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"Female Physician Leadership During Cardiopulmonary Resuscitation Is Associated with Improved Patient Outcomes."

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Abstract

Objective: A recently published simulation study suggested that women are inferior leaders of cardiopulmonary resuscitation (CPR) efforts. The aim of this study was to compare female and male code leaders in regard to CPR outcomes in a real-world clinical setting.

Design: Retrospective cohort review.

Setting: Two academic, urban hospitals in San Diego, California.

Subjects: One thousand eighty-two adult inpatients who suffered cardiac arrest and underwent cardiopulmonary resuscitation.

Interventions: None

Measurements and Main Results: We analyzed whether physician code leader gender was independently associated with sustained return of spontaneous circulation and survival to discharge, and with markers of quality CPR. Of all arrests, 327 (30.1%) were run by female physician code leaders with 251 (76.8%) obtaining ROSC, and 122 (37.3%) surviving to discharge. Male physicians ran 757 codes obtaining ROSC in 543 (71.7%) with 226 (29.9%) surviving to discharge. When adjusting for variables, female physician code leader gender was independently associated with a higher likelihood of ROSC (OR 1.36 (95% CI [1.01, 1.85], p =

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0.049) and survival to discharge (OR 1.53 (95% CI [1.15, 2.02], p<0.01). Additionally the odds ratio for survival to discharge was 1.62 (95% CI [1.13, 2.34], p<0.01) for female physicians with a female code nurse when compared with male physician code leaders paired with a female code nurse. Gender of code leader was not associated with CPR quality.

Conclusions: In contrast to data derived from a simulated setting with medical students, real life female physician leadership of CPR is not associated with inferior outcomes. Appropriately trained physicians can lead high quality CPR irrespective of gender.

Keywords

cardiopulmonary resuscitation; gender; leadership; cardiac arrest; team behavior

INTRODUCTION:

Several studies suggest that clinical outcomes differ based on the gender of the treating physician, with female gender associated with better results[1,2]. Tsugawa, et al., found that elderly hospitalized patients had a lower 30-day-mortality and lower readmission rates when treated by a female physician. This was consistent for a wide range of patient severity of illness and held true in academic as well as non-academic settings. Possible explanations posit that female physicians have better baseline knowledge (women perform as well or better on standardized examinations[3]), better adherence to guidelines[4], and greater likelihood of practicing evidence based medicine[5]. Despite such data, studies indicate major gender bias within evaluations of female trainees[2,3].

How women perform during critical medical emergencies, however, has not been well explored. A recent study from Switzerland examined medical students leading simulated cardiac arrest (CA) resuscitations[6]. In their study, male medical students were found to outperform female students in a simulated setting. Importantly, the performance criterion included objective metrics such as time on the chest (chest compression fraction), but also subjective metrics such as the number of clear leadership statements. Their results led the authors to conclude that, due to inferior female leadership, women perform worse at cardiopulmonary resuscitation (CPR)[7].

If true that the performance of women is inferior to men in cardiopulmonary resuscitations, this has significant implications both for training programs and public health. Over 50% of United States medical students and approximately 33% of critical care fellows are now women.

Using a robust internal database of prospectively collected inpatient CA, we aimed to investigate the association of code leader gender and patient outcomes after CPR in a non-simulated, real life setting. We additionally analyzed the relationship between physician code leader and code nurse gender combinations, and clinical outcomes. Finally, we reviewed the association of code leader gender and a variety of CPR quality metrics including chest compression fraction (CCF), compression rate and compression depth[8]. All data analysis was prespecified.

METHODS:

Study design:

Retrospective review of an inpatient CA database where CA are identified through a robust review of standardized resuscitation records, “code blue” committee minutes, the continuous quality improvement (CQI) database, and the electronic medical record. Following each resuscitation event, clinical and demographic data are abstracted from the electronic medical records. Compression and capnography data are exported from defibrillators (Zoll E & R Series, Zoll Medical Inc., Chelmsford, MA) when available. Information for each CA is entered into a database and cross-referenced to ensure data integrity. This study was approved by the UCSD Human Research Protections Program.

Setting:

Two academic urban hospitals with a combined total capacity of 784 beds, of which 95 are licensed for intensive care. One hospital primarily serves as a county hospital, while the other serves as a quaternary care center. The average total yearly discharges increased from 20,503 in 2006 to 29,200 in 2017 with 4.1 inpatient cardiac arrests/1000 patient discharges.

