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Closing the Circle: The Need for Patient Outcomes in the Prehospital Setting

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BY

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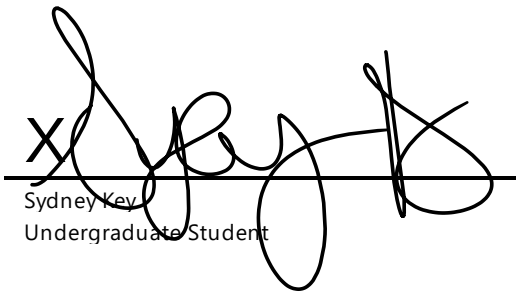

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ABSTRACT

Emergency Medical Services (EMS) providers encounter and treat people with life-threatening medical conditions daily. However, EMS providers are often not given the opportunity to receive any feedback or updates on their patients' outcomes from the receiving hospitals. The lack of patient outcomes or feedback from hospitals has been linked to a strong job dissatisfaction in prehospital providers (Eiche et al., 2021), (McGuire et al., 2022). The purpose of this research was to determine if there were any benefits to providing patient outcomes and feedback to prehospital providers.

This research utilized a mixed methods approach that analyzed quantitative and qualitative data regarding cardiac arrest patient encounters. The quantitative data encompassed certain statistics pertaining to patients that went into cardiac arrest between 2019-2023 (obtained courtesy of Jessamine County EMS in Nicholasville, KY). Patients that went into cardiac arrest with an initial rhythm of ventricular tachycardia (VT), or ventricular fibrillation (VF) were also analyzed in relation to their survival-to-discharge percentages and annual prehospital provider performance. Qualitative data was gathered from an online voluntary anonymous survey; this was followed up with in-person voluntary anonymous interviews process that focused on the effects of giving detailed feedback to prehospital providers by evaluating their perceived improvements in mental health and patient outcomes.

Results from the cardiac arrest data showed an overall increase in return of spontaneous circulation (ROSC) between 2019 until 2023. Results from the cardiac arrest performance table indicated consistency of skills during cardiac arrest runs.

Prehospital providers reported from the surveys and from the interviews that receiving patient outcomes and feedback have contributed to improvements in their mental health and their patient care.

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[I. Introduction]

HISTORY OF EMS

The concept of transporting the sick and injured from the field to hospitals or medical tents has been documented in wartime to Roman and Greek soldiers dating as far back as 1500 BC. The Chief Physician of Napoleon's army, Baron Dominique-Jean Larrey, has been given most of the credit for establishing a structured system to triage and transport wounded persons off the battlefield to aid stations. In the United States, the first civilian ambulances comprised of hospital interns in horse-drawn carriages to pick up and transport the sick and injured to hospitals for further care in Cincinnati, Ohio in 1865 and New York City in 1869 (Manish, 2006).

In the 1950's, modern EMS in the United States consisted of about 12,000 ambulance services, half of which were morticians transporting patients in their communities to hospitals in hearses (Howard, 2009). During this time, EMS was under the Department of Transportation as it mainly served as a transport service. In 1966, a white paper collaborated on by the National Academy of Sciences, National Research Council, the Committee on Trauma and the Committee on Shock, Division of Medical Sciences detailed a list of recommendations to improve EMS (1966). In 1973, the EMS Services Development Act was put into effect creating official EMS services nationwide (Shah, 2006). This act initiated the transition from a transport service into a healthcare profession; the hearse evolved from a simple means of rapid transportation into a bridge where patients could be evaluated and treated by healthcare providers in the field and on the way to the hospital. *Accidental Death and Disability* had also called for

the creation of national education standards to train EMS providers (Committee on Shock and Committee on Trauma et al., 1966). Throughout the 1980s and 1990s, EMS continued to persevere through different challenges and established themselves as competent healthcare providers. Today, EMS has a multifaceted role; while it used to predominantly be viewed under public safety, EMS also plays a part in emergency management, public health, and healthcare (Office of EMS, 2023).

CALL FOR RESEARCH

As emergency medical services transition into a more healthcare-oriented field, there has been a recent shift of focus on increasing scope of practice and following evidence-based medical practices. The procedures performed in EMS are a result of "heirloom knowledge" from other healthcare professions that are in a more controlled, team-dynamic environment (Leggio & Cummins, 2023). Until the 1970's, EMS education was not equal nor standardized across the country; "The *ambulance personnel* were poorly, sometimes negligibly, trained. There was no uniform curriculum. There were numerous efforts at training, but most were totally inadequate." (Howard, 2009, p. 287-288). The lack of education requirements to become a prehospital provider is likely a big factor in the scarce amount of paramedicine scholarly research published by professionals in the field of EMS. Establishing a consistent form of communication between hospitals and EMS workers can create a foundation for more data sharing between both sides of healthcare. Data on patient outcomes can provide support for more evidence-based research and establishing new evidence-based practices. Evidence-based medicine is a key

component to the advancement of healthcare. Unfortunately, the fluidity of the EMS environment can make it challenging to perform different studies due to legal constraints such as informed consent. Further research in EMS is needed to continue to improve patient care, strengthen confidence in skills and enhance workplace morale.

Scholarly Context

Education

Prehospital emergency care is a dynamic profession that requires clinicians to stay up to date with the ever-changing evidence-based practices. Clinical curiosity "is fundamental to understanding each patient's unique experience of illness...deepening self-awareness, supporting clinical reasoning...and encouraging lifelong learning" (Dyche & Epstein, 2011, p. 663). Their study, *Curiosity and Medical Education,* used qualitative research to explore deeper meanings to common terms "curiosity" and "inquisitiveness", and how it relates to medical education. Curiosity is normal and will occur from intrinsic motivation. While their focus was primarily on physicians, one of their concluding statements is very applicable to the prehospital realm: "Doctors are more than technicians: they must have *adaptive expertise*, the ability to manage the unexpected" (p. 667). Prehospital providers are often taught that when all else fails, 'adapt and overcome'. Like physicians, EMS providers must constantly evaluate their patients, identify trends in patient stability, and manage them if they begin to deteriorate rapidly. Unlike physicians, EMS providers are oftentimes unable to check on the status or ultimate diagnosis of their patients because there is no reliable

systematic way to find out what happened. This inconsistent lack of closure can result in accumulated stress. Strong clinical judgement is a skill that is acquired through field experience and feedback from colleagues. Feedback is especially important for new EMS providers to help guide their clinical decision-making skills. According to the National Registry Data Dashboard, in 2023 approximately 20.45% of all levels of providers were newly certified (2023). Regardless of years of experience, receiving feedback and patient outcomes is a vital component to improving patient care. Feedback gives providers the opportunity to validate their knowledge and critical thinking skills. Prehospital providers that receive feedback would be able to compare hospital diagnoses to their field diagnoses to better understand patient presentation and necessary treatments on future calls. A push for more feedback and outcomes in EMS opens the door for improvements within each EMS service and for improving each provider's accuracy in patient care.

