

Automated medication-dispensing system in two hospital emergency departments

JENNY O. GORDON, RONALD S. HADSALL, AND JON C. SCHOMMER

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Management Case Studies describe approaches to real-life management problems in health systems. Each installment is a brief description of a problem and how it was dealt with. The cases are intended to help readers deal with similar experiences in their own work sites. Problem solving, not hypothesis testing, is emphasized. Successful resolution of the management issue is not a criterion for publication—important lessons can be learned from failures, too.

Problem

Emergency departments (EDs) have often dealt with medication dispensing creatively, especially after regular business hours, when hospital pharmacy departments may be closed. Some have opted for keeping stocks of commonly prescribed medications in pre-labeled “starter” containers. This system addresses access to pharmaceuticals but requires the prescriber to provide an additional prescription when therapy beyond the starter supply is necessary. The medications dispensed in the ED are typically handled by nurses, who often must, in addition to their regular duties, select the right drug, correctly label the medication, and educate the patient. It may be difficult or impossible to obtain reimbursement from payers for the medications dispensed.

Recognition of these problems and firsthand experience led to the development of an outpatient auto-

mated dispensing system (ADS) especially designed for EDs. This point-of-care ADS was created to provide a full course of prescription medications to patients in EDs located in hospitals that do not have a 24-hour pharmacy on site. The development of the system was led by an emergency medicine physician who, one night, was unable to locate a 24-hour pharmacy to fill a prescription for his young son, who was suffering from acute otitis media.

This article describes the experiences of two hospitals that had, at the

time of writing, used an automated ADS for 12 and 18 months.

Analysis and resolution

The ADS used by the EDs in the two hospitals, InstyMeds, was developed and is marketed by Mendota Healthcare, Inc. (Eden Prairie, MN). The system is the size of a typical vending machine and is designed to be located in the patient waiting area of the ED. It can dispense nearly all dosage forms, including oral solids, liquids, suspensions, inhalers, ophthalmic or otic drops, and creams or ointments. Its touch-screen patient interface has been designed to be user-friendly. Patient demographic and insurance information is received via a Health Level 7 interface (an industry-standard data feed) with the hospital patient-registration system. A scanner is used for scanning the patient’s medical or prescription drug insurance card. Physicians enter prescriptions via a personal digital assistant with ADS prescribing software designed to accommodate the prescribing patterns of each physician and the ED’s ADS formulary. The patient chooses either to fill the prescription through

JENNY O. GORDON, B.S., Social and Administrative Pharmacy, is a Ph.D. degree candidate; RONALD S. HADSALL, PH.D., is Professor, Department of Pharmaceutical Care and Health Systems, and Associate Dean for Professional Education; and JON C. SCHOMMER, PH.D., is Associate Professor, Department of Pharmaceutical Care and Health Systems, and Director of Graduate Studies in Social and Administrative Pharmacy Track, College of Pharmacy, University of Minnesota,

Minneapolis.

Address correspondence to Ms. Gordon at the College of Pharmacy, University of Minnesota, Minneapolis, MN 55455 (gord0178@umn.edu).

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the ADS kiosk or to have the prescription printed and filled at a community pharmacy of choice. If the patient chooses to use the ADS, the prescription is adjudicated automatically through a commercial transaction service (WebMD Envoy, WebMD Business Services, Nashville, TN).

Third-party payer edits and all insurance issues are handled by the manufacturer's 24-hour, seven-day-a-week support center, and the order is transmitted to the ADS. All units accept credit or debit cards for insurance copayments or full prescription drug payments from customers without prescription drug coverage. An optional cash acceptor-dispenser is also available. Medicaid and public assistance plans are accepted. In addition, the hospital can choose to subsidize a patient's medication.

Key to the technology's safety is the use of three distinct bar codes that are individually read and integrated with each other to ensure that the correct medication is dispensed directly to the patient as a fully labeled, complete course of therapy. A set of bar codes match those on the dosage form, the prescription, and the sleeve (medication slot). This technology reduces errors made during dispensing and eliminates handwritten prescriptions, reducing the risk of medication errors.

Prescription filling and third-party adjudication generally take less than five minutes. If the patient has technical questions, problems with insurance coverage, or drug therapy questions, a telephone near the ADS provides a direct line to the manufacturer's support center. The center is staffed by pharmacists and pharmacy technicians who can answer questions and counsel patients regarding drug therapy.

