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Opioid Administration in the Prehospital Setting

This Senior Project is approved as acceptable

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Opioid Administration in the Prehospital Setting

By

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Op-ed

In the last year, I have gained experience in EMS and had opportunities to be around medication administration as an EMT, and thought nothing of it, but recently, hearing a lot about the administration of fentanyl and morphine raised my eyebrows. In EMS, we can provide such medications to patients experiencing pain, certain conditions, or presenting a need for such medications. We are seeing a steady increase in the number of cases worldwide of fentanyl creating problems, or even killing people, which is only adding to the rise in the opioid pandemic. This can be traced back to the prehospital setting, where some people are introduced to opioids. Is opioid administration a saving grace or an early grave? To limit the fallout of opioid use in the world today, there needs to be better guidance and restrictions on how opioids are used in the prehospital setting. Revisiting EMS protocols and making the much-needed solutions will allow for fewer mishaps and mistakes to occur by the first responders administering these opioids.

Due to the adverse side effects, there are misconceptions and stigmas about fentanyl and morphine as medications that health providers can use to treat patients. On the personal side of things, my mom recently had a skiing accident, and emergency department nurses and doctors administered fentanyl to her, in a small dose, to help with her excruciating pain. Yes, already being an EMT at that time, I knew it was okay in a hospital setting, but my Veteran Affairs Addictions Therapist sister didn't agree so much. Educating the public on the appropriate course of action for such medications will allow more patients to be treated, and patients will be less hesitant to trust the doctors to complete their duty to treat patients. Naturally, these patients will also want the doctors and health providers to be trained more effectively to maximize treatments and to ensure they are not neglected. This carries over into the prehospital setting, where they

follow EMS protocols for how they treat and help the patients they encounter in traumas or other life-threatening situations. There are discrepancies in the protocols that different regional EMS systems follow, which will make a person question what the best course of action, through protocols, is for their well-being and treatment. Specifically collecting data on situations where opioids are administered will allow experts and government officials to uncover where solutions need to occur and other key details to maximize treatment for patients. Another key detail is finding which medication will be best for different situations, will limit side effects, and unnecessary adverse effects. Data will show which medication has the least number of symptoms while effectively being an analgesic (pain reliever), and using that, officials who oversee the EMS protocols can revise protocols for the best outcomes for patients due to their situation and condition.

Abstract

Paramedics are first responders who work in EMS systems that have gone through rigorous training to administer opioids, like fentanyl and morphine, and other medications, like ketamine, acetaminophen, and non-steroidal anti-inflammatory drugs (NSAIDS), to patients for pain management/relief. For medication administration and any other procedure they perform on patients, paramedics follow guidelines and protocols set by the Drug Enforcement Administration (DEA), National Highway Traffic Safety Administration (NHTSA), and the Regional Medical Director. These protocols differ from region to region, and being broad, leave room for first responder interpretation of procedures that the protocols allow paramedics to perform. There needs to be an emphasis on patient treatment through finding solutions for the causes of the mistakes, such as current protocols, medication usage, and training of paramedics. This study used protocols from many United States cities, data across countries' EMS systems, and evidence-based studies from public government records to form tables and graphs. Different cities vary in their protocols for medication administration, such as what indications to look for or what approval is needed, as well as the requirements for recertification. Additionally, other medications, such as ketamine or morphine, are more beneficial than opioids in certain circumstances. The priority is what is and isn't working to treat a wider range of patients. Government agencies and officials need to revisit and revise the protocols to make them more uniform for all EMS providers in the regions across the United States, decide which medication is best for the types of situations that are encountered to ensure patient safety and stability, and implement more frequent and consistent training for all first responders to ensure they are up to date on techniques, procedures, and protocols as a whole.

Acknowledgments

I would like to express my gratitude and appreciation towards my thesis supervisor, Professor Emily Weber. She is the first biology teacher to truly introduce me to the body's biological anatomy and physiology, which stood as the basis for how I connect all bodily systems. She always kept the energy high to make her classes intriguing and exciting. Dr. Weber taught me never to stop pushing forward and to put my best effort forth always, no matter what. Sparking my interest with her teachings and motivation is one thing. Still, now spending countless hours during meetings, guidance, emailing, long talks about the medical field, and revisions for my thesis, this thesis would not have happened without her.

I would like to thank my advisors, Professors Bill Yankosky and Fred Sanborn, and committee members, Professors Bill Grattan and Meredith Gringle, for working behind the scenes to help structure my thesis, give me innovative ideas to cover, and overall, support me through my research and findings. Even with the endless students they were already guiding, being flexible meant so much to me as I knew I could come to them for anything. They would open new areas for ideas to flourish and be considered for inclusion.

I would like to thank my family for their continuing support in getting me where I need to be. My sister, Alex Thomas, has been a huge help, giving much effort to this writing process, even with a full-time job as a Substance Abuse Counselor with a full workload. They would push me to further my research and continue my writing even when I felt defeated in my progress.

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Introduction

Staffing EMS

Emergency Medical Services (EMS) comprises first responders, administrators, dispatchers, and staff members. It is not to be confused with an Emergency Medical Technician (EMT), a certified first responder in EMS. Alongside EMTs are Emergency Medical Responders (EMRs) who are first responders certified at a lower level than an EMT. Advanced Emergency Medical Technicians (AEMTs) and paramedics are first responders certified as higher-level EMTs. Anyone can become a first responder with the right courses/education, a high school diploma, and completed certification tests. EMR, EMT, AEMT, and paramedics courses are offered at community colleges and organizations that are certified to teach these courses. Once a course is fulfilled and completed, these individuals can take the certification exams for that first responder's level.

If working as a first responder is not an option, individuals can work as a division or rescue squad staff member. These members simplify the job of a first responder by making their work very straightforward and eliminating interruptions. They handle all responsibilities, other than running calls as first responders, such as handling management, hiring recruits and newcomers, gaining funding for the organization, organizing work events, etc. Staff members are the backbone of the operations for the entire EMS organization. First responders take on dual roles and can act as staff members. The core values of first responders are compassion, integrity, and truth to prioritize protecting the community.

Paramedics, first responders who can administer opioids, have to complete many courses and lectures to become certified. Many programs require background checks, admissions

interviews, and/or entrance exams to determine eligibility. A program lasts around six to twenty-four months, consisting of 1200 to 1800 hours. Participants will study cardiology, anatomy and physiology, medical procedures, traumas, advanced airway management, starting intravenous access, EKG interpretation, care for all life-threatening emergencies, and medication administration. These courses are taught via labs, lectures, hospital internships, and EMS field experience (UCLA Center for Prehospital Care 2025). During the paramedic pharmacology course, students will focus on the principles of pharmacokinetics (the quantitative analysis of the time it takes for a drug to affect the body), pharmacodynamics (how the drug acts on the body), and drug administration. Additionally, they will review components of drug storage and security, classification of medications, mechanisms of medications, and choosing the right pharmacological intervention based on patient condition and complaint (Virginia's Community Colleges 2025).

Behind the scenes, members are working to make all EMS systems as efficient as possible. Emergency calls are routed to centers that ask for detailed and precise information on the situation and location of the emergency. Dispatchers then decide how the call should be prioritized and what ambulance is needed by utilizing the closest, most capable ambulance and crew. This is achieved through an intricate dispatch system in real-time. The dispatch system allows first responders to retrieve accurate information about the call before arrival at the scene, and directions to the emergency through a centralized channel for fire and rescue (Gurevich et al. 2005). This process ensures efficient and effective dispatch of crews and their units. This information is available through real-time data collection to promote the cooperation of other agencies, police, and fire, as needed.

