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Documentation of pharmacist interventions in the emergency department

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While only a limited number of pharmacists practice in emergency medicine, clinical pharmacy in the emergency department (ED) has been documented since the 1970s.[1-3] The ED offers a unique setting in which pharmacists can solve medication-related problems, identify drug–drug interactions, and prevent medication errors.[4,5]

Part of the daily duties of the ED pharmacists at Grady Health System (GHS) is to document interventions to assess the impact of their services. However, the ED is a busy setting where lack of time or access to computers can dictate the quantity of interventions documented.

Personal digital assistants (PDAs) are a simple and efficient method for collecting pharmacist's interventions and, due to their portability, may be useful documentation tools in the ED.[6,7] Many institutions use computerized methods to document pharmacist interventions, but none have studied their use in the ED.[8-12] In addition to the documentation of interventions, the effect of pharmacy services is assessed by determining the impact of interventions on cost outcomes. Many methods of determining cost avoidance have been reported, but there is no standard model.[13-16]

The objectives of this study were to develop an efficient PDA program to track pharmacists' interventions and calculate cost avoidance using an institution-specific model.

Methods. *Study site.* This study was conducted at GHS, a large, urban, teaching institution in Atlanta, Georgia, which serves a predominantly indigent population, and its ED treats over 100,000 patients annually. Medications are stored in Pyxis machines, and a satellite pharmacy is open from 3 p.m. to 11 p.m. daily to support medication distribution. The clinical pharmacist working at the satellite pharmacy screens and enters orders and prepares a limited number of i.v. admixtures. A clinical pharmacist specialist is available for consultation and responds to cardiac arrest codes from 10 a.m. to 7 p.m. on weekdays. Other pharmacist responsibilities include

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education of the nursing staff and medical residents and provision of drug information.

Study design. This observational study was conducted from December 2003 to April 2004. All ED pharmacists at GHS who owned a PDA participated in the study, and all interventions with complete documentation during this time were included in data analysis. Incomplete documentation was defined as a missing drug name, type of intervention, or cost-avoidance category.

The study was divided into two phases. A two-week pilot phase was conducted before the main data collection period to detect technical obstacles and determine the time required to document an intervention. The pharmacists documented an equal number of interventions on the pharmacy order-entry system (PharmNet) and the PDA during this pilot phase and documented the time it took to enter an intervention. Interventions documented during the pilot phase were excluded from final analysis.

The pharmacists transferred their data from the PDA onto the study computer as often as possible. The time dedicated to complete an intervention was added later in the study to assess the quality of the interventions versus the quantity. The number of interventions documented from the same time period in the previous year on PharmNet was obtained to compare with the number documented on PDAs.

Development of PDA form. The framework for the PDA form was based on an evaluation of the current intervention form and pharmacy intervention data reported in the literature.[7,17-20] In addition, a staff meeting was held to determine the type of data that would accurately reflect the scope of pharmacy services provided. In the past, GHS pharmacists documented interventions in PharmNet. Pendragon Forms, version 4.0 (Pendragon Software Corporation, Libertyville, IL), was chosen to design the PDA form because of its relative ease of use and compatibility with Microsoft Access (Microsoft Corp., Redmond, WA). The use of Pendragon software to construct documentation forms has been described elsewhere.[7,12] The PDA form required pharmacists to provide the following information: the date and time the intervention was recorded, the patient's medical record number, the patient's age, the patient's sex, the primary drug involved in the intervention, dosage, route of administration, drug regimen, additional drugs involved, type of intervention, type of event avoided, probability of adverse outcome, acceptance of intervention by other health care professionals, cost-avoidance category, and time required to complete the intervention. The types of interventions that could be made are listed in Table 1.

Development of cost-avoidance model. The development of this model was based on a decision-tree approach to outcomes and associated costs using a literature-based cost-avoidance model.[13,20-22] The technique identifies outcomes as optimal (no resource utilization) and stratifies nonoptimal outcomes (resource utilization) into seven levels of severity and associated costs attributed to additional resource utilization that may have occurred without pharmacist intervention (Table 2). The severity levels were similar to those defined by Schneider et al.[23] and were ranked from 0 to 6 in accordance with potential resources consumed subsequent to the outcome:

- Level 0: No medication-related problem
- Level 1: Health care professional inquiry (drug information)
- Level 2: Drug therapy modification

Table 1.
Types of Pharmacist Interventions

Intervention	Example
Allergy documentation	Notation of allergy and reaction
Drug information (oral)	Provide verbal response lasting <5 min
Drug information (oral or written, >5 min)	Provide articles or short presentations
Drug–disease interaction	Avoid a drug–disease interaction
Drug–drug interaction	Identify a drug–drug interaction
Drug–food interaction	Avoid a drug–food interaction
Formulary-preferred agent	Switch from a nonformulary to formulary agent
Improper drug selection	Wrong drug for indication
I.V. to p.o. (antiinfective)	Switch from i.v. to p.o.
I.V. to p.o. (not antiinfective)	Switch from i.v. to p.o.
Monitoring	Order laboratory test to monitor drug therapy
More cost-effective drug (nonrestricted)	Switch to a less expensive agent
No indication for drug	Avoid unnecessary therapy
Patient education	Educate about disease states and how to use inhalers and insulin syringes or glucose meters
Polypharmacy	Manage complicated medication regimens
Prevent allergy to prescribed drug	Prevent prescribing of drug to patient with known allergy
Professional services	Respond to cardiac arrests; assist with i.v. drip dose adjustments
Protocol/guideline/standard/pathway	Adhere to hospital protocols
Subtherapeutic dose/frequency	Correct subtherapeutic dosing
Supratherapeutic dose/frequency	Correct supratherapeutic dosing
Therapeutic duplication	Prevent therapeutic duplication
Untreated indication	Recommend therapy for untreated indications
Vaccination required	Recommend vaccination