Lack of feedback from hospitals

Historically, EMS picked up patients, provided treatment, dropped them off at the hospital and generally never heard from them again. Occasionally, providers will receive feedback from hospitals regarding their patient care or the status of the patient. Morrison et al. interviewed twelve paramedics in 2017 to learn about their perceptions of feedback on patient care. They found that feedback is generally “infrequent” and “the quality of the feedback was also inconsistent” (Morrison et al., 2017, p. 91). Their study found three common subthemes in the desire for more consistent feedback: "1) desire for feedback specific to patient cases, 2) desire for

greater insight into the ultimate diagnosis, and 3) desire for knowledge of patient outcome" (p. 92). They also concluded that increased feedback would have a change on the mental health of the providers; while some concern was raised about the negative impact on one's perception of themself and their effectiveness as a provider, the more common theme in the interviews was that it would help EMS providers get closure about their patients and validate their assessment/treatment skills. Wilson et al. conducted a study in 2022 with similar qualitative research methods; they interviewed 24 EMS professionals working in the United Kingdom and asked them open-ended questions about their personal wellbeing, the role of feedback and follow-up in their profession, and current and future support resources they have. They found that a majority of participants felt that their current means to receive feedback was inadequate (Wilson et al., 2022, p. 4) and that a majority of participants “consistently expressed a desire for more feedback” (p. 7). Their participants also reported that increased feedback would improve personnel well-being, as well as “enabling closure and encouraging intra-professional dialogue and peer-support” (p. 7). They also cited Cash et al.’s qualitative study; the Cash et al. study (2017) sent an electronic anonymous survey out to people registered with National Registry of Emergency Medical Technicians (NREMT); they were specifically asking whether providers who had worked in the past 30 days received any patient outcome feedback in the past 30 days. About 30% of the 15,766 providers that responded and met inclusion criteria reported that they did not receive any patient outcome or feedback within 30 days

(Cash et al., 2017, p. 778). Their survey did not however ask any questions on how receiving feedback might impact providers' mental health.

EMS services nationwide encounter similar problems that have made it difficult to create the changes that most providers want to see. One of the biggest challenges that EMS services face is the turnover rate. EMS has one of the highest turnover rates of any other healthcare profession; in 2022, 20-36% of EMTs and paramedics reported leaving EMS to pursue a different profession (Lawrence, 2022). There are a variety of reasons associated with the high turnover rates, including EMS not being seen as a profession, financial limitations, and an absence of room for growth in the profession (Fitch & Associates, 2016). Although there are many operational issues, one of the biggest issues facing EMS is the lack of initiative to improve the mental health of prehospital care providers. Unlike hospitals which have the privilege of healthcare teams with physicians, nurses and specialized clinicians, the care of the patient in the back of an ambulance relies solely on one provider's training, skills and confidence. This comes with an immense amount of pressure regardless of field experience. Generally, EMTs and paramedics only have their trained eyes and hands to rely on when transporting patients; normal human errors and lack of resources can result in prehospital providers potentially missing a specific sign or symptom that might have changed their treatment plan. EMTs and paramedics that are the lead provider can oftentimes have feelings of uncertainty or guilt on certain calls that they had inadequate patient care or that they should have taken a different approach. Giving prehospital providers feedback can provide closure and eliminate feelings of guilt or

inadequacy because they know that they provided the best patient care with the resources they had available. If there were mistakes that occurred during the call, the feedback can be used as learning points to improve patient care which should decrease the risk of the same mistake happening again.

Currently, feedback on patient outcomes from hospitals are very inconsistent across the industry (Cash et al., 2017; Eaton-Williams et al., 2020; Wilson et al., 2022). One service might have the ability to provide patient outcomes to their providers while a neighboring service does not. There are also certain hospitals that will give EMS providers patient outcomes and certain specialized hospitals (such as a comprehensive stroke center or Level I trauma center) that does not give outcomes. A lot of EMS providers find themselves leaving EMS due to extreme burnout. One of the major contributors to the burnout encountered in the prehospital setting can be attributed to the lack of timely feedback on the efficacy of providers' care. Without any affirmation or provision of patient outcomes, EMS providers have no data for quality improvement to take place; when not being told that the care they provide is adequate or inadequate, this can lead to similar routines on the same types of patients. This can lead to a stifling of clinical curiosity, a lack of desire to improve their care, and worst of all, complacency. Absence of feedback from hospitals has created a stagnant educational culture in EMS where there is no incentive to broaden one's knowledge and skills. Feedback can be especially useful rekindle and incentivize providers' desire to learn the outcomes thereby encouraging more continuing education. Significant benefits to providing outcomes and feedback to providers

include potential mental health benefits like improvements in job satisfaction, confidence and motivation in skills and boosting morale (Cash et al., 2017; Morrison et al., 2017; Snowsill et al., 2023; Wilson et al., 2022).

Cardiac Arrest Background Information

Approximately 350,000 Americans experience an out-of-hospital cardiac arrest (OHCA) each year. However, less than 10% of cardiac arrest victims survive up to hospital discharge; this statistic has not improved over the last 30 years (CARES, 2022). A cardiac arrest is when a heart suddenly stops beating and the electrical system and mechanical system fails (Tsao et al., 2023). A cardiac arrest can occur for many reasons including cardiac arrhythmias, embolisms, and trauma. Cardiopulmonary resuscitation, more commonly referred to as CPR, is a first-aid treatment that can save a person's life when initiated. When treating patients in cardiac arrest, the heart's electrical rhythms are categorized as "shockable" or "unshockable." Shockable rhythms are rhythms that can be corrected using defibrillation, including pulseless ventricular tachycardia (pVT) and pulseless ventricular fibrillation (pVF). Pulseless ventricular tachycardia occurs when the heart as a whole is only partly contracting while the lower two chambers of the heart, the ventricles, are producing electrical impulses at a dangerously high rate. The contractions of the heart chambers are out of sync with each other leading to a lack of a palpable pulse. Pulseless ventricular fibrillation occurs when the heart no longer contracts properly and electrical impulses are erratic making the heart muscle as a whole appear to quiver. There are also "unshockable" rhythms known as pulseless electrical activity (PEA) and asystole. Pulseless electrical activity occurs when the heart

is not contracting but still produces electrical impulses (Cleveland Clinic, Ventricular Arrhythmias). Asystole occurs when there is no pulse or electrical impulse being generated by the heart (Cleveland Clinic, Asystole). These patients are considered "clinically dead"; however, immediate intervention can restore that patient's heartbeat and possibly allow that person to return to their daily life (Eisenberg et al., 2018).