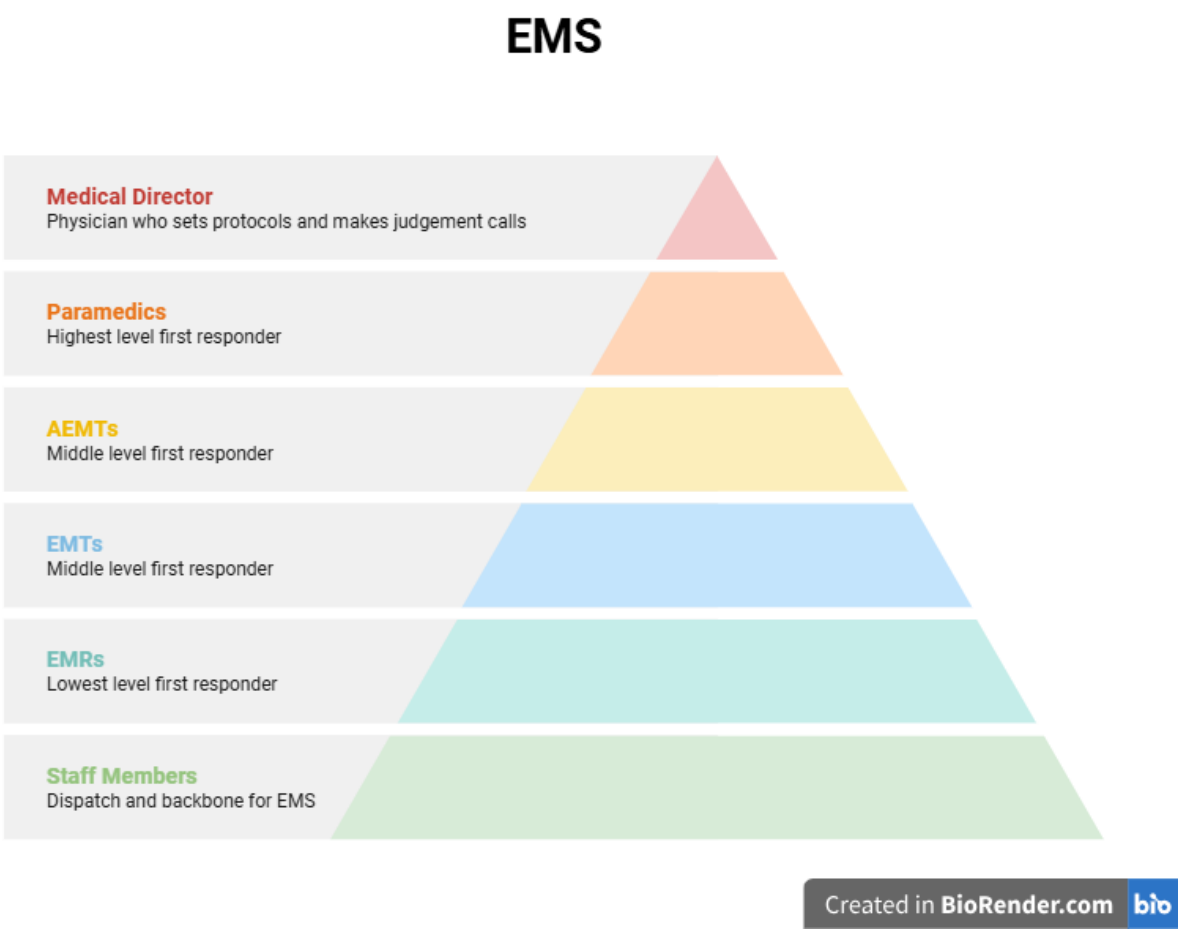

Figure 1: EMS Position Distribution. The abundance of EMS members and first responders varies at different levels and positions in the organization.

The Continuous Quality Improvement (CQI) agency inside EMS has employees who analyze data, calls, patient reports, and other logistics. CQI implements quality assurance initiatives to continually make provisions and revisions to the care provided by the EMS agency. Implementing quality assurance initiatives built by the CQI workers in EMS helps ensure coherence while engaging in patient care and treatment. This is done by collecting and analyzing data needed to understand areas that could benefit from improvement. This group continuously

oversees all distinct aspects of the EMS system (O'Donnell and Gupta 2023). Typically, they will be tasked with reading over the patient reports submitted by the acting attendant in charge (AIC). CQI can fully understand the call, what treatment was rendered, who was involved with what actions of treatment, if more treatment should have occurred, if there were any mishaps, and how efficiently the care was rendered for the patient, all by reviewing the patient report submitted by the AIC (O'Donnell and Gupta 2023).

Effectiveness and Efficiency

AICs use computer software formatted specifically for the needs of EMS first responders. AICs start by documenting the location of the emergency with all additional necessary information on the status of the patient calling 9-1-1 (Short and Goldstein 2022). The AIC records basic demographics and the patient's relevant medical history. This is followed by vital signs, treatments rendered, and medical or trauma assessments to display all aspects of the investigation. Following this data collection, they are ready to start formulating a patient narrative, beginning with a step-by-step depiction of the call from arrival on the scene to turnover of the patient to hospital staff. Having computer software that quickly and efficiently structures the patient report, decreases stress, and allocates more time dedicated to helping the patient while simultaneously documenting as necessary.

Since first responders work extended hours during their shifts, they are at risk of decreasing alertness and effectiveness throughout their shifts and during additional shifts within a given week. EMS employees will normally work 8, 12, 18, or 24 hours. EMS systems work a 48/96 system or "Kelly" shift. A 48/96 is two consecutive 24-hour shifts then 4 days off. A "Kelly" shift is working 24 hours on, off day, 24 hours on, off day, 24 hours on, and then four

days off (“EMTs and paramedics” 2024). With these shift schedules, first responders cannot achieve adequate sleep between shifts and will likely experience circadian dysthymia. In addition to strenuous shift schedules, other factors that may affect their sleep include stress, interruptions during duties due to emergencies, and family matters outside of work (Lockie et al. 2024). This can be challenging, as sleep deprivation and lack of energy can play a role during shifts when trying to achieve peak efficiency and effectiveness as a first responder. In a 2022 study with over 100,000 first responders from 1119 studies, 31% of those individuals had a sleep disorder. Sleep deprivation can also increase their risk for injury, increase stress, and reduce academic performance (Lockie et al. 2024).

First responders experience stress and are at risk of experiencing trauma because of the demands of their work. Research suggests that anxiety, stress, post-traumatic stress disorder (PTSD), substance misuse, sleep disorders, elevated suicide risk, and family or relationship issues have been closely associated with being a first responder (Fisher and Lavender 2023). With that in mind, the certification training course has been established to teach trainees coping mechanisms for such situations. This is achieved through direct training, support groups, debriefing, and peer support activities. In these exercises and groups, instructors can normalize stress reactions, educate trainees about stress and coping tactics, promote emotional processing, and provide referral information (Fisher and Lavender 2023). Traumatic situations can trigger stress, emotional ability, and reactions that both the patient and first responder might not have experienced in other contexts. Exercises to limit the effect of these traumatic situations will ensure that partners have a clear mind and can focus on the patient in front of them.

