Medication Congruence among Patients in a Primary Care Network
Serving North Carolina Medicaid Patients

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ABSTRACT

Context: In its 2001 report on health care quality, the Institute of Medicine (IOM) stated that most medical records are disorganized, illegible, and inaccessible. The IOM targeted safety for improvement, emphasizing that patient information be more available and accessible. In light of the IOM report, this study sought to assess characteristics associated with completeness of medication documentation.

Objective: Medication congruence is the percent agreement between two medication lists. The objective of our study was to assess medication congruence between the primary care physician (PCP) chart and pharmacy claims (used as a proxy for the patient’s medication list) in a broad range of primary care practices. A secondary objective was to identify practice and patient factors associated with medication congruence.

Design: Retrospective cross-sectional study.

Setting: Eight primary care practices—four private practices, two community health centers, and two academic practices—within a network of 30 practices serving Medicaid patients in four North Carolina counties. Four of the practices used paper PCP charts, and four used electronic medical records (EMR).

Participants: One hundred Medicaid patients with at least three providers in six months or at least 15 prescription fills in 90 days, selected from eight practices.

Instrument: Electronic pharmacy claims and chart review, including medication list, problem list, visit notes, and correspondence for one year.

Outcome Measures: Congruence between pharmacy claims and primary care physician (PCP) medication list or complete chart. Congruence was measured as agreement of pharmacy claims
with PCP medication list only (C₁) and with entire PCP chart (C₂). Secondary outcomes included practice and patient characteristics associated with congruence.

**Results:** C₁ and C₂ were 53.8% and 64.6% agreement, respectively (p for difference < 0.001). C₁ was associated with number of chronic conditions (p < 0.001), type of medical chart (p < 0.001), and type of primary care practice (p = 0.017). C₂ was associated with number of chronic conditions (p < 0.001), and number of medications (p = 0.012).

**Conclusions:** Medication congruence in PCP charts is low in a broad spectrum of primary practice settings—private practice, academic clinics, and community health centers—by both measures used in this study. Whether using the PCP current medication list (our C₁ measure) or a more thorough chart review (our C₂ measure), medication congruence is low; however, more complete medication information can be gleaned from a thorough chart review than from the current medication list alone. Documentation improves with use of electronic medical records and increasing number of chronic conditions. Community health centers showed superior documentation relative to private practices.
INTRODUCTION

In its widely cited 2001 report on health care quality, *Crossing the Quality Chasm*, the Institute of Medicine (IOM) stated that most medical records are disorganized, illegible, and inaccessible, “making it nearly impossible to manage many forms of chronic illness that require frequent monitoring and ongoing patient support.” (1) Furthermore, the IOM included safety among its “Six Aims for Improvement,” emphasizing that patient information—including medication lists—be accessible and available “to all who need to know it.” (1) Clearly accurate charting of patient medications is crucial to establishing the safe medical system envisioned by the IOM. Medication errors are the cause of substantial mortality in both the inpatient and outpatient settings. In *To Err is Human*, the IOM estimated that 1 in 131 outpatient deaths and 1 in 854 inpatient deaths were caused by medication errors. (2)

Because the medical chart of the primary care physician (PCP) is a critical component of maintaining quality care, medication documentation errors in the PCP chart may present a risk for medication errors. For example, the medication documentation of the PCP has been found to be an important piece of an accurate medication history at the time of hospital admission. (3) Therefore, understanding factors that contribute to errors in PCP medication lists is important to prevent adverse events. A 2007 study of outpatient medication lists demonstrated a large number of discrepancies in medication lists, with 98.2% of patient charts being inadequately reconciled between patient and providers, and 88.5% of individual medications having discrepancies. (4) While this study provided a detailed picture of the problem of medication list congruence, it was limited in its generalizability by its use of one clinic as a source for the study population and by its reliance on patient phone and email interviews to determine the patient medication list. Other studies have been limited by their inclusion of only specific classes of
medications or by matching only on class of medication rather than on specific medication. (5-11)

