

# Development and Initial Evaluation of a Software-Based Clinical Workload Measurement System for Pharmacists

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## ABSTRACT

**Background:** Implementation of a new pharmacy computer system allowed the creation of a workload measurement system that focused on pharmacists' direct patient care activities.

**Objective:** To describe a workload and outcomes measurement system that was developed within Meditech software and to document its use in a community hospital.

**Methods:** A numeric system was developed for recording pharmacists' workload when documenting interventions in patients' medical records. Interventions were categorized according to the nature of the drug-related problem, the anticipated patient outcome, and acceptance of the intervention by the prescriber. Pharmacists' clinical interventions were quantified over a 6-month period.

**Results:** Fourteen pharmacists tabulated a total of 2645 interventions over the period January to June 2006. The mean number of interventions per pharmacist per clinical shift ( $\pm$  standard deviation) was  $4.6 \pm 3.4$ . A broad range of drug-related problems was identified. For every intervention, a mean of 1.4 clinical, 0.8 humanistic, and 0.1 economic outcomes were recorded. Only 3.2% of the pharmacists' recommendations had been rejected by prescribers at the time of documentation.

**Conclusions:** Numerous drug-related problems were identified by pharmacists, with various anticipated outcomes. Most of the interventions proposed by pharmacists were accepted by the prescribers. The workload measurement system allowed pharmacists to document their clinical activities and the anticipated outcomes of their interventions.

**Key words:** pharmacist, documentation, workload measurement, health outcomes

## RÉSUMÉ

**Historique :** La mise en place d'un nouveau système informatique de pharmacie a permis de créer un système de mesure de la charge de travail des pharmaciens, principalement axé sur leurs interventions de soins directs aux patients.

**Objectif :** Décrire le système de mesure de la charge de travail et des résultats développé à partir du progiciel Meditech et documenter son utilisation dans un hôpital communautaire.

**Méthodes :** Un système numérique a été élaboré pour enregistrer la charge de travail des pharmaciens parallèlement à la consignation des interventions dans les dossiers médicaux des patients. Les interventions ont été catégorisées selon la nature du problème relié à la pharmacothérapie, le résultat thérapeutique escompté, et l'acceptation de l'intervention par le prescripteur. Les interventions cliniques des pharmaciens ont été quantifiées sur une période de six mois.

**Résultats :** En tout, 2645 interventions réalisées par 14 pharmaciens ont été recensées pour la période allant de janvier à juin 2006. Le nombre moyen d'interventions par pharmacien et par quart de travail ( $\pm$  l'écart-type) était de  $4,6 \pm 3,4$ . Un large éventail de problèmes reliés à la pharmacothérapie ont été décelés. Pour chaque intervention, on a recensé 1,4 résultat sur le plan clinique, 0,8 sur le plan humain et 0,1 sur le plan économique. Seulement 3,2 % des recommandations des pharmaciens avaient été rejetées par les prescripteurs au moment de la consignation.

**Conclusions :** De nombreux problèmes reliés à la pharmacothérapie avec des résultats thérapeutiques escomptés variés ont été décelés par les pharmaciens. La plupart des interventions proposées par les pharmaciens ont été acceptées par les prescripteurs. Ce système de mesure de la charge de travail a permis aux pharmaciens de consigner leurs activités cliniques et les résultats escomptés de leurs interventions.

**Mots clés :** pharmacien, consignation, mesure de la charge de travail, résultats thérapeutiques

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## INTRODUCTION

Documentation of clinical activities in patients' medical records is an essential practice standard for pharmacists.<sup>1</sup> This practice facilitates communication and assessment of interventions by health care peers and helps to ensure optimal patient care. In addition, this information can be used to help pharmacists improve their clinical practices through peer mentoring, allows qualitative assessment of interventions, and can be used as an educational tool for staff.