Public Service

The average American is not equipped to address all immediate medical concerns themselves and, in turn, seek professional treatment when needed. EMS is a public service that strives to serve the public and respond to more than 40 million calls nationally, each year (Krohmer et al.). Treatment bills, tax revenue, state and federal funding, municipal general funds, and other property taxes fund a significant portion of EMS (CDC 2024). Per NEMSIS (A national EMS database on the nature and frequency of 9-1-1 EMS calls), EMS receives many calls about traumatic injuries (21.4% of all national 9-1-1 calls in 2020) and abdominal pain/problems (12.3% of all national 9-1-1 calls in 2020). Sometimes they receive more rare calls, such as hypothermia (0.1% of all national 9-1-1 calls in 2020) (Jordan 2023). The goal of EMS, in coordination with government agencies, is to combine resources to maximize benefits and minimize strain on the community. As a result, life-threatening emergencies are addressed with efficiency and in a manner that supports the overall well-being of the public.

Every call received is different, but the procedures and steps first responders take stay the same. The first responder's job is to act as an investigator by providing medical attention, observing all signs, and taking into account previous knowledge that may aid in creating an accurate impression of the situation (Administrator 2021). The investigation process allows first responders to provide treatment catered directly to the patient's condition in an attempt to stabilize them. This process remains foundational throughout the first responder's training. First responders would be mistaken if they did not consider all aspects of a call when administering treatment. First responders need to measure and record the patient's condition by how the patient is at their baseline (initial state of health/condition before treatment) and compare that to how they present in the medical emergency after treatment (Fine 2007). From an ethical standpoint,

first responders must have justification for the course of action they are taking. Looking at how a patient usually presents at their baseline, compared to how they look during the emergency, will indicate the severity of the situation and what course of action the first responder will take in their treatment plan. This is the backbone of how patients are treated in a medical emergency and how the patient is stabilized for transport to the emergency department.

Protocols

The appointed medical director is a physician who provides oversight to all EMS staff. In addition, they review and approve treatment protocols. The protocols in place clarify best practices for first responders providing care. The medical director is tasked with guiding first responders through prehospital care with outlined protocols in place (Garza et al. 2012). Protocols approved by the medical director have granted EMS first responders the ability to assist patients in life-threatening situations (Garza et al. 2012). There are certain practices that each first responder can do based on their level, certifications, and the medical director's approval. A life-saving skill that is only allowed to be administered by some first responders is starting intravenous (IV) access. Becoming certified to start an IV is a privilege granted by EMS protocols and can also lead to medication administration. Because a different medical director is responsible for each region's EMS agency, there are differences among protocols. This lack of uniformity can pose a challenge to those adhering to the instructions they issue. Not having uniform instruction and training can increase patient harm through expired medications, container labeling issues, solutions premixed with medications placed by other crystalloid solutions, and having medications in look-alike vials (Kupas et al. 2012). Small differences in protocols can make small changes in treatment procedure that can then build into bigger, more

impactful mistakes that dictate how a first responder treats a patient and increase the likelihood of a mistake occurring, like how a first responder checks to ensure non-expired medications. These complicate an already quite complex role in which an EMT is being asked to administer care in often critical situations without a patient's health history and with inconsistent oversight.

Most protocols remain the same when treating patients. However, those about pharmaceuticals can differ. For example, fentanyl and morphine are administered to the patient differently depending on the protocols in place. Some protocols instruct first responders to seek further direction before medication administration, by radioing medical control, while others encourage first responders to act on their impression of the case to use medications (CDC 2024). These differences can create large variations in individuals' care during an emergency. Lack of uniformity can put patients at risk of receiving inconsistent, outdated, and less efficient care.

Fentanyl, Morphine, and Ketamine as Medications

Three widely known narcotics (psychoactive substances that can cause numbing and paralyzing effects) that paramedics, not EMTs, can administer as pain relievers are fentanyl, morphine, and ketamine. Fentanyl is a potent synthetic opioid drug (Fentanyl 2021), morphine is a non-synthetic opioid derived from opium (Morphine 2021), and Ketamine is a non-opioid analgesic (Sobieraj et al. 2019). In situations where analgesics like ibuprofen or acetaminophen do not affect the patient, these narcotics are used. Narcotics bear risks due to specific demographics that are more sensitive to opioid effects and can lead to overdose, such as adults who are 65 years or older, have respiratory conditions, wasting syndrome, and impaired energy or strength. Demographics that are at higher risk for misuse include younger adults (18-25 years old), individuals with mental health disorders, and a history of substance or alcohol abuse (US

Department of Labor). Fentanyl, morphine, and ketamine can be administered intravenously, intranasally, intraosseous, and intramuscularly. Each route of administration carries a different rate of absorption (Alagga et al. 2024). The majority of steps taken by paramedics remain the same: verify the patient's identity, verify they are receiving the medication intended to be administered, verify the dosage, verify the route of administration, confirm the medication is not outside its expiration date, check the condition of medication, and document all actions taken by staff (Glass 2021). However, within those steps, EMS protocols will result in differences in indications, dosages, routes of administration, and prevention for misuse. The first responder can adjust as needed to ensure the patient benefits most from the intervention. Based on their professional opinion, first responders can identify the best route of administration, dosage, and additional interventions to best address the patient's condition, and they can do as they see fit if medical control has given the first responders direct instruction or through standing protocols, which vary across regions. In a study containing 100 participants who were paramedics in EMS systems, older and more experienced paramedics were more likely to administer opioids to patients presenting with a lower pain score (O'Connor et al. 2020). This could be due to these first responders experiencing more situations where it is easier to read a situation and make a treatment decision, or a first responder's tolerance for treating a patient complaining of pain is lower.

In a prehospital study, 1,267,008 patients stating they had higher pain scores had increased odds of being treated with opioids, and out of 3,831,768 patients, 269,281 (7.0%) were administered opioids (Dalton et al. 2022). Opioids are more effective at managing acute pain than nonsteroidal anti-inflammatory medications and Acetaminophen (a common analgesic) (Slater et al. 2010). Opioids work by acting on opioid receptors. They inhibit pain receptors and

promote feelings of euphoria (feelings of intense happiness and excitement). Patients can get addicted to this feeling. Non-opioids work by inhibiting the production of prostaglandins: a group of lipid compounds that are hormone-like messengers involved with pain and inflammatory pathways (Bovill 1997). Ketamine may cause potential side effects such as respiratory distress, hypotension, dizziness, and drowsiness, but these are noncritical to the health of the patient being treated (Sobieraj et al. 2019). Ketamine is not as strong as morphine and fentanyl, but it can be used in combination with these medications. Any use of opioids can bring about adverse effects that induce addiction.

Every administration of an opioid can be linked back to its use as treatment in the healthcare system. The opioid epidemic highlighted the mass prescribing of opioids to individuals, resulting in long-term dependence, adverse outcomes, and death in some cases. Opioids, and specifically fentanyl, have been involved in many overdoses worldwide. Opioid administration in the prehospital setting has been criticized for its contribution to the epidemic and further misuse. This could be due to the protocols not being explicit on who should be administered opioids and the chance of mistakes occurring. Opioids are a sensitive topic as they are being used as a recreational drug when they were originally intended for healthcare administration as an analgesic.