A new approach to CPR

In 1990 medical directors in Norway called attention to the lack of data regarding cardiac arrest survival in Utstein Abbey (Otto et al., 2021). They noted that there was almost no data to try and measure performance and no consistency found in the people that did survive from a cardiac arrest. The template they developed for standardized reporting certain measures to ensure effective CPR has been dubbed Utstein Style or Utstein (Otto et al., 2021). The development of standardized data collection and reporting has lead to a dramatic improvement in CPR performance since that first meeting in 1990. There is now an understanding of the mechanics of CPR and how good mechanics increase the chances of survival in cardiac arrest patients. Emergency medical services nationwide are also using technology as a leader to make communication (Telephone-CPR) and feedback easier than ever. Cardiac arrest registries are also available for EMS services to submit their data to, where they could compare their data to other states and the statistics around the nation (CARES, 2018). Moving forward, Utstein Style focuses on measuring performance and looking at variables that may arise during a call. Eisenberg et al. highlighted the point that, "Best

practices are a fluid concept since new therapies and programs begin to define new best practices. Therein lays the power of 'measure and improve'. Constant measuring enables determination of what needs improving and will demonstrate if improvement occurs - which can define new best practices," (Eisenberg et al., 2018, p. 9).

In 2008, King County EMS in Seattle, Washington, received a grant that let them bridge the gap between science and community best practice (Eisenberg et al., 2018). Contrary to other services around the nation, King County EMS defines a successful resuscitation as a patient that was discharged from the hospital. This led to the establishment of the Resuscitation Academy, an organization focused on training providers in their course on High-Performance CPR (HP-CPR). The Resuscitation Academy increased the survival rate of cardiac arrests from 5% to 60% (Eisenberg et al., 2018). The main difference between standard CPR and HP-CPR is that HP-CPR is more descriptive of the standard of skill as opposed to the American Heart Association standard of delivering 2 breaths every 30 compressions, compressing at a rate of 100-120 beats per minute. HP-CPR also highlights the significance of other manual skills during CPR, including a chest compression fraction greater than 90% for a 10:1 compressions-to-ventilation ratio, full recoil of the chest, no pauses in CPR >10 seconds, delivering breaths over one second in volumes of 300-400mL of air, and initiation of intubation and IV/IO without the interruption of chest compressions (Eisenberg et al., 2018). Focusing on these aspects of CPR has shown a drastic increase in the survival rate of victims in cardiac arrest. EMS services can measure these values by using specialized CPR feedback devices that are placed on the patient's chest to

measure quality of compressions during cardiac arrests. Standard cardiac monitors used on routine calls also can measure adequate ventilation during CPR.

Jessamine County EMS Background

Jessamine County EMS (JCEMS) is a suburban EMS service outside of Lexington, Kentucky. JCEMS responds to about 12,000 medical calls a year with three ambulances and two-provider crews on staggered 12-hour shifts. They are approximately 25 minutes from a University hospital with comprehensive stroke capabilities, Level I Trauma designation (the highest designation), and all manner of cardiac emergency capabilities. In March 2019, the JCEMS training director attended The Resuscitation Academy. Three months after attending The Resuscitation Academy, JCEMS started training on high performance-CPR (HP-CPR). In the fall of 2019, JCEMS started performing detailed post event reviews with their providers after a cardiac arrest. During these post event reviews the training director would discuss with crews their performance during the cardiac arrest (chest compression fraction, time off the chest, adequacy of ventilation, etc.) and receive updates on their patient including whether they survived to hospital discharge or the cause of the arrest if the resuscitation was terminated in the field. In 2020, JCEMS continued to work to improve patient outcomes by switching to Zoll X Series monitors that give detailed CPR feedback about providers depth, rate, and release. Recently, in August 2023, JCEMS implemented the use of dual sequential external defibrillation and ECMO ECPR. Dual sequential external defibrillation is where two monitors will deliver electrical energy to the heart simultaneously, which creates more vectors in the heart for the electricity to travel to

(Ramzy and Hughes 2023). ECMO is extracorporeal membrane oxygenation, when combined with CPR it is commonly referred to as ECPR. ECPR is used after CPR is performed on a patient to help stabilize their hemodynamic and respiratory status by promoting adequate organ perfusion. People that receive ECPR treatments appropriately have seen improved neurological outcomes upon discharge from the hospital (Charrière et al 2021). Jessamine County also trains quarterly for cardiac arrests using the Resuscitation Quality Improvement (RQI) program. RQI was created by the American Heart Association and promotes more frequent training than just the biannual certification renewal that most other AHA courses require. RQI integrates training, clinical events, and structured debriefing on a minimum quarterly basis (American Heart Association, 2017). The design of this training gives providers real-time feedback on their skills regarding their ventilation rate, compression adequacy, rate, and depth. Upon completion of the training, the provider will receive a debriefing screen that will report to them their performance on specific aspects of CPR.

[II. Research Methods]

Mixed-Method Approach

Jessamine County EMS was the EMS service that was examined for this study. JCEMS consists of 45 clinicians ranging in levels of care including basic emergency medical technicians, advanced emergency medical technicians, and paramedics. Participants were recruited to participate in this study via email and participated in the study voluntarily. Participants were included in this study based on their employment status at JCEMS. Participants were required to have employment with JCEMS for at least six months, be listed on the electronic patient care report (ePCR) as a provider during a cardiac arrest and participated in a post-event review debriefing. If participants did not meet these criteria, their responses were excluded from the results.

This study used a mixed-methods approach to analyze qualitative and quantitative data from JCEMS. A combination of the providers perspectives from the survey and interviews, their performance during CPR and their resuscitation attempts from 2019-2023 were examined during this study to analyze the improvements in CPR performance and the effects that it had on the providers. A link to the survey with information about this research project was sent to all JCEMS employees via email. The link also included a waiver that provided information about the study and its goals. The initial survey used a Likert scale to judge their perspectives on different aspects of their job including the feedback from hospitals and their service regarding patient outcomes and follow-ups. The study also examined their perception on whether the

receiving patient outcomes had any improvements on their mental health or improvements in their patient care. The second part of the study consisted of open-ended interviews with basic demographic questions to ensure participants met the inclusion criteria and four open-ended questions. Participation was voluntary in this study. Participants were voice-recorded with their consent solely for the purpose of transcription. The voice recordings were deleted after transcription. The interviews lasted an average of 8 minutes, ranging in length from 3 to 15 minutes. There were 12 participants in the interview portion of the study.

This study was approved by the Eastern Kentucky University Internal Review Board in March 2024. After IRB approval, the survey was distributed to Jessamine County EMS employees. The survey was anonymous and consisted of demographic questions, providers perspectives towards the consistency of patient outcomes and feedback from hospitals and Jessamine County EMS. The survey also asked questions regarding changes in their mental health, confidence in skills, and perceived improvements in patient care. A Likert scale was used to measure the participants' perceptions ranging from strongly agree (5) to strongly disagree (1). Voluntary interviews were conducted with survey participants where providers could answer open-ended questions about changes in their patient care and mental health after receiving patient outcomes.

