

An Exploratory Comparison of Medication Lists at Hospital Admission with Administrative Database Records

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ABSTRACT

BACKGROUND: Medication reconciliation is recognized as important, but no one method has been recommended. Research has shown that the most common medication reconciliation errors are attributable to omitted medications and doses. The pharmacy claims aggregator used in this evaluation is a private company that gathers pharmacy claims data from disparate pharmacy benefit managers into a secure repository (hereafter referred to as the claims database) under contracts with public and private health plans. A web interface for the repository can be used by subscribing health systems and health care providers to view patient-level pharmacy claims data to support patient care. At the time of this study, the claims database contained information from 5 public and private health insurance programs covering approximately 500,000 enrollees in Arizona.

OBJECTIVE: To compare current medication lists (medication name and strength) collected by patient interview upon admission at a medical center with those collected by a company that aggregates pharmacy claims data.

METHODS: This study was a retrospective chart review. A list of 300 patients was produced by a medical center using random number generation for patients who were (a) admitted to the medical center from January 1, 2007, through June 30, 2007; (b) aged 18 years or older; and (c) enrollees of health plans that send pharmacy claims data to the claims database. The first 100 patients on this list who were found in the claims database were included in the study sample. Patient-reported current medication information recorded on the medical center's admission medication reconciliation form was compared with the current medication information in the claims database at the time of admission. Medications, including prescription drugs, over-the-counter (OTC) products, supplements, and herbals, were considered current in the medication reconciliation form based on patient reports of medications still being taken upon admission to the medical center. Medications were considered current in the claims database if the most recent fill date plus days supply was equal to or greater than the hospital admission date. Data were collected by an investigator on a standardized data collection form designed for this evaluation. The investigator gathered information from the medical center for each study patient and then queried each patient in the claims database to record data. These 2 medication lists were matched, and discrepancies were noted both at the patient-drug level and at the patient level. Rates of omissions and discrepancies were calculated for each information source, and the McNemar chi-square test for binomial proportions in matched-pair data was used to assess the statistical significance of differences between information sources.

RESULTS: Of the 100 patients, a total of 78 patients had medication reconciliation records in their medical center charts that could be compared with claims data. A total of 280 medications were listed for these 78 patients, with 196 medications recorded in the claims database and 131 recorded on the medication reconciliation form. At the patient-drug level, significantly more medications and strengths were listed in the claims database than in the medication reconciliation form (medications: 70.0% of 280 vs. 46.8% of 280, respectively; strengths: 100.0% of 196 vs. 71.8% of 131, respectively; both comparisons $P < 0.001$). One-half of the medications omitted in the

claims database (42 of 84) were OTC medications. On a patient level, there was no significant between-source difference in the proportion of patients who had at least 1 missing medication (44.9% claims vs. 52.6% medication reconciliation form, $P = 0.337$), but there was a significant difference in the proportion of patients for whom at least 1 strength was missing (0.0% claims vs. 23.1% medication reconciliation form, $P < 0.001$). All medications and strengths matched in 24 of 78 (30.8%) patients.

CONCLUSION: Information collected using a claims database produced a more complete list of medication names and strengths than that compiled upon admission interviews at the medical center. However, the claims database did not contain information about medications that were not reimbursed by insurance. The most accurate method of obtaining the complete medication list may be to combine these 2 techniques.

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What is already known about this subject

- Research suggests that approximately 60% of errors found in patient charts occur when patients are admitted to, transferred within, or discharged from an institution and that 54% to 74% of patients admitted to the hospital may have at least 1 discrepancy in their admission medication history.
- Research has shown that the most common medication reconciliation errors are omitted medications and dose omission/discrepancies.