The Problems

Specific problems have been identified in the protocols of EMS agencies by data collected by the quality initiative, patient care, and general safety committees of EMS. Protocols are vague, and first responders have many factors that play a part in their decision for treatment. Without a strong foundation in the protocols, more mistakes can occur, as first responders must

interpret the protocols for what they are and do not go into detail about them. The Protecting Patient Access to Emergency Medications Act of 2017 allows states to register with the DEA to deliver, store, and receive controlled substances under specific conditions and standing orders. An article from 2017 on the EMS Utilization of Controlled Substances by the National EMS Advisory Committee Report and Advisory states that communication failures between the federal and state regulations can cause massive issues in the EMS system. Federal agencies, like the DEA, make broad, general regulations on opioids that affect EMS practice but do not consider the uniqueness of the EMS system (National EMS Advisory Council). Law No: 115-83 on EMS Practitioners: Protecting Patient Access to Emergency Medications Act of 2017 by the National EMS Advisory Council, shows how states are trying to accommodate the federal regulations by creating their regional regulations, but these efforts are creating discrepancies for first responders; for instance as previously mentioned, different states may have different protocols and laws regarding out-of-hospital medication administration (National EMS Advisory Council et al. 2024).

Adopting uniform federal regulations that agencies and first responders can follow will limit first responder mistakes while also increasing the monitoring of the use of medications, especially opioids, in the prehospital setting (National EMS Advisory Council). The DEA, National Highway Traffic Safety Administration, and regional EMS systems need more direct communication and a change in the structure of these federal regulations through education, training, and more uniform standards for controlled substance safety and accountability. These are ways to address the confusion and malpractice of first responders. Having EMS protocols regulated by the federal government while taking in state requirements/utilization, that can accommodate those specific regions, will allow for more uniform cooperation between the

agencies while also regulating first responders to treat patients more effectively and efficiently (Sargent et al. 2017). This thesis will explore different EMT protocols in a variety of cities and countries to investigate how opioids are administered. This work will reveal differences that occur within this process, with the overall aim of making recommendations towards steps that can be taken for better administration.

Methods

Information was gathered from the city and country government EMS records; these are publicly available. Six cities (Virginia Beach, Virginia, Washington, District of Columbia, Los Angeles, California, New York City, New York, Omaha, Nebraska, and Raleigh, North Carolina) were chosen that varied in population density and location to examine differences in protocols in their EMS systems. Locations for Figure 2 were chosen to create a diverse range of demographics and densities, signifying how structured their city is and how much EMS presence is needed to encompass those residents. Germany's protocols, and their reasons listed in public record, were included to be used as a comparison to the six regional/city protocols. Germany was chosen for comparison because their protocols are the best possible solutions that consider many variables to limit mishaps in the prehospital field. All of the protocols included in this work are evidence-based. All studies used in this writing (other than the column labeled "Germany") were conducted on United States EMS systems.

Results

Populations for Figure 2 are based on the 2023 data collection by the United States Census Bureau (US Census Bureau). Virginia Beach, VA, consists of 453,649 residents and is closely related to Raleigh, NC, which consists of 482,295 residents. Los Angeles, CA, with a population of 3,821,000 residents, is closely related to New York City, NY, with a population of 8,258,000 residents. Omaha, NE, consisting of 483,335 residents, was chosen because it is a city surrounded by a rural area. Washington, D.C., consisting of 678,972 residents, was selected because it is the capital of the United States. These locations were representative of the diverse locations across the United States. All United States locations listed have a “scoop and run,” meaning they want to get the patient to the emergency department (ED) as soon as possible without many prehospital interventions. Trained paramedics and EMTs staff ambulances and use medical oversight. On the other hand, Germany is based on the “stay and stabilize” motive. Emergency physicians, with broad scopes of practice, staff the crews on land ambulances, coastal ambulances, and helicopters to completely treat the patient on scene to decrease the need to transport patients to other facilities and instead treat them on-site (Al-Shaqsi 2010).

	Virginia Beach, VA (Keeler 2025)	**Washington, DC** (Donnelly et al. 2024)	**Los Angeles, CA** (Department of Health Services and County of Los Angeles 2024)	**New York City, NY** (Schenker and Chiang 2023)	**Omaha, NE** (Nebraska Board of EMS 2022)	**Raleigh, NC** (Wake County EMS System 2023)	**Germany** (Vilcane et al. 2023) (Eimer et al. 2023) (Stamer et al. 2005)
Opioids used	Fentanyl, Morphine	Fentanyl, Morphine	Fentanyl, Morphine	Fentanyl, Morphine	Fentanyl, Morphine	Fentanyl, Morphine	Fentanyl, Morphine
Indications	Pain management. Sedation maintenance for mechanically ventilated patients.	Acute Coronary Syndrome/Chest Pain. Pain Management. Burns.	Pain management	Pain management	Pain management	Pain management	Pain management is based on training done annually to refresh paramedics
Dosages (All max dosages for Fentanyl are 200 mcg, and Morphine are 10 mg)	Fentanyl Adult - 50 mcg Peds - 1 mcg/kg Morphine Adult - 5mg Peds - .1 mg/kg	Fentanyl Adult - 25-50 mcg Burn Adult - 50-100 mcg Peds - 1 mcg/kg Morphine Adult - 2 mg Peds - .1 mg/kg	Fentanyl Adult - 50 mcg Peds - 1 mcg/kg Morphine Adult - 4mg Peds - .1mg/kg	Fentanyl 1 mcg/kg Morphine .1mg/kg	Fentanyl Adult 25-100 mcg Peds 1-2 mcg/kg Morphine Adult - 2-4 mg Peds - .05-.2 mcg	Fentanyl Adult 50-100 mcg Peds 1 mcg/kg Morphine Adult - 5-10 mg Peds - .1mg/kg	Fentanyl Adult 50-100 mcg *Minimal dosages are used to limit the risk of addiction Morphine 1-2 mg
Routes of administration	Fentanyl Adult - IV/IO/IN Peds - IN Morphine Adult - IV/IM Peds - IV	Fentanyl IV/IN/IO Morphine IV	Fentanyl Adult - IV/IO/IM/IN Peds - IV/IO/IM Morphine IV/IO/IM	Fentanyl IV/IM/IN Morphine IV/IM	Fentanyl IV/IM/IN/IO Morphine IV/IM/IN/IO	Fentanyl IV/IM/IN/IO Morphine IV/IM/IO	Fentanyl IV Morphine IV
Security	Double lock system, Advanced Life first responders get medication refills and are responsible for such	Double lock system, Advanced Life first responders get medication refills and are responsible for such	Double lock system, Advanced Life first responders get medication refills and are responsible for such	Double lock system, Advanced Life first responders get medication refills and are responsible for such	Double lock system, Advanced Life first responders get medication refills and are responsible for such	Double lock system, Advanced Life first responders get medication refills and are responsible for such	Double lock system, Advanced Life first responders get medication refills and are responsible for such
Prevention of Misuse	First responder's impression	First responder's impression	First responder's impression	Must have medical control approve orders	First responder's impression	First responder's impression	Non-life-threatening situations - medical control should be used

Figure 2: EMS Agency Protocols. This figure shows the EMS opioid protocols in similar cities and countries.

Using public records for data collection, the summary of protocols and information for fentanyl and morphine. Differences in protocols of EMS systems occur in the indications, dosages, routes of administration, and prevention of misuse (Figure 2). Some protocols contain more details than others, creating specificity in the protocols.