The quantitative aspect of this study looked at total resuscitation efforts from 2019-2023 and the average CPR performance annually by JCEMS. The arrests examined were identified as non-traumatic etiology. The cardiac arrest resuscitation

efforts were further categorized as "Witnessed by a Bystander", "Witnessed Arrest by a 911 Responder" or “Unwitnessed Arrest." CPR feedback devices were used during cardiac arrest runs and provided reports of EMS personnel skills during the call. The data reported by the CPR feedback device was used to measure the quality of CPR during calls. The CPR feedback measured average chest compression fraction, average pre-shock pause, average post shock pause, compression quality, average manual depth, average manual rate, average release velocity.

Participant demographics

There were 17 total participants in the online survey. All participants met the inclusion criteria. Participants included in this study ranged from ages 18-55 years. 17.6% of participants were ages 18-25 years old; 64.7% were 25-35 years old; 5.9% were 35-45 years old; and 11.8% were 45-55 years old. Participants were asked how many years of experience they had in EMS: 5.9% had 2 years or less experience; 23.5% had 3-5 years of experience; 41.2% had 6-10 years of experience; 5.9% had 10-15 years of experience; and 23.5% had 15+ years of experience. The final demographic portion of the survey asked how many years they worked at Jessamine County EMS: 17.6% of participants worked at Jessamine County EMS > 6 months but < 2 years; 47.1% of participants worked at JCEMS 2-5 years, 23.5% of participants worked at JCEMS for 5-10 years, 5.9% for 10-15 years, and 5.9% for 15+ years. These demographics were used to help correlate the findings found in the survey and skill performance feedback.

Results

Table 1. Survey Responses

Questions	Agree or Strongly Agree	Neutral	Disagree or Strongly Disagree
I have adequately trained to perform competently at cardiac arrests.	17	0	0
I receive consistent feedback from Jessamine County EMS.	11	4	2
I receive consistent feedback from Jessamine County EMS regarding patient outcomes.	17	0	0
Receiving feedback from Jessamine County EMS has helped me to perform better during cardiac arrests.	17	0	0
I receive consistent feedback from hospitals regarding patient outcomes	11	3	3
I receive consistent feedback from hospitals regarding cardiac arrest patient outcomes	11	3	3
Receiving patient outcomes from receiving hospitals has helped me perform better during cardiac arrests	10	6	1
Receiving patient outcomes from receiving hospitals has helped me be more compassionate with patients	14	3	0
Receiving patient outcomes combined with skills feedback has contributed to an improvement in my mental health	14	2	1
Receiving patient outcomes combined with skills feedback has contributed to an improvement in my skills used during patient care	17	0	0

Table 1 shows the questions asked during the online survey and the responses.

Survey Response Results

There were 17 total participants that completed the anonymous survey. All participants met the inclusion criteria. All 17 participants reported that they felt they

were adequately trained to perform competently at cardiac arrests. 11 of the 17 participants reported that they either “agree” or “strongly agree” that they receive consistent feedback from JCEMS, while 4 participants reported a “neutral” response; 2 reported that “disagree” or “strongly disagree”. All 17 participants responded “strongly agree” or “agree” when asked if they receive consistent feedback from JCEMS regarding patient outcomes. All 17 participants also reported that receiving feedback from JCEMS has helped them to perform better at cardiac arrests. 11 of the 17 participants responded “strongly agree” or “agree” when asked if they received consistent feedback from hospitals regarding patient outcomes. 3 participants responded neutrally to the same question, and the remaining 3 participants responded “disagree” or “strongly disagree”. The participants had similar responses regarding whether they receive consistent feedback from hospitals regarding cardiac arrest victims; 11 of 17 responded with “agree” or “strongly agree”, 3 responded neutrally, and the final 3 responded with “disagree” or “strongly disagree”. The participants were less in agreement on how beneficial hospital feedback was in improving performance during cardiac arrest. 10 of the 17 participants agreed or strongly agreed that hospital feedback helped them perform better during cardiac arrest; 6 were neutral and 1 disagreed or strongly disagreed. 14 of the participants agreed or strongly agreed that receiving patient outcomes from hospitals has helped them to be more compassionate with patients, three reported a neutral feeling. 14 of the participants strongly agreed or agreed that receiving patient outcomes combined with skills feedback has contributed to an improvement in their mental health, 2 were neutral

and one disagreed or strongly disagreed. All 17 participants strongly agreed or agreed that receiving patient outcomes combined with skills feedback has contributed to an improvement in their skills used during patient care.

Interview Responses

Participants at all levels of care at Jessamine County EMS were invited to participate in the interview portion of this study. Participants responses were given pseudonyms based on their level of care.

Question 1. *Describe how you have trained for cardiac arrests that you think is unique to JCEMS.*

Paramedic 7 responded to this question by discussing how all new hires will go through JCEMS cardiac arrest training to ensure that everyone knows their role regardless of level of care. Paramedic 7 reported that training and knowing roles ahead of time helps them focus on other important aspects of the code such as rotating positions on the chest or time to defibrillation. Participants described their implementation of pit-crew CPR which places emphasis on staying on scene to run the code as opposed to “loading-and-going” to the hospital. Participants also reported frequent training on shift with their crew or with the training director. JCEMS employees had similar responses in the interviews and discussed that they participate in the quarterly RQI training program which helps them stay refreshed on their CPR knowledge and skills. EMT 11 discussed the real-time feedback provided from the RQI manikins to help them improve their skills. EMT 11 stated:

> RQI CPR mannequins show your depth and rate of compressions live and then you can also practice ventilations and it has the same the depth of the ventilation and the rate of your ventilations and I'll tell you to speed up slow down go deeper go more shallow.

AEMT 12 had a similar response to EMT 11 and reported:

> We have lots of online modules we have to complete we have quarterly kind of like practice codes… we get like live feedback from mannequins so that you're making sure you're actually good at compressions and not just sitting there in a class doing it.

Question 2. *Describe if you have noticed any changes in your care since receiving the follow-ups and feedback in your care since before receiving feedback.*

All participants had a positive perspective regarding feedback and patient outcomes from hospitals. The participants reported that they used the information from the hospital to guide their treatment plans and differential diagnoses for future runs. Paramedic 5 stated:

> I would say yes [I have noticed changes] just because especially if it's a patient where like I don't really know what is wrong with them I just kind of have to treat their symptoms when we get feedback from it and they kind of tell us like this is what was happening I put that um diagnosis in my life differential diagnosis for new patients that I come across and I'm like well this happened before maybe it's happening again or so things that I just haven't didn't really think about at the time treating the patient when we get that feedback that

> something else was going on and just kind of like lets me know that different patients present different ways.

The participants also reported an increase in confidence following the patient outcomes because the hospital confirmed their line of thinking was correct. EMT 9 responded by saying,

> Especially [during] cardiac arrests or things that we you know you drop them at the door and you're like well they were alive when I dropped them off you don't know anything from there… but now getting the feedback and understanding the things that we have done like the medications we've given … and seeing [them] confirm the things that we were seeing maybe on an equity or something your confidence in your skills so like not only are you doing these skills because you know that the right thing to do but you're doing the skills because you've seen the feedback that says okay, you did the right thing.

