Evaluation of a Clinical Decision Aid and Training Program On the Quality of Pharmacists' Prospective Drug Utilization Review Activities

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The purpose of this study was to evaluate the effect of a checklist decision aid and training program on pharmacists' prospective drug utilization review (DUR). The study utilized a convenience sample of 176 pharmacists practicing in Arizona, Illinois, Iowa and Tennessee, and was organized as a pretest-posttest design. During pretest, the convenience sample of 176 pharmacists identified medication-related problems in patient cases using their normal DUR procedures. Level 1 intervention provided pharmacists with a decision aid with which to assess a second series of cases. Level 2 intervention added a DUR training program which pharmacists completed prior to assessing a third series of cases. The rate of correctly identified medication-related problems showed significant increases from the pretest to Level 1 intervention, and from the pretest to Level 2 intervention. Pharmacists' reached a higher level of agreement with expert evaluators concerning whether the prescriptions should have been dispensed at Level 2.

INTRODUCTION

The drug utilization review provisions of the Omnibus Budget Reconciliation Act of 1990 (OBRA '90) require that pharmacists evaluate prescribed drug therapy prior to dispensing to ensure that therapy is medically necessary, appropriate, and is not likely to result in adverse events. When performing this prospective drug utilization review (Pro-DUR), the pharmacist is specifically required to evaluate medication orders for therapeutic duplication, therapeutic appropriateness, drug-allergy interactions, drug-disease contraindications, drug-drug interactions, correct dosage and duration of therapy, utilization, abuse, and appropriate use of generic products (1).

A recent study by Warholak-Juarez, *et al.* found that pharmacists made better Pro-DUR decisions when they had access to more complete patient information(2). However, the quality of pharmacists' decisions, even in the presence of full patient information, was not as high as expected. This was thought to be due, in part, to the process pharmacists used to perform Pro-DUR. There appeared to be no single, uniform method that pharmacists in this study employed to evaluate prescribed drug therapy. Further, there appeared to be significant fluctuation even in how individual pharmacists approached their prospective DUR activities from day to day. These results suggested the need for educational programming that would provide pharmacists with a standard, systematic process for conducting Pro-DUR in pharmacy practice settings.

Incorporation of standard processes and procedures has decreased the rate of human error in other industries. For

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example, the airline industry has incorporated improved procedures, consideration of human factors in automation development and design, improved training, and increased use of standardization to decrease errors(3). Standardized procedures, such as preflight checklists are routinely used in the airline industry before each take off(4). The drop in the civil air transport accident rate, which has been decreasing since the mid-1940s, has been attributed in part to these standard procedures(5).

Because quality and productivity have been shown to improve as variation is reduced(6), several authors have noted the need for medicine to follow the lead of the airline and other industries by using quality management to decrease unnecessary variation in health care organizations(7-10). A recent Institute of Medicine (IOM) Report suggested that the American health care system could reduce the likelihood of accidents by using the techniques used in other industries to standardize key processes(7). According to medical error expert, Lucian Leape, "standardization is one of the most effective ways to prevent errors"(4).

One way to standardize procedures and decrease the amount of variation is to employ decision-support systems such as algorithms to guide the decision maker(11). Algorithms have been utilized as a mechanism for increasing reliability by decreasing variance in medicine(12-13) and nursing(14).

Evidence from studies of medical decision making have demonstrated that these systems can improve provider performance in such areas as drug dosing, preventive care, antibiotic-selection, anticoagulation, geriatric prescribing, and error reduction(13,15-21).

Algorithms have been created in pharmacy to guide pharmacists in disease management(22). The American Pharmaceutical Association has been particularly active in this area, publishing 45, peer-reviewed drug therapy treatment protocols in nine disease categories to assist pharmacists to improve the safety, effectiveness, and efficiency of patient drug therapy(23).

A review of the literature revealed only one algorithm developed specifically to assist pharmacists to avoid dispensing errors(24), despite mounting evidence that pharmacists have a need for decision support in their prospective drug utilization review activities. In a ten-year study of litigious claims brought against pharmacists, 13.6 percent involved intellectual errors(25). Within this category, problems related to inadequate or inappropriate drug utilization review accounted for 14.7 percent of errors. Importantly, this statistic has increased from just four percent in 1993, and is expected to continue to increase as the current volume of three billion prescriptions dispensed per year in the community setting grows to a projected four billion within the next few years.