What this study adds

- In a comparison of medication lists obtained from a claims database versus inpatient self-report recorded in a medication reconciliation form, 280 medications were listed for 78 patients, with 196 medications recorded in the claims database and 131 recorded on the medication reconciliation form. All medications and strengths matched in 24 of 78 (30.8%) patients.
- More medications and strengths were listed in the claims database than in the medication reconciliation form (medications: 70.0% of 280 vs. 46.8% of 280, respectively; strengths: 100.0% of 196 vs. 71.8% of 131, respectively). One-half of the medications omitted in the claims database (42 of 84) were over-the-counter medications.
- Although the proportion of patients who had at least 1 missing medication did not significantly differ by source (44.9% claims vs. 52.6% medication reconciliation form), there was a significant difference in the proportion of patients for whom at least 1 strength was missing (0.0% claims vs. 23.1% medication reconciliation form).

The Institute of Medicine publication *To Err Is Human: Building a Safer Health System* identified patient safety as a significant problem and recommended that efforts to improve safety focus on systems rather than health care professionals.¹ Medication-related errors (e.g., wrong dose, instructions, and/or drug) account for many deaths annually, and there is increasing evidence that medication errors frequently occur upon hospital admission² and discharge.^{3,4} Many drug-related problems may occur because health care professionals have inadequate access to comprehensive patient medication profiles.⁵ It is, therefore, important that the medication reconciliation process ensures an accurate and complete documentation of the patient's medication profile upon hospital admission and at all transitions of care.

Medication reconciliation has been defined as "the comprehensive evaluation of a patient's medication regimen any time there is a change in therapy in an effort to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions, as well as to observe compliance and adherence patterns."⁶ Medication reconciliation was added as a Hospitals' National Patient Safety Goal established by The Joint Commission in 2005.⁷ Specifically, the Medication Reconciliation Initiative Workgroup of the American Society of Health-System Pharmacists (ASHP) and The American Pharmacists Association (APhA) recommends that medication reconciliation include a standardized set of data elements (i.e., prescriber, drug name, regimen, and allergies).⁶ Thus, obtaining a complete, current medication list is the first step in medication reconciliation.

Research suggests that medication histories are frequently inaccurate.^{2,8,9} Approximately 60% of errors found in patient charts occur when patients are admitted to, transferred within, or discharged from an institution,¹⁰ and 54% to 74% of patients admitted to the hospital may have at least 1 discrepancy in their admission medication history.¹¹⁻¹⁵ The most common medication reconciliation errors are omitted medications^{11-14,16-18} and omissions or discrepancies in dose information.^{12-14,16-18} Although medication reconciliation has been shown to help decrease medication discrepancies,^{10,14,18-21} it is not routinely performed.²² In fact, because of the difficulties that many organizations are having with implementation of the medication reconciliation goal, The Joint Commission is in the process of reviewing and refining this goal.²³

Although medication reconciliation is recognized as important, no one method has been recommended. Studies have evaluated the impact of medication histories collected by a variety of health care and allied professionals^{12,14-16,18,24-28} and the use of tools to assist in the process^{10,19-21,29,30} and have compared electronic medical records with actual medication use,¹⁷ but to the authors' knowledge, a comparison of a health plan's claims database with patient interview to formulate a list of medication names and doses/strengths has not been investigated.

The pharmacy claims aggregator used in this evaluation is RxAccord (Tucson, AZ). RxAccord is proprietary software that aggregates pharmacy claims data from disparate pharmacy benefit managers into a secure repository (hereafter referred to as the claims database) under contracts with public and private health plans. A web interface for the repository can be used by subscribing health systems and health care providers to view patient-level pharmacy claims data for medication reconciliation and treatment purposes. At the time of this study, the claims database contained information from 5 public and private health insurance programs covering approximately 500,000 enrollees in Arizona.

The purpose of this study was to compare medication names and strengths collected by patient self-report at inpatient admission to a medical center with information collected by a pharmacy claims database. The data most commonly omitted in medication reconciliation processes are medication name and dose. However, because dose is not a field in pharmacy claims databases, the decision was made to measure strength for this investigation. Based on their clinical experiences, the investigators hypothesized that the information collected in a claims database would be more complete than that compiled by patient self-report.