Medication Administration Efficacy	**Opioids Vs. Ketamine – Initial Analgesics**	**Opioids Vs. Ketamine – After Inadequate Response to Initial Analgesics**	**Opioid Vs. Opioid and Ketamine**	**Opioids Vs. Acetaminophen**	**Opioids Vs. Nonsteroid anti-inflammatory drugs**
Pain Severity – 15 mins	No evidence of a difference (n = 1128)	Ketamine may reduce pain more than opioids (n = 162)	Combining may reduce pain more than opioids (n = 336)	No evidence of a difference (n = 647)	
Pain Severity – 30 mins	No evidence of a difference (n = 1153)	Ketamine may reduce pain more than opioids (n = 162)	Combining may reduce pain more than opioids (n = 545)	No evidence of a difference (n = 1795)	No evidence of a difference (n = 453)
Pain Severity – 60 mins	No evidence of a difference (n = 1409)	Ketamine may reduce pain more than opioids (n = 162)	No evidence of a difference (n = 241)	No evidence of a difference (n = 1260)	No evidence of a difference (n = 453)
Adverse Events	Opioids may cause fewer (n =398)			Opioids may cause more (n = 1484)	Opioids may cause more (n = 367)
Mental Status Change – Dizziness	Opioids cause less (n = 723)			Opioids may cause more (n = 539)	
Respiratory Depression	Opioids may cause more (n = 491)				
Time to Analgesic Effect		Ketamine may reduce pain quicker (n = 135)		No evidence of difference (n = 1097)	

Figure 3: Medication Administration Efficacy. Findings from a compilation of 52 randomized controlled trials and 13 observational studies conducted in the United States (Sobieraj et al. 2019).

Using public records and meta-analysis for data collection, the findings of the medications in pain severity at 15, 30, and 60 minutes, adverse effects, mental status change - dizziness, respiratory depression (rate of breathing is reduced and oxygen/carbon dioxide exchange is reduced), and time to analgesic effect. Differences in medications administered compared to opioids occur in every category of medication efficacy (Figure 3). Black boxes represent areas where the information was not provided.

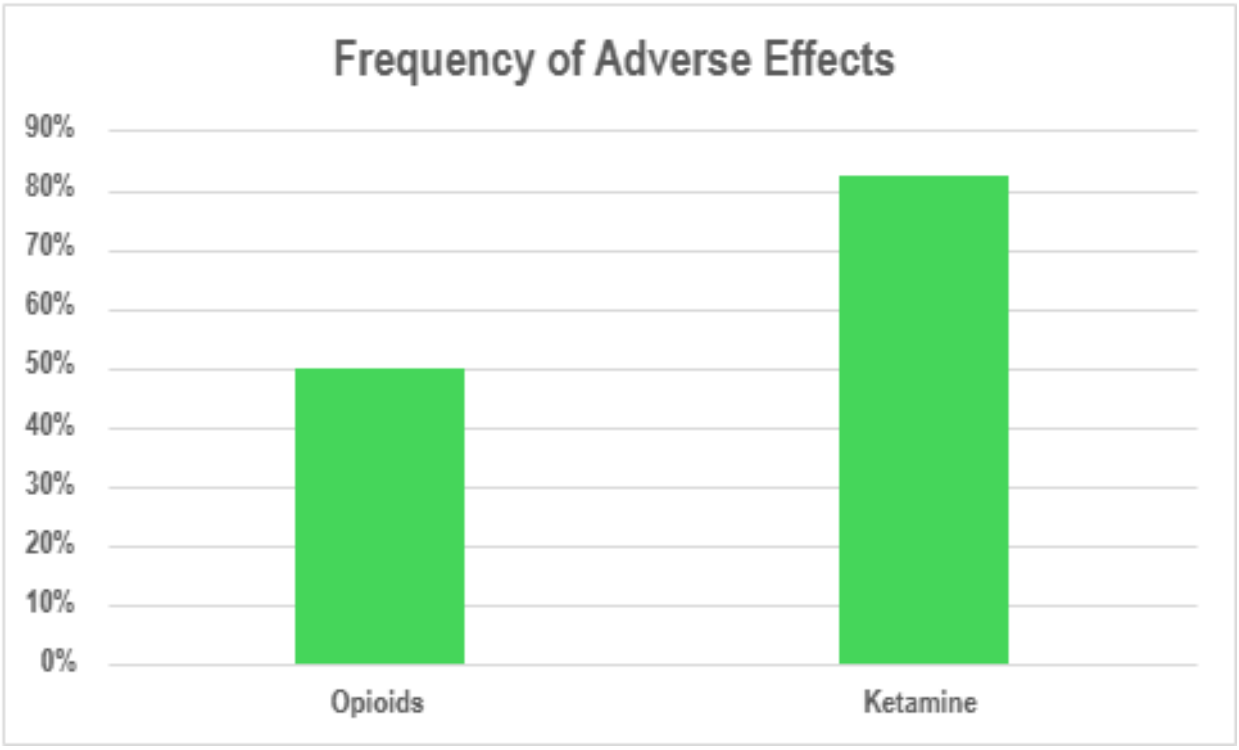

Figure 4: Frequency of Adverse Effects. The frequency of adverse effects of patients administered opioids and ketamine in the prehospital settings from 52 randomized controlled trials and 13 observational studies conducted in the United States (Sobieraj et al. 2019).