While a number of studies have examined medication reconciliation—a process to confirm that medications ordered and administered are identical—in the inpatient and nursing home settings, (12-16) much less is known about adequacy of medication documentation in the outpatient setting. Separate understandings of the current correct medication list for a particular patient are maintained by at least three different parties—the patient, the PCP, and the pharmacy. The term congruence has been used to describe the degree to which these medication lists are in agreement with each other. (17-20) Congruence, expressed as the percent agreement between two medication lists, provides an important indicator of errors of inclusion or omission in a medication list—whether the list is maintained by the PCP, the pharmacy, or the patient. In our study, we calculated congruence between the PCP and pharmacy medication lists, and considered the pharmacy list to be a proxy for the patient medication list. Furthermore, we calculated congruency twice, using two different levels of detail from the PCP chart. An example of a congruence calculation is included for clarity (see Box 1). The two different levels of detail selected were current medication list only, and thorough chart review. The former was selected because it represents the list most frequently referred to by the provider and is the list most often sent to other providers (e.g., consultants, emergency departments, nursing homes, and admitting physicians).

To add to current understanding of the problem of medication list congruence in the outpatient setting, we conducted a descriptive study of medication list congruence in a network of clinics providing primary care to Medicaid patients in North Carolina. Our goal was to define the extent of the problem that currently exists in outpatient medication documentation, and to
understand what practice and patient characteristics are associated with greater congruence, in order to help inform interventions to decrease adverse outcomes from medication errors.

METHODS

Source of study participants

Community Care of Central Carolina (CCCC) is a network of 48 primary care practices serving North Carolina Medicaid patients in Orange, Chatham, Alamance, and Caswell counties, which assists patients in managing chronic health conditions by providing case management and medication therapy management services. (21) CCCC is one of 14 networks comprising Community Care of North Carolina (CCNC), a statewide program that operates in collaboration with North Carolina Medicaid to improve quality, access, and cost-effectiveness within the state Medicaid program. CCNC has been described in detail elsewhere (22), but briefly, it is a statewide community health network of 1200 primary care practices that manages the care of 750,000 Medicaid patients. The 14 local networks each employ a program director, a medical director, and a team of case managers and care coordinators that work to link patients to a medical home, implement quality improvement efforts with member practices, provide case management for high risk patients, coordinate care for patients with multiple health care and social needs, and establish a statewide infrastructure to improve care for Medicaid patients in North Carolina. (22) In addition, CCCC employs a network pharmacist who coordinates a pharmacy home program for network patients. This program provides additional review of patient medications to prevent potential errors, especially among patients who have multiple prescribers. (21)

CCCC collects claims data on its population, which allowed us to identify a group of patients deemed to be at high risk for medication errors: those with multiple medication fills or
those with multiple prescribers. To do this, we used Medicaid electronic pharmacy claims data
to identify adult patients within the network who had at least 15 drug fills in the previous 90
days, or had medical visit claims from three or more practices in the previous six months. We
used these two criteria to select our subjects based on the hypothesis that medication
documentation would be more problematic with either increasing number of medications or
increasing number of practices providing care, and for our purposes we considered these subjects
to be “high risk” for medication documentation errors. We identified 806 high-risk patients who
met these criteria from among the 30 CCCC practices in two of the network counties. Next, we
selected eight of these network practices that represented a spectrum of different practice
characteristics we were interested in studying: practice type (academic, private, community
health center), practice size (solo, 2-5 providers, more than 5 providers), and type of medical
record (paper, electronic).

