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Development of an Emergency Medicine Pharmacy Intensity Score Tool

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Development of an emergency medicine pharmacy intensity score tool

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Purpose. Emergency medicine pharmacists (EMPs) have been demonstrated to have a positive impact on patient outcomes in a variety of clinical scenarios in the emergency department (ED), yet their distribution across the nation is suboptimal. An emergency medicine pharmacy intensity score tool (EMPIST) would not only facilitate the quantification of EMP staffing needs and ideal resource deployment times, but would also allow practitioners to triage patient care activities. The purpose of this investigation was to develop an EMPIST and evaluate its relationship to EMP activities.

Methods. This was a multicenter, prospective, observational analysis of an EMPIST developed by practicing EMPs. EMPs prospectively documented their clinical activities during usual care for patients in their ED. Spearman's rank-order correlation was used to determine any correlation between the EMPIST and pharmacist activities.

Results. In total, 970 EMP activities and 584 EMPIST items were documented in 352 patients by 7 EMPs across 7 different EDs. The most commonly documented EMP interventions performed were bedside monitoring (12.7%), initiation of nonantimicrobial therapy (12.6%), and antimicrobial therapy initiation and streamlining (10.6%). The total EMPIST was found to significantly correlate with EMP activities, and this correlation was consistent across both "diagnostic/presentation" and "medication" items ($P < 0.001$ for all comparisons).

Conclusion. The EMPIST significantly correlated with EMP activities, with consistent correlation across all subgroups. Its utilization has the potential to enhance bedside clinical practice and optimize the deployment of limited EMP services. Additional investigations are needed to examine the validity of this tool and identify any relationship it may have to patient outcomes.

Keywords: emergency medicine, patient acuity, pharmacists, pharmacy, triage

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The practice of emergency medicine pharmacy has grown dramatically over the last few decades, and emergency medicine pharmacists (EMPs) are now endorsed by multiple organizations, including the American College of Emergency Physicians and the American College of Medical Toxicology.[1,2] Guidelines from the American Society of Health-System Pharmacists suggest that EMPs provide a multitude of essential direct patient care services such as medication therapy monitoring, resuscitation, medication procurement and preparation, care of admitted patients, and provision of drug information.[3] Further, EMPs have been demonstrated to have positive impacts on patient outcomes in the settings of postintubation care, acute ischemic stroke, acute myocardial infarction, and a variety of other clinical scenarios in the emergency department (ED).[4-7] However, despite this broad foundation of support, the presence of EMPs is not ubiquitous and most institutions that have EMP services in the US report having coverage for less than 8 hours each day while 35% do not provide any coverage on the weekends.[8]

Traditionally, the need for healthcare resources has been determined based on measures of patient acuity or census. While these measures may accurately reflect the overall severity of illness of each patient, they do not always accurately reflect the pharmacotherapy needs of each patient.[9-11] To address this gap, some have developed scoring systems based on medication regimens and their complexity. These scoring systems aim to provide a tool to better categorize and identify patients who are most likely to need, and subsequently benefit from, pharmacotherapy services.[12-14] For a tool to be functional in the EM setting, it needs to be inclusive not only of medications but also of initial patient presentation characteristics, to address the wide variety of patients who reside in the ED, from admitted patients to emergent presentations.[2,15,16] An emergency medicine pharmacy intensity score tool (EMPIST) would allow for better quantification of EMP staffing needs,

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help identify ideal resource deployment times, and help practitioners organize, design, and triage their patient care activities over the course of their day. The purpose of this investigation was to develop an EMPIST and evaluate its relationship to EMP activities in a prospective fashion across multiple institutions.

Methods

This study was a multicenter, prospective, observational study conducted by the American College of Clinical Pharmacy (ACCP) Emergency Medicine Practice and Research Network (EMED PRN) Research Committee. The committee was composed of volunteer members from the ACCP EMED PRN. A subcommittee of 8 EMPs evaluated 129 parameters derived from existing research into a medication regimen complexity score.[13,17-19] Monthly virtual meetings were conducted, and consensus was reached via group discussion on 97 parameters to include in an anonymous survey that was developed and distributed to the entire ACCP EMED PRN Research Committee (n = 26) for validation (eAppendix A). Each parameter consisted of 3 questions: Should it be included? (yes/no); How selective is this in estimating pharmacotherapy needs? (ordinal scale: 1-4); Comments? (open-ended). On the basis of the responses to this survey, items were identified as eligible for inclusion and were subsequently weighted via a consensus mathematical model of the subcommittee, assigning higher values based on the selectivity of the item as estimated by survey respondents. Following a virtual group discussion and anonymous voting by participants on the appropriate cutoff value for parameter inclusion, the subcommittee achieved a consensus regarding 36 of the highest-scoring parameters to include in the EMPIST (Box 1). A subsequent survey was built for 7 EMPs to pilot the tool over a total of four 40-hour weeks at each practitioner's respective institution (1,120 total hours) (eAppendix B). Each

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individual EMP prospectively documented their clinical activities practicing in the ED during usual care for patients in their ED via a previously published validated pharmacy intervention structure and simultaneously documented the presence or absence of any of the 36 parameters in question in real time.[20] The total EMPIST score was the sum of all parameters present. All results were deidentified. The survey was open from May 27 to December 1, 2021. Institutional review board approval was obtained for this investigation.