Study population:

All adult (18 years or older) inpatients who suffered a CA (defined as unresponsiveness, apnea and lack of a palpable pulse), requiring CPR or defibrillation, were included in the analysis. Only index events, defined as the first arrest for patients having more than 1 arrest during the same hospitalization, were included. We excluded all cardiac arrests in which resuscitation was initiated out of the hospital, in the emergency department, in the trauma bay, in the operating room, or cardiac arrests in patients with an active do-not-attempt resuscitation order. We furthermore excluded arrests where the gender of the code leader could not be identified. Arrests were excluded from the subgroup quality analysis (as detailed below) if the resuscitation event was shorter than 5 minutes, or was interrupted by episodes of return of spontaneous circulation (ROSC).

Resuscitation Program:

All practitioners undergo UC San Diego Advanced Resuscitation Training (ART) annually which includes the utilization of electrocardiography (ECG) filtering during compressions, CPR feedback and quantitative end-tidal capnography to provide real time feedback during the resuscitation. Of note, this training emphasizes a collaborative team approach and includes frequent just-in-time training and simulation exercises. The code responders include a physician code leader with at least one year of internship completed, a code nurse leader, an airway physician, a pharmacist, respiratory therapists and the patient’s primary nurse. Other responders may include members of the primary care team.

Predictor of Interest:

The gender of the code physician leader was identified through chart review and confirmed by review of documentation from quality assurance reporting submitted by the code nurse

and reviewed by the code committee. The gender of the code nurse is identified through the code nurse quality assurance report.

CPQ Quality subgroup analysis:

CPR quality data is routinely analyzed by a critical care physician (RES) using Zoll RescueNet Code Review, Enterprise edition, and reported back to the resuscitation team as average chest compression fraction (CCF %), chest compression rate (compressions per minute) and chest compression depth (inches) for each minute of CPR. CCF% greater than 80%, compression rate 100–140, and depth >2 inches are reported as good quality. For the purposes of the subgroup analysis in this study, only the first 5 minutes of CPR data were reviewed and reported.

Covariates:

Based on prior literature[9] we adjusted for factors known to be associated with outcomes such as shockable rhythm, time of day, weekday vs. weekend, patient sex and patient age.

Main outcome:

The main outcomes were sustained return of ROSC, defined as pulsatile blood flow for at least 20 minutes without chest compressions, and survival to discharge. Our secondary outcome was CPR quality including CCF greater than 80%, compression depth greater than 2 inches, and compression rate 100–140 per minute.

Statistics:

Descriptive statistics (proportions for categorical variables and means and standard deviations for continuous outcomes) were computed for variables of interest and compared between male and female code leaders using the (two-sample) t-test or chi-square test as appropriate[10]. Generalized linear models with an appropriate link function (e.g., identity link for continuous and logit link for binary responses) were used to assess association of the gender of the physician code leader with return of spontaneous circulation (ROSC), survival to discharge and other related quality outcomes, either with or without controlling for relevant covariates described above[10].

RESULTS:

Cardiac arrest demographics

There were 1210 index inpatient cardiac arrests between July 2005 and October 2017. One hundred and twenty-eight cardiac arrests did not have an identified code physician leader and were excluded, leaving 1082 cardiac arrests to review. Cardiac arrest patients were more commonly men than women (688 (64%) vs. 394 (36%)) with an average age of 59 years. Initial shockable rhythms occurred in 185 patients (17%). Most arrests occurred in the day shift (54.7% vs. 45.3%), on weekdays vs. weekends (62.7% vs 37.3%), and in the intensive care unit (ICU) rather than on the ward (57.6% vs 42.4%). ROSC occurred in 794 patients (73%), and 348 patients survived to discharge (32%) (Table 1).

Physician code leader gender and outcomes

Three hundred twenty-seven (30.2%) of the cardiac arrest resuscitation attempts were led by a female physician. The proportion of women code leaders ranged between 18% and 41% over the years, but there was no significant trend over time. When comparing codes run by female physicians to those run by male physicians, there was no statistically significant difference in the percentage of male patients, initial shockable rhythm, day shift, weekday, ICU location, or average age (Table 1).

ROSC occurred in 251 patients (76.8%) with female physician code leaders, and in 543 patients (71.7%) with male physician code leaders (p=0.0818). Survival to discharge occurred in 122 patients (37.3%) with female physician code leaders and 226 patients (29.8%) with male physician code leaders (p=0.0151) (Table 2). When adjusted for patient age, patient sex, initial shockable rhythm, patient location, time of day and weekday/weekend, female physician code leadership was associated with a significantly higher rate of ROSC, OR = 1.37, 95% CI = [1.01, 1.85], p = 0.049, and survival to discharge, OR = 1.53, 95% CI = [1.15, 2.03], p<0.01 (Figure 1 and Table 2).

