Is Emergency Medical Dispatcher Low-Acuity Code Selection Influenced by a User-Interface Software Modification?

Greg Scott, MBA, EMD-Q-I[1]; Chris Olola, PhD[1]; Isabel Gardett, PhD[1]; Meghan Broadbent, BS[1]; Srilakshmi Sangaraju, MS[1]; Bryon Schultz, BA[2]; Lisa Burnette[3]; Jeff Clawson, MD[1]

1. International Academies of Emergency Dispatch, Salt Lake City, Utah, USA
2. Emergency Medical Services Authority (EMSA), Oklahoma City and Tulsa, Oklahoma, USA
3. Salt Lake City 911, Salt Lake City, Utah, USA

Corresponding Author
Greg Scott
International Academies of Emergency Dispatch
110 Regent Street, 8th Floor, Salt Lake City, UT 84111 USA
Phone: 801-363-9127 Ext 205
Email: greg.scott@emergencydispatch.org

Keywords
Low-Acuity Calls, No Priority Symptoms Coding, Sick Person Protocol, Emergency Medical Dispatch, Medical Priority Dispatch System, User Interface Design.

Citation
Scott G, Olola C, Gardett I, Broadbent M, Sangaraju S, Schultz B, Burnette L, Clawson J. Is emergency medical dispatcher low-acuity code selection influenced by a user-interface software modification? *Ann Emerg Dispatch & Response*. 2018;6(2):11-16.

ABSTRACT

Introduction: *Sick Person (Specific Diagnosis)* is one of the most commonly used Chief Complaint Protocols in the Medical Priority Dispatch System™. Within the Sick Person Protocol, the 26-A-1 coding represents a group of patients with no specific identifiable complaint. This vague categorization presents a problem for dispatch systems and EMS responders alike, since so little is captured about the patient's true condition.
Objectives: The objective of this study was to determine whether changing the order of the "No" answer choice on the single Key Question, "Is 'primary problem' one of the listed ALPHA-level NON-PRIORITY complaints (2-12)?" would lower the frequency of selecting "No," along with the corresponding 26-A-1 final coding, and increase the frequency of selecting one of the other, more specific ALPHA- or OMEGA-level conditions.
Methods: This was a retrospective and prospective, non-randomized, observational study conducted at two IAED™ Accredited Centers of Excellence (ACEs) in the USA. For the control phase, the EMDs continued to use the existing MPDS® software system. For the intervention phase, a study protocol was developed that integrated two modifications into the ProQA® software: An answer choice was moved within a drop-down list and a dialog "comment" box was added.
Results: The percentage of ALPHA-level calls coded as 26-A-1 decreased significantly following the intervention (13.2% before and 9.3% after; $p < 0.001$). The amount of the decrease varied by study site. The overall frequency of ALPHA-level codes increased, while the frequency of OMEGA-level codes decreased. Some specific ALPHA-level codes, such as 26-A-2, increased following the intervention.
Conclusion: While it might not completely eliminate default selection and "work-arounds," a permanent change to the software, matching the modifications made for the intervention phase of this study, would be a first step to improving accuracy in selecting codes for this protocol.

INTRODUCTION

Sick Person (Specific Diagnosis) is one of the most commonly used Chief Complaint Protocols in the Medical Priority Dispatch System (MPDS).[1] Emergency medical dispatchers (EMDs) are trained to use this Chief Complaint (labeled numerically as Protocol 26) when the 911 caller describes a patient with no priority symptoms, no traumatic injuries, and no other identifiable primary problems that can be categorized in one of the other, more specific, Chief Complaints; it is also used when the caller proffers a "specific diagnosis" for the patient that is already known, such as sickle cell disease, as the immediate reason for the call. After selecting this protocol, the EMD completes a set of Key Questions in an attempt to discover a specific symptom (priority or otherwise), sign, or condition. The EMD then assigns a dispatch determinant code that, in turn, drives the response: the type of personnel sent and whether the crew(s) respond in a lights-and-siren mode.

Of particular concern among the *Sick Person* dispatch Determinant Codes is the 26-ALPHA-1 (26-A-1) code: *Sick Person, No priority symptoms (conditions 2-12 not identified).* As its full name suggests, this code is designed to be used only when the EMD cannot discover a more specific complaint, such as one of the listed NON-PRIORITY complaints—a menu of 11 specific common conditions that, by themselves, are not associated with time-critical emergencies and therefore receive a low-acuity (ALPHA-level) priority. In other words, the 26-A-1 coding represents a group of patients with no specific identifiable complaint other than, in some cases, an initially stated "diagnosis" that the patient is known to have,

and often only the very generic description of "sick." This vague categorization presents a problem for dispatch systems and EMS responders alike, since so little is captured about the patient's true, full condition.