The two hospitals included a small-to-medium-sized hospital in a rural community and a larger tertiary care urban hospital. A series of interviews were conducted with key staff

at each hospital. The staff members to be interviewed were identified by the manufacturer as the people most intimately involved in the implementation or use of the ADS. Hospital employees and selected physicians were asked to discuss their experiences with and opinions about access to ED prescription drugs prior to installation of the ADS and to briefly describe access since the ADS was introduced. Frequent users of the system were queried about any problems with the system and asked to provide ideas and suggestions for improving the service. Oral interviews were conducted by using questionnaires with open-ended questions (appendix). All interviews were tape-recorded. Approval was obtained from the institutional review boards of all the institutions involved.

Secondary data available to or residing within the ADS manufacturer's databases were used to complete the case reports. These data included utilization of the ADS, prescribing and dispensing data, and ED-visit data.

Urban hospital

The urban hospital is a large non-profit institution in Minneapolis. It is part of the Allina Hospitals and Clinics system, a family of hospitals, clinics, and care services in Minnesota and western Wisconsin. The hospital has approximately 625 staffed beds and receives about 36,000 ED visits per year (averaging 100 visits daily). Some 35% of ED visits at this facility result in a hospital admission; this rate is higher than at most community hospitals.

The hospital has an onsite community pharmacy that is open from 7:30 a.m. to 9 p.m. Monday through Friday and from 8 a.m. to 4 p.m. Saturday and Sunday. Even though this pharmacy is located in the hospital complex, it is difficult for patients to use it because of heavy security around the ED perimeter. Parking facilities are not immediately adja-

cent to the ED, so patients must walk a long way to reach the ED.

Before the ADS was introduced, the onsite pharmacy stocked the ED with selected medications to accommodate a physician dispensing system for ED patients during off-hours, when other community pharmacies in the area were closed. The 43 products selected included analgesics, antibiotics, inhalers, and other short-term therapies commonly prescribed in the ED. (The hospital had elected to dispense full courses of therapy rather than one- or two-day starter packs.)

In this prior system, ED physicians were responsible for retrieving, labeling, and dispensing medications and providing administration instructions to patients. The nursing staff or the clerical staff was responsible for recording insurance information so that the pharmacy could pursue reimbursement on the next business day. This arrangement was labor-intensive and created stress for the physicians, nurses, and pharmacy staff.

The ED did not have the resources to collect any payments from patients. Also, there were times when patients would appear without their insurance information and when medications dispensed by a physician were not covered by the patient's health plan. This resulted in substantial losses for the pharmacy, even after expending a great deal of time trying to adjudicate the claim. The management estimated that the debt exceeded \$10,000 per month when the manual physician dispensing system was discontinued in 1998.

When the physician dispensing system was discontinued, a small-scale service for indigent patients was maintained. A few medications were still available, but their use was closely monitored by the pharmacy department. For the next two years, most ED patients were discharged with only a hard-copy prescription and a list of nearby 24-hour pharma-

cies. In 1999 and 2000, the two closest community pharmacies discontinued their 24-hour service, thereby exacerbating the problem of access. These service issues placed severe limitations on access to off-hour pharmacy services for patients without transportation or relying on public transportation. (Many community residents seen at this hospital rely on public transportation.)

Even though the hospital's onsite pharmacy filled only about 7% of all ED prescriptions, the changes in the availability of local community pharmacy services dictated that the problem had to be addressed. After researching the matter, the pharmacy department postulated that ADS technology not only could provide ED patients with quicker access to take-home medications, but also could do so safely and with minimal contribution to the hospital's debt. Patient convenience, and not a desire for increased profitability, drove the decision to acquire an ADS.

The ADS was installed in May 2002. It can be accessed by patients 24 hours a day, seven days a week, regardless of whether the hospital's pharmacy is open. Originally, approximately 55 drugs were available in 80 sleeves; these represented approximately 90% of all the drugs prescribed in the ED. The ADS manufacturer and the hospital's ED identified the medications most commonly used in the ED and stocked the ADS with them. If a physician prescribes a dosage form or quantity not available in the ADS, the patient can receive a printed prescription to be filled at a local pharmacy. In the time since the interviews were conducted, the ADS's capacity has been increased to 102 sleeves.