Based on an estimated standard deviation of 10%, we determined that we would require
32 subjects to identify a 10% difference in congruence between two groups with an alpha of 5%
with 80% power. However, we opted for a larger sample size because we had no pilot data on
which to base our estimation of standard deviation; therefore, we planned for a sample size of
100 subjects. The eight practices we identified had a total of 421 high-risk patients, representing
52% of all CCCC high risk patients in the two counties evaluated. The list of eligible patients
from these practices was then arranged in random order for each practice using a computerized
randomization algorithm, and the first 13 patients from each of these lists were selected for the
study to achieve a sample size of 104. In some instances, fewer than 13 patients were available
within a particular practice, so we selected additional patients sequentially from the randomized
list from a similar practice in the network so that the range of patients from a given practice was
 Ultimately, we had a sample size of 100 patients (12% of the high risk patients), with an average of 12.5 patients from each practice.

**Outcome: medication congruence**

Pharmacy dispensing records have previously been shown to be a sensitive measure of doses of medication consumed, (6, 23) so we used electronic pharmacy claims as a proxy for the patient medication list. We obtained pharmacy claims data for the 365 days immediately preceding the chart review for each of the 100 patients in the study. We performed a chart review to obtain the PCP medication list, and then used pharmacy claims to obtain prescription fills for each patient over the 12 months prior to chart review. The chart review was performed between November 9 and December 20, 2007. Medications were included in the PCP medication list if they were documented in one of the following sections of the chart: current medication list, visit notes in the past 12 months, or correspondence section of the chart in the past 12 months.

Medications were excluded from both the PCP and claims list if they were over-the-counter (OTC), as needed (PRN), or acute medications. Thus, our study examined the documentation of scheduled, chronic prescription medications only. We excluded OTC medications because they could not be identified by pharmacy claims. If the medication appeared in the PCP chart but not the pharmacy claims, and if there was an OTC form available (e.g., aspirin, ibuprofen, or docusate), the medication was considered OTC. Medications that may be obtained OTC were included if they appeared in the pharmacy claims. Medications were considered PRN only if explicitly written as such in the PCP chart, or if standard administration of the medication is on a PRN basis (e.g., sublingual nitroglycerine or sildenafil). Medications were considered acute if the PCP chart specifically indicated it was to be used for a limited time;
in addition, medications that appeared in the pharmacy claims but did not have at least one fill with a minimum of 28 days’ supply were considered acute medications.

Medications were considered matches if the generic equivalent of the medication appeared in both the PCP chart and the pharmacy claims list. Because dose, route, and frequency are not provided by the pharmacy claims, matching was only on generic equivalent of the agent. Different formulations of the medication were not considered a match; for example, a medication that appeared as an extended release formulation was not a match with a non-extended release formulation. Medications were not considered matches if they appeared as a combination formulation in one list, but as separate entities in the other list. The few instances of combination oral contraceptive pills that varied in brand name were considered equivalent if both were formulations of an estrogen and a progestin.

Medication list congruence—the percent agreement between the PCP and pharmacy claims lists—was calculated in two ways for each patient. The first congruence calculation, C₁, compared pharmacy claims with only those medications found in the current medication list section of the PCP chart. The second congruence calculation, C₂, compared pharmacy claims with all medications found in the complete chart review, including current medication list, visit notes, and correspondence sections. We felt that calculating congruence in these two different manners provided additional insight into medication congruence by representing different levels of chart review. C₁, which was calculated only by considering the current medication list section of the chart, best represents the information that could be gleaned from a cursory review of the chart. C₂, which was calculated by considering the current medication list as well as visit notes and correspondence over a full year, represents the information that could be obtained by a provider who had read the chart more thoroughly. The distinction is important, we believe,
because although a thorough chart review is ideal, we found that reviewing notes (only looking for medications) for an entire year could require up to 30 minutes for more complex patients. In practice, we believe that many providers will yield to time constraints and simply look at the medication list on the front sheet, so the $C_1$ measure is more likely to be the more realistic and practical measure of congruence.