Widely known and available, but not formally published data indicate a substantial use of the 26-A-1 Determinant Code. This one code accounts for between two and three percent of *all* emergency medical calls, and as high as 14–15% of calls handled on Protocol 26, even in high-compliance, IAED-accredited agencies. It is unclear whether EMDs are selecting this code correctly in most cases, or if it is simply a shortcut that provides a way to achieve a final coding without completing the last step of specifying one of the listed 11 conditions, which would trigger a final coding of 26-A-2 through 26-A-12. This explanation is plausible given the configuration of the Key Question answer choices in the current version of the MPDS software (ProQA, v13.0), the software version of MPDS. The Key Question, "Is 'primary problem' one of the listed ALPHA-level NON-PRIORITY complaints?," and its corresponding answer choices (a list of each of the 11 specific ALPHA conditions), are displayed along with an answer choice of "No." Currently the "No" answer choice is at the top of the list, making it the default answer that can simply be selected by pressing the "Enter" key. Once the default "No" answer is selected, 26-A-1 becomes the only ALPHA-level code available, and is the typical assigned code, provided a "No" answer is subsequently entered to the following question, which asks about the existence of any OMEGA conditions (which are also displayed as a list that allows selection of any of the OMEGA-level codes 2–28).

OBJECTIVE

The objective of this study was to determine whether changing the order of the "No" answer choice on this single Key Question would lower the frequency of selecting "No," along with the corresponding 26-A-1 final coding, and increase the frequency of selecting one of the other, more specific ALPHA- or OMEGA-code conditions.

METHODS

Study design and setting

This was a retrospective and prospective, non-randomized, observational study conducted at two IAED-Accredited Centers of Excellence (ACEs) in the USA: Emergency Medical Services Authority (EMSA), Oklahoma City and Tulsa, Oklahoma, and Salt Lake City 911 Bureau (SLC), Salt Lake City, Utah. Both centers used MPDS version 13.0 (NAE-OMG, 2015) and ProQA Paramount for Medical (5.1.1.20; 2017) logic engine software version during the study period.

The study consisted of two phases: a control phase (retrospective) and an intervention phase (prospective). For the control phase, EMDs continued to use the existing MPDS software system. For the intervention phase, a study protocol was developed that integrated two modifications into the ProQA software. Study data were collected from January through October, 2017; the intervention began on May 29 at EMSA and June 9 at SLC.

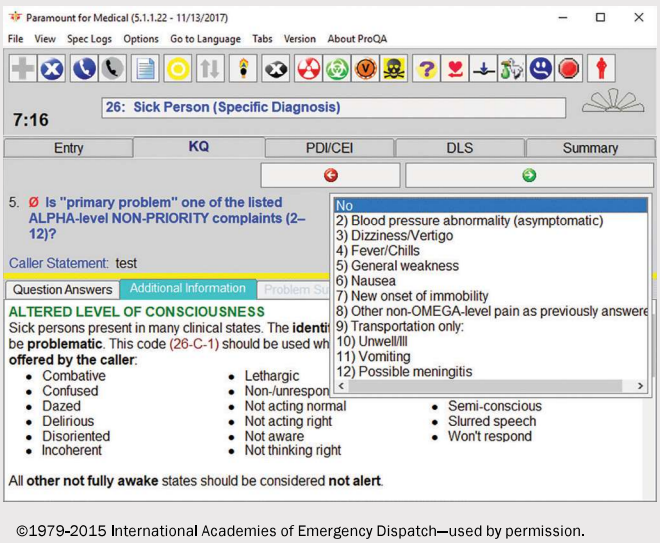


Figure 1a. ALPHA-level NON-PRIORITY Complaints list, prior to intervention

The study modifications affected a single Key Question on the Sick Person Protocol: Blue Operator Key Question 5, "Is 'primary problem' one of the listed ALPHA-level NON-PRIORITY complaints (2-12)?" The first modification was a change to the answer choice selection list. In the control (standard) software program, the answer choice "No" is the default answer at the top of the list, which includes 12 total options (Fig. 1a). In the study version of the software, the "No" answer choice was moved to the bottom of the list, removing it from the default position. The second software modification was the creation of a dialog (free text) box that automatically popped-up each time the "No" answer was selected, prompting the EMD to enter a description of the patient's actual, known condition, intended to capture the caller's description of the patient's primary complaint. In both the control and study versions, a "No" answer to the ALPHA-level complaints question brings up the OMEGA-level complaints question (Fig. 1b). Answering "No" to both questions is required to achieve the 26-A-1 code, since the selection of any OMEGA-level complaints would drive an OMEGA-level code.