Methods

This study was a retrospective chart review of patients admitted to a medical center. Data were obtained from a medical center and from a pharmacy claims aggregating database. Patients who were eligible for participation were (a) admitted to the medical center between January 1, 2007, and June 30, 2007; (b) aged 18 years or older; and (c) enrolled with public or private insurance health plans whose data were contained in the claims database. Patients were excluded if they were transferred from an assisted living facility or nursing home or were intubated. A randomly sampled list of 300 patients who met the study inclusion criteria was produced by the medical center via random number generation. The first 100 patients on this list who were found in the claims database were included in this study (approximately 150 patients were examined to find 100 matches). Approval for this investigation was obtained from the University of Arizona Institutional Review Board (IRB), which is also the "IRB of Record" for the medical center, and site approval was received from the medical center.

The RxAccord pharmacy claims database contains medication history information for patients enrolled with several insurance groups. The information contained in the claims aggregating database includes medication name, strength, quantity dispensed, date filled, days supply, compliance information (i.e., filled late or early as calculated by fill date plus days supplied), and prescriber. Patient information in the claims database can be accessed by health care professionals via the web-based portal whenever a patient enters the hospital (Figure 1).

It is important to note that for many medications, dose and

frequency can be inferred by multiplying strength times quantity divided by days supply and by dividing number dispensed by days supply, respectively. Many clinicians who use the claims database for medication reconciliation use the database in this manner. However, because the frequency instructions and dose can change after the drug is dispensed, it is considered good practice to confirm with the patient or a caregiver how the drug is currently being taken. Therefore, for this scientific investigation, the decision was made to measure only the fields for which inference is unnecessary (i.e., drug and strength).

The medical center that participated in this evaluation is a level I trauma center located in the American Southwest that has more than 20,000 inpatient admissions (excluding newborns) and more than 86,000 outpatient visits (55,000 emergency department and urgent care) annually. Prior to The Joint Commission's National Patient Safety Goal requiring medication reconciliation, 2 documented medication histories had been routinely taken for each patient, one by the admitting medical staff provider as part of the History and Physical, and the other by the admitting nurse as part of the Nursing Admit in the patient's progress note. Both of these records were part of the patient's permanent medical record. At the time of this study, these 2 documents had been combined into a single Admission Medication List & Reconciliation Form (hereafter referred to as the medication reconciliation form), which was included as a part of the History and Physical Form. In most cases, the physician was the first to document a patient's medical history and current medications after interviewing the patient or caregiver; however, in some cases, the admitting nurse was the first to develop the list of current medications. In both situations, medications were documented on the medication reconciliation form, signed by the health care professional acquiring the information, verified with the patient, and reconciled against admission drug orders by the other health care professional. Both the admitting medical staff provider and the admitting nurse signed the medication reconciliation form (Figure 2).

For the present study, patient-reported current medication information that was recorded on the medical center's admission medication reconciliation form was compared with the current medication information in the claims database at the time of medical center admission. Medications, including prescription drugs, over-the-counter (OTC) products, supplements, and herbals, were considered current in the medical center records based on patient reports of medications still being taken upon admission to the medical center. Medications were considered current in the claims database if the most recent fill date plus days supply was equal to or greater than the hospital admission date. Data were collected by an investigator on a standardized data collection form designed for this evaluation. The same investigator gathered information from the medical center for each study patient, then queried each patient in the claims database to record data. These 2 medication lists were matched at the patient

FIGURE 1 Claims Database Screen Shot with Fictitious Patient Information

You are logged in as: I, Jon.