To restock the ADS, 30–45 minutes of technician time per day is required. This time includes walking to and from the pharmacy to the dispenser in the ED lobby and inserting the sleeves. Each morning, the manufacturer provides a restocking re-

port to the pharmacy that includes a list of sleeves to add to the dispenser. The pharmacy restocks the ADS with replacement sleeves, which are automatically shipped to the site by the manufacturer.

Overall, staff members feel that patient care has been substantially improved with the ADS, and patient satisfaction with services has increased. There are fewer problems with physician handwriting and fewer errors due to prescriptions with missing information; thus, fewer prescriptions have to be sent back to the prescribing physician for clarification or correction. Patients have expressed gratitude about being able to access their medications within minutes of being discharged from the ED. Physicians believe that they have fewer interruptions from the pharmacy.

The current version of the ADS prescribing software includes a pediatric dosage calculator, therapeutic dosage guidelines, and alerts that prompt the prescriber to review the patient's medication allergies when selecting pharmacotherapy.

A system feature that the pharmacy staff has requested (and that the manufacturer is evaluating) is a drug-use-review (DUR) component. A DUR module could improve patient care and medication safety. The pharmacy's request includes software to help automate allergy checks, dosage checks, and drug–drug interaction screening. When the hospital finishes implementing a computerized prescriber-order-entry (CPOE) system, it plans to interface it with the ADS. This interface will provide complete DUR capabilities at the point of prescribing.

The staff reports that the ADS has enabled the ED to improve patient care because of the immediate access to prescribed medications. Financially, the system shows a small profit—not including any savings realized from elimination of the starter doses formerly given in the ED. Since the

debut of the ADS, there has been no significant decrease in the number of prescriptions filled by the onsite community pharmacy. Figure 1 plots the growth in prescriptions entered by physicians in the ED and dispensed through the ADS from June 2002 through July 2003. The increase in dispensed prescriptions indicates that physicians and patients became increasingly comfortable with the ADS. Figure 2 shows the percentage of prescriptions written that were actually filled (the prescription-capture rate) over the same period. The installation of the cash payment option to the existing automated dispensing machine in January 2003 led to an increase in the prescription-capture rate. This feature added convenience for patients who wanted to use this system but had no credit or debit cards when they were in the ED.

The ED staff have embraced the ADS and feel that it has helped them perform their duties without distractions. They believe that they can better concentrate on their core responsibilities and not assume responsibilities for which they are not prepared, such as dispensing take-home prescription medications.

When the postimplementation interviews were conducted, the staff identified two system limitations. First, the number of product locations limited the dispenser's capacity. As a consequence, staff members felt that the ADS would be an excellent solution for a single-specialty facility but would probably not be suited to multispecialty environments unless capacity was increased. Second, some physicians said they had to spend time explaining the ADS option to patients. According to the ED medical director, this burden has since lessened, in part because of patients' becoming familiar with the ADS service. The ED staff indicated it would like to see patients be better informed about the ADS before they are seen by an ED physician. Since the interviews, the dispenser capacity

was increased from 80 to 102 compartments, and written information was made available to patients.

Rural hospital

The rural hospital is a nonprofit,

35-bed facility that serves a regional community and receives approximately 22,000 ED and urgent care visits per year. There is no outpatient pharmacy on site, and the inpatient pharmacy is not set up or staffed to

fill take-home prescriptions. The nearest 24-hour pharmacy is 25 miles away. The local community pharmacies typically close at 9 p.m. during weekdays and have reduced weekend hours. Thus, local pharmacy services are not available to the ED patient for substantial periods.

Figure 1. Number of prescriptions filled at urban hospital emergency department (ED) with automated dispensing system (lower curve) versus total number of prescriptions written in ED (upper curve).