RESEARCH QUESTIONS

Pharmacy curricula have not historically included extensive training in performing Pro-DUR. Moreover, continuing professional education programs typically do not directly address this important skill[1]. The purpose of this study was to evaluate the impact of a systematic approach to performing Pro-DUR on the quality of pharmacists' clinical decisions. Dubbed SMORES (Standardized Medication Order Review and Evaluation System), this systematic approach to performing Pro-DUR represents a structured educational program within which a stepwise algorithm for performing Pro-DUR is embedded.

The following research questions were investigated in this study: (*i*) Does the application of a clinical decision aid during prescription review improve pharmacists' dispensing-related decisions? (*ii*) What is the incremental effect of a clinical decision aid and Pro-DUR training on pharmacists' dispensing-related decisions? (*iii*) Does focused training in Pro-DUR improve the quality of pharmacists' dispensing-related decisions?

METHODS

The systems approach model for the design of instruction developed by Dick and Carey (26) was used as the template for developing the SMORES program. This model is a reliable method for designing instruction that is intuitive and relatively easy to apply.

The ten steps of the Dick and Carey Instructional Design process are as follows: 1. assess needs to identify instructional goals; 2. conduct instructional analysis; 3. analyze learners and contexts; 4. write performance objectives; 5. develop assessment instruments; 6. develop instructional strategy; 7. develop and select instructional materials; 8. design and conduct formative evaluation of instruction; 9. revise instruction; and 10. design and conduct summative evaluation. The method also includes several feedback loops that delineate interrelationships of system components and assist the designer to reexamine and revise steps in the process as needed in order to maximize their contributions to the overall instructional objective. At the heart of the SMORES program is an algorithmic approach to Pro-DUR. The algorithm was evaluated and edited by a panel of five experts in medication order review. A visual representation of the final algorithm is included in Appendix A.

The resulting algorithm was imbedded in the SMORES training program during which the participant learned a systematic approach to the Pro-DUR mandated by OBRA '90. The program provided the participant with three hours of American Council on Pharmaceutical Education (ACPE) approved continuing education credit. Given a comprehensive medication history for a specific patient, the overall instructional goal for the SMORES program was to assist participants to more effectively identify potential problems in prescribed drug therapy.

It has been suggested that learning can be more effective if the reasons for engaging the students in an activity are presented(27). SMORES training therefore began with an explanation and discussion of the laws that mandate pharmacist participation in Pro-DUR. As case-based instruction has been demonstrated to be a useful mechanism for developing problem-solving ability(28), this method of instruction was heavily utilized in both SMORES training and evaluation. Because SMORES training involved intellectual skill development, practice and feedback were considered to be necessary to give the learner an opportunity to assess the results of their practice(27). Opportunity for practice and feedback were therefore incorporated into the training session and were arranged into a three-hour workshop.

Clinical case scenarios containing drug therapy problems were developed by a panel of three experts in pharmacotherapy. All three experts hold Doctor of Pharmacy degrees and have substantial clinical practice and teaching experience.

[1]Vrahnos, Travlos, D., Personal Communication (dvrahnos@acpe-accredit.org) RE: CE listing. E-mail to Warholak-Juarez, T. (TWARHO@Arizona.Midwestern.edu), (April 20, 2000).

Table I. Mean Kappa of agreement between experts and pharmacists on Pro-DUR DAI items

	Pretest			Level 1 intervention			Level 2 intervention		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Community	114	0.3619	0.2513	144	0.2771	0.2131	114	0.3591	0.2607
Institutional	18	0.3511	0.2926	18	0.2288	0.2549	18	0.2716	0.1760
Sample	140	0.3658	0.2558	140	0.2718	0.2154	140	0.3454	0.2475

Cases were developed with two principle criteria in mind: First, medication problems included in cases must be representative of those commonly encountered in pharmacy practice(29). Second, the level of pharmacist knowledge required to identify the prescribing problem in question should not exceed that of the average baccalaureate-trained pharmacist. To ensure that case development criteria had been met, a panel of five pharmacists from the Phoenix area assessed the appropriateness of the cases. These pharmacists represented a variety of clinical and practice backgrounds. Pursuant to these reviews, twelve cases were ultimately retained for use in the evaluation component of the study. Additional cases that were selected using the same criteria were used as practice cases during SMORES training.