Paramedic 3 reported

> If you do something that the hospital didn't like or something that was, you know, on the fence about, you learn from it and you know next time that situation happens if it occurs you are less likely to make that error mistake.

Paramedic 4 reported that they can better prioritize care and they are able to better prioritize certain treatments during future runs and that it gives them more comfort. Overall, all providers felt there was an improvement in their care, whether in their confidence or treatment of future patients.

Question 3. *Do you think that receiving outcomes and feedback has improved your mental health or provide closure help you think you made the right call. Can you explain or describe it?*

Participants reported an improvement in their mental health or that they received closure as a result of receiving patient feedback. Participants agreed in their separate interviews that receiving outcomes and feedback helped to not continuously think about the situation and the "what-ifs." Paramedic 3 discussed how things were different when they started EMS. Paramedic 3 reported that they did not receive patient outcomes at a different service and stated

> I had to learn at that point not to think too far into those like critical patients we dropped off I kind of learned to put it out of my mind-that closure, but then you get the feedback working at Jessamine County and it's like okay what we did help that person and you know, they're doing better, they've been discharged, I don't have to sit there and overthink and self-criticize everything that I did on that call.

EMT 6 reported that, "some kind of feedback saying they're like oh yeah that's really good I wouldn't have changed anything you guys did a really good job I think that's really reassuring encouraging." EMT 9 responded to the question by describing a particular call that they ultimately lost sleep over, which was not ideal as a mother of four. The provider described that she felt like she had made an error, however, she was able to get a patient outcome from the hospital that provided further explanation of what was wrong with her patient and that her treatments did not inflict further

harm on her patient. EMT 9 finalized her response by stating, “I definitely think it improves mental health especially with the closure end of things whether the patient made it or not you at least understand if you did right or wrong and why you did right or wrong.” Participants did report that it did not always improve their mental health. Paramedic 5 stated

> I think the feedback is kind of 50/50 like obviously the obvious answers are if it's a good feedback … [but] if it's patients that kind of expired in the ED (emergency department) or didn't make it out of the hospital I feel like I internalized that but also use that compassion I guess that I get from that to help me to treat patients better. I think it's the ones that I expected to survive and like walk out of the hospital that didn't, are the ones that plays the biggest part on my mental health.

Question 4. *Do you have anything you would like to add regarding the follow-up process?*

Participants responded to this question by stating that they wished more hospitals and EMS services would prioritize outcomes and feedback. EMT 9 extended this statement and said,

> I think it changes morale because like you work with so many burnout paramedics and for that to change for them for them to see the outcomes for them to see you know the positive they're putting in the world I think that would change morale for them too and I think people who are scared when

> they come into EMS. Like new people I think them being able to see the positive and the negative of their choices is a good thing.

EMT 4 responded to this question by discussing their desire for more communication between hospitals' clinicians and prehospital providers. EMT 4 stated in the interview,

> I think having a hospital EMS agency communication is very good, very pertinent thing it's something to be … I think we had a little bit of division … I think we need the opposite, having that like streamlined communication … I think it'd be extremely beneficial if we have more open communication if nurses and doctors and residents were open to the fact that we are also medical professionals who don't just drive an ambulance a lot of us have very in-depth knowledge of what's possible to be happening or what is exactly happening … I think having that open communication would be good for mental health, for training and knowledge, and so I think these are good questions to be asking for us to have that communication to further EMS and first response prehospital care.

Paramedic 7 responded to this by reinforcing the idea that it can expand their thinking and help them with future patient care. Paramedic 7 stated

> All the notes inside of our messaging tool and our PCR and I'll get to see what the doctor's thinking and sometimes knowing that the doctor thinks like all these are quick bullet points and I kind of think the same way as paramedic… the fact that the doctors kind of thinking the same way and he goes through that methodical process now you see how he's thinking it does it does really

help put you in a frame of mind on what happened with that patient and how you can do better.

Cardiac Arrest performance

Following their attendance to The Resuscitation Academy in 2019, JCEMS switched to Zoll X Series monitors in 2020 to help better monitor their performances during cardiac arrests. Table 2 is the report on overall performance of JCEMS crews during cardiac arrests from 2020 to 2023.

Table 2 Cardiac Arrest Performance for JCEMS 2020-2023

Trend	ACCF*	APRSP*	APOSP*	CQ*	AMD*	AMR*	ARV*
Targets	≥ 90%	≤ 5 secs	≤ 5 secs	≥ 60%	2-2.6 in	100-120cpm	≥ 400mm/s
Max	92.85	15.45	7.52	48.37	2.49	110.56	394.80
Median	91.25	6.35	3.37	42.53	2.41	106.98	366.91
Min	80.71	N/A	N/A	0.21	1.97	104.92	341.26
Mean	92.70	7.57	5.59	42.53	2.41	106.44	385.67
STD	0.03	2.81	2.12	0.07	0.15	1.52	12.91

Table 2 is the report of overall performance of JCEMS crews during cardiac arrests from 2020-2023.
Reference the glossary for abbreviations labeled with an asterisk (*).

The table above represents the average calculated performance by category from 2020-2023. Jessamine County EMS had an average chest compression fraction of 92.70% which exceeded the goal of 90%. JCEMS had a maximum average CCF of 92.85% and a minimum average CCF of 80.71%. On average they surpassed their goal with an average CCF of 92.70%. The calculated standard deviation for average CCF was 0.03. The goal for the average pre-shock pause was less than or equal to 5 seconds. The longest pre-shock pause recorded from 2020-2023 was 15.45 seconds, and the minimum pre-shock pause was not accurately reported in the given data. The average pre-shock pause from 2020-2023 was 7.57 seconds with a standard deviation of 2.81. The average post-shock pause goal is expected to be less than or equal to 5 seconds.

The maximum post-shock pause was 7.32 and the minimum post-shock pause was unable to be determined. The average post-shock pause was 5.59 seconds with a standard deviation of 2.12. The average compression quality was expected to be greater than or equal to 60%. This goal had not been achieved in the average calculations from 2020-2023. The maximum recorded compression quality was 48.37% and the minimum compression quality recorded was 0.21%. The average compression quality recorded was 42.53%, the standard deviation calculated was 0.07. The ideal average manual depth is expected to be 2-2.6 inches deep. JCEMS generally achieved this goal, the maximum recorded average manual depth was 4.49 inches and the minimum was 1.97. The average recorded AMD was 2.41 inches and the standard deviation calculated was 0.15. The average manual rate is expected to be 100-120 compressions per minute. JCEMS consistently stayed within the goal with a maximum of 110.56 compressions per minute and a minimum of 104.92 compressions per minute. The average compression rate was 106.44 compressions per minute and the calculated standard deviation was 1.52. Jessamine County EMS did not achieve their average release velocity goal of greater than or equal to 400mm per second. JCEMS' highest ARV was 394.80 and their lowest was 341.26. The average ARV from 2020-2023 was 385.67 and the calculated standard deviation was 12.91.

