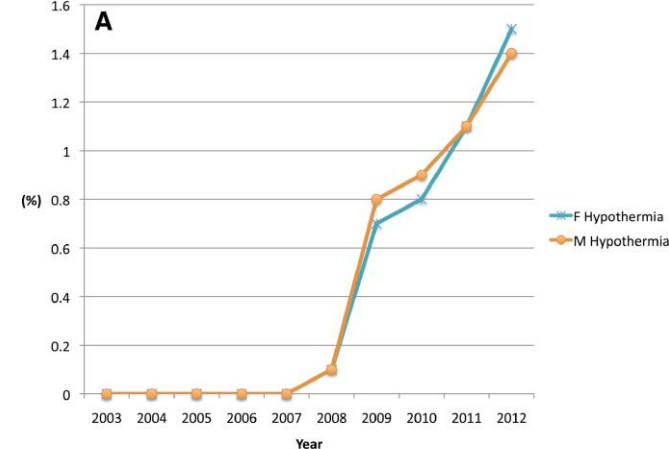
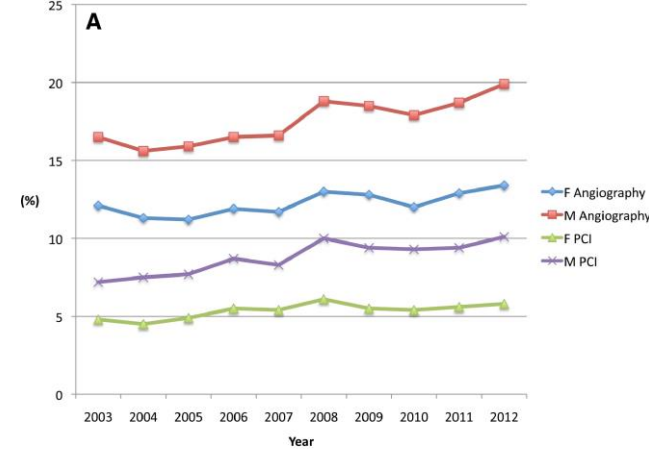


- Public access AED use: 3.2% (men) vs 1.5% (women)
  - Among reproductive age patients: 7.0% vs 3.8%

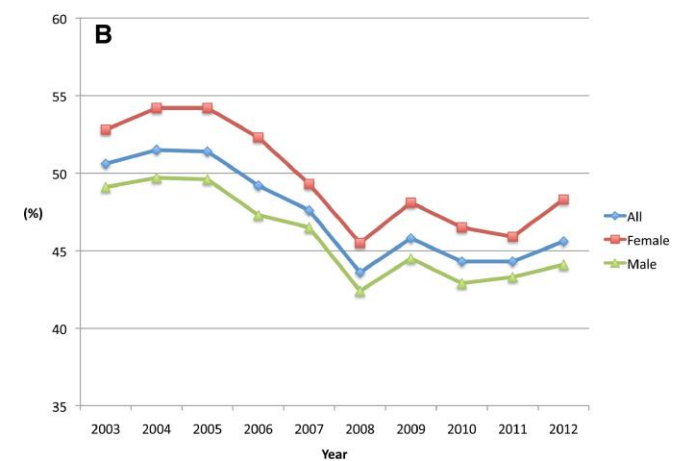
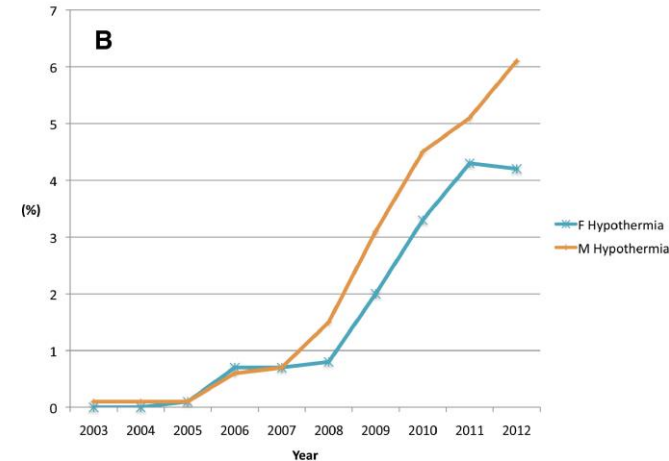
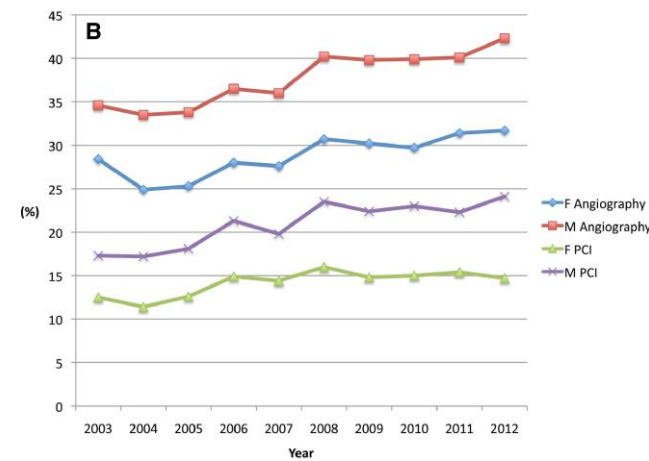
# THE GENDER GAP: POST-ROSC