All cases included the following standard patient information set:

- the name and strength of the medication
- the amount to be dispensed
- directions for use
- a patient medication profile and refill history
- patient age, gender, and known allergies
- the diagnosis or reason for use of the prescribed medication
- the patient's current complaints
- findings of the physical exam
- patient history
- pertinent lab data
- diagnoses for the patient's other current medical problems
- the physician's progress notes and therapeutic plan.

An example of a typical case is included in Appendix A.

The Dispensing Appropriateness Index (DAI), which had been used in a previous study(2,30), was used to objectively evaluate pharmacists' Pro-DUR decisions. The DAI was further revised for this study so that the items adequately reflected the Pro-DUR requirements of OBRA '90. A copy of the DAI is included in Appendix B.

Study Population. A convenience sample of 176 pharmacists in Arizona, Illinois, Iowa, and Tennessee were recruited for the study. Pharmacists were trained in three-hour workshops in groups of approximately 30.

Study Design. The study was organized as a pretest-posttest control group design. At the beginning of the workshop, pharmacists were provided with four clinical cases that had been randomly selected for that session from the twelve cases developed for study. This was the pretest or No DAI phase. Pharmacists were instructed to perform Pro-DUR as they normally would during the dispensing process. For each case, pharmacists evaluated the appropriateness of the prescribed drug therapy using the information available, and documented their decisions via free-form narrative.

Following the pretest, pharmacists received a brief tutorial on the use of the DAI decision aid. Pharmacists were then provided with four more clinical cases and instructed to perform Pro-DUR. This served as the Level 1 intervention phase or DAI phase. Pharmacists evaluated the appropriateness of the prescribed drug therapy in each case using the information available, and documented their decisions by completing the DAI. Following this phase, pharmacists received SMORES training and reviewed a third series of four patient cases. This served as the Level 2 intervention or DAI + SMORES phase. During case assessment, pharmacists had access to information references.

Two weeks after receiving SMORES training, participants were sent a survey to assess their opinion on the utility of SMORES training, and determine the extent to which they had incorporated this systematic method of Pro-DUR screening into their practice.

Statistics. The quality of pharmacists' DUR-related decisions was assessed by comparing their responses on the DAI with the consensus judgment of the three clinical experts. The data analysis was completed in three stages: (*i*) categorization of the free-form narrative responses to the pre pretest DAI; (*ii*) calculation of a Kappa coefficient of agreement between the pharmacist and the expert judges, and; (*iii*) aggregation and statistical testing of Kappas across pharmacists by phase of study. Similar to a correlation coefficient, κ is a measure of agreement between two parties, where 1 = perfect agreement and 0 = no more agreement than would be expected by chance(31).

As is illustrated in Table I, the Kappa coefficients for the 11 Pro-DUR items on the DAI were relatively low, and in some cases actually appeared to decrease as SMORES training progressed from pretest through Level 2 intervention. However, closer examination of the data revealed that participants seemed to be correctly identifying the medication-related problems in the cases. Whereas significant agreement existed between study pharmacists and the experts as to the identification of medication-related problems in the cases (*i.e.,* "true" positives), this agreement was being obscured in the Kappa values by disagreement resulting from study pharmacists' increasing tendency to identify false positives as a result of SMORES training.

That is, during SMORES training, participants became better able to identify medication-related problems. However, the training seemed to cause them to be overly sensitive to the identification of problems to the extent that they tended to perceive problems where the experts had not. When Kappa coefficients were calculated, these false positives were reflected in lower Kappa values. Upon closer inspection of the pharmacists' responses, it was determined that a number of legitimate, albeit minor, potential problems were identified by participants but not by the expert judges. To address this problem, participants' answers were dichotomized as either 'appropriate' or 'inappropriate' for the known major medication-related problem(s) in each case. In this way, participants were scored as

Table II. Mean Kappa of agreement between pharmacists and experts on whether to dispense prescription

	Pretest		Level 1 intervention		Level 2 intervention	
	N	Mean	N	Mean	N	Mean
Communitv	81	0.1235	81	0.1852	81	0.2346
Institutional	15	0.2667	15	0.2667	15	0.2000
Sample	102	0.1471	102	0.2010	102	0.2353

either correctly identifying the major problem, or not. This procedure was also applied in the analysis of the identification of minor medication-related problems. Thus, reported means indicate the mean proportion of pharmacists correctly identifying the medication problem.