The primary outcome was the correlation between the total sum of the EMPIST score and the sum of EMP activities, with each individual item and activity assigned a point value of 1. Secondary outcomes included the relationship of individual EMPIST items and items in the EMPIST subcomponents of "diagnostic/presentation" and "medication" with EMP activities. EMPIST items were broken into "diagnostic/presentation" (eg, acute stroke or open fracture) and "medication" (eg, epinephrine or mannitol) groups to better identify parameters that account for emergent presentations and parameters such as medications used in emergent situations that are readily available data points to use in calculating expansion of EMP services. Study data were collected and managed using REDCap.[21] Statistical analysis was completed using IBM SPSS Statistics for Windows, Version 28.0 (IBM Corporation, Armonk, NY). Descriptive statistics were calculated for all variables, and agreement between EMP activities and the scoring tool was assessed using Spearman's rank-order correlation coefficient (*r*). A two-sided *P* value of <0.05 was considered statistically significant.

Results

A total of 970 EMP interventions were performed by 7 EMPs, with 584 EMPIST items documented, in 352 patients over the survey period (Table 1). The most frequently documented EMP interventions performed were bedside monitoring (12.7%), initiation of

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nonantimicrobial therapy (12.6%), and antimicrobial therapy initiation and streamlining (10.6%) (Table 2). Of the total 584 EMPIST items documented, 69.9% were "diagnostic/presentation" items, with the most common being "trauma alert" (17.9%), "acute stroke" (14.5%), and "Glasgow Coma Score <8" (14.2%). Of the 176 EMPIST "medication" items, "neuromuscular blocking agent-bolus dose only" (18.8%), "vasopressor continuous infusion" (17.0%), and "epinephrine" (15.3%) were the most common.

The total EMPIST score, "diagnostic/presentation" subgroup score, and "medication" subgroup score were all found to significantly correlate with EMP activities ($P < 0.001$ for all comparisons). Individual components of the EMPIST were also found to correlate significantly with EMP activities, with "mechanical ventilation" ($r = 0.304$), "Glasgow Coma Score <8" ($r = 0.296$), "neuromuscular blocking agent-bolus dose only" ($r = 0.288$), and "systolic blood pressure <90 mm Hg" ($r = 0.274$) having the strongest correlations. When only significantly associated individual components were included in the model, a stronger correlation with pharmacist activities was noted ($r = 0.450$; $P < 0.001$).

Discussion

In this prospective, multicenter, observational analysis, the total EMPIST score significantly correlated with EMP activities. This significant correlation was consistent across both the "diagnostic/presentation" and "medication" subgroups. The strength of the correlation was enhanced further through the use of only the individual components found to demonstrate significance. The most frequent activities documented by EMPs, "bedside monitoring," "initiation of nonantimicrobial therapy," and "antimicrobial therapy initiation and streamlining," are consistent with those documented in other larger studies of EMP activities.[20] The individual EMPIST items that displayed the strongest correlation with EMP

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activities are also consistent with EMP activities that have been documented in the literature with regard to areas where EMPs have positive impacts on patient care. The significant correlations noted for “mechanical ventilation,” “Glasgow Coma Score <8,” and “neuromuscular blocking agent-bolus dose only” are all consistent with the documented role EMPs have in rapid-sequence intubation.[22,23] In addition, the significant correlations noted with “systolic blood pressure <90 mm Hg,” “mean arterial pressure <65 mm Hg,” “vasopressor continuous infusion,” “epinephrine (any form),” and “inotropes” are all consistent with the identified role EMPS have in the management of sepsis and septic shock.[7,24]

To our knowledge, this is the first investigation to develop such a tool specifically for the ED and demonstrate a relationship between the scoring tool and EMP activities. Utilization of the EMPIST can have wide-ranging benefits, including the real-time identification of ED patients who can benefit the most from EMP cognitive and physical services, as well as providing objective data to justify the much-needed expansion of EMP services within EDs. Although copious data exist describing the benefits of, and support for, EMP services, data are sparse describing the optimal deployment and organization of these services.[7] In fact, most institutions with EMP services report limited coverage per day and even more limited coverage on weekends.[8] While this incongruent coverage is concerning for patient care, it is due in part to the fact that very little is known about the optimal EMP staffing model and factors that contribute to variability in the current staffing model. In addition to substantial staffing model differences, variations in training and education have also been noted. One survey found that the training and education of EMPs varied greatly, with less than 20% having completed EM postgraduate year 2 training while almost half had completed only postgraduate year 1 residency training.[25] In a practice setting with a diverse

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array of emergent clinical presentations, limited training and experience can lead to a multitude of challenges for EMPs, particularly when deciding where and when to deploy cognitive services when presented with multiple emergently ill patients.

