Synopsis of Presentation by Andra Farcas, MD

In the out-of-hospital cardiac arrest chain of survival, the first 4 of the 6 links depend on prehospital events, specifically bystander intervention and actions of Emergency Medical System providers. These include recognition of cardiac arrest, activation of the emergency response system, early CPR with an emphasis on chest compressions, rapid defibrillation, and advanced resuscitation including by EMS providers. The 2021 report from the Cardiac Arrest Registry to Enhance Survival reported 40% of patients received bystander CPR and 10% had a bystander apply an AED. Additionally, EMS providers responded in an average of 7 minutes and had 27% return of spontaneous circulation rate in the field with 24% surviving to hospital admission. At every stage of this sequence, there are both differences and disparities based on sex and gender.

In terms of sex/gender-related differences in demographics, women have a lower annual rate of cardiac arrest than men. They tend to be older when they arrest: studies show anywhere from 3 to 9 years older than their male counterparts. They tend to have a non-shockable rhythm more often, on average being half as likely to present with ventricular fibrillation (VF). They are often less likely to arrest in public and therefore less likely to have a witnessed arrest.

In terms of disparities in care, studies have mixed results but, in general, female patients are less likely to receive bystander CPR and to have an AED placed. The time from dispatch to first EMS rhythm captured tends to be longer in female patients, as does the time from EMS arrival to first shock for ventricular fibrillation. Females are less likely to have IV as the route of access and more likely to have IO – and there are a few studies that suggest there's an association with IO access and worse outcomes in cardiac arrest. Females are also less likely to receive epinephrine and received fewer doses. Female patients are less likely to be transported to hospital intra-arrest than male patients rather than be declared on scene; when they do get transported, fewer female patients were transported to PCI-capable hospitals.

How do we account for the differences and improve the disparities in prehospital care of arrest patients? In a survey about barriers to performing bystander CPR, laypersons shared concerns about the social stigma or accusations of sexual assault in exposing or touching a women's chest, the frailty of women and causing harm with CPR, and the inability to recognize acute medical distress in a female as heart disease is generally thought to be a male problem.

Therefore, we need more layperson education on recognizing cardiac arrest and should make efforts to decrease the social stigma associated with bystander CPR on female patients. One thing to consider is incorporating female manikins into CPR training, which are currently lacking. If bystanders are less likely to think women are having a cardiac event, then they are less likely to report it as such when calling 911 and the event is less likely to be recognized as cardiac arrest or more likely for there to be a delay in recognition, which may account for the slower EMS arrival to defibrillation

time interval. Increasing EMS provider education on these disparities, as well as actively managing quality assurance and improvement programs and benchmarking performance specifically geared to address this would all be beneficial in reducing these disparities.

Synopsis of Presentation from Pavitra Kotini-Shah, MD

SEX & GENDER DISPARITIES AT THE HOSPITAL LEVEL AFTER OUT-OF-HOSPITAL CARDIAC ARREST

Despite two decades of research in cardiac arrest resuscitation, sex and gender perspectives have not been taken into consideration for the post-resuscitation care of cardiac arrest patients. Sex differences in survival outcomes have been reported, with males having worse survival and neurological outcomes than females, although the biological factors underlying these sex differences are not yet clearly elucidated.[5-7]Futhermore, gender inequities in the care rendered at the hospital level have been documented. Overall, the sex and gender differences from the fundamental biology and pathophysiology to disparities in care that have thus far been described are starting to build awareness of a knowledge gap.

This is a call to develop awareness, so that we can take deliberate intentional effort to address the inequities, disparities, and differences.

Notable disparities:

- Numerous studies have documented that women receive less of these interventions. [8-10] If a coronary angiography (CAG) was performed, women are overall less likely to have the culprit lesion identified and are less often revascularized.[8] Inpatients without ST-segment–elevation myocardial infarction (STEMI) post- arrest, women received less CAG compared to men.[8,11]

- Initiation of TTM for non-shockable rhythms indicated a significant sex difference.[12] Morris et al boldly state that women receive less TTM and this inequity has been consistent over the past decade.[13] Interestingly, the authors also looked at subset of 27K patients that had data on *why* TTM was not utilized and revealed that a higher percentage of women did not receive TTM due to DNR/family request and because of non-shockable rhythms.[13]

- Women were more likely to be treated with catecholamines or vasopressor infusions but were less likely to undergo percutaneous left ventricular assist device (pLVAD) support.[14,15] Part of the underuse stems from the concern for smaller vessel size in females and that the cannulas are specifically not designed for female patients. What this highlights is a potential sex-specific selection bias in the use of pLVADs for the treatment of cardiogenic shock and indicates that these devices might not be optimized for the use in female patients to begin with.

- Perman et al has shown that women who survive to hospital admission are significantly more likely than men to have a DNAR order established within the first 24 h of in-hospital treatment. The establishment of a DNAR order is associated with patients undergoing fewer and less-aggressive intervention.[16] Elmer et al have also shown that in cardiac arrest patients, earlier withdrawal of life support was more common in female patients.[17]

These studies indicate opportunities for reducing gender disparities after OHCA. It should be noted that the literature is fraught with inconsistencies in reporting of sex differences in outcomes after OHCA. Variability in inclusion criteria (from OHCA event vs inclusion of those that survived to hospital admission), reporting of results (crude vs adjusted odds ratios), geographic, and timeframe issues have contributed to divergent findings.