Descriptive statistics were performed to describe pharmacist demographics and program evaluation. The pharmacists were not compared with respect to practice setting because of insufficient power to do so. The SAS system was used for all data analysis (32).

RESULTS

Characteristics of Pharmacist Participants

The average age of the participating pharmacists in the study was 43.7 years (SD=12.4 years, N=167). These pharmacists had been in practice for a mean of 19 years (SD=12.6, N=164) and had been practicing in their current setting for 9.3 years (SD=8.8, Median=6). Pharmacists were evenly split with respect to gender (47.7 percent female and 47.2 percent male). The majority of the participants held a Bachelors of Science in Pharmacy (73.9 percent) with Doctor of Pharmacy degree holders representing the remaining 19.9 percent.

At the time of data collection, 82.3 percent (N=145) of the pharmacists were employed in the community practice setting. Of those, 50 percent were employed in a chain pharmacy setting, while 9.1 percent were employed in a food store-based practice setting. Of the 15.3 percent of pharmacists who were employed outside the community practice setting, over half were working in the hospital setting, two in the long term care industry, one in home health care, and two each in pharmacy research, and the pharmacy benefit management arena.

DUR Decisions

The DAI was used in this investigation primarily as a standard data collection instrument to capture pharmacists' Pro-DUR decisions. However, because the DAI also provides a structured approach to reviewing prescription drug therapy, the investigators anticipated that it may directly improve the quality of pharmacists' clinical decisions even in the absence of the SMORES training.

To test this conjecture, the change in scores from the pretest (major problem No DAI, mean = 0.4532; minor problem No, DAI, mean = 0.0330) and the Level 1 intervention (major problem DAI, mean = 0.6424; minor problem DAI, mean = 0.3135) were used to assess the effect of the DAI decision aid on the quality of pharmacists' Pro-DUR decisions. Contrasts revealed that the difference in these two phases were statistically significant (major problem F=7.8, P=0.0162; minor problem F=20.5l, *P*=0.0201), indicating that pharmacists who used the DAI correctly identified more major and minor medication-related problems than those who did not.

The second research question addressed in this investigation relates to the effect of a comprehensive training program and clinical decision aid on pharmacists' ability to apply patient information during their review of prescription drug therapy. The SMORES program provided pharmacists with training in a systematic method of Pro-DUR aimed at decreasing variation and improving quality.

ANOVA results indicated a significant difference in the main effects for both major (F=5.73, *P*=0.0092) and minor (F=23, *P*=0.0026) medication-related problem identification (major problem identification F=5.73, *P*=0.0092 and minor problem identification F=23, *P*=0.0026). Because a difference was noted in the main effect, subsequent analysis was planned to determine which component(s) were responsible for this difference.

The change in scores between the Level 1 intervention (major problem DAI, mean = 0.6424; minor problem DAI, mean =0.3135) and Level 2 intervention (major problem DAI + SMORES, mean = 0.6108; minor problem DAI + SMORES, mean = 0.3036) was used to assess the effect of the SMORES training program on the quality of pharmacists' Pro-DUR decisions. Analysis revealed that the difference in these two phases was not statistically significant for either major or minor medication related problem identification (major problem F=0.77, *P*=0.3962; minor problem F=0.09, P=0.7848). Stated differently, pharmacists who completed the SMORES training program did not correctly identify more major or minor medication-related problems than those who did not.

Net Dispensing Decisions

In addition to the 11 specific DUR-related areas of assessment, pharmacists were asked to indicate on the DAI if they would have dispensed the medication order as written. As illustrated in Table II, pharmacists generally achieved a relatively low overall agreement with the judges as reflected by Kappa scores, although agreement scores did increase as SMORES training progressed. Because these data were not normally distributed, Wilcoxon Signed Rank Tests with a Bonferoni correction was performed to determine if Kappa increases were statistically significant.