The information contained in medical record notes is rarely usable by external pharmacy stakeholders, such as hospital administrators. Therefore, an alternative source of information about clinical workload and health outcomes is required to demonstrate the effects of pharmacists' involvement in patient care. Workload measurement systems have traditionally been used for assessing staffing levels, justifying clinical activities, and assessing impacts on patient outcomes.<sup>2</sup> Unfortunately, many workload-measurement systems are inefficient, poorly utilized, and cumbersome to interpret.<sup>2,3</sup> An ideal system for measuring the productivity of clinical pharmacists would be seamless, paperless, linked to patient outcomes, benchmarked to "best practices", and weighted to account for patient acuity and the difficulty of different tasks.<sup>4</sup>

The David Thompson Health Region covers a large geographic region (60 000 km<sup>2</sup>) in central Alberta and serves approximately 300 000 people. It comprises 17 rural hospitals, a regional psychiatry hospital, and a referral community hospital. The referral hospital employs 18.1 full-time equivalent pharmacists for 350 acute care and 200 continuing care beds. At present, this health region maintains paper-based patient medical records but is participating in a provincial initiative to implement a standard computer system (developed and distributed by Meditech) to facilitate the sharing of pharmacy data, diagnostic information, and laboratory results among users in Alberta. Within that system, a computerized pharmacy documentation and workload measurement system has been developed to facilitate communication of pharmacists' direct patient care activities to their colleagues and other health care professionals and to allow clinical workload quantification that is easy for pharmacists to perform and for administrators to interpret. Using the workload measurement system, pharmacists log their interventions numerically while they are creating electronic and hard-copy medical record notes. The pharmacists previously used a paper-based system for workload

measurement, with the documentation being compiled by the health records department. However, the paper system was time-consuming, was used inconsistently by different pharmacists, was only available at the referral hospital, and resulted in a significant (6- to 18-month) delay in the reporting of workload results from health records.

In this article, we describe the new system for measuring pharmacist workload associated with patient care, which accompanies medical record documentation. We also describe quantitatively and qualitatively the interventions performed by pharmacists in the region's community referral hospital, as well as the potential outcomes of the interventions. We hypothesized that implementation of an electronic workload measurement system would capture pharmacist interventions and their anticipated impact on patient outcomes. The primary objective of our study was to determine, using the workload measurement system, the number of interventions by staff pharmacists over a 6-month period (January to June 2006). The secondary objectives were to calculate the number of interventions per clinical shift for each pharmacist, to determine if residency training and years of work experience affected the number of drug-related problems (DRPs) reported, to quantify the nature of the interventions according to the category of DRP, to quantify the anticipated outcomes, and to determine the proportions of suggested interventions that were accepted and rejected by physicians. We also calculated the average number of anticipated outcomes per suggested intervention.

## METHODS

### Development of the Workload Measurement System

As part of routine practice within the David Thompson Health Region, pharmacists document interventions in patients' medical records using the FARM format (findings, assessment, resolution, monitoring).<sup>5</sup> With the implementation of the Meditech computer system (Client/Server 5.5 SR2, Meditech, Westwood, Massachusetts), these notes were created electronically in the "Clinical Interventions" module of the system; they were also printed and placed in the "progress notes" section of the patient's hard-copy medical record. The workload measurement system was built into this task by having the pharmacist record a variety of numeric codes (indicating type of DRP, date, acceptance of recommendation by the prescriber, time spent, and anticipated outcomes) in the electronic pharmacist



documentation system for each patient. DRPs were defined according to Hepler and Strand,<sup>6</sup> with the addition of 3 other drug-related issues of interest. The type of DRP was recorded to characterize the breadth of clinical practice and for future research and strategic planning purposes. Health outcomes were defined according to the ECHO model (economic, clinical, and humanistic outcomes).<sup>7,8</sup> Humanistic sub-outcomes were combined into a single category to simplify reporting. Economic sub-outcomes were also combined to focus specifically on drug costs that were quantifiable by the pharmacist (Table 1).

A pocket-sized card describing the coding template and numeric options for data entry was given to every pharmacist. Further progress with respect to the resolution of DRPs and corresponding workload could be included as an addendum to the original note. However, pharmacists were discouraged from editing notes and codes once they had been entered, to optimize efficiency and to minimize the number of notes. Workload was recorded at the time a medical record note was created, and monthly feedback was provided to staff (with each pharmacist receiving an anonymized comparison of his or her workload with that of others in the department).

## System Evaluation

The second part of this study was an evaluation of pharmacists' clinical interventions as recorded in the workload measurement system. Only actions associated with pharmacists' direct patient care activities on inpatient and ambulatory care units at the region's referral hospital (Red Deer Regional Hospital Centre) were included. Workload data on activities other than direct patient care responsibilities, such as distribution activities (e.g., order clarification) and educational endeavours, are captured by the workload measurement system but were not included in this analysis. Data recorded by pharmacists who were not employed with the health region for the entire duration of the study were also excluded.