Home/Patient Lookup | Change Password · Login/Logout | Help

Audit Trail | Update Users

Results for: F DOBirth: 02/1 /19_2 HCH A00

Drug	Date filled	Strength	Days supply	Qty	Days late	Days early	Prescriber
ACCU-CHEK AVIVA TEST STRI	09/26/2008		25	100	22		N
CYCLOBENZAPRINE TAB	09/07/2008	10 MG	13	40	19		N
LISINAPRIL TABLET	08/28/2008	20 MG	30	30		1	N
LEVOTHYROXINE TABL	08/22/2008	50 MCG	30	30			N
GLYBURIDE TABLET	08/11/2008	5 MG	30	60			N
ACCU-CHEK AVIVA TEST STRI	08/10/2008		25	100			N
HYDROCODONE-APAP	08/06/2008	7.5-750	30	60			N
CYCLOBENZAPRINE TAB	08/06/2008	10 MG	13	40	23		N
RANITIDINE TABLET	07/30/2008	150 MG	30	60			N
LISINAPRIL TABLET	07/30/2008	20 MG	30	30			N
LOVASTATIN TABLET	07/23/2008	40 MG	30	30			N
LEVOTHYROXINE TABL	07/23/2008	50 MCG	30	30			N
CYCLOBENZAPRINE TAB	07/01/2008	10 MG	13	40			N

level, and discrepancies were noted.

A medication was considered omitted if it was included on the medical center list but not on the claims database list or vice versa. The percent of omitted medications that are available OTC was also assessed. The number of omitted strengths was assessed by reviewing the medications listed in each information source. Strength was assessed only for listed medications; that is, if a medication was omitted, the strength was not assessed. Statistical significance was calculated using a McNemar's chi-square test for matched-pair samples, comparing the proportions of omissions (medications and strengths) in the medication reconciliation form with the claims database with an a priori alpha of 0.01. Data were analyzed using SPSS version 17 (SPSS Inc., Chicago, IL).

Results

Of the 100 patients selected for study participation, 5 were not included in this study because of an omitted or unavailable medical center record, and an additional 17 of the remaining 95 records were not included because they did not contain the medication reconciliation form. This left a sample of 78 patients whose medication reconciliation forms could be compared with claims data.

A total of 280 medications were listed for these 78 patients. Significantly more medications and strengths were listed in the claims database than in the medication reconciliation form (Table 1). Of 280 patient-medication combinations, claims listed 196 (70.0%) and the medication reconciliation form listed 131 (46.8%, $P < 0.001$). Strengths were listed in 196 (100.0%) of 196 claims and in 94 (71.8%) of 131 medication reconciliation forms ($P < 0.001$). One-half of the medications omitted in the claims database (42 of 84) were OTC medications.

At the patient level, there was no significant between-source

difference in the proportions of patients who had at least 1 missing medication (35 of 78 [44.9%] for the claims database vs. 41 of 78 [52.6%] for the medication reconciliation form, $P=0.337$). However, there was a significant difference in the proportions of patients for whom at least 1 strength was omitted (0 of 78 [0.0%] vs. 18 of 78 [23.1%] for the claims database and medication reconciliation form, respectively, $P<0.001$). Perfect matches of medications and strengths were found in 24 of 78 patients (30.8%).

Discussion

This study compared a list of medication names and strengths created using patient self-report with a list created from pharmacy claims data. Other investigators have examined several different methods of medication reconciliation. For example, Leape et al. (2006) investigated barriers to implementation,³¹ and Orrico (2008) investigated the discrepancies between one health plan's electronic medical record and patient report.¹⁷ Our study adds to this literature by offering a preliminary evaluation of the completeness of the medication names and strengths in a pharmacy claims database that represents several different plans. This approach is useful if the patient uses 2 insurance plans or has recently switched plans.

Other investigators, such as Lau et al. (2000)¹¹ and Pippins et al. (2008),³² performed evaluations of comprehensive medication reconciliation procedures that involved significant time and personnel resources to gather and verify information. For example, Pippins et al. performed a gold standard medication reconciliation procedure by gathering information from the patient, his/her family, medication bottles, electronic medical records, previous discharge summaries, primary care providers, and community pharmacies. While this process is comprehensive, it is resource intensive. Our study offers an alternative to this method that may help clinicians gather information about medications and strengths—the most common medication reconciliation problems—using a pharmacy claims database. This approach may help providers gather pharmacy information for patients using any web-enabled computer.