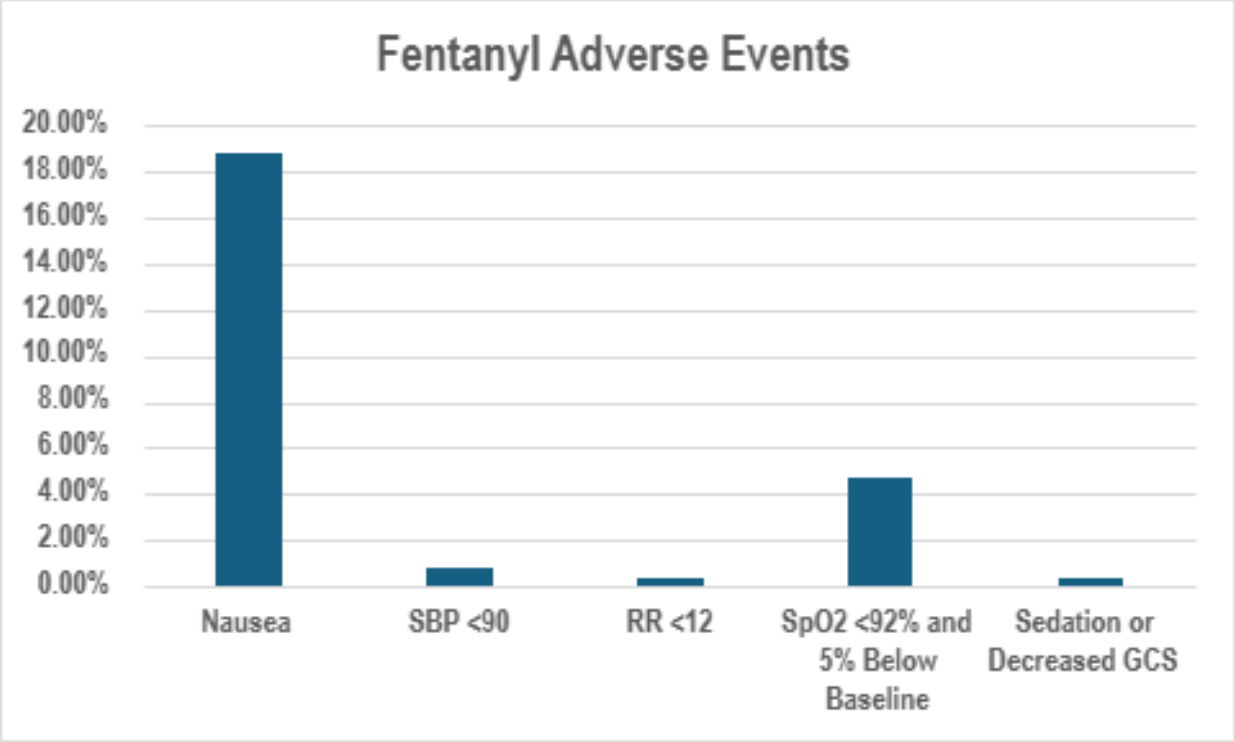

Figure 5: Fentanyl Adverse Events. The fentanyl adverse events were observed when patients (n = 363) were administered fentanyl in the prehospital setting of Multnomah County, Oregon (Fleischman et al. 2010). Systolic blood pressure (SBP), Respiration rate (RR), Arterial Oxygen Saturation (SpO2), and Glasgow Coma Scale (GCS).

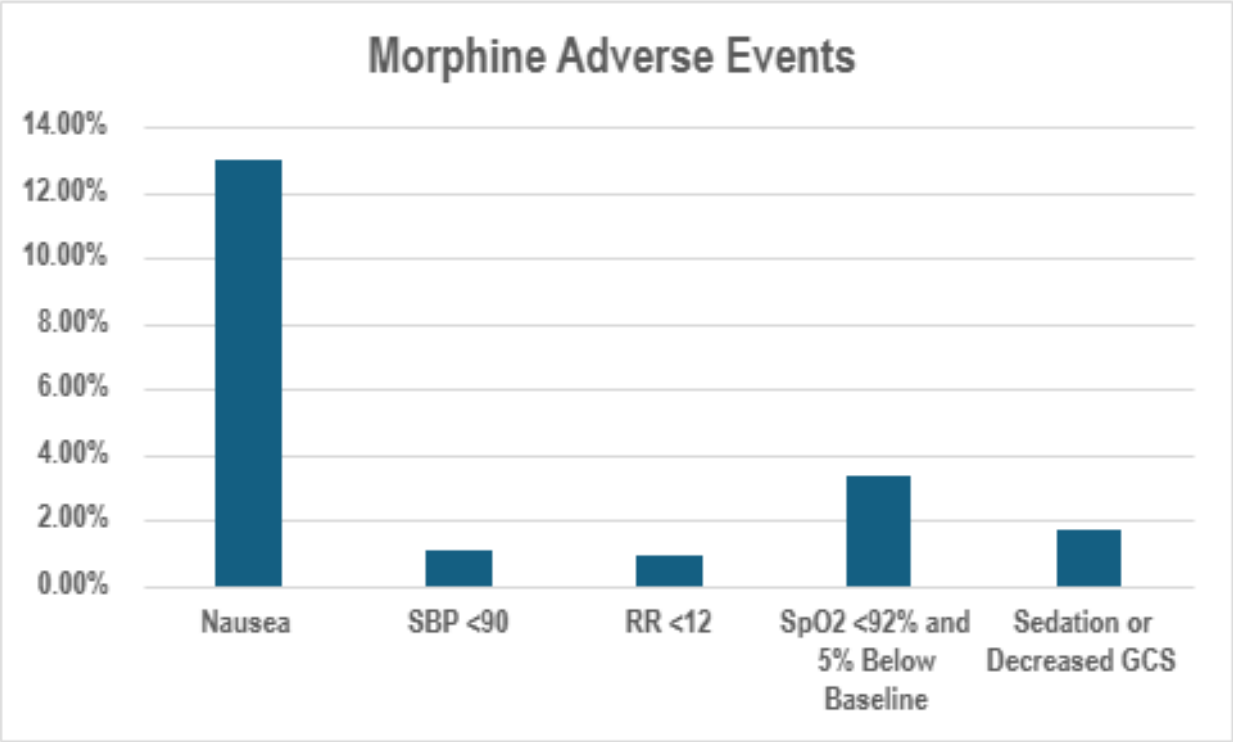

Figure 6: Morphine Adverse Events. The morphine adverse events were observed when patients (n = 355) were administered morphine in the prehospital setting of Multnomah County, Oregon (Fleischman et al. 2010). Systolic blood pressure (SBP), Respiration rate (RR), Arterial Oxygen Saturation (SpO2), and Glasgow Coma Scale (GCS).

Using meta-analysis studies of public records for data collection, these graphs show adverse events of opioids, morphine, and ketamine in prehospital settings. Multnomah County, Oregon, was the study's location, and no other research could be found to show this data. This location had no significance otherwise. 82.40% of patients administered opioids, and 50% of patients administered ketamine experienced adverse effects (Figure 4). 18.80% of patients administered fentanyl experienced nausea, 0.30% experienced respiratory rates (RR) less than 12, 0.30% experienced sedation or decreased Glasgow Coma Scale (GCS), 0.80% experienced systolic blood pressure (SBP) less than 90, and 4.70% experienced oxygen saturation of

peripheral blood (SpO2) less than 92% and 5% below baseline (Figure 5). 13.00% of patients administered morphine experienced nausea, 0.90% experienced respiratory rates (RR) less than 12, 1.70% experienced sedation or decreased Glasgow Coma Scale (GCS), 1.10% experienced systolic blood pressure (SBP) less than 90, and 3.40% experienced oxygen saturation of peripheral blood (SpO2) less than 92% and 5% below baseline (Figure 6).