The following data were collected or determined by subsequent analysis: total number of interventions by staff pharmacists during the 6-month study period, number of interventions per pharmacist clinical shift, impact of residency training and years of work experience on the number of DRPs reported, nature of the interventions according to the category of DRP, proportion of suggested interventions accepted and rejected by physicians, and average number of anticipated outcomes per DRP.

**Table 1. Coding System for Recording the Medical Workload of Pharmacists**

<b>General Format for Entries</b>	
<b>Acceptance</b> (1 character) / <b>Date</b> (DD-MMM-YYYY) / <b>Drug-related problem</b> (2 characters) / <b>Pharmacist identification</b> (6 characters) / <b>Time spent, in minutes</b> (3 characters) / <b>Outcomes</b> (2 characters; many may be selected)	
Example: 1/08-JUN-2005/01/999999/060/1A/2A/3B	
<b>Content</b>	<b>Numeric Code</b>
<b>Acceptance of recommendation by prescriber</b>	
Accepted	1
Rejected	2
Unknown, waiting for response, unable to follow up	3
Not applicable	4
<b>Patient's drug-related problem</b>	
Needing pharmacotherapy but not receiving it	01
Taking or receiving the wrong drug or wrong form of drug	02
Taking or receiving too little of the correct drug	03
Taking or receiving too much of the correct drug	04
Experiencing (or at risk of experiencing) an adverse drug reaction	05
Experiencing (or at risk of experiencing) a drug-drug, drug-herb, or drug-food interaction	06
Not taking or receiving drug as prescribed	07
Taking or receiving a drug for which there is no valid medical indication (may include duplication)	08
Requiring medication counselling (education) but not receiving it	09
Requiring discharge counselling or preparation but not receiving it	10
No drug-related issues identified; follow-up only	11
<b>Anticipated outcomes</b>	
<i>Clinical</i>	
Cure a disease	1A
Eliminate or reduce signs or symptoms	1B
Arrest or slow a disease process	1C
Prevent a disease or symptom	1D
Achieve desired alterations in physiologic processes	1E
<i>Humanistic</i>	
Improve physical, mental, or social function or satisfaction with care (feeling better)	2A
<i>Economic</i>	
Drug cost savings of \$1 or more/day	3A
Drug cost increases of \$1 or more/day	3B

The raw workload data were extracted from the Meditech computer system and imported into Excel software (Microsoft, Seattle, Washington) for tabulation of data and generation of reports. The number of clinical shifts was calculated from the number of 8-h daytime shifts during which pharmacists provided clinical services to patients on their assigned units. Some pharmacists also had clinical shifts in an 8-h evening



“float” position, where they triaged and resolved DRPs on floors lacking daytime pharmacist coverage. Daytime clinical shifts were considered full clinical shifts, and evening shifts were weighted as half shifts, since the other half of the pharmacists’ time was spent in the dispensary. The number of DRPs per shift was compared for pharmacists with and without residency training and for pharmacists with 5 or more years and less than 5 years of experience, by applying Student’s *t* test (using SPSS software, version 12.0.1; SPSS Inc, Chicago, Illinois).

## RESULTS

Fourteen pharmacists performed direct patient care activities at the community referral hospital during the period of data collection. Two of these pharmacists initiated clinical services in new ambulatory clinics, 3 were transferred to different clinical floors during the study period, and 9 continued in their assigned clinical area for more than 6 months. Eleven of the pharmacists had evening “float” shifts, which constituted 9% of all clinical shifts; however, most of their clinical time was spent on their respective primary clinical units. Most of the pharmacists were female (11 or 79%), had been practising for more than 5 years (10 or 71%), and worked in inpatient areas (11 or 79%); half (7 or 50%) had undergone residency training.

During the study period, 2645 interventions were initiated during 627.5 clinical pharmacist shifts. The majority (569 or 91%) of these shifts were daytime shifts. The mean number of interventions per pharmacist per shift was 4.6 (standard deviation 3.4, median 4.0, range 0.1–11.1 [Table 2]). There was no difference in the number of DRPs resolved by pharmacists with and without residency training or by pharmacists with at least 5 years or less than 5 years of practice experience. The most common types of interventions were related to follow-up of patients and their DRPs (625 or 23.6%), absence of required drug therapy (402 or 15.2%), and supratherapeutic drug dosing (373 or 14.1%) (Table 3).