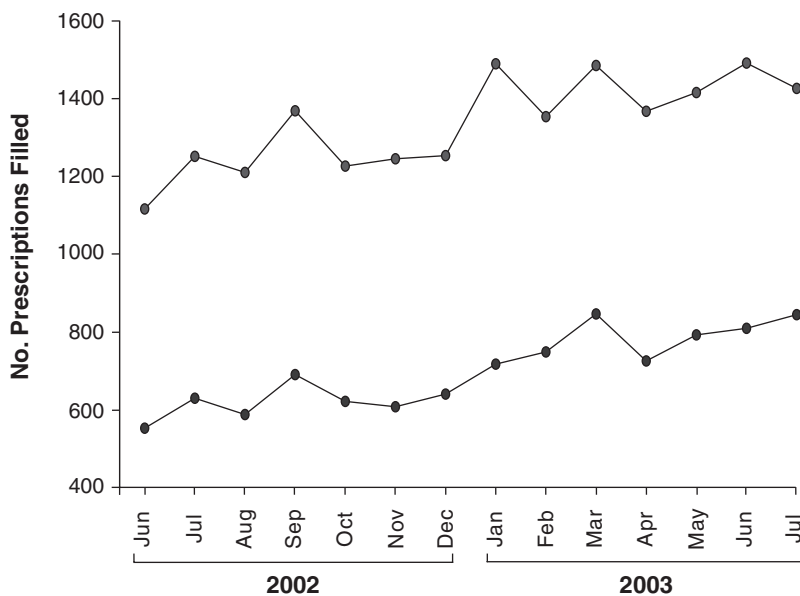
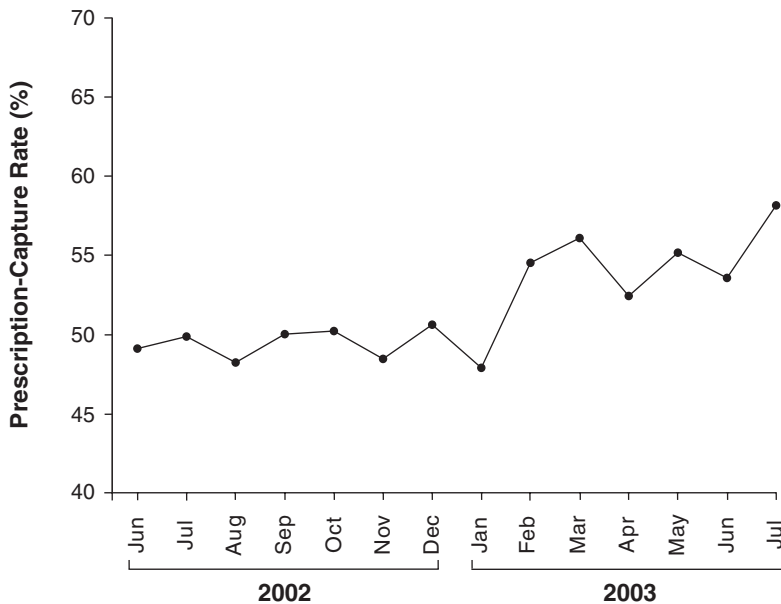


Figure 2. Prescription-capture rate (percentage of prescriptions written that were actually filled) at urban hospital emergency department with automated dispensing system.



Before the ADS was implemented, the pharmacy provided starter doses of medications to patients seen in the ED. Up to 50 types of drugs were stocked in the ED. Starter packs were dispensed to patients discharged from the ED during the hours when local community pharmacies were closed. These starter packs consisted of four dosage units (e.g., tablets, capsules) of a given drug. In addition, the physician wrote a prescription for the starter pack and a full prescription for filling at a local pharmacy.

A significant problem was the hospital's inability to obtain reimbursement for the starter packs from third-party payers. It was estimated that the pharmacy department lost \$3000 per month on starter doses. This was a driving factor behind the acquisition of an ADS. Another was the desire to give ED patients convenient access to prescription drugs. The institution wanted to offer dispensing services to patients but did not have enough staff and resources to enable operation of an outpatient pharmacy on site.

The ADS began operating in the ED in September 2002. There were a few initial technical problems, and some adjustments (mostly due to software issues) were needed for the system to work optimally. Minor issues with some of the thermal printers used in the ED were resolved when the facility obtained laser printers in 2004.

The staff interviews suggested enthusiastic acceptance of the ADS and an improvement in convenience and care. Since the interviews, the dispenser has been upgraded to hold up to 102 sleeves, thus allowing a wider

variety of medications to be supplied by this technology. As is also the case with the urban hospital, the manufacturer sends the stock report daily and ships the sleeves necessary for restocking.

Problems have included medication containers occasionally getting stuck and not dispensing. Because a cashier sits directly across from the ADS (24 hours a day, seven days a week) who already accepts cash for ED-visit copayments, the hospital decided not to order the optional cash acceptor–dispenser. (Some of the cashiers have disagreed with this decision, indicating that they would prefer not to have to accept and reconcile cash from patients using the ADS.)

