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Fast Drivers, Slow Progress: An Investigation of Evidence-Based Protocols in Kentucky Emergency Medical Services

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Abstract: Emergency medical services (EMS) is responsible for the prehospital management of medical emergencies. EMS professionals operate under the license of a practicing physician, or "medical director." The skills and procedures which EMS providers may perform are outlined as written "protocols." To investigate the evidence-based nature (or lack thereof) of EMS protocols, a convenience sample of ground EMS agencies within the state of Kentucky which provide ALS-level patient care was used. This sample consisted of agencies of varying run volumes that were located across all major geographic regions of the state. Twenty six agencies constituted the final sample. The full list of approved protocols for these agencies were requested through an open records request through the Kentucky Board of Emergency Medical Services (KBEMS), along with KBEMS' protocols. These protocols were examined for compliance with evidence-based practices which were supported by a literature review. Ten practices were selected for review, five pertaining to the management of suspected spinal injury through spinal motion restriction and five pertaining to the management of chest pain of suspected cardiac origin. **Conclusion:** Over 90% of agencies were compliant with 7 of the 10 examined practices, while less than 15% were compliant with the remaining 3

practices. KBEMS protocols were compliant with the same 7 practices, and non-compliant with the remaining 3. Overall, level of adherence with state-wide protocols had a much stronger relationship to compliance with the evidence base than any other studied agency demographical information (agency run volume, urban vs. rural).

Key words and phrases: Emergency medical services (EMS), evidence-based medicine, spinal motion restriction, acute coronary syndromes (ACS), Kentucky Board of Emergency Medical Services (KBEMS), protocols, emergency medical technician (EMT), paramedic.

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Introduction

Over the past two and a half decades, there has been a push within multiple professional fields to incorporate "evidence-based practices" (EBP) into everyday patient care. This term originated within medicine as "evidence-based medicine" (EBM) in 1992, which has since spread to the allied health professions and become the broader daughter term "evidence-based practice" (Ghali et. al, 1999). Generally, EBM can be defined as medical professionals' use of empirical data from clinical research trials to guide their diagnostic and/or treatment modality selection when caring for patients. Marjukka (2003, p. 1) stated more eloquently that evidence-based medicine is based on three principles: "1) finding dependable evidence to support health care decisions, 2) applying the evidence with clinical skill and experience, considering the clinical situation, patient or population expectations and values, and 3) evaluating the results."

While the practice of EBM was initially intended to improve clinical medicine and patient outcomes, there are specialized fields of the healthcare system which do not readily fit into the definition of a "clinical" setting, including emergency medical services (EMS). According to the National Highway Traffic Safety Administration (NHTSA), EMS is defined as "an intricate system" consisting of "agencies and organizations (both public and private), communications and transportation networks, trauma systems, hospitals, trauma centers, specialty care centers, rehabilitation facilities, highly trained

professionals . . . [and] an informed public" (NHTSA, n.d.). However, for the purposes of this project, EMS is defined as consisting of the healthcare professionals who are directly responsible for the medical care of patients and for the transportation of those patients from a scene to a healthcare facility or between two such facilities. In the American EMS system, this typically consists of emergency medical responders (EMRs), emergency medical technicians (EMTs), advanced emergency medical technicians (AEMTs), and paramedics (including flight paramedics). The most common levels of provider are EMTs and paramedics (The National Registry Data Dashboard, 2017).

This study focuses on advanced life support (ALS) EMS ground agencies in the state of Kentucky. An ALS agency is defined here as an EMS service which currently utilizes paramedics and is licensed by the state to allow these paramedics to perform within their scope of practice under formal medical direction. "Medical direction" in the context of this study should, unless otherwise specified, be assumed to represent the "medical director(s)" of the agency. Medical directors are physicians under whose license all EMS professionals of a specific agency function. The medical director forms and approves a set of protocols which outline the skills/procedures EMS providers may perform.

One final clarification that should be noted is that a "ground" EMS agency is an EMS agency whose primary mode of transporting patients is via ground ambulance. An "air" EMS system would represent an EMS system who transport patients via air ambulance (i.e., a helicopter or fixed-wing aircraft).

In accordance with the working definitions of these aforementioned terms, this study aims to investigate the frequency with which ground ALS EMS agencies within the state of Kentucky conform to the principles of evidence-based medicine. This was

accomplished through the review of protocols from a convenience sample of such agencies. The protocols were reviewed for spinal motion restriction criteria and the management of chest pain of suspected cardiac origin (for the remainder of this work, the term "chest pain" can be assumed to represent cardiac chest pain, also termed "acute coronary syndromes" [ACS]).

Current Literature

In order to examine the level of compliance by the studied agencies with EBM, a strong understanding of the current literature, or the "dependable evidence," as put forth by Majurkka (2003, p. 1) is necessary. The first category of evidence examined in this study pertains to prehospital spinal motion restriction. Since the inception of EMS, patients with suspected traumatic spinal injuries have been affixed to rigid long spine boards (LSBs) in order to "immobilize" the spine to prevent further spinal injury/neurological deficit. The most common protocol for "spinal immobilization" among EMS agencies is that of the National Association of Emergency Medical Technicians' (with collaboration of the American College of Surgeons' Committee on Trauma) Prehospital Trauma Life Support (PHTLS) curriculum. This curriculum includes mechanism as an inclusion criterion for spinal motion restriction (McSwain & Pons, 2016, p. 300). However, Hong et. al (2014) studied the efficacy of three spinal motion restriction protocols: the PHTLS recommendations, the Domeier protocol (which parallels the National Emergency X-Radiography Utilization Study [NEXUS] criteria), and the Hankins' criteria (immobilization for patients <12 or >65 years, those with altered consciousness, focal neurologic deficit, distracting injury, or midline or paraspinal tenderness). The authors found the PHTLS protocol to be the least effective of the three. This alludes to a clear lack of incorporation of EBM into EMS.