The analysis revealed a significant increase in agreement between pharmacists and experts between the pretest (No DAI) and Level 2 intervention (DAI + SMORES), S: = 229.5, *P*=0.0095, but not between pretest (No DAI) and Level 1 intervention (DAI). Thus, when using the DAI in combination with SMORES training, pharmacists reached a higher level of agreement with the experts concerning the net practical decision of whether the prescription should be dispensed.

Demographic Correlation

In general, demographic indicators that were collected from participants demonstrated no relationship to the quality of pharmacists Pro-DUR decisions. The exception was pharmacists' prior experience using SOAP notes (subjective, objective, assessment, and plan), which showed a significantly positive correlation between the Level 1 intervention and the Level 2 intervention (r = 0.36142, *P*=0.0147). That is, there

was a significant relationship between prior experience using SOAP notes and pharmacists' ability to identify more medication-related problems after receiving SMORES training. Other correlations with demographic variables were not statistically significant.

Program Evaluation

After each training session, participants were asked to share their opinions and comments in an anonymous paper-based survey. Of the 175 pharmacists who completed an evaluation form, 87 provided narrative comments. The comments fell into three categories: (*i*) positive comments regarding the usefulness of the SMORES training or the DAI algorithm; (*ii*) comments stating that changes might need to be made in the length of SMORES training (some suggested lengthening the program to provide additional practice while others suggested condensing it); and (*iii*) a listing of barriers to implementing the SMORES method in clinical practice (*i.e.,* lack of time and patient information).

In addition to the evaluation assessment completed by participants upon completion of the SMORES, a follow-up survey was sent to participants approximately two weeks after the program. This survey was intended to assess the extent to which pharmacist participants utilized the SMORES method upon returning to their practice environments.

A total of 176 participants participated in the SMORES data collection. Of those, 55 returned surveys (31.4 percent). Of the surveys returned, most (N=31) indicated they had used the SMORES Pro-DUR in their practice. Of those who had used the method, 29 (94 percent) were either very satisfied or satisfied with the SMORES approach.

Respondents also indicated how SMORES training had affected their Pro-DUR skills. Of those responding, most (N=31) indicated the SMORES training had either greatly improved or improved their Pro-DUR skills. An additional 19 indicated their Pro-DUR skills were slightly improved as a result of the SMORES program.

Many of those who had not used the SMORES method in practice listed a number of practical barriers. These barriers generally fell into two major categories: (*i*) lack of time to perform Pro-DUR; and (*ii*) insufficient patient information on which to base Pro-DUR assessments.

General comments fell into three categories. These included: (*i*) positive comments regarding the usefulness of the SMORES training or the DAI algorithm; (*ii*) comments stating that additional training time might be useful; and (*iii*) comments in which participants stated the DAI was useful but that the algorithmic portion of the SMORES training was too burdensome to be easily used in pharmacy practice.

DISCUSSION

Pharmacists in this study who used the DAI correctly identified more major and minor medication-related problems than those who did not. This result provides support for the concept that simple decision support devices, such as flow charts and checklists, can improve the performance of key processes in pharmacy practice. The DAI itself significantly improved the quality of pharmacists' clinical decisions, insofar as their ability to identify true medication problems. Use of decision aids in Pro-DUR may help pharmacists in the practice setting to identify medication-related problems thereby decreasing medication errors. More research in this area is needed.

Analysis indicated that the quality of pharmacists' DUR decisions did not significantly improve when SMORES training was added to the DAI decision aid. This suggests that SMORES training was not successful in the manner hoped for and revisions in the program must be made. Data from the field test contain some clues to the revisions that may increase program effectiveness.

One reason may have been that the three-hour time span allotted for each SMORES session was insufficient for a training program of this scope. When practicing a skill, mastery is influenced by the difficulty of the skill and the amount of practice performed. Future SMORES programs will be lengthened to provide more practice time to allow for skill mastery.

Fatigue was also observable in the participants during the training sessions. Many participants attended SMORES training after working for 8 to 12 hours, and appeared tired by the end of the training. Participants who appeared to be motivated during the pretest and Level 1 intervention (No DAI and DAI) seemed to lose motivation for seriously contemplating case evaluation in the Level 2 intervention (DAI + SMORES). Several subjects did not complete Level 2 assessments at all, and had to be dropped from analysis. Thus, SMORES training should probably be split into multiple sessions, especially if the duration of training is to be increased.