Physician code leader and code nurse gender pairings and outcomes

Of the 1084 cardiac events, 1076 also included information on the gender of the code nurse leader. One hundred and seventy-four (16.2%) CA had a male physician code leader and male code nurse, 577 (53.6%) had a male code leader and female code nurse, 243 (22.6%) had a female code leader and female code nurse, and just 82 (7.6%) had a female code leader and male code nurse. When adjusted for patient age, patient sex, shockable rhythm, day shift, weekday/weekend, and ICU location, gender pairing was not statistically associated for ROSC (p=0.06) but was significant for survival to discharge. The combination of female physician code leader and female code nurse had an OR of 1.62 (95% CI [1.13, 2.34], p<0.01) when compared with a male physician code leader and female code nurse for survival to discharge. Other gender pairings did not show statistical differences (Figure 2 and Table 3).

Physician code leader gender and CPR quality

To examine the relationship between physician code leader gender and standard measures of quality CPR, we examined a subgroup of two hundred twenty-seven resuscitations with an initial 5 minutes of CPR parameter data. One hundred forty-nine (65.6%) had ROSC, and 39 (17.2%) survived to discharge. Seventy-three (32.2%) of the resuscitation attempts were run by female physician code leaders. The overall subgroup average CCF was 91%, the average rate was 112 compressions per minute, and the average depth was 2.70 inches.

Within the subgroup, female physician code leaders were 1.91 times more likely to achieve ROSC (95% CI [1.0306, 3.6721], p=0.04), but gender of the physician code leader was not associated with survival to discharge. There was no significant association between code leader gender and either chest compression rate, depth or fraction (Supplemental Digital Content - Table 1).

DISCUSSION:

Patients treated by female physician code leaders had significantly more ROSC and survival to discharge as compared to patients whose resuscitation were led by a male physician. In addition, CPR quality metrics did not differ significantly by code leader gender. Our results indicate that women are not inferior to men in leading cardiopulmonary resuscitations in real-life.

Literature suggests that women are more likely to follow guidelines[5] and guideline-recommended high quality CPR has been associated with improved outcomes[8,11,12] We examined a subset of resuscitations where chest compression fraction, rate and depth was available for the first 5 minutes of the resuscitation. The demographics of this subgroup were similar to the larger cohort as outline above. There was no association between gender of the physician code leader and chest compression fraction, compression rate, or compression depth. This suggests that adherence to resuscitation guidelines was not the only contributor to good outcomes in our cohort and does not account for the observed differences.

Differences in leadership style between men and women have been described outside the medical field with women portrayed as having a “leadership advantage” in times of crisis[13], despite suffering disadvantage from “prejudicial evaluations of their competence as leaders”[14]. In the setting of resuscitation, gender differences in leadership were also noted in a medical student CPR simulation study[6]. The behavior of medical students during a simulated exercise may be different than that of trained physicians in a real-life critical event, however, we also feel that while characteristics traditionally attributed to males (being assertive, displaying confidence, or talking in a loud voice) may seem desirable in a chaotic resuscitation event, characteristics typically attributed to females (strong communication skills and a collaborative teamwork approach) may also be useful during CPR. Stereotyping physician behavior by gender alone lacks validity and may further fuel bias and discrimination already widely encountered by female physician trainees[15–17]. Whether or not the physician code leaders in our database displayed traditional “male” or “female” leadership styles during their CPR resuscitation attempts is not known, and ultimately not important. Adequately trained, physicians can lead high-quality CPR irrespective of gender.

LIMITATIONS:

This is a retrospective cohort study performed at a two hospital, single health care system and subject to possible reporting bias despite careful prospective collection of data. We did not include patient-level details such as individual co-morbidities. Identifying the code leader was based on quality assurance reporting by the code nurse and chart review, and contributions from other responders to the event may not adequately be incorporated. While all physician code leaders had at minimum one year of post-medical school internship training, we could not adjust for years of experience. Given the random nature of cardiac arrest events, selection bias is unlikely to have occurred. Selection bias for code leader is also unlikely as intensive care unit rotations are mandatory regardless of gender for trainees at our institution. In addition, our institution is fortunate to have a robust training infrastructure, and thus the results may not be generalizable to other hospitals.