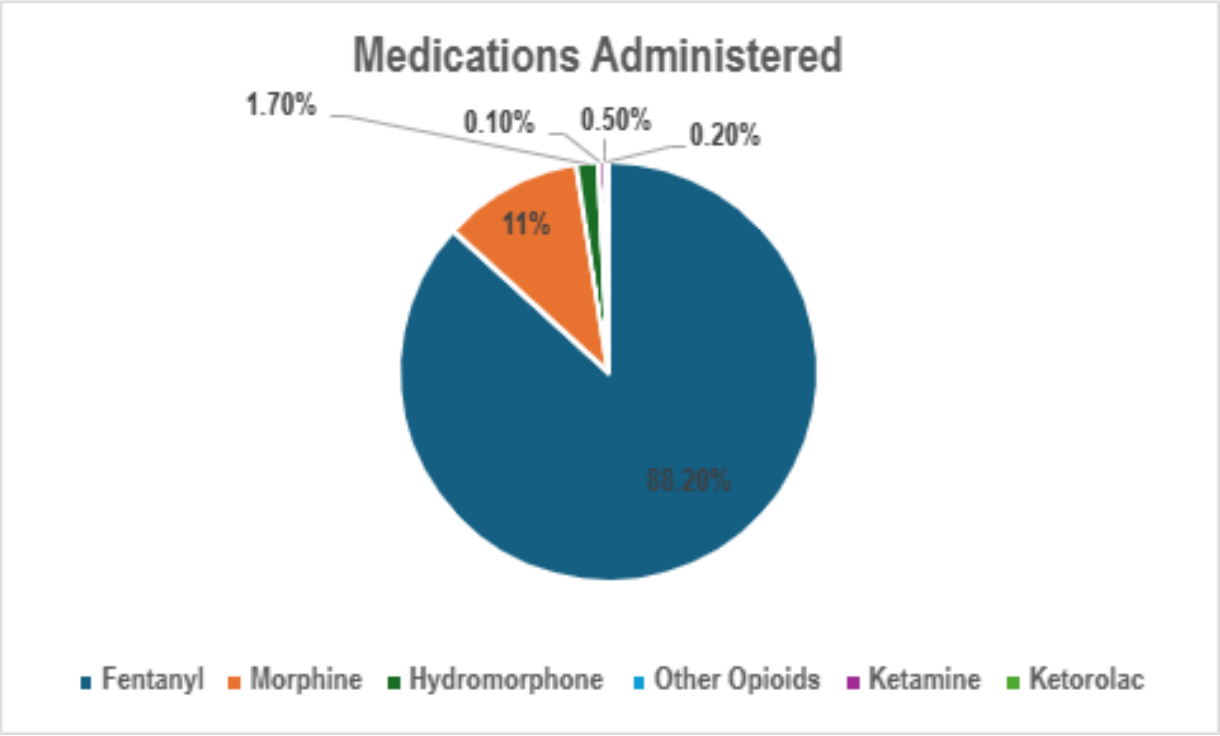

Figure 7: Medications Administered. The percentages of medications administered to patients (n=269,281) per NEMSIS (Dalton et al. 2022).

Using the 2019 National Emergency Medical Services Information System (NEMSIS) dataset, this graph shows different percentages for the medications administered to patients in the prehospital setting and transported to the hospital. 88.20% were administered fentanyl, 11%

morphine, 1.70% hydromorphone, 0.10% other opioids, 0.50% ketamine, and 0.20% ketorolac (Figure 7).

Discussion

Interpretation of Results

All listed figures include differences in the medications, opioid/non opioid analgesics, and differences in protocols across regions. This showcases how the different regions differ because the federal regulations do not create a uniform list of protocols for the whole United States to follow that accommodate the specific regions. Contrasting these protocols shows exactly where the DEA is missing specific details that are then left for Medical Control to decide, indirectly creating discrepancies.

Depicted in Figure 2 are the differences in active protocols used today amongst varying EMS systems. The first difference is within the “Indications” sections, which all contain pain management; some are more detailed than others, making those more specific scopes of practice. On the other hand, broader protocols allow the first responders more flexibility in their interpretation. This type of approach equates to a greater scope of practice, including the ability to administer opioids for treatment more readily. Due to this increasing need, first responders lacking proper training are more at risk for adverse outcomes, such as respiratory depression, nausea, dizziness, tachycardia (fast heartbeat), drowsiness, and others. First responders need to adhere to the protocols specific to the region they’re conducting treatments in, which can be confusing and negatively impact the provision of appropriate care.

"Prevention of Misuse" in Figure 2 showcases how, although many EMS systems rely on the impression of their first responders, New York and Germany must receive prior approval from medical control before administration. By gaining prior approval from qualified officials, EMS can limit misuse and negative consequences. Medical control can review information quickly, concluding the best course of action for the patient, especially when administering controlled medications. Medical control can ensure that first responders are provided the necessary support and further verification to prevent conditions from worsening and promote stabilization (Cline et al. 2024). First responders experience factors that can impact their work ethic and attitude while at work, including anxiety, stress, PTSD, substance misuse, sleep disorders, and family/relationship issues. Those who work for EMS dedicate a significant amount of time and energy to helping others. They often display a commitment to prioritizing the needs of others before their own, and do not let their personal lives interfere with their important work. However, that does not discount that they are people too and should be treated as such. Access to resources and additional support is imperative to the health and longevity of EMS and its members.

One key detail that stands out from the rest of the protocols in Figure 2 is that Germany conducts training annually to refresh paramedics on opioid administration. Details on this for other organizations do not seem public, but general paramedic recertification exams are held every four years in North Carolina (North Carolina DHSR OEMS). These provide opportunities for the paramedic to have to be knowledgeable on all training (more specifically medication administration) previously taught, and that would be needed for the recertification exam. Germany's training conducted on a timely basis would limit the number of mistakes that occur from first responder error by keeping first responders knowledgeable every year instead of every

four years. It would also make sure that first responders get all the up-to-date changes that might occur in the protocols. Getting in-depth training will allow them to adapt to changes much quicker than a mere communication announcement.

Presented in Figure 3 are the differences in pain, adverse effects, and time to analgesic effect when administering opioids and compared to other analgesic medications. Opioids may cause fewer total side effects compared to ketamine, but combining an opioid and ketamine may reduce a patient's pain more than an opioid by itself. When initial morphine is administered and is inadequate, giving ketamine may give greater and quicker pain relief than giving additional opioids. This provides evidence that ketamine should be implemented in treatment when considering the use of a narcotic analgesic. However, compared to opioids, using acetaminophen or other NSAIDs shows no difference in pain reduction from opioids and has fewer adverse effects than opioids. In light of this, first responders should think twice about their treatment to push narcotic analgesics and incorporate more acetaminophen and NSAIDs. If first responders are insistent on using some form of opioids, they should provide ketamine with the treatment of opioids, as it will reduce pain quickly.

The idea of adverse effects from opioids and ketamine was stated in Figure 3, but in Figure 4, seeing the prevalence of adverse effects in these gives more insight. While Figure 3 does not include which treatment induces more adverse effects, we see these details presented in Figure 4. Of patients administered opioids, 50% experienced adverse effects, which is less than the 82.40% of patients administered ketamine. This data shows that the adverse effects are lower among opioids compared to ketamine, even though ketamine helps with analgesic pain when used in conjunction with opioids. Having these facts for the DEA and Medical Director to use when specifying protocols can create a better treatment for the patient. The options are to use

opioids that are highly addictive and have fewer adverse effects, to use ketamine, which is not as addictive but has more adverse effects, or acetaminophen or other NSAIDs. Creating more detailed protocols on which situations to utilize the different medications based on the indications listed in Figure 2 will maximize medication treatment.

Knowing which opioid to use in treatments depends on the protocols, standing orders, first responder impression, and situation. Figures 5 and 6 give statistics on the percentage of specific adverse effects experienced by patients administered either fentanyl or morphine. Morphine is shown to have a lower percentage of adverse effects overall. For these two figures, they do not state the number of patients administered one opioid or the other, nor the dosages or condition of patients. Figure 7 sheds light on the number of patients administered various opioids and other medications. According to a study from NEMSIS in 2019, using the reports on 269,281 patients, fentanyl is the most commonly used analgesic medication. Morphine has a lower amount of adverse effects, but is used considerably less than fentanyl. This raises the question of whether it was used just as much as fentanyl, would it have the same lower prevalence of adverse effects, or would it increase as the usage increases? Assuming the statistic will only increase proportionally (morphine could have the same number of adverse effects, or more, if it were administered more), fentanyl would be the more suited opioid to use out of morphine and fentanyl.

Limitations

Specifically, in the prehospital setting, more data is needed to improve the accuracy of findings on the time to effect of different analgesics and their associated adverse effects. To help address this gap, Figure 3 was created based on data from the study "*Comparative Effectiveness*

of Analgesics to Reduce Acute Pain in the Prehospital Setting". The study included fifty-two randomized controlled studies and thirteen observational studies, but included indirect data from the emergency department setting. This can create discrepancies and biases as the emergency department and prehospital settings differ significantly regarding provider training, patient population, and available resources. The conclusions drawn from the emergency department data may not apply to the prehospital setting, and overall, this results in a reduction in the strength of the evidence presented in the comparisons of analgesics. The need for prehospital specific data is much needed if there are to be conclusions drawn from the analgesics used on patients to the adverse effects patients present. This data would then be applied in the revisions of protocols to treat patients more effectively.