- INTCAR: study by May, Skinner, et al.
  - Patients resuscitated from OHCA from 7 centers, 2006-2017
  - 966 patients: 29% women, 71% men
- Women:
  - less likely to have prior CAD, less likely to have STEMI
- Without STEMI: **women** compared to **men** were less likely to even get angiography (**51%** vs **61%**), have culprit identified (**29%** vs **45%**), undergo revascularization (**44%** vs **52%**).

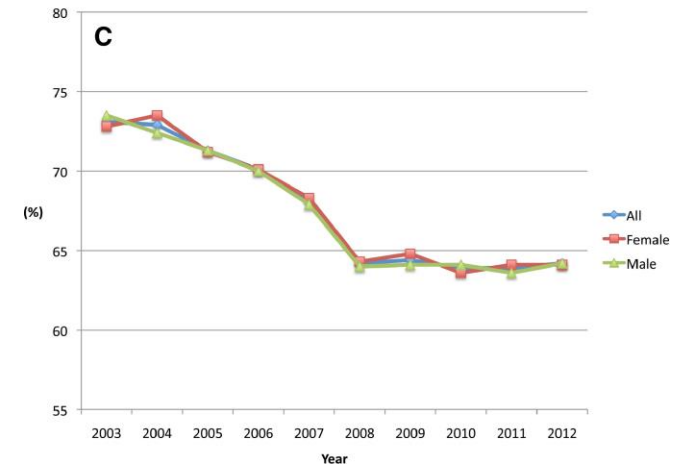
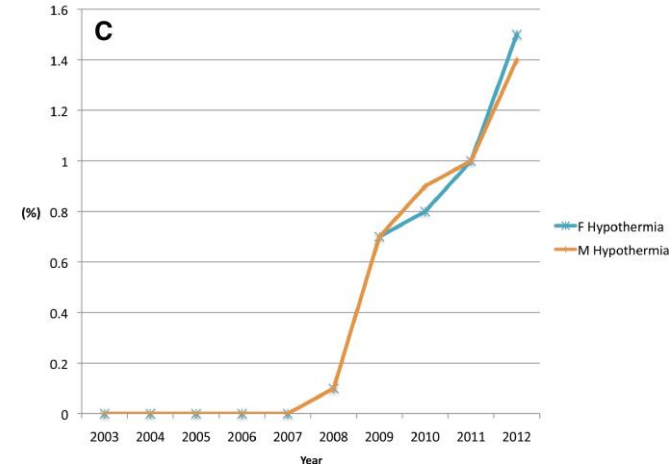
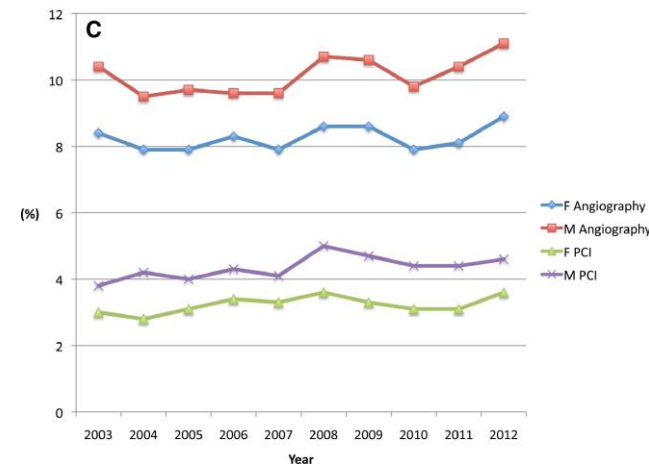
ALL cardiac arrests