Next, there is a wide variety of medical protocols for cardiac emergencies within EMS. Savino et. al (2015, p. 993) outline the medical protocols of multiple EMS agencies in California. The authors argue that the protocols "vary widely" across the state. The authors list the current recommendations for chest pain protocols, and compare each agency studied to current national guidelines. These recommendations show how several widely-accepted treatments (such as nitroglycerine administration) are "prehospital recommendations that are based on only poor quality or minimal [level of evidence] studies or based on consensus" rather than based on controlled studies (p. 984). On the other hand, several agencies do not comply with evidence-based recommendations (e.g., field 12-lead interpretation and cardiac catheterization laboratory activation). One ALS agency did not even allow for the field interpretation of 12-lead electrocardiograms. This is a prime example of a discrepancy between the literature and common EMS practice and protocol. The most important contribution made by Savino et. al (2015, p. 984) is their assignment of a "Level of Evidence" (LOE) ranking to different practices performed in the prehospital setting by EMS agencies. Practices which were assigned a Level A rating were claimed to be "prehospital recommendations with a strong degree of certainty based on one or more [high LOE] studies." The authors found that these practices, in the context of a patient presenting with chest pain, were to withhold oxygen administration to normoxic patients (>94% peripheral capillary oxygen saturation [SpO_2]), administration of acetylsalicylic acid (aspirin—324 mg), the rapid acquisition of a 12-lead electrocardiogram (ECG) by the first medical contact, interpretation of the 12-lead ECG by EMS, and field activation of a cardiac catheterization (a percutaneous coronary intervention—PCI) lab, if available (if transport >90 minutes, transport should be initiated to a fibrinolytic-capable facility).

Methods

This study aimed to investigate whether EMS protocols in the state of Kentucky were based on evidence-based medicine, or whether they were more rooted in tradition. Exempted institutional review was sought (and granted) through the Eastern Kentucky University Institutional Review Board (IRB). Upon receipt of IRB approval, two separate open-records requests were placed through the Kentucky Board of Emergency Medical Services (KBEMS). KBEMS is the regulatory body that performs initial/renewed licensure for EMTs and paramedics, along with the licensure of ground and air ambulance services in the state of Kentucky (KBEMS, n.d.a).

The initial open-records request was used to determine the agencies which would be studied. The request was for the overall run volume of each licensed EMS agency within the state of Kentucky (N=199) during the most recent calendar year for which there was a full set of data, 2016. This request was filled using National EMS Information System (NEMSIS) 3.4.4 data points. The data points furnished consisted of:

- Agency Name (dAgency.03)
- Agency State (dAgency.04)
- Incident Year (2016)
- Agency Level of Service (dAgency.11)
- Count of Events

This report (provided as a Microsoft Excel® spreadsheet) was organized by descending number of run volume (count of events) for each agency in the state of Kentucky. Then, the agencies were divided into quarters of overall run volume by numbering each agency 1-199. Agencies 1-50 composed Quarter 1 (Q1, top quarter of agencies in Kentucky by run volume), Agencies 51-100 composed Q2 (second-highest

quarter), Agencies 101-150 composed Q3 (third quarter), and Agencies 151-199 composed Q4 (fourth, or bottom, quarter of agencies by run volume). A convenience sample was then created using multiple services from each individual quarter. To be included into the studied sample, the agency had to be 1) a ground EMS agency (air ambulance services were excluded) and 2) an ALS agency (under dAgency.11, only agencies listed as "2009 paramedic" were included). Initially, 33 agencies were intended to be included in the sample. After exclusions (discussed in "Data"), ten agencies from Q1, four agencies from Q2, seven agencies from Q3, and five agencies from Q4 were selected to be included in the final sample, for a total of 26 agencies. This convenience sample was representative of urban (n=9), rural (n=15), and super rural areas (n=2), as defined within U.S. Centers for Medicare & Medicaid Services [CMS] (2018). A considerable portion of the convenience sample was selected from geographic areas with which the author is particularly familiar (the Louisville area, central Kentucky, and eastern/southeastern Kentucky). This includes both agencies with which the author is currently employed. However, the author made a conscientious effort to select agencies from all major geographic regions of the state. There was also a considerably larger number of agencies from the highest quarter studied. This was partially due to the limited data from smaller agencies, and low run volume agencies were less likely to fit the ALS definition required for consideration in the sample. However, agency run volumes within the sample varied greatly, from a maximum of >120,000 runs to a minimum of 36 runs in 2016.

Once the sample was defined, a second open-records request was submitted to KBEMS. The entirety of approved protocols for each agency in the sample as of the 2016

calendar year were requested, along with current approved Kentucky state EMS protocols. This was accomplished using NEMSIS 3.4.4 data points including:

- dAgency.15 (Statistical Calendar Year) [2016]
- dConfiguration.10 (EMS Agency Protocols)

Upon receipt of the documents for each EMS agency's specific protocols, two tables were generated as rubrics to evaluate compliance with evidence-based practices. For spinal motion restriction, the practices/evidence-based criteria examined included:

1. The use of mechanism of injury as EXCLUSION criteria for spinal motion restriction rather than INCLUSION criteria.
2. A documented focus on limiting the use of rigid adjuncts (including the cervical collar).
3. Mention of either:
    a. To not delay airway management, hemorrhage control, or rapid transport for management of the spine.

    OR

    b. "Immobilization" being contraindicated for penetrating trauma unless neurological deficit is noted upon physical exam.
4. A focus on "spinal motion restriction" rather than rigid "spinal immobilization."
5. Elimination of the use of the long spine board (LSB) other than as an extrication tool.