Table 3 Cardiac Arrest Performance for JCEMS 2021

Trend	ACCF*	APRSP*	APOSP*	CQ*	AMD*	AMR*	ARV*
Targets	≥ 90%	≤ 5 secs	≤ 5 secs	≥ 60%	2-2.6 in	100-120cpm	≥ 400mm/s

Median	87.40	6.74	3.59	39.60	2.26	107.52	356.79
Mean	86.81	6.74	3.85	39.68	2.24	107.40	361.89
STD	0.05	0.35	1.58	0.08	0.11	1.17	16.92

Table 3 is the report of overall performance of JCEMS crews during cardiac arrests in 2021.
Reference the glossary for abbreviations labeled with an asterisk (*).

Table 3 represents the recorded performances by JCEMS from 2021. Jessamine county EMS did not achieve their average chest compression fraction goal of greater than or equal to 90%. The average chest compression fraction was 86.81 and the calculated standard deviation was 0.05. Jessamine County did not achieve their average pre-shock pause goal of less than or equal to five seconds. The average pre-shock pause recorded was 6.74 seconds with a standard deviation of 0.35. The average post-shock pause of less than or equal to five seconds was achieved. JCEMS' average post-shock pause was 3.85 seconds with a 1.58 calculated standard deviation. The intended compression quality was supposed to be greater than or equal to 60% however this goal had not been achieved in 2021. The average compression quality recorded was 39.68% and the standard deviation was 0.08. The average manual depth goal recorded in 2021 was achieved with an average of 2.24 inches and a standard deviation of 0.11. The average manual rate was also achieved in 2021 with an average rate of 107.4 compressions per minute and a standard deviation of 1.17. The average release velocity goal was not successful with an average RV of 361.89 and a standard deviation of 16.92.

Table 4 Cardiac Arrest Performance for JCEMS 2022

Trend	**ACCF***	**APRSP***	**APOSP***	**CQ***	**AMD***	**AMR***	**ARV***
Targets	≥ 90%	≤ 5 secs	≤ 5 secs	≥ 60%	2-2.6 in	100-120cpm	≥ 400mm/s
Median	91.22	6.77	2.94	38.70	2.22	105.56	354.11

Mean	90.67	8.41	2.92	37.61	2.24	105.97	357.59
STD	0.02	4.90	0.75	0.02	0.11	1.07	16.68

Table 4 is the report of overall performance of JCEMS crews during cardiac arrests in 2022.
Reference the glossary for abbreviations labeled with an asterisk (*).

Table 4 shows the performance of specific skills by JCEMS in 2022. Jessamine County EMS consistently achieved their average chest compression fraction goal of greater than or equal to 90% with an average of 90.67%. JCEMS stayed consistent with their average chest compression fraction as seen with the 0.02 calculated standard deviation. JCEMS did not achieve their average pre-shock pause goal of less than or equal to five seconds, the average recorded pre-shock pause was 8.41 seconds and the calculated standard deviation was 4.90. Jessamine County did consistently achieve their post-shock pause goal of less than five seconds with an average post-shock pause of 2.92 seconds, and a standard deviation of 0.75. JCEMS did not meet their compression quality goal of greater than or equal to 60%, with an average CQ of 37.61, however they consistently stayed in this quality percentage with a standard deviation of 0.02. JCEMS met their goal of an average manual depth of 2-2.6 inches and on average achieved a manual depth of 2.24 inches and a standard deviation of 0.11. The average manual rate was also achieved with an average manual rate of 105.97 compressions per minute and a calculated standard deviation of 1.07. The average release velocity had not been achieved, with an average of 357.59mm/s and a standard deviation of 16.68.

Table 5 Cardiac Arrest Performance for JCEMS 2023

Trend	**ACCF***	**APRSP***	**APOSP***	**CQ***	**AMD***	**AMR***	**ARV***
Targets	≥ 90%	≤ 5 secs	≤ 5 secs	≥ 60%	2-2.6 in	100-120cpm	≥ 400mm/s
Median	91.62	5.13	2.31	36.69	2.33	107.51	374.04
Mean	90.84	4.07	2.07	33.48	2.26	108.08	369.68

STD	0.02	2.77	1.52	0.08	0.20	1.70	13.42

Table 4 is the report of overall performance of JCEMS crews during cardiac arrests in 2023.
Reference the glossary for abbreviations labeled with an asterisk (*).

Table 5 depicts overall cardiac arrest performance for Jessamine County EMS in 2023. JCEMS was successful in achieving their average chest compression fraction goal of greater than 90% with an average of 90.84% and a standard deviation of 0.02. The ideal average pre-shock pause should be less than or equal to 5 seconds, JCEMS achieved this goal with an average pre-shock pause of 4.07 seconds, and a calculated standard deviation of 2.77. Jessamine County EMS achieved their average post-shock pause goal of less than or equal to five seconds with an average post-shock pause of 2.07 and a standard deviation of 1.52. JCEMS did not achieve their compression quality goal of greater than or equal to 60%, with an average of 33.48% and a standard deviation of 0.08. JCEMS had a average manual depth goal of 2-2.6 inches, this goal was achieved with an average 2.26 inches and a standard deviation of 0.20. The ideal average manual rate was 100-120 compressions per minute; this goal had been achieved with an average of 108.08 compressions per minute and a standard deviation of 1.70. The average release velocity goal had not been achieved at greater than or equal to 400mm/s, their average release velocity was 369.68mm/s with a calculated standard deviation of 13.42.

Cardiac Arrest Resuscitations

This section recorded the resuscitation attempts by Jessamine County EMS from 2019-2023. The people that were treated in this data were pulseless and apneic, EMS crews initiated cardiopulmonary resuscitation on these patients. There are three

different categories of cardiac arrests that were examined, bystander witnessed cardiac arrest, 911 responder witnessed and unwitnessed. A bystander witnessed arrest is when a person (usually a family member or friend) witnesses when the patient goes into cardiac arrest (the person may have collapsed or fainted). A witnessed arrest by a 911 responder is when a first responder (fire, EMS or police) witnesses a person go from a conscious state to an unconscious state and go into cardiac arrest. These people are generally “peri-arrest” or awake and talking then go into cardiac arrest. The third category was unwitnessed arrest, meaning that someone found them “down”: unconscious, unresponsive, pulseless, and apneic for an unknown amount of time, but they did not have the protocols to consider it an obvious death. There are different rhythms that patients can be found in when they are in cardiac arrest; these are split into two categories, shockable rhythms, and unshockable rhythms. Shockable rhythms include ventricular tachycardia and ventricular fibrillation, these generally have higher chances of survival because they are true cardiac arrests. Unshockable rhythms are pulseless electrical activity (PEA) and asystole. PEA is when the heart is still producing electrical current, but they do not have a pulse meaning that there is no conduction or mechanical action, and the heart is dying. When a person is in an asystole there is no electrical impulse being generated and there is no pulse able to be palpated. The patients that were analyzed in this study were found initially in a shockable rhythm.