In other areas of the hospital, scoring systems have been developed with the aim of providing a tool to better categorize and identify patients who may benefit from pharmacotherapy services.[12,13] The medication regimen complexity index (MRCI) and the medication regimen complexity-intensive care unit (MRC-ICU) are 2 such tools that have been developed for different clinical settings. Further studies have even established that the MRC-ICU, as well as its modified version (mMRC-ICU), correlates well with patient clinical outcomes such as length of stay and mortality.[17,26] Hence, this problem is not unique to EM, but the size of the opportunity in EM dwarfs that in other areas due to the continuous, around-the-clock care that is necessary and the emergent nature of its provision. Further, these tools rely heavily on existing pharmacotherapy and medication orders; as such, their utility and validity for undifferentiated patients presenting to the ED with no existing medication orders is limited.[2,15,16] An EMPIST would help to address this deficiency, assisting in the identification of optimal EMP deployment times and aiding practitioners with real-time triage of patients during the busiest portions of the day or in locations of the ED that are more removed from practitioners' immediate physical location (eg, a pediatric ED located across the hall). One recent report described the merger of 5 hospitals and the challenges of aligning their EMP services.[27] All had different weekday and weekend coverage hours, and very disparate EMP clinical services were provided at each site. The authors used existing guidelines and consensus opinion to identify optimal workflows and achieve practice alignment. However, utilization of a quantifiable tool such as the EMPIST could be an additional objective tool to help achieve optimal deployment of these limited resources.

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Subsequent studies are needed to establish the validity of the EMPIST and its utility in triaging patients at the bedside and designing optimal practice models. Further, exploration of its correlation with patient outcomes and, by association, the potential impact of bedside EMPs on those outcomes is also warranted. Future integration of such a scoring tool into the electronic medical record for immediate application at the bedside, both for emergent patient care and for optimization of resource distribution, particularly in times of crisis (eg, disasters or pandemics), could be of great utility in responding to the ebbs and flows of emergency medical care.

Although this was a multicenter analysis, its generalizability is limited due to the small subgroup included compared to the diversity of EDs across the nation. Certain factors identified a priori were unable to be fully assessed due to the absence of those factors in patients presenting during the study timeframe. Further, the design of this study limited the identification of any relationship between the EMPIST, EMP activities, and patient outcomes. Additional studies are needed to identify these relationships, if any. As with any investigation involving self-documentation of EMP activities, there was the potential for bias, including both under- and overdocumentation of activities performed by the pharmacists, which may have influenced the results of the analysis. Further, as the researchers' activities were also the focus of the investigation, this may have led to unintended modifications in behavior by the participants that went unmeasured. The time period of data collection was inclusive of the coronavirus disease 2019 (COVID-19) pandemic, albeit during the second year. The impact that the pandemic had on patient presentations, diagnosis, and consequently EMP activities is difficult to distill and is an unmeasured confounder.

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Conclusion

The EMPIST significantly correlated with EMP activities, and this correlation was consistent across all subgroups. Utilization of such a tool has the potential to enhance bedside clinical practice and optimize the deployment of limited EMP services. Additional investigations are needed to ensure the validity of this tool and identify any relationship it may have to patient outcomes.

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Disclosures

The authors have declared no potential conflicts of interest.

Additional information

The authors have submitted this work on behalf of the Research Committee of the Emergency Medicine Practice and Research Network of the American College of Clinical Pharmacy. It does not necessarily represent an official American College of Clinical Pharmacy commentary, guideline, or statement of policy or position.

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Key Points

- The need for emergency medicine pharmacists (EMPs) has traditionally been determined based on measures of patient acuity or census, which do not reflect the pharmacotherapy needs of individual patients.
- An emergency medicine pharmacy intensity score tool (EMPIST) would allow for better quantification of staffing needs, help identify optimal deployment times, and assist practitioners in identifying and triaging patient care activities.
- In this prospective, multicenter analysis, the total EMPIST score significantly correlated with EMP activities, and this correlation was consistent across all subgroups.