In addition to the rubric generated for spinal motion restriction, one similar to that developed by Savino et al. (2015) was used to examine chest pain protocols:

1. A specific mention of rapid 12-lead electrocardiogram (ECG) acquisition and interpretation by a paramedic.
2. Allow for cardiac catheterization lab field activations (including transmission of 12-lead ECG if necessary).
3. Mention of:
    a. Witholding oxygen administration to normoxic patients (SpO_2 > 94%).

    AND/OR

    b. Ensuring oxygen administration for patients with signs of heart failure, shock, or hypoxia.
4. Administration of 324 mg of acetylsalicylic acid (aspirin) in cases of suspected myocardial infarction (MI).
5. The transportation of ST-Elevation Myocardial Infarction (STEMI) patients directly to a percutaneous coronary intervention (PCI)-capable facility OR transportation to a thrombolytic-capable facility if no available PCI center within 90 minutes transport.

Once each agency's protocols (including the state protocols) had been analyzed for compliance with the above spinal motion restriction and chest pain practices, the results were transposed to a Microsoft Excel® spreadsheet and data analysis was conducted.

Data

When investigating the protocols of each studied agency, the "protocol status" of each agency was determined. Protocol status refers to three options that EMS agencies in Kentucky may select when adopting patient care protocols. A second open-records

request furnished by KBEMS defined the protocol status of the agencies requested through the sample. This list of statuses was accompanied by a letter of brief description of each of the status options. The full letter received by KBEMS may be referenced in Appendix. However, the brief descriptions of status defined in the letter are as follows:

Full Adoption of State Protocols – EMS agencies can choose this option and their protocols and the protocol is automatically approved.

Partial Adoption with Additions or Deletions – This option allows EMS agencies to use the KY State Protocols as a guideline and they can add or delete from the document as their situation requires, and as approved by their medical director.

Autonomous Protocols – This option allows agencies to create their own, ad hoc protocols. These protocols will look quite different from the state protocols.

An understanding of these statuses can be used to interpret the data furnished by KBEMS. Below is **Table 1**, which was provided by KBEMS outlining the protocol status of each agency which was originally intended to be included in the sample. However, the agencies included were assigned numeric identifiers to maintain agency anonymity. These numeric identifiers were roughly assigned through a direct relationship to the agency's run volume. However, to maintain anonymity, the order within each individual quarter was shuffled. Agencies 1-14 are representative of Quarter 1 (Q1, top quarter of agencies in the state of Kentucky by run volume), Agencies 15-20 compose Q2 (second-highest quarter of agencies), Agencies 21-27 compose Q3 (third quarter), and Agencies 28-32 compose Q4 (fourth, or bottom, quarter of agencies by run volume).

Table 1

Protocol Status of All Agencies Originally Intended to be Included in the Sample

Agency	Quarter	CMS Designation	Protocol Status
1	Q1	Urban (U)	Autonomous
2	Q1	U	State with Addendums
3	Q1	Rural (R)	State with Addendums
4	Q1	R	Autonomous
5*	Q1	U	Autonomous
6	Q1	U	State with Addendums
7	Q1	R	State with Addendums
8*	Q1	U	Autonomous
9*	Q1	R	State with Addendums
10	Q1	R	State with Addendums
11	Q1	U	Full State Protocols
12*	Q1	R	Autonomous
13	Q1	R	Full State Protocols
14	Q1	U	State with Addendums
15	Q2	R	State with Addendums
16	Q2	U	Full State Protocols
17*	Q2	R	Autonomous
18*	Q2	R	State with Addendums
19	Q2	R	State with Addendums
20	Q2	R	State with Addendums
21	Q3	R	State with Addendums
22	Q3	R	State with Addendums
23	Q3	Super Rural (B)	Full State Protocols
24	Q3	R	Full State Protocols
25	Q3	R	Full State Protocols
26	Q3	U	State with Addendums
27	Q3	U	Full State Protocols
28	Q4	U	Autonomous
29	Q4	B	Full State Protocols
30	Q4	R	Full State Protocols
31*	Q4	U	No Data Available
32	Q4	R	Full State Protocols
33	Q4	R	Full State Protocols

* Agency was excluded from the final sample.

Of these agencies, KBEMS did not have data for Agency 31, and thus it was excluded from further data analysis. Also, two agencies (Agencies 17 and 18) were excluded due to a lack of availability of the full set of protocol addendums. In addition, Agencies 8, 9, and 12 were excluded because their protocols as furnished were either incomplete or missing data points required for this study. Finally, Agency 5 was excluded because its protocols pertaining to chest pain of suspected cardiac origin or spinal motion restriction were not explicitly stated.

For the agencies included in the sample, the full list of approved protocols were reviewed in order to determine the rate of compliance with the evidence-based practices stated within the methods section. Below are **Table 2** and **Table 3**, which present an analysis of the agencies' spinal motion restriction and ACS protocols, respectively.

In each table, a "yes" designation indicates that the agency's protocols were explicitly consistent with the evidence-based practice indicated in that column. A "no" designation indicates that the agency's protocols were either explicitly inconsistent with the practice or did not explicitly support the evidence-based practice. For some data points, short qualifiers are included along with the "yes" or "no" designation to indicate specifics of the assigned designation.

Below the two tables are Figures 1-4. **Figure 1** shows the percentages of agencies within each quarter which are compliant with each studied evidence-based spinal motion restriction practices. **Figure 2** shows the percentages of agencies within each quarter that are compliant with each studied evidence-based chest pain practice. **Figure 3** shows percentage of agencies compliant with spinal motion restriction protocols by CMS designation. **Figure 4** depicts percentage of agencies compliant with chest pain protocols by CMS designation.