CONCLUSION:

Our data indicate that in a cohort of real life (and death) CPR resuscitation attempts, female physician code leaders were indeed not inferior. The presence of a female physician code leader was associated with improved outcomes. In contrast to a recently published simulation study of medical students, our real life setting data suggest that appropriately trained physicians can lead high quality CPR irrespective of gender.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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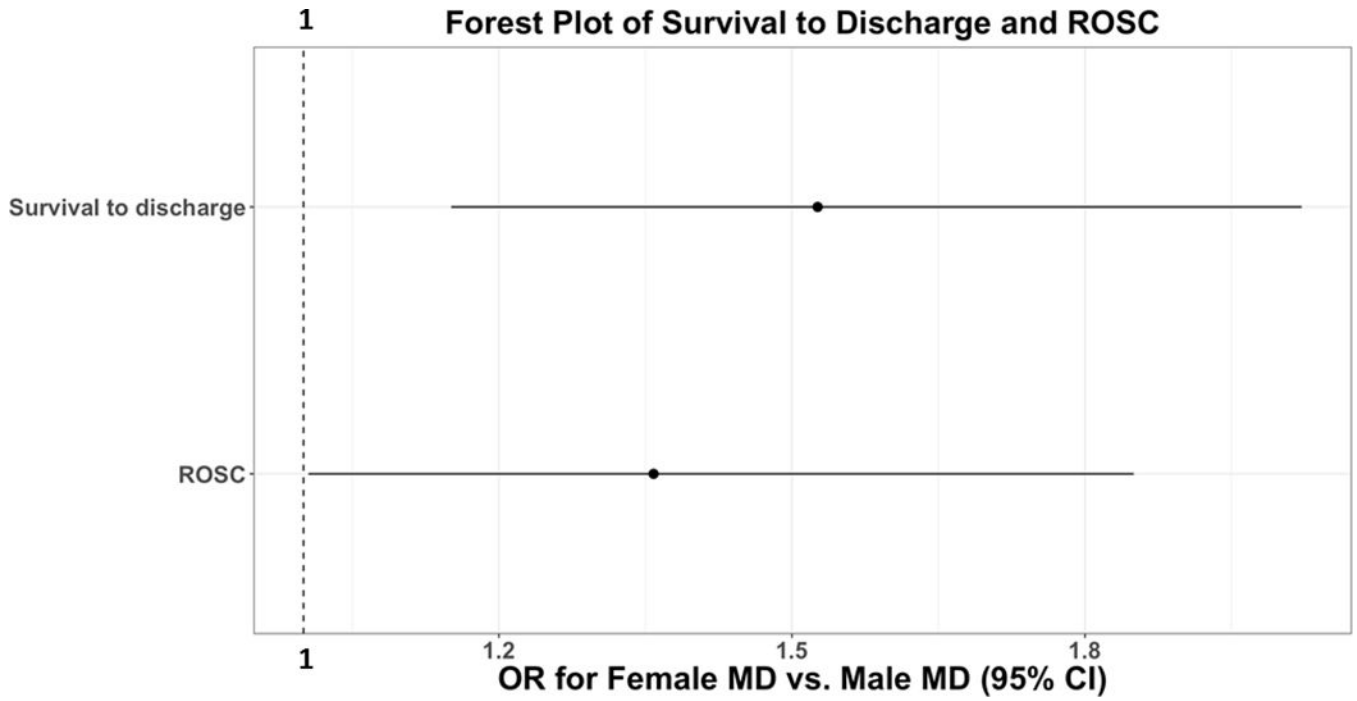

Figure 1:

Adjusted Odds Ratio (Odds of Female MD / Odds of Male MD) to predict ROSC and survival to discharge for physician code leader gender.