There is an uncertainty for the future data results if more patients were to be administered NSAIDs. The data presented in Figure 7 on medication administration showcases that opioids are used more on patients than nonopioids by a large margin. This larger sample size strengthens the validity and reliability of the data on opioids, leading to more accurate results that first responders can then expect to see in patients administered those opioids. With nonopioids only being administered to less than 1%, the data's frequency of adverse side effects seen can be taken into consideration. Still, it will not be accurate for all patients in the prehospital setting.

There is a need for research that can give evidence and reasoning for using medications in specific situations and that takes into account the rate and chance of misuse. Finding the medications that can give the best outcome for the patient while reducing the frequency of adverse effects needs more data testing. It is a cost-and-reward when looking at the adverse events in Figure 3. Opioids may cause more adverse events than acetaminophen and NSAIDs, but, looking at Figure 7, opioids are administered more often. There is no strong evidence-based

data to back up the reasoning for such protocols to be changed due to fear of misuse and addiction. Only basing reasoning on adverse effects might create confusion for the first responders and the public if protocols are being changed for a reason that isn't backed up by research. Research and further testing need to occur to finalize protocols and medication administration.

Future Considerations

To tackle the ongoing opioid misuse epidemic, there needs to be better drug regulation, community education on opioids, prevention programs/campaigns, and restrictions on opioid prescriptions from pharmaceutical companies and medical first responders (The Lancet Regional Health-Americas 2022). Health and Human Services agencies are working to provide preventative measures, substance use treatment, and treatment groups to those affected by this epidemic. The sheer number of people directly and indirectly affected by opioids continues to put stress on first responders, prevention, and treatment efforts (NCDHHS).

Medical providers in the hospital setting are instructed by guidance and protocols, just like first responders in the prehospital setting. Medical providers are responsible for providing medications to patients to help with pain management and other symptoms. Just like first responders, these providers have a lot of weight on their shoulders to create the best course of action and prescribe the right amount of medications for their patients. They follow guidelines on how they are to prescribe such medications to patients. These providers are confident in their ability to use these guidelines to give patients prescriptions, but this overshadows the concerns they are also supposed to take into account for the addictive effects of opioids (Pearson et al. 2017). Medical providers need to be vigilant and considerate of their patients, so they don't

overlook the effects of their actions. In a study looking at the comfort level of providers prescribing narcotics, the majority of providers were comfortable prescribing narcotics to cancer patients but not to patients presenting with chronic or acute pain, like back pain. This study also looked at how many providers are not conducting urine toxicology tests, which look for a history of medications/narcotics used, before providing opioid therapy (Bhamb et al. 2006). Taking precautions when dealing with patients' lives is necessary and should not be overlooked for any reason. As medical providers, a patient's life is the number one priority. Being uncomfortable to give narcotics is one thing, but not taking into account a person's background before prescribing narcotics is negligence. Providing the right, concise instructions, education, and protocols will allow for comfort for all health providers, no matter the field.

Conclusion

Summary of Key Findings

The EMS systems across the country and in other countries continue to show differences in their opioid-related training of first responders and the protocols they are to follow. For example, they differ in their decisions to stay on scene or "scoop-and-go" and in the training given to first responders to ensure they are knowledgeable and can make quick, but thoughtful decisions when administering medications. In emergencies, time is the most valuable thing and a provider's best friend when administering medications via different routes and dosages. However, over time, first responders can get clouded in their judgment and expertise to make timely decisions without mistakes occurring. Revising protocols to limit confusion and stress, especially for ones already dealing with out-of-work stressors, a first responder can experience,

can increase the treatment of patients and limit mishaps from occurring. There are too many discrepancies between the regional protocols in the United States, and many mistakes are still occurring. These mistakes will have a bigger effect on a national level. Showing the protocols that differ will give the DEA and federal agencies a clear view of what needs to be revisited and revised.

Solutions

Finding that opioids are the most used medication in the prehospital setting shows just how much trust first responders have in the medications they are administering, but recently, there are better options to limit adverse effects from occurring while keeping the same level of pain relief. Gaining more statistical evidence to support this is what future research hopes to uncover to make more efficient protocols that prioritize patient treatment while limiting the strings that are attached. The goal is to better understand and support paramedics in their use of opioids while also making sure that better potentially, less risky treatments will need to be explored and possibly implemented.

Funding for lots of the government EMS systems comes from the citizens' tax dollars, and they hope that the government is there to provide services that they can rely on in times of emergency. EMS first responders are there to serve the public without any obstacles hindering them from getting to the patient, treating them, and getting to the hospital. Millions of emergencies are responded to each year, and patients continue to receive treatment no matter the case in the United States. There is no doubt that first responders are proficient in conducting their duties as public servants. The question is how the government is utilizing data and other facts to find risks for patient harm, point them out, and fix them before harm can be done. CQI is in place

to exploit this information. They find the mishaps and find the cause; whether that be the provider, the protocols given by the location EMS system, the protocols the DEA has outlined, the training not rendered, the additional training needed, or the supervisors that are in charge of those first responders giving guidance. Asking the question of utilization comes with how much information is being siphoned through to find the mistakes that occur. One mistake can lead to many others, especially if the cause is not caught and rectified. Even though adverse effects and mistakes can occur, with the right training and protocols, opioids can be utilized effectively for the care of patients.

It is advantageous to have agencies and teams in place at the regional levels to maximize the efficiency of drawing attention to problems to finding solutions, but the federal government needs effective communication with these EMS systems to maximize efforts. Federal agencies need to receive information on which national (medication) protocols are working (or not) and use that information to rework them. The latest version, put into effect under the Protecting Patient Access to Emergency Medications Act of 2017, is outdated and needs revisiting. Collecting data on these protocols and reworking them to fit a more uniform mold will move these from unsolved problems into revised solutions.

EMS systems carry the power to administer these medications in a controlled, responsible environment, but many variables, like first responder training, protocols, availability of opioids, route of administration access, age of provider, and first responder stress, play a role in the overall administration. The first responders have the final judgment to provide whatever action they see necessary to give to the patient, but careful consideration of the variables can prevent mistakes in their line of duty. Opioids, compared to acetaminophen and NSAIDs, cause no difference in pain reduction over the time intervals 15, 30, and 60 minutes (Figure 3), but cause

more adverse effects, which can create many questions as to why opioids are utilized more often in prehospital care. Opioids are a public epidemic compared to other medications, which can leave patients and officials (the DEA, the National Highway Traffic Safety Administration, and regional medical directors) who authorize the protocols wary of the use of opioids in emergencies. Without sufficient evidence to state that opioids are more effective at treating patients than nonopioids, administering nonopioids should be utilized. As stated above, opioids have more patients in the studies to create more statistically significant data, and the data does not look at the long-term effects of opioids and NSAIDs. However, if government agencies were to bring in more non-opioid medication administration, more training, literature, and visiting protocols would need to be put into place by the government agencies superseding the EMS systems (O'Connor et al. 2020). Through consistent, constant guidance of first responders and uniform protocols about how to appropriately use opioid medications in the prehospital setting, there would be benefits to the treatment and care of patients.

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