Table 2

Spinal Motion Restriction Protocol Compliance of Agencies Within the Sample

Agency	Uses mechanism as EXCLUSION criteria, rather than INCLUSION (NEXUS/CCSR)	Focus on limiting the use of spinal adjuncts	Mentions to not delay of airway management, hemorrhage control, or rapid transport **OR** No immobilization for penetrating trauma unless neurological deficit is noted upon exam	Focus on "spinal motion restriction" rather than "spinal immobilization"	Eliminated long spine board other than for use as an extrication tool
KBEMS	Yes	Yes	No	Yes	No
1	Yes	Yes	Yes (penetrating trauma)	Yes	No
2	Yes	Yes	No	Yes	No
3	Yes	Yes	No	Yes	No
4	No	No	Yes (Maintenance of ABCs paramount)	No	No
6	Yes	Yes	No	Yes	No
7	Yes	Yes	No	Yes	No
10	Yes	Yes	No	Yes	No
11	Yes	Yes	No	Yes	No
13	Yes	Yes	No	Yes	No
14	Yes	Yes	No	Yes	No
15	Yes	Yes	No	Yes	No
16	Yes	Yes	No	Yes	No
19	Yes	Yes	No	Yes	No
20	Yes	Yes	No	Yes	No
21	Yes	Yes	No	Yes	No
22	Yes	Yes	No	Yes	No
23	Yes	Yes	No	Yes	No
24	Yes	Yes	No	Yes	No
25	Yes	Yes	No	Yes	No
26	Yes	Yes	No	Yes	No
27	Yes	Yes	No	Yes	No
28	Yes	No	No	No	No
29	Yes	Yes	No	Yes	No
30	Yes	Yes	No	Yes	No
32	Yes	Yes	No	Yes	No
33	Yes	Yes	No	Yes	No

Table 3

Chest Pain Protocol Compliance of Agencies Within the Sample

Agency	Rapid 12-lead ECG acquisition and interpretation	Cardiac catheterization lab field activations (transmission of 12-lead ECG if necessary)	Withholds oxygen administration for normoxic patients (>94% SpO_2) **AND/OR** Ensures oxygen administration for patients with signs of heart failure, shock, or hypoxia	324 mg of acetyl-salicylic acid (ASA—aspirin)	Transport for STEMI patients directly to PCI-capable center. If >90 minutes, transport to thrombolytic-capable facility.
KBEMS	Yes	Yes	No (15 lpm universal)	Yes	Yes
1	Yes (5 min acquired, 10 min transmission)	Yes	Yes (>95%)	Yes	Yes
2	Yes	Yes	No (15 lpm universal)	Yes	Yes
3	Yes	Yes	No (15 lpm universal)	Yes	Yes
4	Yes	Yes	Yes (>94%)	Yes	Yes
6	Yes	Yes	No (15 lpm universal)	Yes	Yes
7	Yes	Yes	No (15 lpm universal)	Yes	Yes
10	Yes	Yes	Yes (>90% and lack of patient distress)	Yes	Yes
11	Yes	Yes	No (15 lpm universal)	Yes	Yes
13	Yes	Yes	No (15 lpm universal)	Yes	Yes
14	Yes	Yes	No (15 lpm universal)	Yes	Yes
15	Yes	Yes	No (15 lpm universal)	Yes	Yes
16	Yes	Yes	No (15 lpm universal)	Yes	Yes
19	Yes	Yes	No (15 lpm universal)	Yes	Yes
20	Yes	Yes	No (15 lpm universal)	Yes	Yes
21	Yes	Yes	No (15 lpm universal)	Yes	Yes
22	Yes	Yes	No (15 lpm universal)	Yes	Yes
23	Yes	Yes	No (15 lpm universal)	Yes	Yes
24	Yes	Yes	No (15 lpm universal)	Yes	Yes
25	Yes	Yes	No (15 lpm universal)	Yes	Yes
26	Yes	Yes	No (15 lpm universal)	Yes	Yes
27	Yes	Yes	No (15 lpm universal)	Yes	Yes
28	Yes	Yes	No ("Optional" if >95%)	Yes	Yes
29	Yes	Yes	No (15 lpm universal)	Yes	Yes
30	Yes	Yes	No (15 lpm universal)	Yes	Yes
32	Yes	Yes	No (15 lpm universal)	Yes	Yes
33	Yes	Yes	No (15 lpm universal)	Yes	Yes