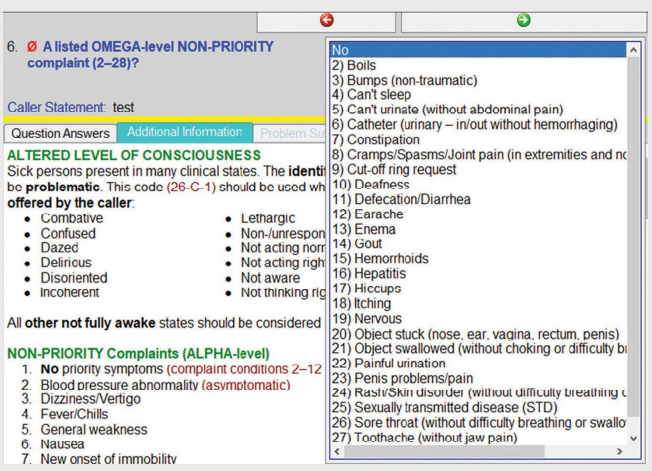


Figure 1b. OMEGA-level NON-PRIORITY Complaints list

Study population

The study population included all calls handled using the Sick Person Protocol (Protocol 26) at the study sites during the date ranges (approximately five months before and five months after the intervention, depending on the specific date the agency actually implemented the intervention version of the software).

Outcome measures

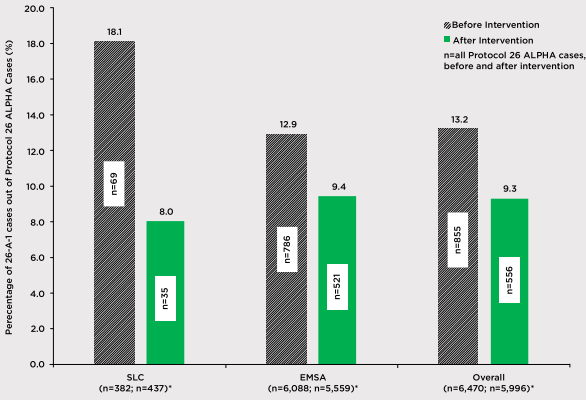
The primary endpoints were the frequency with which the "No" answer was selected for Key Question 5 in the Sick Person Protocol, both before and after the intervention, and the types of specific descriptions documented in the new dialog box by the EMD after a "No" answer was selected post-intervention. The secondary endpoint was the number of times each of the other ALPHA- and OMEGA-level codes were selected before and after the intervention.

Data analysis

R statistical software (RStudio, Inc., version 1.0.153 ©2009–2017) and STATA for Windows (STATA Statistical Software: release 14.2 ©1985–2015 StataCorp, College Station, TX) were used for data analysis. Descriptive statistics were used to present study analytics. The first analysis looked at the distribution of calls triaged using the 26-A-1 Determinant Code before and after the intervention, categorized by agency and overall. The next analyses assessed the overall distributions of cases for each Determinant Code in the ALPHA and OMEGA Priority Levels, before and after the intervention. Time-series analysis also characterized the distribution of 26-A-1 Determinant Code calls by week, before and after the intervention. The final analysis described the most common patient/caller problems, as documented by EMDs in the comment box.