Lastly, the realm of biological differences post-rosc remains largely unexplored. Phenotypic differences in presentations of cardiovascular disease, such as diastolic dysfunction, fibrosis, cardiomyopathy, SCAD or microvascular dysfunction have been reported more often in women.[18] Furthermore, sex differences in cellular responses to stress need to be detected for potential therapeutic targets. There are complex molecular mechanisms that underlie pathological manifestation of the sex-specific injury response that need to be better understood.

A personalized approach to resuscitation that incorporates the sex-specific physiological state is needed to improve survival and recovery. Here is a short list of some of the knowledge gaps I wanted to highlight:

1. Understanding physiological basis for sex differences in post-cardiac arrest syndrome, specifically the inflammatory cascade that ensues after ROSC.
2. Modifying post-resuscitation care to match severity of PCAS- moving away from the one approach fits all.
3. Need to assess for appropriate inclusion of females in cardiac arrest resuscitation clinical trials.
4. Clinical trial assessing sex differences in mechanical hemodynamic support such as pLVAD after cardiac arrest.
5. Sex differences in pharmacokinetics and dosing of resuscitation medications.
6. Gender related aspects of treatments rendered or withheld. Understanding hospital level barriers to implementing the 72 hr recommendation for neuroprognostication and preventing new DNR within 24 hours (with exceptions).

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Synopsis of Presentation from Carolyn M. Zelop, MD

Disparities in Resuscitation… Why pregnant people are different.

The US paradoxically has the highest pregnancy related morbidity and mortality of all developed nations. The pregnancy morbidity and mortality crisis further underscores health care disparities since pregnant people of color experience the highest risks. Explanations for this national crisis are complex and multifactorial including: increased patient co-morbidities; social, economic and demographic disparities; and gaps in clinical care and team performance. Cardiac arrest during pregnancy represents a final common pathway for a variety of pathophysiologic insults including: hemorrhage, cardiovascular disease, thromboembolic events, sepsis and hypertensive disorders.

Although pregnancy is not a disease, the unique physiologic changes of pregnancy increase susceptibility to cardiopulmonary insults. Resuscitation algorithms require accommodation of the physiological changes of pregnancy and rescuers must be familiar with these unique physiologic changes of pregnancy to appropriately manage cardiac arrest during pregnancy. Cardiac output increases by 40% to accommodate the metabolic demands of the uterine-placental unit. Aortocaval compression which decreases cardiac venous return and increases afterload and the work of the myocardium becomes clinically significant when the uterus is 20 weeks size. Pregnancy increases the risk of hypoxemia and airway compromise. The cornerstone of CPR during pregnancy is concurrent interventions of chest compressions with ventilation and airway management and left lateral uterine displacement if the uterine size is 20 weeks or greater. Rapid defibrillation for shockable rhythms is unchanged by the pregnant state. When initial interventions for cardiac arrest do not lead to ROSC when the uterus is 20 weeks or greater, perimortem or resuscitative cesarean birth should be accomplished by 5 minutes from the initial time of arrest.

How do we improve resuscitation outcomes during pregnancy?

Since the problem is multifaceted, the solution will require a multi-pronged approach. Research is needed to improve pregnancy resuscitation science to move the needle that drives systems of care. Pregnant patients need to be accommodated by current US resuscitation registries or funding must be provided for the development of a unique pregnancy resuscitation registry. The AHA is developing teaching and learning modules for the management of cardiac arrest during pregnancy. Simulation and other teaching modalities can facilitate clinician and institutional preparedness. Advanced interventions such as extra-corporeal life support may be particularly beneficial in the pregnant population. Finally, improved strategies that optimize clinical care post ROSC will improve long term survival with preserved neurological function and mental health.

Summary of Presentation on Disparity in Bystander CPR by Katie N. Dainty, PhD

We know that bystander CPR can double a cardiac arrest victim's chance of survival. However, data to date shows that bystander CPR is applied in only 35-40% out-of-hospital cardiac arrests period; less so in specific groups, particularly women and racialized individuals.

What we also know is that responding to OHCA is a traumatic experience which requires people to make a choice to get involved in a very challenging situation. I posit that having enough people "trained" is only the tip of the iceberg and that using social & behavioural psychology can help us to understand more deeply about why people respond or don't respond or why responding to certain populations is problematic.

The statistics which define the disparities have been published over and over. Only 39% of women receive bystander CPR compared to 45% in men, although it is almost equal when the arrest occurs in a private setting (people's homes). Another issue is that we only have gender data representing two genders and as such we know nothing about barriers to bystander CPR in other sexual and gender minority populations. From the race perspective, Black (43.1%) and Hispanic victims (29.21%) receive bystander CPR less often than White (51.1%), American Indian (62.5%) or Asian victims (54.8%). These differences actually hold true both in public AND private settings...so what is it about location and potentially victim-responder relationship that changes the response rate? It is questions like this that we need to delve into to understand the statistics and move the needle on bystander CPR.

We recently published an AHA Scientific Statement on "Understanding the Importance of the Lay Responder Experience in Out-of-Hospital Cardiac Arrest" which outlines what we have learned from more qualitative data on the experience of those who have witnessed or responded to a cardiac arrest. We know that certain neighborhoods are less likely to get involved in the business of others or call 9-1-1, that the sexualized view of the female chest or removing clothing to place the AED is a barrier to bystander CPR being started in women and that while racism may be present, it is perhaps more likely a lack of awareness within specific neighborhoods that is holding people back.

The bottom line on disparities in bystander CPR is that we need to better understand the nuances of the barriers and facilitators to bystander CPR in these groups rather than trying to use blanket approaches for all. This is how we will truly increase willingness to respond (not just training) across all genders, races, and socio-economic levels.