VT/VF arrests



PEA/asystole arrests



# US/CANADA 2020

| Characteristics <sup>*</sup>               | Women<br>(N= 1,825) | Men<br>(N= 3,050) | P-Value |
|--------------------------------------------|---------------------|-------------------|---------|
| Age, years                                 | 67.5 (16.9)         | 65.3 (15.7)       | <0.001  |
| Bystander cardiopulmonary resuscitation, % | 49.1                | 54.9              | <0.001  |
| Witnessed, %                               | 55.1                | 64.5              | <0.001  |
| Initial shockable rhythm, %                | 24.3                | 44.6              | <0.001  |
| Public location, %                         | 10.8                | 26.6              | <0.001  |
| EMS response time, minutes                 | 5.8 (2.5)           | 5.7 (2.5)         | 0.22    |
| Amount of fluids administered, mL          | 549 (411.6)         | 577 (465.4)       | 0.33    |
| Epinephrine dose, mg                       | 2.7 (1.6)           | 2.8 (1.8)         | 0.39    |
| Duration of resuscitation, minutes         | 14.6 (8.3)          | 13.5 (8.6)        | <0.001  |
| 12-lead electrocardiogram                  | 91.6                | 93.4              | 0.03    |
| ST-Elevation present, %                    | 19.4                | 32.4              | <0.001  |
| <b>In-hospital procedures</b>              |                     |                   |         |
| Targeted temperature management, %         | 35.1                | 44.6              | <0.001  |
| Coronary angiography, %                    | 14.3                | 30.2              | <0.001  |