Pharmacists anticipated that their documented interventions would lead to a total of 6101 outcomes (Table 4). Over 62% of the anticipated outcomes were clinical, 32.9% were humanistic, and 4.5% were economic. An average of 2.3 outcomes were associated with each intervention. For every intervention, there were on average 1.4 clinical outcomes, 0.8 humanistic outcomes, and 0.1 economic outcomes.

The majority of interventions were accepted by physicians (Table 5). However, the acceptance or rejection status of a large number of interventions

**Table 2. Number of Interventions Documented by 14 Individual Pharmacists**

Pharmacist	Mean No. of Interventions per Shift
A	11.1
B	10.0
C	8.3
D	7.0
E	4.8
F	4.6
G	4.6
H	3.5
I	3.2
J	3.0
K	2.8
L	1.3
M	0.4
N	0.1

**Table 3. Actual or Potential Problems Addressed by 2645 Pharmacist Interventions**

Problem Addressed	No. (%) of Interventions
Patient needs medication	402 (15.2)
Patient taking wrong drug or wrong form of drug	205 (7.8)
Patient’s medication dose too low	244 (9.2)
Patient’s medication dose too high	373 (14.1)
Patient experiencing adverse drug reaction	294 (11.1)
Patient experiencing drug interaction	143 (5.4)
Patient compliance issue	45 (1.7)
Patient taking drug with no indication	144 (5.4)
Patient needing medication counselling	
About medications	119 (4.5)
Related to discharge	49 (1.9)
Patient follow-up	625 (23.6)
Problem not documented	2 (0.1)

remained unknown at the time of documentation. The number of interventions per pharmacist varied (Table 1), and acceptance rates varied with each pharmacist. The average time spent per intervention was 24.7 min (median 20 min, range 1 to 180 min); time was not documented for 61 interventions.

## DISCUSSION

Today’s health care system demands accountability for resources both to patients and to the public in general. The application of principles of pharmaceutical care could reduce health care costs, and could also reduce hospital admissions and deaths, by approximately 60%.<sup>7</sup> In 1997, Johnson and Bootman,<sup>9</sup> applying a cost-of-illness model in the United States, estimated that



**Table 4. Anticipated Outcomes of Pharmacists' Interventions (n = 6101)**

<b>Anticipated Outcome</b>	<b>No. (%) of Outcomes</b>
<b>Clinical</b>	
Cure disease	722 (11.8)
Eliminate or reduce signs or symptoms	1010 (16.6)
Arrest or slow disease process	155 (2.5)
Prevent a disease or symptom	1624 (26.6)
Achieve desired alterations in physiologic process	309 (5.1)
<b>Humanistic</b>	2008 (32.9)
<b>Economic</b>	
Drug cost savings	203 (3.3)
Drug cost increases	70 (1.1)

**Table 5. Acceptance of 2645 Pharmacists' Interventions at Time of Documentation**

<b>Acceptance</b>	<b>No. (%) of Interventions</b>
Accepted	1040 (39.3)
Rejected	85 (3.2)
Unknown, waiting for response, or unable to follow up	790 (29.9)
Not applicable	730 (27.6)

pharmaceutical care in ambulatory care pharmacy settings would reduce the occurrence of negative therapeutic outcomes by 53% to 63% and would avoid US\$45.6 billion dollars in direct health care costs. Bond and others<sup>10-12</sup> reported that increased staffing with clinical pharmacists and increases in some clinical pharmacy services were associated with reductions in hospital drug costs and in mortality rates.

The workload measurement system described here has a number of advantages over the previous system. Workload is recorded electronically and in real time, which allows for timely analysis of data. Workload is linked to a patient's medical record note, so it can be tracked for quality assurance purposes. This, and the ease of data entry, may increase the frequency of reporting by pharmacists at all sites throughout the health region. Finally, the use of computerized records provides legible information that is easily converted into databases and reports.

In the study reported here, pharmacists recorded 2645 interventions, an average of 4.6 interventions per pharmacist per clinical shift. There was significant variation among the pharmacists, which may be related to the novelty of this area of practice, as well as the pharmacists' lack of familiarity with documentation and with the computer system itself. This variation could not

be explained by differences in years of practice or completion of a residency program. In general, documentation increased during each successive month for most pharmacists (data not shown), possibly because of increasing familiarity with the program and/or the immediate and regular feedback provided through monthly reports comparing the performance of all pharmacists. This feedback was well received by staff. One pharmacist began documenting via the electronic system halfway through the study, whereas another did not document at all; both reported manually recording their interventions in the patient medical record and have subsequently converted to the computer recording system.