Table 2.
Outcomes of Pharmacist Interventions in the Emergency Department[a]

Level	Cost Avoidance	Explanation	Category	Cost ($)
0	Other	Other	None	0
1a	Health care professional inquiry (search and present oral information ≤5 min)	Present verbal drug information	Drug information	26.17
1b	Health care professional inquiry (search and present oral and written information >5 min)	Present verbal drug information as a presentation, provide articles	Drug information	54.89
2a	Nonformulary medications	Drug cost avoidance	Drug cost avoidance	30.35
2b	Therapeutic duplication	Drug cost avoidance	Drug cost avoidance	30.35
2c	Restricted medications	Drug cost avoidance	Drug cost avoidance	30.35
2d	Dosage adjustments (no potential for harm)	Drug cost avoidance	Drug cost avoidance	30.35
2e	I.V. to p.o. switch (not an antiinfective agent)	Drug cost avoidance	Drug cost avoidance	30.35
2f	I.V. to p.o. switch (antiinfective agent)	Drug cost avoidance	Drug cost avoidance	34.31
3a	Additional treatment	Medications, aerosolizations, transfusions, oxygen	Avoidance of additional treatment	260.46
3b	Additional tests	Serum drug or electrolyte concentrations, CBC count	Avoidance of additional treatment	109.00
3c	Noninvasive procedure, additional tests	Angiography, CT scan, ECG, Doppler ultrasound, EEG, ECHO, fluoroscopy, MRI scan, x-ray, PFT, plus 3b	Avoidance of additional treatment	320.70
4a	Additional treatment, additional tests	See 3a and 3b	Avoidance of additional treatment	370.04
4b	Noninvasive procedure, additional tests, additional treatment	See 3a and 3c	Avoidance of additional treatment	581.75
4c	Increased length of stay or MRP admission, additional tests, additional treatment, noninvasive procedure	Daily room rate plus 4b	Avoidance of additional treatment	3,562.79
4d	Invasive procedure, increased length of stay or MRP admission, additional tests, additional treatment, noninvasive procedure	Coronary catheterization, myocardial perfusion studies, pericardiocentesis, PTCA, surgery, dialysis, plus 4c	Avoidance of additional treatment	6,437.13
5a	Transfer to ICU, additional tests, additional treatment, noninvasive procedure, increased length of stay or MRP admission	ICU bed, insertion of arterial line or Swan-Ganz catheter, intubation, cardiac arrest, plus 4c	Avoidance of additional treatment	6,592.03
5b	Transfer to the ICU, additional tests, additional treatment, noninvasive procedure, invasive procedure, increased length of stay or MRP admission	Same as 5a but includes invasive procedures as well	Avoidance of additional treatment	9,466.36
5c	Long-term care admission, additional tests, additional treatment, noninvasive procedure, invasive procedure, Increased length of stay or MRP admission, transfer to ICU	Self-explanatory	Avoidance of additional treatment	11,837.51
6	Death	Self-explanatory	Avoidance of additional treatment	100,000.00

[a]CBC = complete blood cell, CT = computed tomography, ECG = electrocardiogram, EEG = electroencephalogram, ECHO = echocardiogram, MRI = magnetic resonance imaging, PFT = pulmonary function test, MRP = medication-related problem, PTCA = percutaneous transluminal coronary angioplasty, ICU = intensive care unit.

- Level 3: Additional tests or treatments or noninvasive procedures
- Level 4: Additional tests or treatments or noninvasive procedures and increased length of stay or drug-related admission
- Level 5: Any resource utilization in level 4, long-term-care admission, or required transfer to intensive care unit
- Level 6: Death

Assessment of costs. The initial cost-avoidance framework was based on Schneider et al.'s[23] model for drug-related morbidity costs and Kinky et al.'s[21] drug cost-avoidance model with adjustments for medical inflation to 1999 dollars.[24] The final step in creating this model was to develop subcategories similar to the method described by Kinky and colleagues,[21] with some minor revisions based on GHS cost data. For example, we revised level 1 to address drug information inquiries and attached cost savings between $26.17 and $54.89, depending on the time required to obtain information to respond to the question and the probability that the questions resulted in potential cost savings. Level 2 was revised to address costs avoided by drug therapy modification.[18]

The types of pharmacist interventions were characterized into events avoided due to the intervention, which were further divided by cost avoidance. For example, a pharmacist might recommend a laboratory test to determine a patient's drug level. This intervention is then categorized as an event avoided because of the potential for subtherapeutic or supratherapeutic drug levels. A cost was assigned to the cost-avoidance category and then multiplied by the number of interventions documented to calculate total cost avoidance. Types of events avoided included suboptimal disease management, adverse drug reaction, drug cost avoidance, provider knowledge deficit, medication error, and patient nonadherence. In the example above, the intervention of recommending a laboratory test avoided suboptimal disease management, and the cost avoidance was associated with negated need for additional treatment.