Currently, about 420 prescriptions per month are being dispensed through the ADS. The hospital has calculated a positive financial return of approximately \$22,000 per year from the system. In contrast to the urban hospital, this hospital perceives large financial savings—even with far fewer prescriptions being filled per month.

The number of written and filled prescriptions fluctuated greatly over the observation period (Figure 3). The pattern differs markedly from that at the urban ED, probably because of the type of care delivered at EDs in rural settings. Figure 4 shows the prescription-capture rate over the same period. The steep increase beginning in February 2003 can be traced to the resolution of software problems.

Discussion

To date, there have been no ideal solutions to the hospital pharmacist’s dilemma of how to safely and conveniently dispense prescription medications to ED and other outpatient clinic patients. For both hospitals described in this article, the main motive behind obtaining the new technology was the desire to provide patients with more convenient access

to drug therapy, enhance patient care, and eliminate the need to stock outpatient prescription drugs in the ED. Physicians and nurses are now able to concentrate on their core duties without the distractions of drug

dispensing. The ADS may also increase the safety of dispensing, since it provides a three-bar-code checking system (bar codes for dosage form, prescription, and the ADS) and avoids errors caused by handwriting

Figure 3. Number of prescriptions filled at rural hospital emergency department (ED) with automated dispensing system (lower curve) versus total number of prescriptions written in ED (upper curve).

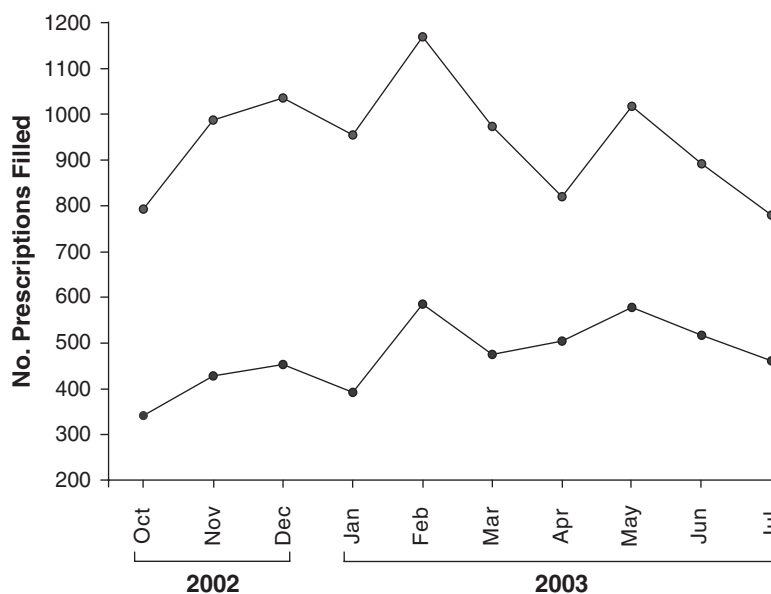
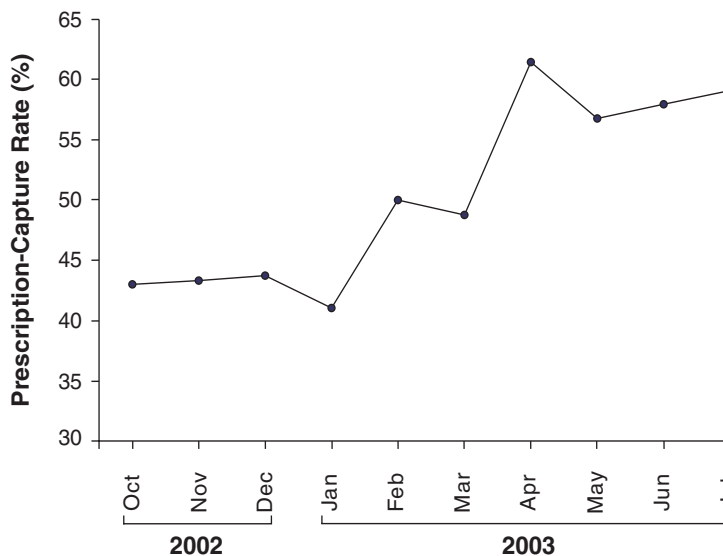


Figure 4. Prescription-capture rate (percentage of prescriptions written that were actually filled) at rural hospital emergency department with automated dispensing system.



and mislabeling. No medication errors involving the system in either ED have been reported.