# KOREA 2021

**Baseline characteristics of the patients with out-of-hospital cardiac arrest.**

| Characteristics                                        | All (N=670)  | Men (n=482)  | Women (n=188) | P     |
|--------------------------------------------------------|--------------|--------------|---------------|-------|
| Age <sup>§</sup>                                       | 61.4 (±15.9) | 59.7 (±14.7) | 65.9 (±18.1)  | <.001 |
| Preexisting conditions – n (%)                         |              |              |               |       |
| Hypertension                                           | 264 (39.4)   | 176 (36.5)   | 88 (46.8)     | .018  |
| Diabetes                                               | 144 (21.5)   | 105 (21.8)   | 39 (20.7)     | .85   |
| Dyslipidemia                                           | 41 (6.1)     | 29 (6.0)     | 12 (6.4)      | 1     |
| Bystander witnessed – n (%)                            | 489 (73.0)   | 355 (73.7)   | 134 (71.3)    | .59   |
| Bystander CPR – n (%)                                  | 317 (47.3)   | 235 (48.8)   | 82 (43.6)     | .26   |
| Initial shockable rhythm – n (%)                       | 269 (40.1)   | 217 (45.0)   | 52 (27.7)     | <.001 |
| Prehospital defibrillation – n (%)                     | 284 (42.4)   | 231 (47.9)   | 53 (28.2)     | <.001 |
| Arrest location* – n (%)                               | 379 (56.6)   | 265 (55.0)   | 114 (60.6)    | .21   |
| ED visit not during working hours <sup>†</sup> – n (%) | 179 (26.7)   | 231 (47.9)   | 98 (52.1)     | .37   |
| Hospital course – n (%)                                |              |              |               |       |
| Intubation                                             | 618 (92.2)   | 442 (91.7)   | 176 (93.6)    | .50   |
| Use of inotropic agents                                | 496 (74.0)   | 348 (72.2)   | 148 (78.7)    | .10   |
| CAG                                                    | 202 (30.1)   | 174 (36.1)   | 28 (14.9)     | <.001 |
| Revascularization – n (%)                              | 107 (16.0)   | 93 (19.3)    | 14 (7.4)      | <.001 |
| PCI                                                    | 74 (11.0)    | 67 (13.9)    | 7 (3.7)       | <.001 |
| CABG                                                   | 8 (1.2)      | 7 (1.5)      | 1 (0.5)       | .55   |
| rTPA                                                   | 39 (5.8)     | 30 (6.2)     | 9 (4.8)       | .59   |
| IABP                                                   | 22 (3.3)     | 20 (4.1)     | 2 (1.1)       | .07   |
| ECMO                                                   | 32 (4.8)     | 27 (5.6)     | 5 (2.7)       | .16   |
| TTM                                                    | 209 (31.2)   | 173 (35.9)   | 36 (19.1)     | <.001 |
| Poor outcome <sup>‡</sup> – n (%)                      | 492 (73.4)   | 336 (69.7)   | 156 (83.0)    | .001  |

CABG = coronary artery bypass grafting, CAG = coronary angiography, CPC = cerebral performance category, CPR = cardiopulmonary resuscitation, ECMO = extracorporeal membrane oxygenation, IABP = intra-aortic balloon pump, PCI = percutaneous coronary intervention, rTPA = recombinant tissue plasminogen activator, SD = standard deviation, TTM = targeted temperature management.

\* Arrest occurring in a private home or unknown location.