**Other variables**

Because we were interested in examining patient and practice characteristics that may be associated with congruence, we also collected patient age, sex, list of chronic conditions, number of clinic visits in the past 12 months, date of last PCP visit, number of providers in the practice, type of practice, and type of medical record. We obtained patient age at time of chart review and sex from the CCCC database. In addition, we identified the number of chronic conditions for which the patient was being treated by reviewing the current problem list, clinic visit notes in the past 12 months, and the correspondence section of the chart in the past 12 months. From the chronic conditions list for each patient, we identified the presence or absence of two common diagnoses commonly encountered in primary care (hypertension and diabetes mellitus), as well as the presence or absence of a psychiatric diagnosis (including substance abuse). Also during the chart review, we recorded the number of PCP visits in the past years, the date of the last PCP visit, number of providers in the practice (including physicians, physician assistants, and nurse practitioners), type of practice (academic, private, or community health center), and type of medical record (paper or electronic).

**Statistical analysis**

Before evaluating for associations between independent variables and congruence, we used a paired t-test to determine if there was a significant difference between the two different
measures of congruence, C\textsubscript{1} (percent agreement between pharmacy claims and those medications found only in the current medication list section of the PCP chart) and C\textsubscript{2} (percent agreement between pharmacy claims and those medications found in the current medication list, visit notes, or correspondence sections of the PCP chart).

Next, we performed bivariate analyses to determine if particular independent variables were associated with congruence before adjusting for covariates. We used a two-sample t-test for the following dichotomous variables: sex, type of medical record, psychiatric diagnosis, hypertension diagnosis, diabetes mellitus diagnosis, high risk status based on at least 15 prescription fills in three months, and high risk status based on at least three practices providing care in six months. We used one-way ANOVA for the following categorical variables: type of primary care practice, and number of providers per practice.

We performed multivariate linear regression using all independent variables listed above to determine which variables were associated with congruence after adjusting for covariates. Independent variables that were weakly associated (p > 0.05) with congruence after adjusting for covariates were dropped from the model using backward, stepwise selection. The final adjusted model included only independent variables that were significantly associated with congruence at the 5% level.

For this study, a two-sided p-value ≤ 0.05 was considered significant. Statistical analysis was performed using Stata/IC 10.0 for Windows (StataCorp LP, College Station, TX).

**Human Subjects Review**

Prior to data collection, we obtained approval for this study from the UNC Biomedical Institutional Review Board.
RESULTS

Pharmacy Claims and PCP Medication List

The average number of medications in the pharmacy claims data was 10.2 medications (SD 5.4, range 1-27) (See Table 1). We used two different measures of the PCP medication list. The first measure (used in the C₁ calculation) was the list as obtained directly from the current medication list maintained in the PCP chart, and the second measure (used in the C₂ calculation) was the list of medications obtained from the current medication list, plus all medications that were found to have been prescribed in the visit notes and correspondence section of the PCP chart. PCP medication list by the first measure was on average 7.3 medications (SD 4.4, range 0-23), while PCP medication list by the second measure was on average 9.6 medications (SD 5.0, range 1-26). The lengths of these lists were significantly different from one another (p < 0.001, paired t-test).

Patient Characteristics

The average age of our final 100 subjects was 46.2 years (SD 12.3, range 19-81), and 74.0% were female (See Table 1). As previously noted, we randomly selected our subjects from a pool of patients who were deemed at high risk for medication errors based on two criteria—at least 15 prescriptions filled in the past three months, or at least three practices providing care in the past six months. 88.0% of our subjects fit into the former category, 36.0% fit into the latter category, and 24.0% fit into both categories. Subjects visited their PCP an average of 6.7 times in the past 12 months (SD 5.0, range 0-25), and an average of 95.3 days had elapsed since their last PCP visit (SD 152.8, range 0-1058) had elapsed since their last PCP visit. Subjects had an average of 5.7 chronic conditions (SD 2.9, range 0-13), 70.0% of subjects carried a psychiatric
diagnosis (including substance abuse), 35.0% had a diagnosis of diabetes mellitus (type I or type II), and 50.0% had been diagnosed with hypertension.