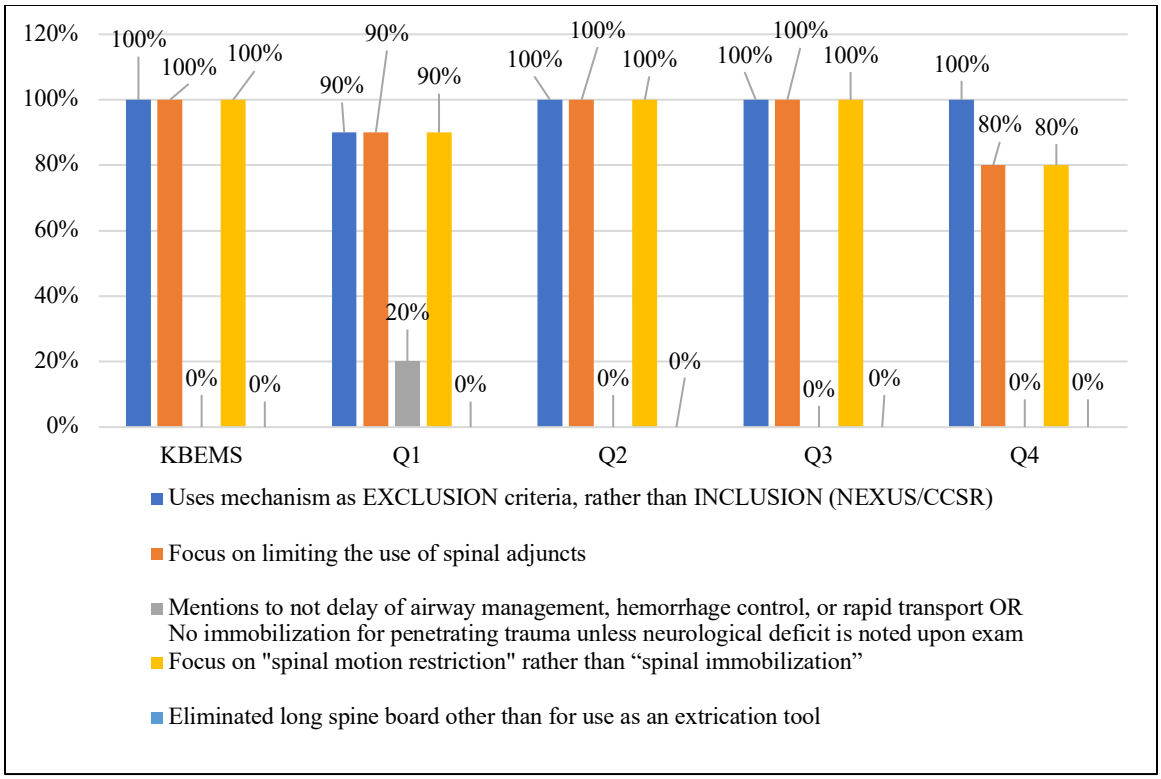

Figure 1. Percentage of agencies compliant with evidence-based spinal motion restriction protocols among all agencies studied by quarter.

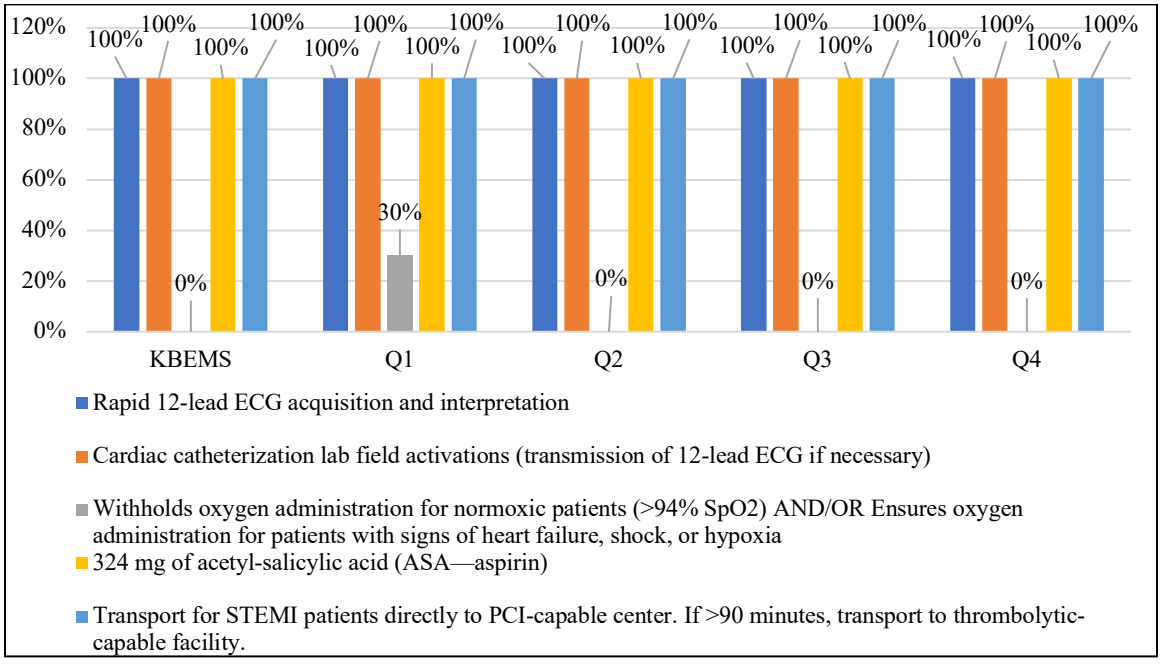

Figure 2. Percentage of agencies compliant with evidence-based chest pain protocols among all agencies studied by quarter.

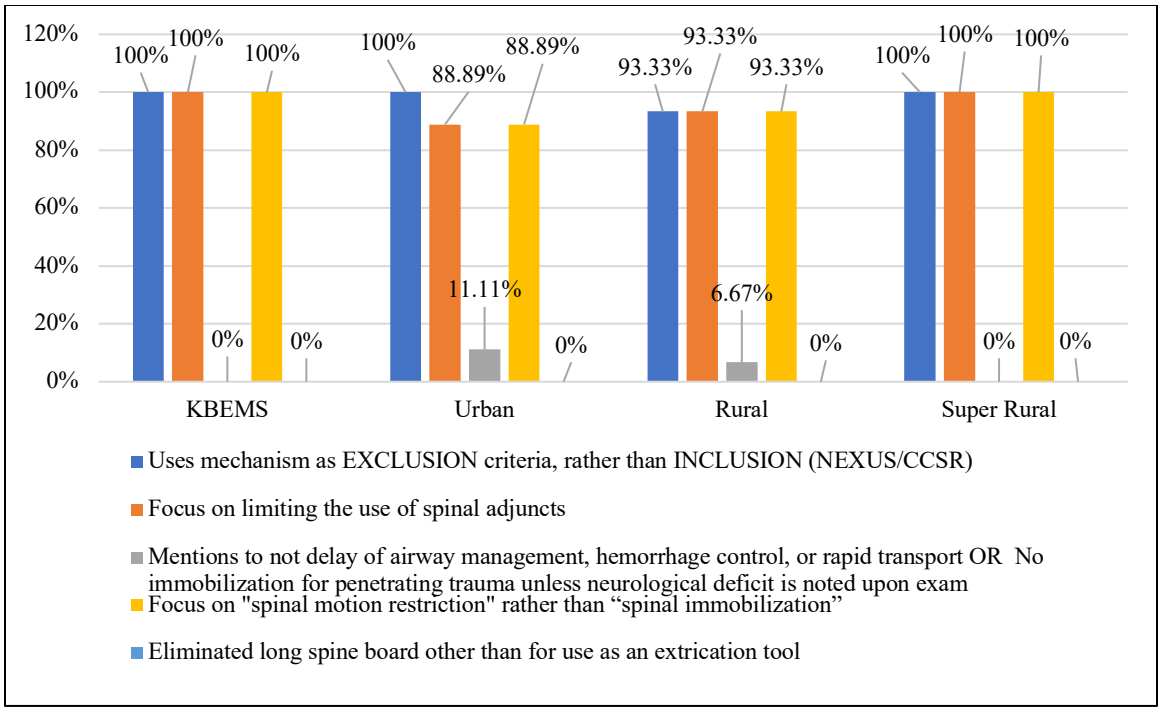

Figure 3. Percentage of agencies compliant with evidence-based spinal motion restriction protocols among all agencies studied by CMS designation.