Omitting medication names and doses/strengths in the medication history is not surprising due to the many challenges facing health care providers when attempting to complete medication reconciliation. Among these challenges are the brief time available to conduct a patient interview, the patient's familiarity with the medication regimen, language barriers, the severity of the patient's illness, the patient's cognitive status, and the ability of the patient interviewer.^{27,28}

Findings of the present study suggest that a list of medication names and strengths from the claims database is more complete than data gathered using patient self-report. However, claims database medication lists may not reflect changes made in therapy since the last time the patient visited the pharmacy. That is, the patient may no longer be taking a medication for a variety of

TABLE 1 Comparison of Medication Reconciliation Form with Claims Database

Patient-Medication Combinations	N = 280
Drug not listed	
In medication reconciliation form (n)	149
In claims (n)	84
Medication reconciliation form omission rate (%) ^a	(149/280) 53.2%
Claims omission rate (%) ^a	(84/280) 30.0% ^b
Strength not listed	
In medication reconciliation form (n)	37
In claims (n)	0
Medication reconciliation form omission rate (%) ^c	(37/131) 28.2%
Claims omission rate (%) ^c	(0/196) 0.0% ^b
Unique Patients	
N = 78	
Patients with at least 1 drug not listed	
In medication reconciliation form (n) ^d	41
In claims (n) ^d	35
Medication reconciliation form omission rate (%) ^e	(41/78) 52.6%
Claims omission rate (%) ^e	(35/78) 44.9% ^f
Patients with at least 1 strength not listed	
In medication reconciliation form (n) ^d	18
In claims (n) ^d	0
Medication reconciliation form omission rate (%) ^e	(18/78) 23.1%
Claims omission rate (%) ^e	(0/78) 0.0% ^b
Exact matches for all medications and strengths were found between sources in 24 of 78 patients = 30.8%	

^aNumber of omissions expressed as a percentage of total number of patient-drug combinations (n = 280).

^b $P < 0.001$ using McNemar's chi-square test for differences in proportions in matched-pair samples.

^cNumber of omissions expressed as a percentage of the total number of medications listed in each source.

^dIndicates whether patient had at least 1 medication with this type of error.

^eExpressed as a proportion of the total unique patient count (n = 78).

^f $P = 0.337$ using McNemar's chi-square test for differences in proportions in matched-pair samples.

reasons (e.g., allergy, side effects, or inadequate response). Thus, neither the patient-reported medication list nor the claims data produce the absolute complete list of medications. Additionally, although not assessed in this evaluation, medication frequencies and routes may be inferred from the claims database. This information would need to be checked with the patient or caregiver but may make the process of medication reconciliation faster if the patient does not have to come up with a medication list de novo. Instead, the claims list can be presented to the patient for additions, deletions, and corrections.

Thus, the claims database could be a viable starting point for medication reconciliation. Health care providers can work with patients to record changes made to therapy in recent weeks, add OTC medications, and add medications for which the patient paid cash. Patient populations for whom such a process would be most beneficial include poor historians, the elderly, the medically

illiterate, and patients on multiple medications. For patients who cannot verbalize (such as those who are unconscious or have memory problems), the claims database can be used as a starting point for caregiver clarification or subsequent record review from the patient's other providers. Further, the claims database provides data to the health care provider quickly when accessed via the web-based portal. Such use has the potential to significantly reduce the health care personnel time required for the medication reconciliation process. Future studies should assess the impact of the addition of a claims database with regard to time spent on medication reconciliation and resultant costs avoided.