RESULTS

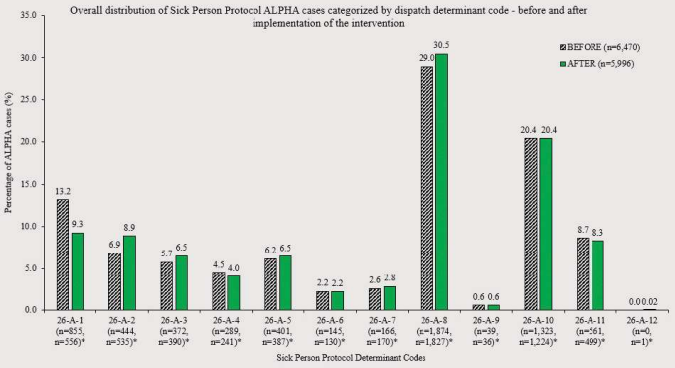
Overall, 12,466 of the calls handled on Protocol 26 during the study period were coded in the ALPHA level, of which 6,470 (51.9%) were in the control group (prior to the intervention). Likewise, of the total 3,425 OMEGA-level calls collected, 1,942 (56.7%) were in the control group. The percentage of ALPHA-level calls coded as 26-A-1 decreased significantly following the intervention (13.2% before and 9.3% after; $p < 0.001$) (Fig. 2). The amount of the decrease varied by site: from 18.1% to 8.0% ($p < 0.001$) in SLC and from 12.9% to 9.4% ($p < 0.001$) in EMSA.



*n = total Protocol 26 ALPHA cases, before and after the intervention, respectively

Figure 2. Distribution of 26-A-1 final coding (out of all ALPHA-level calls on Protocol 26)

The intervention also affected the frequency of other codes in both the ALPHA and OMEGA levels. In the ALPHA level, this included an increase in 26-A-2 (Blood pressure abnormality) to nearly 9% of all Protocol 26 ALPHAs, as well as increases in both 26-A-8 (Other pain) and 26-A-3 (Dizziness/Vertigo) (Fig. 3). Changes within the OMEGA level included a substantial decrease in 26-O-1 (No Priority Symptom (1st/2nd party)), but a matching increase in 26-O-28 (Wound infected), as well as increases in 26-O-8 (Cramps/Spasms/Joint Pain) and 26-O-19 (Nervous) (Fig. 4).



*n=ALPHA cases assigned the code before and after the intervention, respectively

Figure 3. Distribution of changes in the ALPHA Priority Level codes following the intervention

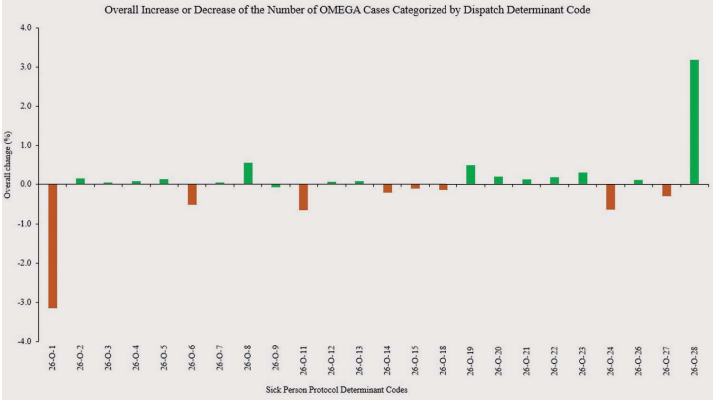


Figure 4. Distribution of changes in the OMEGA Priority Level codes following the intervention

Time-series analysis indicated that the frequency of occurrence of 26-A-1 sharply decreased after the implementation of the intervention, with variations by week (Fig. 5). Overall, the percentage of Protocol 26 calls handled in the ALPHA level increased following the intervention, while the percentage of OMEGA-level calls decreased ($p<0.001$ for both) (Table 1).

Figure 5. Time-series analysis of the distribution of 26-A-1 determinant calls before and after the intervention (black dotted line).

After the automatic comment box was added as part of the intervention, "pain" was the most common problem documented by the EMD, followed by "abnormal laboratory values" and "swollen" body parts (Table 2). Many EMDs also documented a single character (such as "X") in the comment log for a substantial number of cases.

DISCUSSION

The results of this study confirm that the simple graphic change of presenting answer choices in a different order in the ProQA software can have a measurable and significant influence on determining the answer choice selected by the EMD, and consequently the final Determinant Code assigned. In particular, this study shows that EMDs demonstrate a bias toward selecting the "first-listed" answer on the answer choice list, which is also the default answer (i.e., it can be selected simply by pressing the "Enter" key on the keyboard). Prior to the intervention, this default was the "no" answer, which led almost always to the outcome of 26-A-1. While these results demonstrate a likely problem with the current design of one particular user-interface feature within the medical ProQA software, they also provide an opportunity to improve dispatch accuracy by making some relatively simple changes to the software. In fact, user interface issues involving lists appear often in the published literature on computerized decision-support software,[2-4] with lists often leading to default-selection issues or wrong-item selection.