Another possible reason that pharmacists had trouble performing in the DAI + SMORES phase could be because it was too much of a change from their routine behaviors. As one participant commented, "(I am) not sure its helpful for pharmacists who are currently practicing - they seem to have a 'way' and it is tough to rethink and re-learn." If this is the case, repeated sessions and subsequent exposures to the SMORES algorithm and DAI may be necessary for pharmacists to receive optimal benefit from the decision aid and training (DAI + SMORES). This also suggests that pharmacy students may benefit more from the SMORES program or the DAI than practicing pharmacists, because students have presumably not developed a routine process for performing Pro-DUR.

The apparent importance of routine also suggests that the DAI or SMORES algorithm may be more useful if they are integrated into to the pharmacist's own practice environment. If the DAI or SMORES algorithm can be integrated into routine pharmacy practice via standard procedures and/or pharmacy computer systems, they might more easily become routine practice, with less interruption in workflow.

Although pharmacists identified a higher proportion of drug therapy problems during the Level 1 intervention (DAI), as training progressed it became apparent that they were also identifying less important - and even questionable - drug therapy concerns. This over-sensitization may partially explain why the Kappa values of agreement with the expert judges for the Level 2 intervention (DAI + SMORES) did not increase as anticipated.

This over-sensitization can be considered a natural byproduct of a clinical training program like SMORES (*i.e.,* if pharmacists knew they were expected to find problems - then they were determined to find all possible problems). However, while perhaps useful as an intellectual exercise in a workshop environment, this effect could produce significant workflow problems if transferred into the practice setting. Future programming should better assist pharmacists to confirm and disconfirm the existence of problems with medication therapy that may be suspected on the basis of initial DUR.

Pharmacists in the study were asked to make a net dispensing decision for each case during the pretest (No DAI),

Level 1 intervention (DAI), and Level 2 intervention (DAI + SMORES). Analysis of these data revealed that pharmacists reached progressively higher agreement with the judges on these decisions as SMORES training progressed. However, only the Kappa increase from pretest (No DAI) to Level 2 intervention (DAI + SMORES) showed statistical significance. This suggests that SMORES training increased the quality of the pharmacists' net dispensing decision and thus may play a different role in improving pharmacists' Pro-DUR activities than does the DAI.

Use of the DAI may increase pharmacists' sensitivity to the identification of medication problems, but the SMORES training and algorithm may assist the pharmacist to prioritize the possible problems they have identified. The rating of the perceived severity or importance of a probable medication-related problem is addressed more specifically in the SMORES training than on the DAI. Perhaps additional SMORES training could provide pharmacists with an increased ability to evaluate problem importance. When it comes to evaluative skills, subjects' ability is related to the number of practice attempts(33). Clearly, more research in this area is needed.

A Significant relationship was observed between pharmacists in this study who had prior experience using SOAP notes, and their ability to identify more medication-related problems after completion of SMORES training. This may indicate there is a learning curve associated with utilizing patient information. To use the patient information contained in SOAP notes in their clinical decision-making, pharmacists may need to receive additional training. This could become especially important in the event that centralized repositories of patient information become available to pharmacists. If additional patient information were to become readily available, pharmacists should be trained in how to optimally use this information in their Pro-DUR decision-making.

Limitations

Every effort was made in the study to keep the conditions under which pharmacists completed their review of the clinical cases as similar as possible. However, given the disparate circumstances under which the program was offered to different groups, it was not possible to ensure that its delivery was identical for each. In an effort to maintain a workshop environment for the SMORES training sessions, it was important to limit participation for each of the data collection sessions. Thus, to obtain sufficient participation for adequate statistical analysis, the SMORES program was offered a total of 12 times. During some data collections, chairs in the meeting room were not movable, making participant collaboration and discussion difficult. In addition, some rooms were larger than optimal for small groups. This may have affected the results because less discussion may have decreased practice and feedback quality thereby decreasing the benefit of the practice session.

Pharmacists self-selected participation in the study by responding to a program announcement. Because pharmacists who are willing to attend a three-hour continuing education session on Pro-DUR may be different than the typical pharmacist in how they respond to a training program, the results of this study cannot be generalized to all pharmacists. While every effort was made to ensure the validity of the cases that were used in this study, in the future, it would be worthwhile to include more experts in the case validation process.