Figure 1 Bystander Witnessed Cardiac Arrest with an Initial Rhythm VT/VF

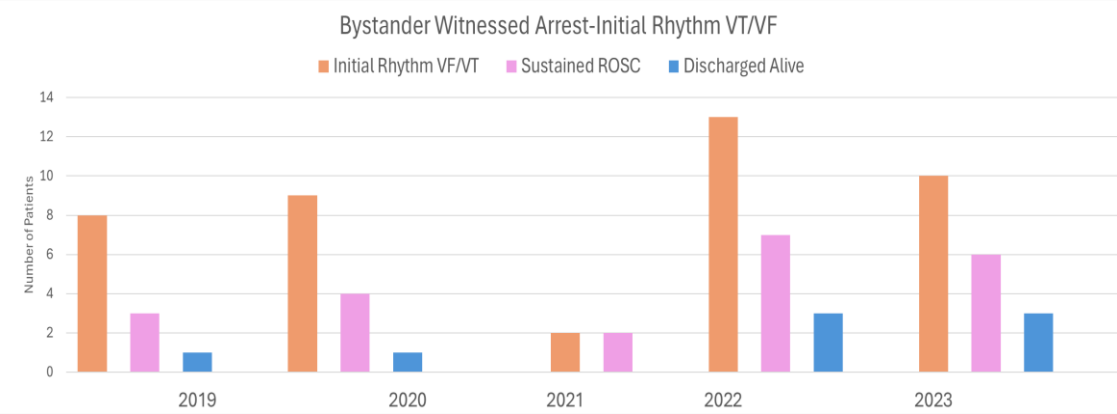
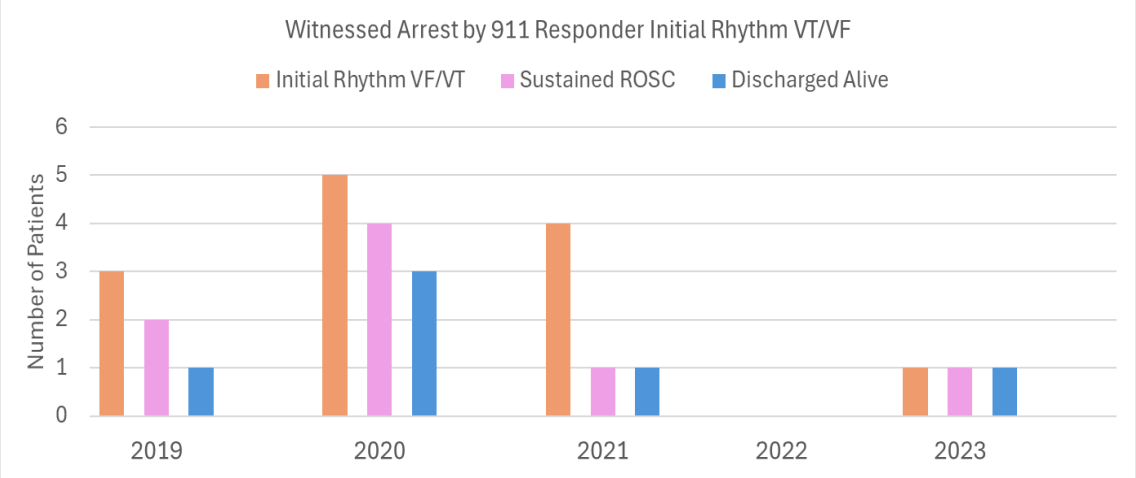


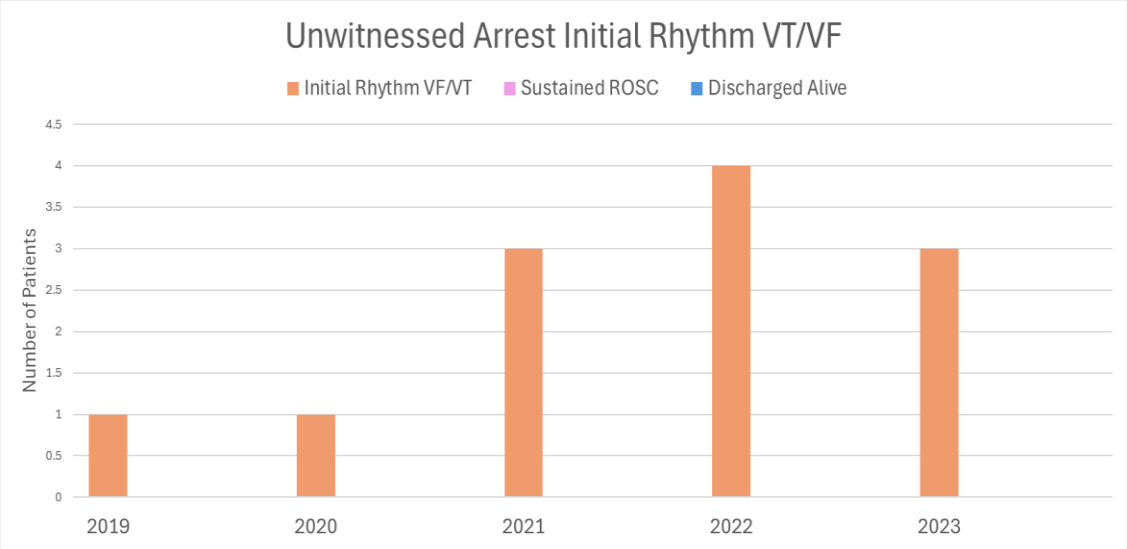
Figure 1 illustrates patients that had a bystander witnessed cardiac arrest from the years 2019-2023. In 2019 there were 8 witnessed cardiac arrests, JCEMS obtained ROSC on 3 patients (37.5%) of the patients and 1 (12.5%) patient survived to hospital discharge. In 2020, 9 patients experienced a witnessed cardiac arrest, JCEMS obtained ROSC on 4 of the 9 patients (44%) however, only one person (11%) survived up to hospital discharge. In 2021 JCEMS responded to two witnessed arrests and obtained ROSC on both patients. However, no patients survived up to hospital discharge. In 2022, JCEMS responded to 13 witnessed arrests and achieved ROSC on 7 of patients (53.84%). Jessamine County EMS had a total of 3/13 patients (23.07%) of patients survive to hospital discharge. In 2023, there were 10 witnessed cardiac arrests, JCEMS achieved ROSC on 6 of the 10 patients (60%), and 3 of the 10 patients (30%) survived to hospital discharge. From 2019 to 2023, JCEMS saw a 22.5% increase ROSC for witnessed arrest patients. Jessamine County EMS also saw an increase in survival to hospital discharge rate of approximately 11% over the last four years.