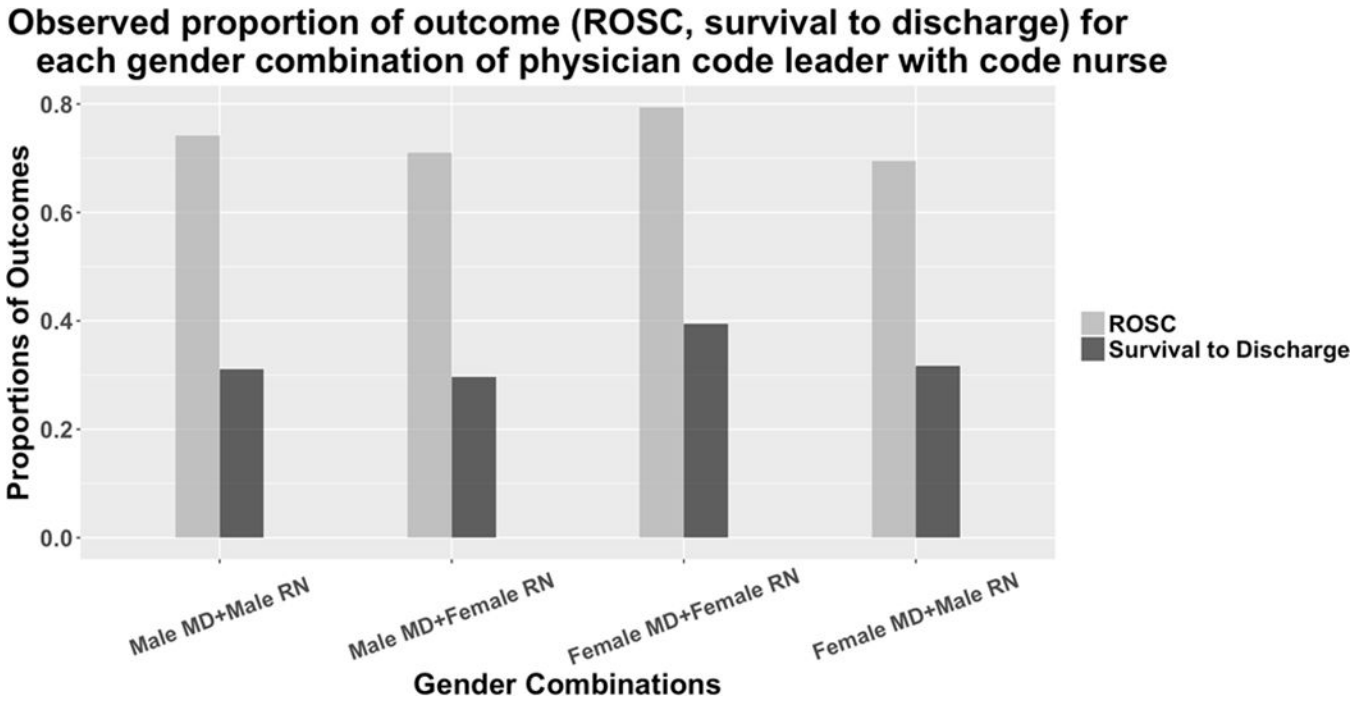

Figure 2:

Observed proportions of outcome (ROSC, survival to discharge) for each gender combination of physician code leader with code nurse (male code physician leader with male code nurse, male physician code leader with female code nurse, female physician code leader with female code nurse and female physician with a male code nurse).

Table 1:

Patient demographics for all inpatient cardiac arrests.

Patient variables	All Cardiac Arrests (n=1082)	Cardiac arrest with Male Code MD (n=755)	Cardiac arrest with Female Code MD (n=327)	P Value (Male Code MD vs. Female Code MD)
Patient Gender	36.4% F 63.6% M	37.0% F 63.0% M	35.2% F 64.8% M	0.5751
Patient age (mean, in years)	59.0	58.5	60.1	0.1340
Shockable rhythm (%)	17.1	17.5	16.2	0.6088
Day shift (%)	54.7	56.4	50.8	0.0859
Weekend (%)	37.3	38.0	35.8	0.4855
ICU location (%)	57.6	56.4	60.2	0.2429

Table 2:

Unadjusted and adjusted outcomes (return of spontaneous circulation and survival to discharge) for all inpatient cardiac arrests.

Percentage Outcomes	All Cardiac Arrests (n=1082)	Cardiac arrest with Male Code MD (n=755)	Cardiac arrest with Female Code MD (n=327)	Odds Ratio (Female vs Male)	95% Confidence Interval	P Value
% ROSC (unadjusted)	73.2	71.7	76.8	1.31	[0.97, 1.77]	0.082
% Survival (unadjusted)	32.1	29.8	37.3	1.40	[1.07, 1.84]	0.015
% ROSC (adjusted)	73.2	71.7	76.8	1.37	[1.01, 1.85]	0.049
% Survival (adjusted)	32.1	29.8	37.3	1.53	[1.15, 2.02]	<0.01

Table 3:

Likelihood of ROSC associated with female physician code leader and female or male code nurse gender parings when compared with male physician code leader paired with female code nurse.

Gender pairing of code leader and nurse	Odds Ratio for ROSC	P Value	95% Confidence Interval	Odds Ratio for Survival	P value	95% Confidence Interval
Female MD and female nurse (n=243)	1.62	<0.01	[1.13, 2.34]	1.68	0.002	[1.22, 2.32]
Female MD and male nurse (n=82)	1.01	0.96	[0.61, 1.69]	1.25	0.39	[0.75, 2.32]
Male MD and male nurse (n=174)	1.15	0.48	[0.78, 1.70]	1.07	0.72	[0.74, 1.56]