The wide range of types of DRPs identified in this study suggests that pharmacists are applying a broad knowledge base for this aspect of their work. The most common DRPs identified were similar to those reported in previous research, in which dose-related issues and suggestions to add pharmacotherapy were the most common interventions by clinical pharmacists.<sup>13</sup> At our site, each pharmacist provides clinical services to 30 to 40 patients. They are encouraged to provide the full spectrum of pharmaceutical care to at least one patient at all times, while triaging and resolving DRPs and related issues identified by them, by their colleagues, and by other health care workers for other patients.

In this study, the majority of the interventions that were recorded at the time of medical record documentation were accepted by physicians. However, the status of acceptance or rejection of a large number of interventions remained unknown, because data were tracked at the time the medical record note was written. In some cases, the pharmacist had not yet discussed the DRP with the prescriber when the note was written, in which case the acceptance status of the interventions would not be known at the time of workload entry. The acceptance status "not applicable" was commonly associated with interventions related to follow-up (69%); however, the fact that 31% of interventions with "not applicable" status related to DRP 01 through DRP 10 (i.e., actual interventions; see Table 1) suggests that further pharmacist education is needed to ensure that acceptance of an intervention is documented appropriately.

Physicians rejected only 3.2% of recommendations, which is slightly higher than the rate of rejection reported previously in the literature. Kucukarslan and others<sup>13</sup> found that 2% of pharmacists' suggestions were rejected, and only 1% of pharmacists' recommendations were rejected in a study by Leape and colleagues.<sup>14</sup> However,



both of those studies involved pharmacists “rounding” with their respective health care teams, which rarely occurs at our community hospital. Also, these prior studies were limited to general medicine or intensive care settings, whereas our study involved pharmacists primarily covering ambulatory care, medicine, the emergency department, rehabilitation, intensive care, palliative care, and psychiatry.

The *raison d’être* of contemporary pharmacists is to improve the quality of patients’ lives. Health outcomes (including clinical, humanistic, and economic outcomes) must be measured to provide feedback to the caregiver responsible for the patient, as well as to the administrators who determine the relative spending advantages of one health service over another. More than 6000 outcomes were anticipated by the pharmacists’ interventions in this study. The literature on the effects of pharmacist interventions on health-related quality of life is inconsistent.<sup>15</sup> The low number of economic outcomes in this study may be due to underreporting. In addition, lack of clarity regarding the payer for the economic outcomes (e.g., patient or hospital) could have led to confusion as to whether or not drug costs increased or decreased. The pharmacists in our study were most likely to report anticipated clinical outcomes, such as disease-related outcomes, which are generally easier to predict and measure than humanistic or economic outcomes.

Several limitations of this study should be acknowledged. First, the study involved pharmacists at only one hospital, which limits its external generalizability. Also, there were 2 interventions for which a DRP category was not listed. Twenty-one DRPs were not included in the analysis because they were not associated with an existing pharmacist Meditech identification number. Students’ and residents’ documentation was not included, as these groups of practitioners were not present for the entire duration of the study, and their workload expectations differ from those of staff pharmacists. Data for these practitioners were also not included with their preceptors’ statistics, although the preceptor may have played a large part in identifying or resolving the DRP. When calculating the number of activities per clinical shift, other professional activities, such as teaching and committee work, were not considered. In addition, clinical interventions suggested by dispensary pharmacists were not included, as they are captured by a different workload function of the Meditech system. Thus, the data presented here provide information on only a small portion of pharmacists’ duties.

Quality control was not performed to validate the

accuracy and precision of self-reporting by pharmacists. Risks of “double documentation” (e.g., in cases where one pharmacist carries on a task begun by another), incorrect categorization of DRPs, and incorrect assignment of anticipated outcomes are possible. Finally, the economic outcomes of the workload measurement system assessed only drug costs, not other economic outcomes such as readmission rates and length of hospital stay.<sup>7</sup>

## Future Plans

To date, data have been tabulated and reports run with Excel software. It is anticipated that using Microsoft Access database software to generate reports will offer more flexibility in analyzing and reporting the data. A quality assurance assessment is being planned to determine if documentation and coding are accurate and whether the outcomes anticipated by pharmacists are actually being achieved.