Figure 2 Bystander Witnessed Arrest by 911 Responders with an Initial Rhythm of VT/VF



In 2019, Jessamine County EMS and 3 witnessed arrests by 911 responders, they achieved ROSC on 2 (66%) of those patients and 1 (33%) survived to hospital discharge. In 2020 JCEMS had 5 witnessed arrests, they achieved ROSC on 4/5 patients (80%) and 3/5 (60%) patients survived to hospital discharge. In 2021 there was a decrease achieved ROSC; only one of the four patients (25%) had ROSC, the one patient that did regain a pulse survive to hospital discharge. In 2021, JCEMS had a 25% survival rate in arrests witnessed by a 911 responder. In 2022, Jessamine County did not have any patients that had witnessed cardiac arrest by a 911 responder. In 2023 Jessamine County EMS had one call where 911 responders witnessed arrest; on that call they achieved ROSC, and the patient was discharged from the hospital.

Figure 3 Unwitnessed cardiac arrest with an initial rhythm VT/VF



In 2019 JCEMS had one unwitnessed arrest, JCEMS also had one unwitnessed arrest in 2020. They did not achieve ROSC on either of these patients. In 2020, JCEMS had 3 unwitnessed arrests and did not achieve ROSC on any of the three patients. In 2022 Jessamine County EMS had 4 unwitnessed arrests and did not achieve ROSC on any of the patients. In 2023 JCEMS had 3 unwitnessed arrests and did not achieve ROSC on any patients. No patients were successfully resuscitated during unwitnessed arrests from 2019-2023.

Conclusion

Providers had positive perspectives towards receiving feedback and patient outcomes from hospitals. Jessamine County's use of the RQI program gives providers specific feedback during training to meet the standards of high-quality CPR. The manual CPR goals that were achieved during cardiac arrest calls such as average manual rate and depth and average chest compression fraction are also focused on during RQI training. The goals that were observed to not be achieved in the recorded cardiac arrest performance data (release velocity, compression quality and pre/post-

shock pauses) are not highlighted during RQI training. Combining continuous training and real-time feedback, the RQI program allows providers to develop muscle memory during their training that not only improves their skills, but also increases their patients' chances of survival through high quality CPR. This study found that Jessamine County EMS has seen an increase in survival rate of witnessed cardiac arrests and witnessed arrests by a 911 responder. The consistent feedback that the EMS providers received from 2019-2023 simultaneously showed an improvement in consistency of performance during cardiac arrests and an increase in survival rate.

Providing patient outcomes and feedback to prehospital providers is not limited to improving patient care; there are also benefits for the providers as well. When providers receive feedback and patient outcomes from hospital this can improve their confidence in their clinical decision making. This is important for new providers or providers that have advanced their level of care. Receiving feedback gives providers definitive answers by giving a hospital diagnosis where providers can learn more about their patient and apply the acquired knowledge to future calls and ultimately improve patient care. Prehospital providers also have the opportunity to establish closure on particularly difficult runs. Occasionally EMS providers will encounter a patient and the only treatments they are able to provide is treatment of symptoms due to resources available in the back of an ambulance. Some providers may feel as if the care they provided was inadequate because they were unable to determine a field diagnosis. With a patient outcome, providers reported improvements in their mental health because their remaining questions were

answered, and they did not have to continue replaying the call which oftentimes lead to feelings of guilt and anxiety. The integration of patient outcomes for prehospital providers helps to improve overall mindset in the workplace where providers are seeking outcomes to improve their patient care and their headspace. All components analyzed in this study including the survey, the interview, the cardiac arrest performance, and the resuscitation attempts, support the concept that giving prehospital providers feedback will improve their patient care and their mental health. There were little to no consequences reported by the providers because of receiving feedback and patient outcomes.

Discussion

Limitations

The conclusions drawn from this study are limited to the responses of the single EMS service that was analyzed. The perspectives and responses from one EMS service are not by any means summative or reflective of all other EMS providers or services. Participation in this study was completely voluntary; no incentives were offered for participating. The voluntary participation, rather than mandatory participation, could affect the quantity of responses that were received in both the survey and the interviews. There were JCEMS employees that declined participation in the study, their responses could have affected the information gathered from this study. The service that was analyzed prioritizes frequent high-quality training in addition providing feedback for their providers especially post-cardiac arrest event reviews. The feedback/outcome system used at Jessamine County EMS was well

established a few years prior to when the study took place. Only patients that were found in an initial rhythm of ventricular tachycardia or ventricular fibrillation were analyzed. The research was limited to patients in VT or VF because patients in shockable rhythms are found to have a better prognosis than patients found in unshockable rhythms such as asystole or PEA, due the possibility for the arrest originating from a cardiac issue (Kashef & Lotfi, 2021), (Kato 2021 et al., 2021), (Cleveland Clinic, Ventricular Arrhythmia).

Future of EMS

Further analysis of the benefits of providing patient outcomes to EMS providers has the ability to make a long-awaited change in EMS. In Utah, a similar program has been implemented that allows a HIPPA compliant standardized hub that shares clinical information from EMS to hospital and vice versa (Office of EMS, 2018). Modern technology has also played a role in helping providers both in and out of hospital have a more standardized transfer of care. ESO is an electronic health charting software program commonly used by EMS services in Kentucky. In 2021, ESO launched a "Health Data Exchange" to create a standardized emergency department and hospital dispositions feature that makes data and patient outcomes easily accessible for EMS (French, 2021). There are small steps being taken to make these changes for providers; however, there is limited research to support the benefits of the changes that are being made. As EMS continues to evolve, it is important to recognize the importance of the wellbeing of providers. One way to do so would be to offer patient outcome data as evidence to validate their current protocols and illustrate areas for quality

improvement. Doing so will ensure that prehospital healthcare providers are better equipped with more tools to provide the best possible patient care now and in the future.

Glossary of Abbreviations:

ACCF- Average chest compression fraction

AMD- Average manual depth

AMR- Average manual rate

APOSP- Average post-shock pause

APRSP- Average pre-shock pause

ARV- Average release velocity

CPR- Cardiopulmonary Resuscitation

CQ- Compression quality

ECMO- Extracorporeal membrane oxygenation

EMS- Emergency medical services

EMT- Emergency medical technician

HP-CPR- High performance cardiopulmonary resuscitation

JCEMS- Jessamine County EMS

OHCA- Out of hospital cardiac arrest

PEA- Pulseless electrical activity

P/VF- (Pulseless) ventricular fibrillation

PVT/VT- (Pulseless) ventricular tachycardia

ROSC- Return of spontaneous circulation

RQI- Resuscitation Quality improvement

STD- Standard deviation

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Cardiac arrest data courtesy of Jessamine County EMS in Nicholasville, Kentucky.