However, the distribution of codes following the intervention suggests that the default-selection problem is not completely solved by the movement of the "no" answer option. Following the intervention, while the percentage of 26-A-1 codes decreased, the percentage of 26-A-2 codes increased. Given the nature of the 26-A-2 code (Blood pressure abnormality), its previous very low frequency, and the fact that it increased significantly more than any other single ALPHA-level code, it seems more than likely that at least some EMDs were still simply using "Enter" to select the first-available answer choice—now resulting in a 26-A-2 code. Moreover, the comments entered by EMDs in the comment box following the intervention, which they were required to do each time they selected "no" (now at the bottom of the list), suggested that there remained many calls for which "no" was still not the best answer. For example, many of the types of pain listed in the comments would have been better assigned to one of the ALPHA- or OMEGA-level codes, and although there was some increase in the specific pain-related codes, these types of pain were also still

	OVERALL		BEFORE		AFTER		p value
	n	%	n	%	n	%	
P26	26,447		14,128		12,319		
P26 ALPHAs*	12,466	47.1	6,470	45.8	5,996	48.7	<0.001
P26 OMEGAs*	3,425	13.0	1,942	13.7	1,483	12.0	<0.001

Table 1: Overall changes in ALPHA- versus OMEGA-level codes

Type of EMD-recorded problem		Specific problem
General comments	Pain	Pain all over/Other Pain Leg Pain Abdominal Pain Foot Pain Knee Pain Back Pain Arm Pain Surgery Pain Facial Pain Nerve Pain Throat Pain
	Labs	Abnormal Lab Values Critical Labs
	Swollen	Swollen Limbs Swollen Swollen and Pain Swollen Face parts/Neck
	Other	Sick/Weakness, Peg Tube Isues, Kidney Problems, Ear Problems, BP Issues, skipped by user, Wounds, Cold/Shivering/Shaking, Infections, Anxiety, Panic Attack, Dehydration, Catheter Problems, Cough/Fever.

Table 2. Most common problems, as documented in the comment box (post-intervention)

often recorded in the "no" option via a comment. Also, many EMDs simply entered "X" or another nonsensical character in the box, suggesting that they were trying to avoid the extra work of adding the required comments at all. For these cases, it is still unknown whether "no" was the best answer and 26-A-1 the most appropriate code, or whether EMDs simply quickly learned the new system and invented new "work-arounds" and defaults.

Several explanations are possible for these EMD behaviors. The use of a default answer—one highlighted by the cursor at the top of the answer choice list—is the standard convention for all Key Questions in the ProQA software. However, Key Questions are most often presented to the EMD in a standard *Yes*/*No*/*Unknown* answer format immediately following a scripted Key Question. The Key Question studied here differs from the usual pattern. First, the EMD is presented with a list of answer choices that represent 11 separate patient conditions, with "No" as the only alternative to those conditions. Second, this Key Question is presented as an "operator question"—a question in blue text, which indicates that the EMD should simply enter an answer without asking the question aloud. The reason for this is that the answer should already be obvious based on information provided earlier in the call. The caller provides a description of the problem at the start of the medical interrogation (in response to the query "Tell me exactly what happened"), and the EMD is expected to select the condition that best matches that description, should it be one of the 11 conditions on the list on Protocol 26. The atypical formatting of this particular blue operator-type Key Question could be a confounder that not only requires the EMD to remember information from Case Entry, but gives the EMD a long list of answers to select from, possibly making for a less accurate selection than would otherwise be expected.

Another possible explanation for the EMDs' initial bias in favor of the "no" answer is that the Key Question studied here is presented only after all higher priority-level conditions have been ruled out. Hence, by the time this question is presented to the EMD, it is already a given that the case will not be assigned one of the higher priority levels (BRAVO through ECHO). And since few EMS response systems (in the U.S.) operationally distinguish between different ALPHA codes, or even between ALPHA-level and OMEGA-level codes (i.e., by assigning unique response modes and personnel/equipment to them), EMDs may be aware that their system's actual EMS response will not change regardless of the answer choice they select. With this knowledge in mind, the EMD may be prone to taking the path of least resistance and selecting the default answer choice.