Because a large percentage of patients in the United States have some form of medication coverage as part of their health plan, pharmacy claims data should be more widely available to health care providers across the continuum of care to assist with medication reconciliation and other clinical decision making. There are several ways to operationalize this availability. For example, efforts could be made to include OTC medications in the claims databases by using point-of-sale barcoding as a method of recording and importing these data into the database. Alternatively, more health plans could add OTC benefits to their plans as a method of capturing OTC data. Another infrastructure option might utilize electronic prescribing (e-prescribing) systems. That is, if an emergency department utilized an e-prescribing system that provides medication history functionality, medication information from community pharmacies would be available for viewing by providers. Still another option may include providing medication information via a health information exchange (i.e., the sharing of health care information for treatment purposes across medical settings). While patients could be given the option to opt in or opt out of such a data sharing arrangement, the Health Insurance Portability and Accountability Act (HIPAA) does allow for "Business Associate Agreements" to permit the sharing of protected health information (PHI) with other covered entities and with contracted noncovered entities and services related to business functions that makes patient assent to such information unnecessary.³³

Limitations

First, this study assessed a small sample of patients using an exploratory design. To further investigate the possible benefits of the reconciliation method that we suggest would require a larger sample and, preferably, a randomized design.

Second, while the reconciliation of the patient-reported medication list with prescription claims data generates a fairly comprehensive list, the list represents what was dispensed, not necessarily what was prescribed. Claims databases have limitations that affect their usefulness for the purpose of medication reconciliation. They contain only prescription medications and OTC medications or herbals that are reimbursed by insurance. Data are not included for medications for which the patient paid

out-of-pocket, for patients not covered by one of the health plans with whom the aggregator contracts, or for prescriptions that were not filled. Additionally, because the data are adjudicated by pharmacy benefit managers prior to aggregation, there is a time lag of approximately 2 weeks before the claims data are available through this venue. Finally, a medication may have been discontinued by the patient's health care provider and remain listed as a current medication in the claims database. For example, it is possible that the provider told the patient to stop taking the medication after the most recent fill and that these changes were wrongly counted as omissions from the medical center record.

Third, the medical center is a nonprofit level 1 trauma center located in Tucson, Arizona, that serves a population of 1.2 million citizens from southern Arizona and western New Mexico. The facility treats patients with emergency trauma, immediate surgical intervention, intensive care, medical/surgical care, obstetrics, pediatrics, and post-discharge follow-up. Therefore, our patient sample may not be representative of patients admitted to other types of hospitals.

Fourth, the claims database represents a limited set of health plans. Therefore, study results may not be applicable to patients with other forms of insurance. However, claims databases are becoming more prevalent in the United States, and pharmacy claims database companies are constantly acquiring contracts with additional health plans. For example, the number of covered lives and contracted health plans contained in the claims database used in this evaluation has almost tripled since this study was initiated. Fifth, results should be generalized cautiously to other hospitals that may have different methods of medication reconciliation already in place. Sixth, the goal of this study was to assess completeness of the medication name and strength in the medication list. An analysis of the costs and harm of these omissions is beyond the scope of this project.

Conclusion

Medication information collected by the claims database produced a more complete list of medication names and strengths than that compiled using admission interviews at the medical center. Each method of medication reconciliation has strengths and weaknesses. For example, the claims database provides a comprehensive listing of the medications paid by the patient's insurance. Although patient self-report, the method used by the medical center to produce a medication reconciliation list, may provide a less comprehensive list, it may have the advantage of reflecting recent changes to therapy and may include OTC and other medications not paid by the patient's insurance. The most accurate method of obtaining the current medication list may be to combine these 2 techniques, which may significantly reduce the number of medication discrepancies upon hospital admission and may lead to more favorable patient outcomes.

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DISCLOSURES

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Concept and design were performed primarily by Fink, Smith, and Warholak with the input of the other authors. Data collection was performed by McCulloch and Baumgart. Warholak interpreted the data with the assistance of McCulloch and Baumgart and wrote and revised the manuscript with the input of the other authors.

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