The staff at both hospitals reported that patients are satisfied with the ADS, especially after being discharged from the ED. Patients no longer have lengthy waits for their medications, nor are they forced to travel a great distance to have their prescriptions filled.

At both hospitals, the initial period after ADS implementation involved adjustments for patients, prescribers, and administrative staff. At first, physicians felt the need to thoroughly explain the ADS option to patients. As time passed, patients became more aware of the system, and now some are already familiar with it when they arrive at the ED.

Staff members expressed satisfaction with the technical support provided by the manufacturer, especially at the rural hospital, which had a difficult transition, mostly because of software incompatibilities between the hospital's computer system and that used by the ADS.

While the rural hospital serves a varied patient population that includes both adult and pediatric patients, the larger urban hospital sees only adult patients. This accounts for the differences in the hospitals' prescribing patterns, which in turn result in the differences in each ADS's formulary.

The difference in demographics also has a huge impact on the transportation needs of the populations served. At the rural hospital, lack of pharmacy services was a problem during hours when local community pharmacies were closed. Patients visiting the urban hospital generally use public transportation. Therefore, even when local pharmacies are open, there are still significant difficulties with access to prescription drugs.

Another factor behind the difference in the experiences of these hospitals is the lack of a cash acceptor-dispenser in the ADS at the rural

hospital. Even though a nearby cashier accepts cash, this manual system seems to inhibit some patients from choosing to use the ADS.

One limitation of the ADS is lack of direct access to a pharmacist at the site of dispensing—a limitation that is somewhat overcome by access via a telephone available next to the ADS unit. However, before the ADS was installed, neither hospital was able to offer traditional pharmacy services in the ED. Physicians and nurses dispensed medications.

Although there have been no substantial increases in revenues with this system, significant savings are possible because of reimbursement from third-party payers for the medications dispensed.

A pending upgrade is the incorporation of DUR software as a standard feature. The manufacturer is investigating the advantages of this enhancement. A factor to consider is that many hospitals are adopting CPOE and electronic medical record systems that already offer this capability at the point of prescribing.

Conclusion

An ADS implemented at two hospitals increased patient access to medications and was well received by ED staff and patients.

Appendix—Interview questions regarding automated dispensing system (ADS)^a

Administrative staff

1. Could you describe in general the challenges and issues the facility faced in providing prescription medication services to the emergency department (ED) patient or outpatient prior to the ADS?
2. What were your greatest concerns with the then current system (no prescription service after hours, starter doses, cost, labor, etc.)?
3. Was your staff satisfied with the then current system?
4. Were your patients satisfied with the then current system?
5. Why did you want to try the ADS?
6. How has your staff (pharmacy, nurses, physicians) embraced the ADS? What do they like? What do they not like?
7. How have your patients embraced the

ADS? What do they like? What do they not like?

8. What has the ADS done for patient care?
9. What is the financial impact or outcome with the ADS installed?
10. Do you believe the ADS is a safe dispensing system for your patients? Why?
11. Are there any other benefits of the ADS that we have not discussed? Negatives?
12. Overall, has the ADS been a favorable change within your facility?

Pharmacy staff

1. What is the current number of staffed beds in the facility?
2. What is the current number of ED visits annually?
3. Were you providing prescription medication services to the ED patient or outpatient prior to the ADS? Twenty-four hours a day, seven days a week?
4. If you were providing these services, were you providing prescription medication services through a dedicated outpatient pharmacy (what were the days and hours of operation)? Through inpatient pharmacy? Through starter doses? By sending the patient to the nearest retail pharmacy? Other?
5. How close was the nearest 24-hour retail pharmacy prior to the ADS?
6. Identify your patient demographics' or location's (distance to nearest pharmacy) impact on prescription medication services after hours.
7. What were your greatest challenges in providing prescription medication services to the outpatient prior to the ADS?
8. If you used starter doses, describe what a starter dose was (i.e., first dose, four tablets, 24 hours, 48 hours or more).
9. What was the average number of starter doses distributed in a month?
10. If you used starter doses prior to the ADS, describe the pharmacy workflow process from beginning to end, including who was responsible for each step in the process (i.e., pick, count, package, label, document, deliver to ED, track product, narcotic counts, etc.). How often did this process occur (daily, weekly)? Who performed these steps (pharmacy technician, pharmacist)? What was his or her hourly wage? How much time was allocated to this process each time? Can you quantify the labor costs per starter dose?
11. What was the average drug cost per starter dose?
12. What were the greatest challenges or issues with starter doses?
13. Were you impacted by the pharmacist shortage just prior to the ADS?
14. Were your patients satisfied with the prescription medication service prior to the ADS?
15. Is there anything else about the environment of providing prescription medication services to the outpatient prior to the ADS that we should know about?
16. Why did you want to try the ADS?
17. Describe the current pharmacy workflow