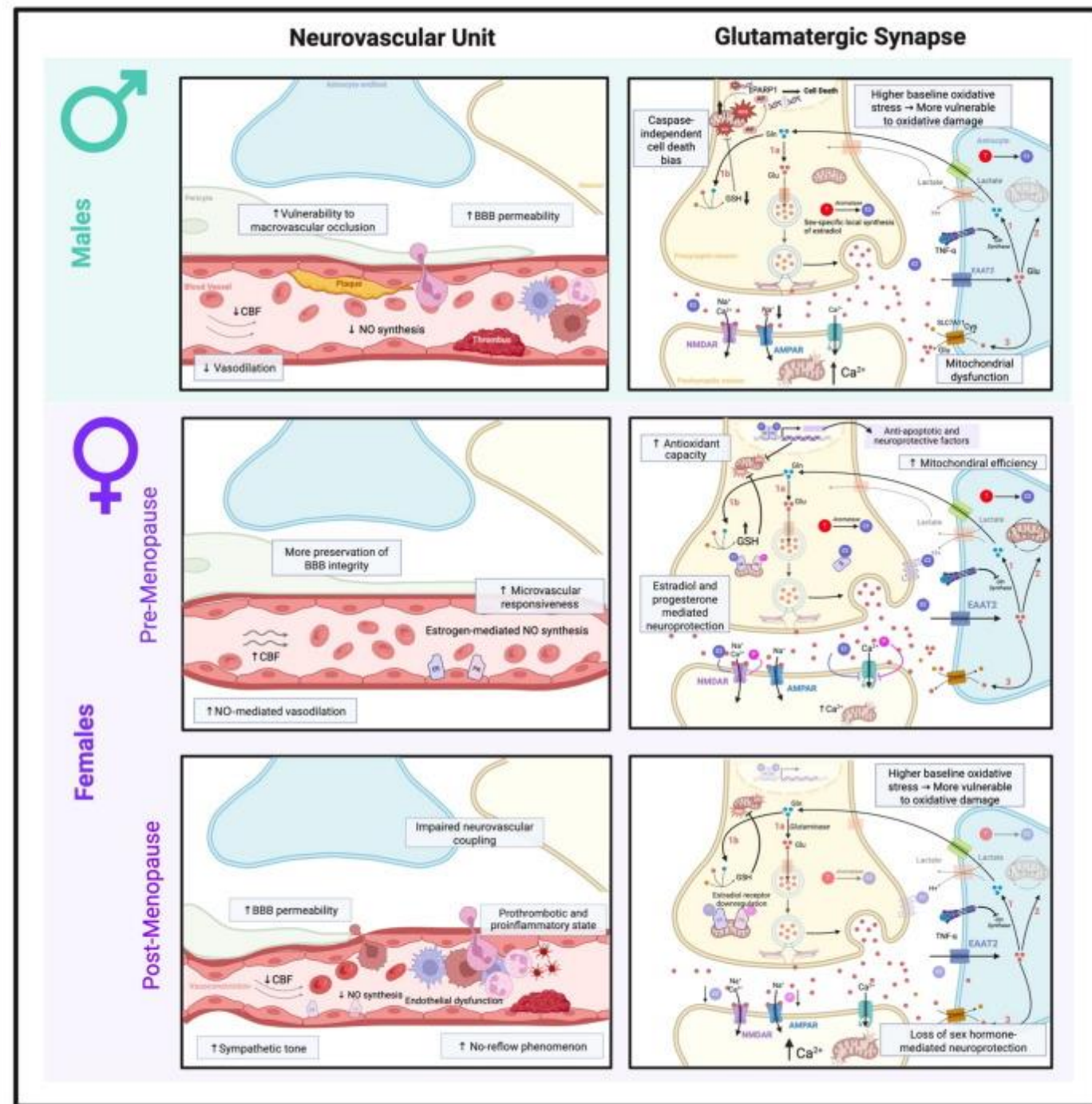
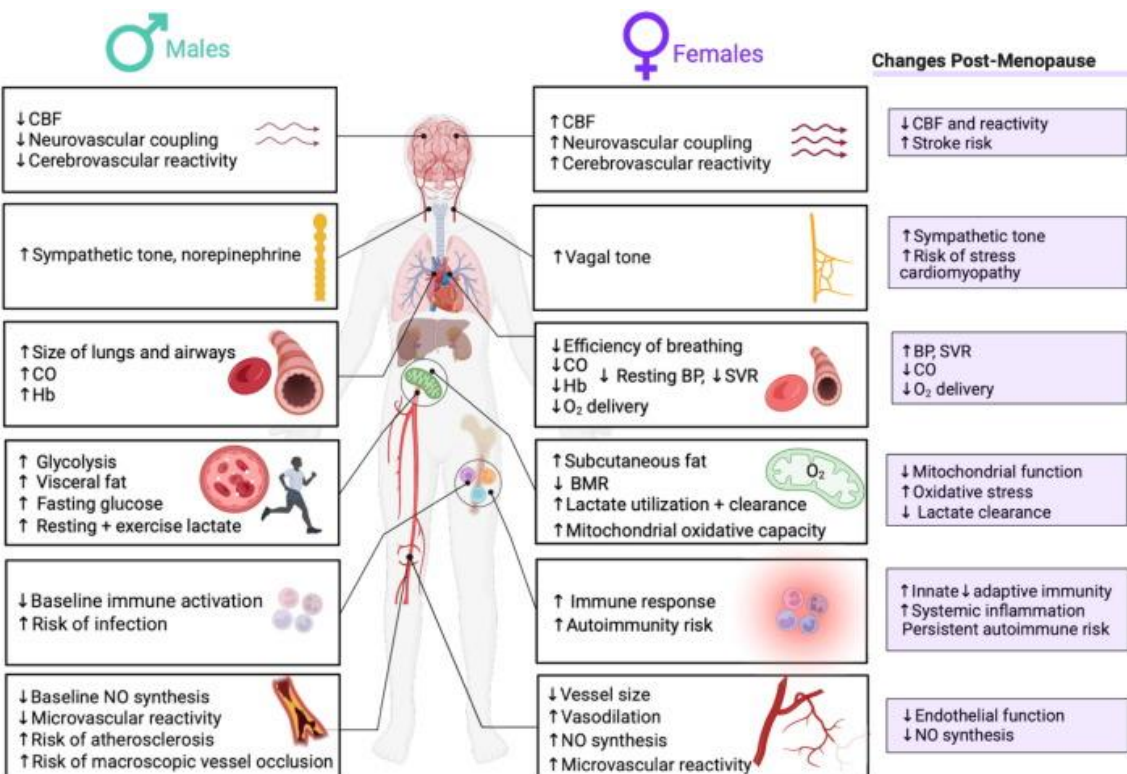
<sup>†</sup> 5 p.m. to 8 a.m. and weekends.