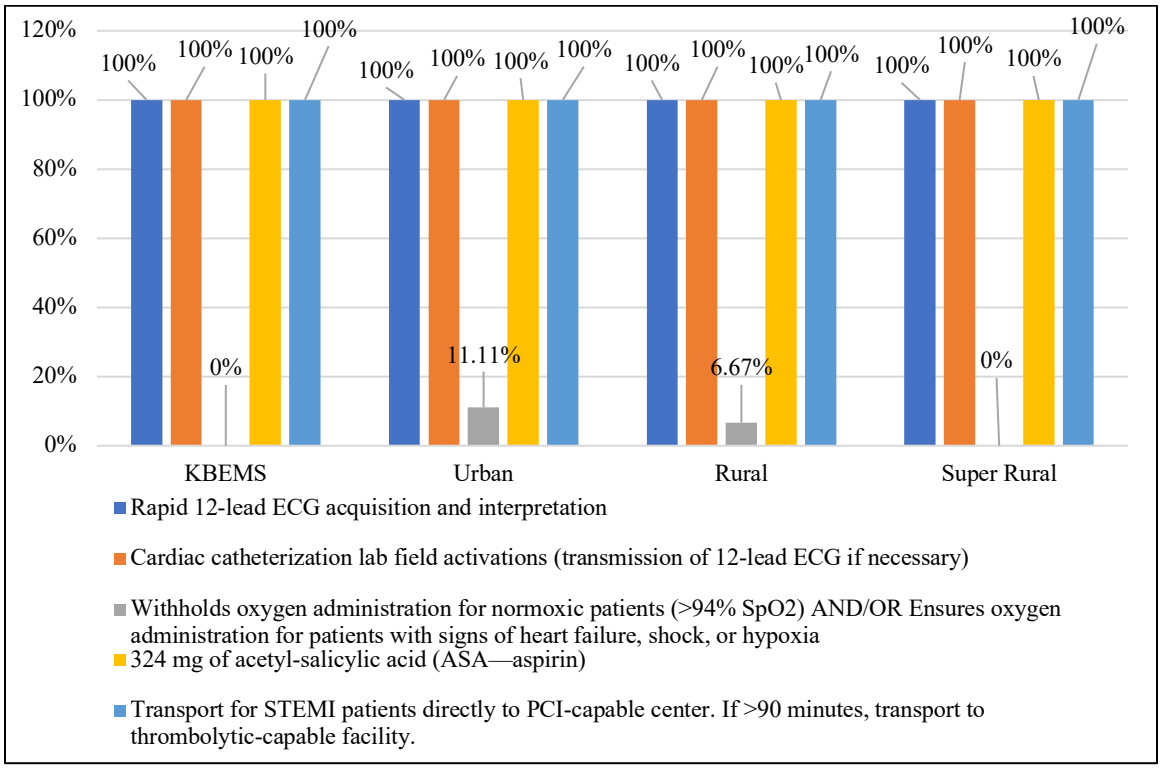

Figure 4. Percentage of agencies compliant with evidence-based chest pain protocols among all agencies studied by CMS designation.

Below is **Figure 5**, which depicts a broader outline of total compliance among agencies studied with each individual evidence-based practice examined. The percentage of agencies (n=26) compliant with each individual practice is shown.