Cases were developed to be representative of the types of knowledge and prescribing problems that would routinely be experienced in pharmacy practice. This was ensured by a review by community pharmacy practitioners. Although all clinical cases were assumed to be of equal difficulty, this may not have been the case. Participant comments suggest that certain cases may have been more difficult than others. Although steps were taken to prevent this bias by randomly assigning cases for each treatment prior to each data collection session, unequal case difficulty could have still biased the results, depending on which phase of the study the easier or more difficult cases were assessed. Methods to ensure the equivalence of case difficulty (*e.g.,* Rasch Analysis) may prove useful in future applications of SMORES training(34).

CONCLUSION

The DAI clinical decision aid helped pharmacists improve their dispensing-related decision-making by allowing them to identify more potential medication-related problems. Thus, this study provides some support for the use of clinical decision aids in pharmacy continuing education. However, more research is needed to determine if the increase in problem identification will translate into a decreased incidence of medication errors the pharmacy practice setting.

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APPENDIX A. SAMPLE CASE

Date Today
Patient Richard Patient
Chief Complaint: Inability to achieve/maintain erection.

Subjective

57-year-old male recently remarried. First wife died 2 years ago. Psychological distress secondary to unsatisfactory sexual relations with new spouse because erections are generally insufficient to achieve penetration. Denies erectile dysfunction during prior marriage. Occasionally awakens with erection. Denies difficulty with urination.

PMH	**Chronic Medications**	
Hypertension	Lisinopril 40mg qd	ASA 325mg qd
Hyperlipidemia	Lasix 40mg qd	Zocor 20mg qd
S/P Myocardial Infraction	Digoxin 0.25 mg qd	NTG 0.4 mg sl prn
CHF		

Objective

Height: 70 inches Weight: 95 kg
Allergies: No Known
BP: 145/85 Temp: 98.8 Pulse: 64 Resp: 20

Physical Exam:
Neck Veins Flat Cor: Regular Rate & Rhythm,
Lungs: Clear Abd: Soft, No bruits
Extremities: 1+ pedal edema Genital: Normal external male
Rectal: prostate wnl genitalia

Labs:

BUN	12	(7-18 mg/dL)	Total Chol.	230	(<200 mg/dL)
Creat	0.8	(0.4-1.3 mg/dL)	HDL Chol.	38	(27-67 mg/dL)
Na	139	(140-148 mEq/L)	LDL Chol.	146	(goal<100mg/dL)
K	3.8	(3.6-5.2 mEq/L)	Triglycerides	220	(<160 mg/dL)
CI	105	(98-108 mEq/L)	Digoxin	1.1	(0.9-2.0 ng/dL)
CDAI	28	(22-30 mEq/L)	Glucose	98	(70-115 mg/dL)

Problem List
Erectile Dysfunction Hypertension Congestive Heart Failure
Hyperlipidemia Coronary Artery Disease

Treatment Plan
Viagra 50 mg 1 tab 1 hour prior to sexual intercourse, Disp. #6
Increase Zocor to 40 mg qd
Continue other medications

Return to Clinic
1 month

APPENDIX B.

The Dispensing Appropriateness Index

Instructions: Please evaluate the appropriateness of the medication order by checking the box next to the answer that best matches your assessment. If there is additional information you would like to share, please include it under "Comments' below.

	Appropriate	**Probably Appropriate**	**Inappropriat**	**Probably Inappropriate**
Drug-allergy interactions	☐	☐	☐	☐
Dosage	☐	☐	☐	☐
Directions for use	☐	☐	☐	☐
Route and dosage form	☐	☐	☐	☐
Duration of therapy	☐	☐	☐	☐
Drug-drug interactions	☐	☐	☐	☐
Indications/goals of therapy	☐	☐	☐	☐
Therapeutic duplication	☐	☐	☐	☐
Drug-condition interactions	☐	☐	☐	☐
Utilization	☐	☐	☐	☐
Completeness of therapy	☐	☐	☐	☐

Given the information available, would you dispense this prescription as is? ☐ Yes ☐ No

How confident are you that you have made a correct evaluation of this therapeutic plan?

Very Confident	Fairly Confident	Somewhat Confident	Not at All Confident
☐	☐	☐	☐

APPENDIX THE SMORES ALGORITHM