Results. During the pilot phase, an equal number of interventions were documented on PDAs ($n = 26$) and PharmNet ($n = 26$). The average time required to document an intervention was 4 minutes (range, 2–12 minutes) using PharmNet and 2 minutes (range, 1–3 minutes) with PDAs. The types of interventions documented were similar between the two groups.

During the second phase of the study, 401 interventions were documented with the PDAs, compared with 286 in PharmNet in the previous year. Forty-one interventions were excluded from the analysis due to incomplete documentation.

The top five interventions captured were switching from a nonformulary to a formulary preferred agent (16%), correcting a subtherapeutic dose or frequency (15%), correcting a supratherapeutic dose or frequency (14%), providing professional services (13%), and documenting allergies (9%). The five drugs most commonly involved in the documented interventions were levofloxacin, azithromycin, midazolam, piperacillin–tazobactam, and doxycycline.

The acceptance rate of pharmacist interventions by other health care professionals was 89%. The types of events most frequently avoided were suboptimal disease management (42%), adverse drug reactions (29%), and drug cost avoidance (21%). The probability of these events occurring without pharmacist intervention was determined by the recording pharmacist to be possible in 48%, probable in 33%, and definite in 13% of the interventions.

Of the 161 intervention forms that included the time to make the intervention, 52% took 21–30 minutes to complete, 19% required 31–60 minutes, 11% took 11–20 minutes, and 9% required either less than 11 minutes or more than 60 minutes to complete. In terms of cost avoidance, 60% of interventions involved the avoidance of additional treatment, followed by drug cost avoidance (31%), and drug information (9%). The total cost avoidance estimated for these interventions was $192,923.

Discussion. In this study, implementation of the PDA program increased intervention documentation by 40%. Documentation also took about half the time to complete on a PDA versus PharmNet. The types of interventions documented were reflective of our highly restrictive formulary, so it was not surprising that the most common type of intervention performed was enforcement of formulary restrictions.

The acceptance rate of recommendations in this study was lower than the >90% reported acceptance rates at other institutions.[25-27] Overall acceptance rates of pharmacists' recommendations at our institution for the past 10 quarters (2001–2004) exceeded 91%. The lower acceptance rate in this study may be because the pharmacists were encouraged to document all interventions, regardless of their potential for acceptance.

The majority of interventions took between 21 and 30 minutes to complete; however, many interventions took over 30 minutes. These lengths of time may be explained by the unique services of an ED pharmacist. ED pharmacists provide pharmaceutical care at the patient bedside, and the provision of some services, such as adjusting the dosage of an i.v. drip, can require significant amounts of time.

Several studies have shown that pharmacist participation on internal medicine teams and intensive care units improved patient outcomes by reducing the number of adverse drug events, but few studies have evaluated the benefit in the ED.[25,28,29] In this

study, pharmacist interventions prevented suboptimal disease management and adverse drug reactions in nearly one half and one third of documented cases, respectively. The probability of suboptimal disease management and adverse drug events occurring had a pharmacist not intervened was judged to be possible or probable in 80% of these cases. Despite the theoretical benefits of pharmacy services in an ED, pharmacy directors are frequently required to associate a value to these services to justify the cost incurred. Identification of pharmacist activities is dependent on documentation, and, unfortunately, documentation systems are underutilized. Reasons for lack of documentation include poor access to documentation systems and difficulty of use. With a PDA form, the rate of documentation improved at GHS, and cost avoidance by ED pharmacists reached nearly $200,000 over a four-month period.

There are several limitations to this study. First, the cost of implementing a PDA program must be considered. While the health system already owned the rights to Pendragon software, there was no funding available to purchase PDAs. Therefore, only pharmacists who already owned PDAs were able to participate. Also, documentation was voluntary; therefore, there may have been some loss of data due to underdocumentation. Another major limitation of this study was the subjectivity of the data collected. The accuracy of data classification relied on the pharmacist to select the most appropriate categories. To minimize subjectivity, pharmacists received a detailed handout and attended a teaching session before the study. Due to the subjective nature of documentation, bias could not be entirely eliminated. Calculation of cost avoidance was also subjective, as it was based on the interpretation of other pharmacoeconomic models. Another limitation was the subjectivity of the cost savings of pharmacist interventions identified through use of the cost-avoidance model. Some costs may not be applicable to other institutions, and the lack of a formal cost-accounting system potentially undermines the accuracy of the cost of resource utilization.

Conclusion. The use of PDAs by ED pharmacists increased the rate of intervention documentation, reduced the time it took to document interventions, and led to an estimation of significant cost savings.

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