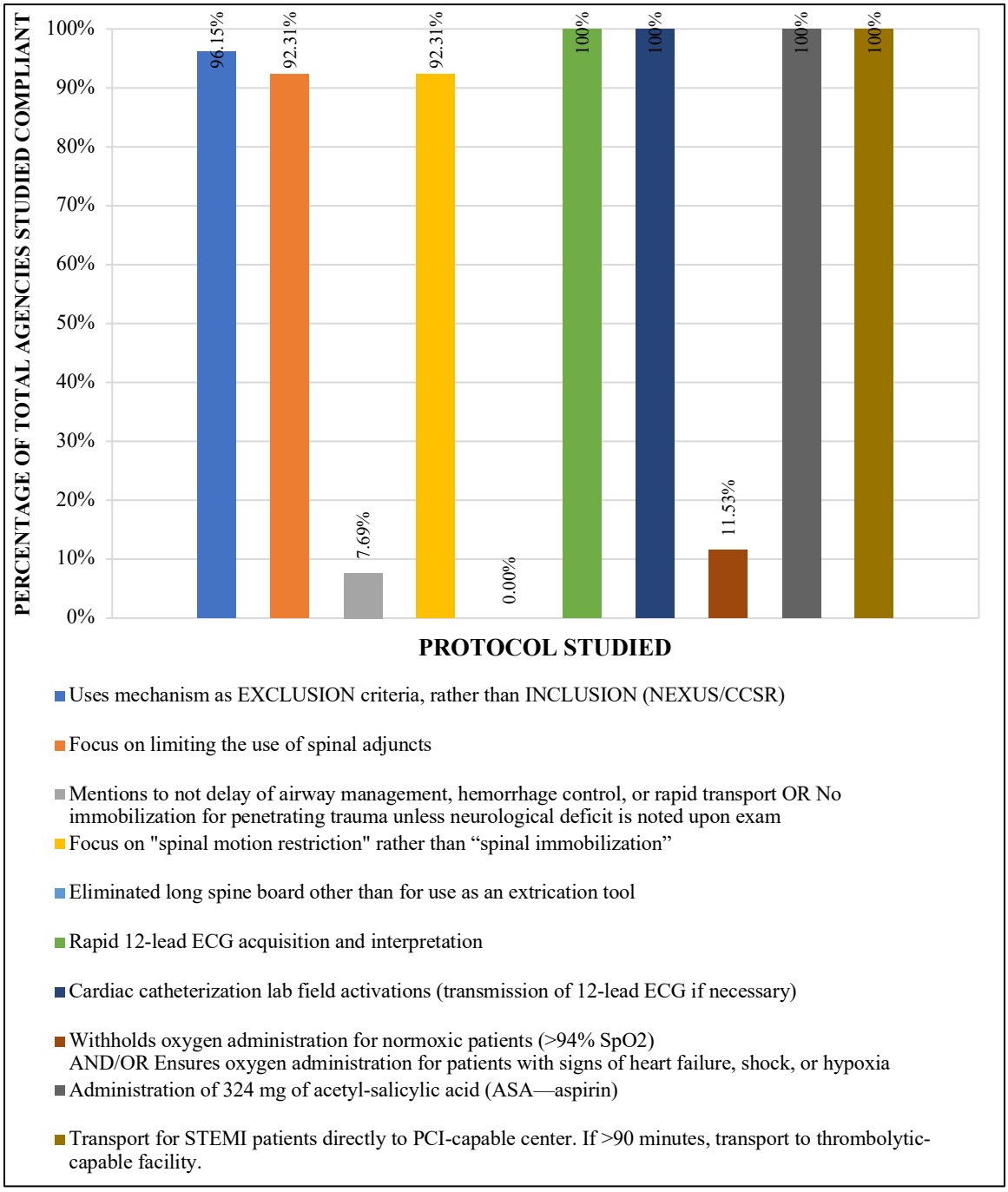

Figure 5. Percentage of total agencies compliant with each individual evidence-based practice examined.

Discussion

The overwhelming majority of agencies studied were compliant with 70% of the protocols investigated and non-compliant with the remaining 30%. As depicted in **Figure 5**, The protocols which had greater than 90% compliance among agencies studied were as follows:

Spinal:

- The use of mechanism of injury as EXCLUSION criteria for spinal motion restriction rather than INCLUSION criteria. (96.15% compliance)
- A documented focus on limiting the use of rigid adjuncts (including the cervical collar). (92.31%)
- A focus on "spinal motion restriction" rather than rigid "spinal immobilization." (92.31%)

Cardiac:

- A specific mention of rapid 12-lead electrocardiogram (ECG) acquisition and interpretation by a paramedic. (100%)
- Allow for cardiac catheterization lab field activations (including transmission of 12-lead ECG if necessary). (100%)
- Administration of 324 mg of acetylsalicylic acid (aspirin) in cases of suspected myocardial infarction (MI). (100%)
- The transportation of ST-Elevation Myocardial Infarction (STEMI) patients directly to a percutaneous coronary intervention (PCI)-capable facility OR transportation to a thrombolytic-capable facility if no available PCI center within 90 minutes transport. (100%)

The following protocols, on the other hand, had a rate of compliance less than 15%.

Spinal:

- Mention of either:
    a. To not delay airway management, hemorrhage control, or rapid transport.

    OR

    b. Immobilization being contraindicated for penetrating trauma unless neurological deficit is noted upon physical exam. (7.69%)
- Elimination of the use of the long spine board (LSB) other than as an extrication tool. (0.00%)

Cardiac:

- Mention of:
    a. Witholding oxygen administration to normoxic patients (SpO_2 > 94%).

    AND/OR

    b. Ensuring oxygen administration for patients with signs of heart failure, shock, or hypoxia. (11.53%)

These percentages show an overall trend in the data that the majority of agencies were “hit or miss” in their compliance with the current literature. Overall, the sample was relatively homogenous upon analysis of protocol compliance with each individual evidence-based practice. Typically, dissenting agencies were those whose protocols were “autonomous” in nature—those which did not resemble Kentucky state protocols in any fashion. Interestingly, the greatest predictor of agency compliance with individual

evidence-based practices was a factor which the author did not originally intend to study—the level of incorporation of state protocols by the agency.

The other factors examined, run volume and CMS designation, did not produce a significant difference in the rate of compliance among agencies. When examining **Figure 1** and **Figure 2**, it is clear that the overall number of agencies which were compliant with specific protocols did not appear to greatly differ between Q1, Q2, Q3, or Q4. While there were slight differences between quarters, agency protocols appeared to be quite similar to KBEMS protocols. This same trend can be witnessed in **Figure 3** and **Figure 4**, as well. There was no significant difference found between the protocols of agencies located within urban, rural, or super rural CMS-designated areas. In fact, each designated group had nearly identical rates of compliance among the different protocols, nearly matching that of KBEMS, as well.

However, it is worth noting that while there were no significant differences in the rate of compliance between these different demographical groups of agencies, there was a difference in the number of agencies in these groups which strictly adhered to state protocols. As can be seen in **Table 1**, agencies within Q1 and Q2 were the most likely to have protocol statuses of "autonomous" or "state with addendums." Including agencies which would later be excluded from the final sample, only 14.3% of agencies within Q1 had a protocol status of "full state protocols," compared to 80% of agencies in Q4. One can then see that agencies which have a lower run volume are more likely to utilize state protocols.

In addition, urban agencies were similarly more likely to adopt "autonomous" protocols than rural or super rural agencies. Out of the 7 agencies which adopted "autonomous" protocols, 4 (57.1%) of those agencies are urban by CMS designation.