- process with the ADS. How much time is allocated to this process or steps in the process?
18. Have you eliminated starter doses if you used them? If not, why? If starter doses are still being used, what percentage has been eliminated?
 19. Have you had any errors with the ADS (patients getting the wrong medication)?
 20. What are your average daily and monthly dispensing numbers?
 21. Has the ADS allowed pharmacy to reallocate any staff to work functions other than prescription medication services to the ED patient?
 22. How has your staff embraced the ADS?
 23. What is your impression of how the ED has embraced the ADS? What do they like? What do they not like?
 24. How have your patients embraced the ADS? What do they like? What do they not like?
 25. What has the ADS done for patient care?
 26. What is the financial impact or outcome with the ADS installed?
 27. Do you believe the ADS is a safe dispensing system for your patients? Why?
 28. Are there any other benefits of the ADS that we have not discussed? Negatives?
 29. Overall, has the ADS been a favorable change within your facility?
- Emergency department physicians and nurses**
1. What is the current number of staffed beds in the facility?
 2. What is the current number of ED visits annually?
 3. Were you providing prescription medication services to the ED patient or outpatient prior to the ADS? Twenty-four hours a day, seven days a week?
 4. If you were providing these services, were you providing prescription medication services through a dedicated outpatient pharmacy (what were the days and hours of operation)? Through inpatient pharmacy? Through starter doses? By sending the patient to the nearest retail pharmacy?
 5. How close was the nearest 24-hour retail pharmacy prior to the ADS?
 6. Did your patient demographics or location (distance to nearest pharmacy) impact prescription medication services after hours?
 7. What were your greatest challenges in providing prescription medication services to the outpatient prior to the ADS?
 8. If you used starter doses, describe what a starter dose was (i.e., first dose, four tablets, 24 hours, 48 hours or more).
 9. Describe the prescription medication starter-dose process in the ED prior to the ADS, including who was responsible for each step in the process (i.e., physician writes two prescriptions, and nurse goes to cabinet or pharmacy for starter doses, completes label, dispenses doses to patient, educates patient, provides documentation, etc.).
 10. How much time was allocated to this process for each starter dose? What is the hourly wage of an ED nurse? What was the labor cost per starter dose?
 11. What were the greatest challenges or issues in providing starter doses to the ED patient in general?
 12. Did you receive frequent pharmacy callbacks to the ED physician or nurse regarding prescriptions prior to the ADS?
 13. Were your patients satisfied with the prescription medication service prior to the ADS?
 14. Is there anything else about the environment of providing prescription medication services to the outpatient prior to the ADS that we should know about?
 15. Why did you want to try the ADS system?
 16. Describe the current ED workflow process with the ADS. How much time is allocated to the steps in the process?
 17. Have you eliminated starter doses? If not, why not?
 18. Have you had any errors with the ADS (patients getting the wrong medication)?
 19. What are your average daily or monthly dispensing numbers?
 20. How has your staff embraced the ADS?
 21. How many physicians or physician assistants were trained to use the ADS?
 22. How has physician acceptance been of the electronic prescribing system? How many use the system regularly? Exclusively?
 23. What is your impression of how pharmacy has embraced the ADS? What do they like? What do they not like?
 24. How have your patients embraced the ADS? What do they like? What do they not like?
 25. What has the ADS done for patient care?
 26. Do you believe the ADS is a safe dispensing system for your patients? Why?
 27. Are there any other benefits of the ADS that we have not discussed? Negatives?
 28. Overall, has the ADS been a favorable change within your facility?

^aAll the questions for the administrative staff, physicians, and nurses were asked after the ADS was implemented. For the pharmacists, questions 1–16 were asked before implementation, and questions 17–29 were asked more than one year after implementation.