<sup>‡</sup> Defined as CPC ranging from 3 to 5 or all-cause death within 30 days.

<sup>§</sup> Values are means ± SD.

# OUTCOMES

- INCIDENCE of OHCA: M > F
- Witnessed: M
- Shockable rhythm: M ( $p < 0.001$ )
- More likely to have non-ischemic etiology (SCAD, Takotsubo, PE): F
- More likely to get CPR: M ( $p < 0.001$ )
- More likely to undergo TTM: M ( $p < 0.001$ )
- More likely to coronary angiography: M ( $p < 0.001$ )
- More likely to be made DNR (and earlier): F
- More likely to have good neurological outcome: pre-menopausal F > M > post-menopausal F



# TL;DR

- Cardiac arrest survival: poor
- Rates of CPR: low
- Women and men present differently
- Women: less likely to get CPR, angiography, revascularization, or MCS
- Survival better in men (lower risk of death or poor neurological outcome)
  - Varies by subgroup → pre- vs post-menopausal women
- Some due to biological differences
- Some due to medical treatment or lack thereof

# THE GENDER GAP: HOW DO WE CLOSE IT?

- Pre-hospital gap:
  - Will you hurt a woman by performing CPR?
    - No, if she needs CPR, she is already dead, and it is really possible that you can cause further harm.
  - Do breasts get in the way of CPR?
    - No, you are still using the sternum as you would with men
  - Use female mannequins in BLS/ACLS training
  - Teach chest exposure, bra removal, pad placement
  - Strengthen recognition – public and dispatcher

# THE GENDER GAP: HOW DO WE CLOSE IT?

- Post-arrest:
  - Use protocolized post-arrest pathways
    - Hemodynamic monitoring
    - Temperature control
    - Seizure detection
    - Neurological monitoring
  - Guideline directed ischemia workup, including angiography/PCI and MCS as indicated
  - Delayed neuroprognostication (e.g. do not rush to DNR/WLST)
  - Engage in hospital QI processes

## THE UPDATED AHA ADULT CHAINS OF SURVIVAL

### Out-of-hospital Cardiac Arrest



### In-hospital Cardiac Arrest



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# THANK YOU!

Email: [Boskey.Patel@hhchealth.org](mailto:Boskey.Patel@hhchealth.org)

Cell: 413.896.9483

Twitter: @OneMoreDrPatel