The most obvious mitigation for achieving a more accurate determinant coding within the 26-ALPHA-priority level is to adopt the study version of the software as the new standard. This change may not perfectly address the problem, but in this study it certainly decreased the incidence of 26-A-1 and increased the incidence of other, more specific complaint description selections. Another possibility is to remove the "No" option altogether and replace it with "Other," including a required comment box with the selection of "Other." That way, the question would not be "does the patient have" any of the listed conditions, but "what is" or "what best describes" the patient's condition? That way, every patient's condition would be described using some specific code or EMD input, since EMDs would not have the "No" option as an alternative to entering or selecting specific information.

However, further study is required to understand the rationale behind the EMDs' behaviors following the intervention. One option would be a simulation, or "user experience," study, in which EMDs could be observed using the software so that their actual behaviors could be catalogued and their thought processes verbalized and documented. Specifically, the process known as "adherence engineering" can be used to analyze why noncompliant behaviors are occurring and to redesign protocols to encourage compliance.[5] For example, OMEGA-level codes 26-O-1 and 26-O-28, the first and last options on the OMEGA list, switched frequencies following the intervention: the frequency of 26-O-1 codes decreased (unexpectedly) by the exact amount that 26-O-28 codes increased (also unexpectedly). It is possible that EMDs assumed that the "no" answer in the OMEGA list had also been moved to the bottom and used the same work-around that they learned in the ALPHA list, going directly to the last item in the list without even seeing what it was. However, such an unsupported theory cannot be proven without actually watching the EMDs use the software. Understanding the EMDs' reasoning behind their selections would help ensure that changes made to the system would actually be adopted by EMDs, and potentially solve the default-selection problem.

Another option would be to develop a survey to determine EMDs' opinions regarding the purpose, importance, and function of this Key Question and its answer choice list. If EMDs believe that their selection of a specific condition-relevant Determinant Code will not affect any operational outcomes, they may have no motivation to change their behaviors. In fact, the selection of specific Determinant Codes is critically important. Past studies consistently indicate that certain high-acuity conditions, such as heart attack[6] and stroke,[7] can present with vague or low-acuity symptoms such as dizziness or nausea—and thus may end up receiving an ALPHA-level code. Selection of a specific condition code could indicate to responding EMS crews that a more serious condition is present. Moreover, the selection of specific condition codes allows for later research to be conducted on those codes, providing large-scale insight into which low-acuity presentations may need to be upgraded, more fully assessed, or clinically monitored because they indicate possible higher-severity conditions.

Although this study is relatively limited in its direct effects—touching as it does on only one subset of ALPHA-level codes with, in most agencies, limited operational effect—it nonetheless brings to light a significant larger issue: the need to optimize emergency dispatch software for usability and adherence. If the movement of a single answer choice can affect the incidence of not only all the other ALPHA codes but the OMEGA-level codes as well, it is likely that the positioning, logic, and presentation of other questions, lists, and interface elements is also affecting final coding and, as a result, dispatch decisions and resource allocation in many other call types.

LIMITATIONS

Since this study was done in just two of the several thousand agencies using the ProQA software, both located in the U.S., it is possible that these results are not generalizable to all agencies using ProQA. This limitation is significantly narrowed by the fact that these are proven, highly-compliant emergency dispatch agencies, as demonstrated by their ACE designation. Further, there may be operational factors that could influence EMD behavior at agencies not included in this study, such as unique response assignments for different ALPHA-level codes within Protocol 26 or use of an alternative care referral system, which would necessitate a much higher degree of answer choice precision for the Key Question studied here.

CONCLUSION

For EMDs using the ProQA medical software, there was a significant decrease in the number of cases coded as 26-A-1 after the order of the answer choice list was changed. Also, the frequency of ALPHA-level codes decreased overall, while the frequency of OMEGA-level codes increased. These results suggest that, while it might not completely eliminate default selection and "work-arounds," a permanent change to the software, matching the modifications made for the intervention phase of this study, would be a first step to improving accuracy in selecting codes for this protocol. Future research should examine the EMDs' judgment regarding the perceived value of this question to determine whether additional education is needed for this component of the MPDS ProQA software. Additional training on correct Chief Complaint selection and specific symptoms that do not belong in the ALPHA level should also be considered. Moreover, further research is needed to better understand the effect of usability and "adherence engineering" elements of emergency dispatch software on user coding and resources dispatched.

ACKNOWLEDGMENTS

The authors would like to acknowledge Denise Jorgensen for her administrative support in conducting this study. (Denise passed away unexpectedly on February 15, 2018.)

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