This is a disproportionately large percentage of urban agencies, which comprise only 12 (36.4%) of the original 33 agencies intended to be studied. However, it is notable that urban agencies were more likely to have larger run volumes (66.7% of urban agencies were in Q1 and Q2). Thus, it can be assumed run volume is a stronger determinant of protocol status than CMS designation.

It is noteworthy that the protocols of EMS agencies studied were, overall, based in science. At least 90% of agencies were compliant with 70% of the practices examined. However, there is still significant room for improvement, and a precipitous increase in state-wide compliance could occur if there are future revisions of state protocols which serve to incorporate additional evidence-based practices.

One promising methodology for improvement of state-wide protocols is the diversification of the multidisciplinary team which reviews and revises these protocols. At the time of this paper, the medical oversight committee for KBEMS is comprised of emergency physicians, paramedics, and EMTs (KBEMS, n.d.b). Diversification of this committee could be a potential source of improvement of protocols through broadened expertise. For example, the state of Vermont recently incorporated the input of an emergency-medicine (EM) specialized pharmacist into the development and revision of pharmacological EMS protocols at the state level (Groth, McMillian, & Wolfson, 2015). The authors comment on the usefulness of the input of an EM pharmacist, and how such collaboration had the potential to reduce medication administration errors by EMS providers in the state.

Further, Munjal (2016) exposes the necessity of the EMS medical director (specifically, an EM physician) at the level of individual agencies to lead a “collaborative effort” (p.11) which would include physicians across numerous specialties, including (but

not limited to) cardiologists, critical care physicians, internists/family medicine physicians, pulmonologists, and endocrinologists. This type of collaboration could also be used at the state-wide level to help further refine the evidence-based protocols currently employed by the state.

To a certain degree, KBEMS has incorporated a range of medical disciplines into its review of protocols. Most prominently, KBEMS has designated a specific subcommittee on furthering an agenda to improve EMS management of "cardiac and stroke care (CSC)" (KBEMS, n.d.c). The current chair of the CSC subcommittee is a neurovascular surgeon. While this is a testament to the adoption of a multidisciplinary approach to the management of cardiovascular issues, the inclusion of other physicians from numerous specialties, as set forth by Munjal (2016), could serve to further enhance the management of all medical emergencies encountered in the prehospital setting.

Limitations

This project investigates the incorporation of evidence-based medicine into EMS in Kentucky. While the experimental design of this study examined the rate of adoption of evidence-based protocols by EMS agencies within the state, no data put forth by the author serves to implicate the rate of evidence-based practice by EMS providers within the state. Additional studies would be required to determine whether individual EMS personnel within the state adhere to elements of evidence-based medicine more so, less than, or at similar rates as EMS agency protocols, as a whole. A study of prehospital care in Iran showed a 20% protocol violation by prehospital EMS when presented with a patient experiencing chest pain and loss of consciousness (Mehrara et. al, 2017). The authors thus exposed the potential for sizeable differences between protocol and practice.

Further, this project focused on only two specific situations experienced within the prehospital setting—suspected spinal injury and chest pain of suspected cardiac origin. Due to the multiplicity of possible situations encountered in the prehospital environment which require protocols outlined by individual agencies, rate of compliance with evidence-based practice may differ in other areas of EMS patient care. However, an investigation of other medical emergency protocols (e.g. diabetic emergencies, cerebrovascular accident, or cardiac arrest) were beyond the scope of this study.

Additionally, there could be updated revisions of the studied agencies' protocols since 2016. However, calendar year 2016 was the most recently available full set of data and protocols, other than KBEMS' protocols, whose 2018 revisions were furnished.

Finally, this study was limited to the state of Kentucky. Additional studies would be required in order to determine the rate of incorporation of evidence-based protocols on a national scale. However, the results from this project may be used to examine the impact of state-wide protocols on individual agency compliance with EBM.

Conclusion

Overall, EMS agencies in the state of Kentucky providing ALS services were found to be evidence-based in nature when pertaining to suspected spinal injuries and cardiac emergencies. Over 90% of the agencies studied were compliant with at least 70% of the different protocols investigated. While there is significant room for improvement, it is clear that the majority of services examined followed the protocols of the Kentucky Board of Emergency Medical Services. These state-wide protocols had a much stronger relationship with the rate of compliance with practicing evidence-based medicine than did demographic differences between agencies (i.e. run volume, rural vs. urban setting).

However, rural agencies with lower run volumes were found to be more likely to strictly adhere to the full state protocols without additional, agency-specific addendums.

In sum, further revision of state-wide protocols in the state of Kentucky could result in an increased compliance of the majority of EMS agencies with the current foundation of evidence and lead to improved patient clinical outcomes for those who experience a prehospital medical emergency in the state.

Appendix

Email Regarding a Brief Explanation of Protocol Status Furnished Through KBEMS

10/01/2018

Transcribed by Author

Email Regarding a Brief Explanation of Protocol Status Furnished through KBEMS

10/01/2018

Transcribed by Author

Mr. Jones,

Kentucky EMS agencies are given three options for adopting patient care protocols. I will list those options with a brief description below. I have included a list of the agencies you requested with the option they chose. I will also include the Kentucky State EMS Protocol, which has been adopted by the Kentucky Board of EMS as a pre-approved option for patient care protocols. Within the file provided you will find the additions and deletions from the agencies marked "State with Addendums" as well as the Autonomous Protocols.

Full Adoption of State Protocols – EMS agencies can choose this option and their protocols and the protocol is automatically approved.

Partial Adoption with Additions or Deletions – This option allows EMS agencies to use the KY State Protocols as a guideline and they can add or delete from the document as their situation requires, and as approved by their medical director.

Autonomous Protocols – This option allows agencies to create their own, ad hoc protocols. These protocols will look quite different from the state protocols.

Thank you.

[Name redacted]

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