Once the workload measurement system has been validated and implemented across the David Thompson Health Region, it is anticipated that it could be used to demonstrate and quantify clinical pharmacists’ impact on patient safety and the quality of patient care.

Further review of the workload measurement system may lead to encouragement of pharmacists to “edit” coding of particular interventions when new information (e.g., data related to acceptance) becomes known, as a way to improve accuracy.

As this program becomes integrated in clinical practice across all sites in our health region, we anticipate that we will be better able to benchmark ourselves and to use the information for strategic planning purposes. In addition to patient outcomes, patient acuity and practitioner competency should be considered when evaluating pharmacist productivity.<sup>4</sup> This information could be used by management to adjust clinical staffing patterns, measure staff productivity, determine which cognitive pharmacy services have the highest impact in specific patient populations, and identify areas for professional development of individual pharmacists.

## CONCLUSIONS

The workload measurement system that we have described is an effective tool for tracking patient-focused tasks carried out by clinical pharmacists in a community referral hospital. The system allows pharmacists to document interventions according to the nature of the DRP, the anticipated outcomes, and the acceptance of interventions by prescribers. The



documentation can be done in a timely manner and allows the pharmacist to associate workload with specific interventions. More research is needed to determine the applicability of the tool to pharmacists' workload in other settings.

## References

1. Canadian Society of Hospital Pharmacists, Pharmaceutical Care Advisory Committee. *Information paper on documentation of pharmaceutical care in the health care record*. Ottawa (ON): Canadian Society of Hospital Pharmacists; 2003/2004.
2. Donaldson M, Hope J, Jewesson P. Computer-assisted retrospective clinical activities statistics (CARCAS) program. *Can J Hosp Pharm* 1993;46(1):17-22.
3. Zimmerman CR, Smolarek RT, Stevenson JG. A computerized system to improve documentation and reporting of pharmacists' clinical interventions, cost savings and workload activities. *Pharmacotherapy* 1995;15(2):220-227.
4. Abel S, Dobesh P, Frye C, McWhinney B, Price P, Raebel M, et al. Measurement of clinical pharmacy productivity. In: *Resource kit: documenting the value of clinical pharmacy services*. Kansas City (MO): American College of Clinical Pharmacy; 2003. p 260-267.
5. Canaday BR, Yarborough PC. Documenting pharmaceutical care: creating a standard. *Ann Pharmacother* 1994;28(11):1292-1296.
6. Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. *Am J Hosp Pharm* 1990;47(3):533-543.
7. Canadian Society of Hospital Pharmacists. *Information paper on directing the pharmacist's practice toward health outcomes*. Ottawa (ON): Canadian Society of Hospital Pharmacists; 2004.
8. Kozma CM, Reeder CE, Shulz RM. Economic, clinical, and humanistic outcomes: a planning model for pharmaco-economic research. *Clin Ther* 1993;15(6):1121-1132.
9. Johnson JA, Bootman JL. Drug-related morbidity and mortality and the economic impact of pharmaceutical care. *Am J Health Syst Pharm* 1997;54(5):554-558.
10. Bond CA, Raehl CL, Franke T. Clinical pharmacy services, pharmacist staffing, and drug costs in United States hospitals. *Pharmacotherapy* 1999;19(12):1354-1362.
11. Bond CA, Raehl CL, Pitterle ME, Franke T. Health care professional staffing, hospital characteristics, and hospital mortality rates. *Pharmacotherapy* 1999;19(2):130-138.
12. Bond CA, Raehl CL, Franke T. Clinical pharmacy services and hospital mortality rates. *Pharmacotherapy* 1999;19(5):556-564.
13. Kucukarslan SN, Peters M, Mlynarek M, Nafziger DA. Pharmacists on rounding teams reduce preventable adverse drug events in hospital general medicine units. *Arch Intern Med* 2003;163(17):2014-2018.
14. Leape LL, Cullen DJ, Clapp MD, Burdick E, Demonaco HJ, Erickson JI, et al. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA* 1999;282(3):267-270.
15. Pickard AS, Johnson JA, Farris KB. The impact of pharmacist interventions on health-related quality of life. *Ann Pharmacother* 1999;33(11):1167-1172.

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