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Table 1. Emergency Medicine Pharmacist Characteristics

Characteristic	**EMPs (n = 7)**
Years in practice, No. (%)	
>1-3	1 (14.3)
>3-6	3 (42.8)
>6-12	2 (28.6)
≥12	1 (14.3)
ED visits per year, mean (SD)	78,286 (27,369)
Institution type, No. (%)	
Academic medical center	4 (57.1)
Community teaching	1 (14.3)
Community nonteaching	2 (28.6)
Region, No. (%)	
West	3 (42.8)
Midwest	1 (14.3)
South	2 (28.6)
Northeast	1 (14.3)
Typical hours covered, No. (%)	
Day (eg, 7 AM-3 PM)	1 (14.3)
Midday (eg, 9 AM-7 PM)	3 (42.8)
Swing (eg, 1 PM-midnight)	3 (42.8)
Special populations seen, No. (%)	
Pediatrics	5 (71.4)
Trauma	5 (71.4)
Stroke	7 (100)

Abbreviations: ED, emergency department; EMPs, emergency medicine pharmacists.

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Table 2. Pharmacist Activities

Type of activity	Activities (n = 970)[a]
Bedside monitoring	123 (12.7)
Initiation of nonantimicrobial therapy	122 (12.6)
Antimicrobial therapy initiation and streamlining	106 (10.9)
Culture follow-up after emergency department discharge	54 (5.6)
Emergency code stroke participation	53 (5.5)
Drug information consultation	53 (5.5)
Discontinuation of clinically unwarranted therapy	51 (5.3)
Emergency procedural sedation or rapid-sequence intubation participation	48 (4.9)
Dosage adjustment: no continuous renal replacement therapy	43 (4.4)
Rapid response team participation	42 (4.3)
Major ADE prevention	33 (3.4)
Patient own medication evaluation	30 (3.1)
Recommended laboratory monitoring	27 (2.8)
Prevention of unnecessary high-cost medication	26 (2.7)
Minor ADE prevention	24 (2.5)
Cardiopulmonary arrest participation	24 (2.5)
Anticoagulant therapy management	14 (1.4)
Drug information consultation: toxicology specific	11 (1.1)
Medication reconciliation resulting in major ADE prevention	10 (1.0)
Medication route: hypertensive crisis management	9 (0.9)
Medication reconciliation resulting in minor ADE prevention	8 (0.8)
Sepsis alert participation	8 (0.8)
Medication teaching or discharge education	8 (0.8)
Therapeutic interchange	8 (0.8)
Antimicrobial pharmacokinetic evaluation	7 (0.7)
Medication route: shock management	6 (0.6)
Blood factor stewardship	6 (0.6)
Pharmacist-provided drug protocol management pursuant to a collaborative practice agreement	5 (0.5)
Rejection of a restricted medication	4 (0.4)
Preventing unnecessary labs and/or tests	3 (0.3)
Medication route: IV to oral conversion	2 (0.2)
Total parenteral nutrition management	1 (0.1)
Initiation of stress ulcer prophylaxis	1 (0.1)
Prevention of inappropriate screening of heparin-induced thrombocytopenia	0 (0)
Dosage adjustment: continuous renal replacement therapy	0 (0)
Changed venous thromboembolism prophylaxis to most appropriate agent	0 (0)
Initiation of venous thromboembolism prophylaxis	0 (0)
Initiation of ventilator-associated pneumonia prophylaxis with chlorhexidine	0 (0)
Antivenin stewardship	0 (0)

Abbreviations: ADE, adverse drug event; IV, intravenous.

[a]Data shown as No. (%).

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Box 1. Emergency Medicine Pharmacy Intensity Score Tool[a]

EMPIST
Diagnostic/presentation items
Acute stroke
Arrhythmias
Arterial dissection
Extracorporeal membrane oxygenation
Exogenous medication pump
Glasgow Coma Score <8
Mechanical ventilation
Mean arterial pressure <65 mm Hg
Open fracture
Procedural sedation
Reported overdose
Sepsis alert
Status epilepticus
ST-segment elevation myocardial infarction alert
Systolic blood pressure >220 mm Hg
Systolic blood pressure <90 mm Hg
Trauma alert
Traumatic brain injury
Ventricular assist device
Medication items ordered
Four-factor prothrombin complex concentrate/andexanet alfa/idarucizumab
Antidotal therapy (eg, naloxone)
Crotalidae polyvalent immune Fab/crotalidae immune Fab_2
Epinephrine (any form)
Heparin IV bolus/infusion
Hypertonic saline (any percentage)
Inotropes
Ketamine
Lidocaine continuous infusion
Mannitol
Neuromuscular blocking agents-bolus dose only
Procainamide
Rabies vaccine/immunoglobulin
Thrombolytics
Vasopressor continuous infusion
Vasopressor bolus dose
U-500 insulin

Abbreviations: EMPIST, emergency medicine pharmacy intensity score tool; IV, intravenous.

[a]All items contribute a point value of 1.

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