**Practice Characteristics**

Our subjects were drawn from three types of practices: two community health centers, two academic practices, and four private practices. Overall, 24.0% of the subjects had a community health center as their primary provider, 24.0% went to an academic practice for their primary care, and 52.0% had a private practice provider (See Table 1). 13.0% of the subjects were seen in a practice with only one provider, 28.0% went to a practice with two to five providers, and 59.0% were seen in a practice with more than five providers. Of the 100 subjects, 48.0% had electronic medical records in the PCP office, while 52.0% had paper charts.

**Overall Congruence**

Congruence was calculated two different ways. The first method, $C_1$, was meant to represent a quick review of the face sheet of a paper chart or the summary screens of an electronic chart; this method considered only the medications found on the summary list of current medications in the PCP chart. The second method, $C_2$, was meant to represent a more exhaustive review of the chart, including summary list of current medications, as well as visit notes and correspondence for the past year. As seen in Table 2, there was a significant difference between the two measures of congruence ($p < 0.001$): $C_1$ yielded a 53.8% agreement between the PCP chart and pharmacy claims (SD 23.9%, range 0.0%-100.0%), while $C_2$ yielded a 64.6% agreement (SD 21.6%, range 0.0%-100.0%). Only 4 out of 100 charts had 100% congruence as measured by $C_1$, while only 8 out of 100 charts had perfect congruence as measured by $C_2$. 

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Bivariate Analysis

Bivariate analysis of all categorical dependent variables showed statistically significant associations between congruence, as measured by C_1, and both type of medical record and number of providers in practice (See Table 3). Electronic medical records had significantly higher congruence than paper records (p = 0.006), as did practices with more providers (p = 0.009). In contrast congruence, as measured by C_2, was not significantly associated with any categorical dependent variables.

Multivariate Analysis

In our multivariate analysis, we found higher C_1 values to be significantly associated only with higher number of chronic conditions (p < 0.001), electronic medical record (p < 0.001), and community health centers (P = 0.017). Our linear regression model indicated that for each additional chronic condition a patient has a 3.1 percentage point increase in congruence. For type of chart the linear regression model shows that subjects with an electronic PCP chart have a 22.7 percentage point increase in congruence, compared to patients with a paper PCP chart. Linear regression demonstrated a significant difference in congruence between community health centers (mean congruence: 66.6%) and private practices (49.5%). With a mean congruence of 50.2%, academic centers are not significantly different from either community health centers or private practices after adjusting for covariates.

When switching to the C_2 measure of congruence that utilized a more complete PCP chart, we found higher congruence to be significantly associated only with greater number of chronic conditions (p < 0.001) and lower total number of medications (p = 0.012). Our linear regression model shows that for each additional chronic condition a patient has a 3.8 percentage point increase in congruence.
DISCUSSION

In this study of medication list congruence between the PCP chart and pharmacy claims in a primary care network serving Medicaid beneficiaries, we have demonstrated that agreement about the medication list between the primary care physician and patient (as measured by prescriptions actually filled) is suboptimal. Furthermore, the summary list of current medications found in PCP charts is missing significant detail about prescribed medications, even though this information is discernable upon a more thorough review of the physician's chart. It should be noted, however, that even a thorough review of the chart yielded only a 64.6% congruence rate (in contrast to the 53.8% congruence rate of the summary medication list).

Another key finding of our study is that higher congruence is associated with use of EMR, receiving care at a community health center, and greater number of chronic conditions.

Our findings are consistent with an earlier study that also found low rates of medication congruence in the primary care setting. A 2001 study of congruence between patient medication lists and primary physician charts within a single academic practice found a mean medication congruence of 65%. (17) This study differed from ours in that the patient medication list was obtained during a home visit, and the primary physician extracted a current medication list from the chart. We feel that this method of chart extraction would be most similar to our \( C_2 \) measure, since the physician had access to the entire chart; therefore, their findings are very comparable to our overall \( C_2 \) congruence of 64.6%.

The type of patient chart was found to be a significant determinant of medication congruence in our study, with electronic medical records improving congruence over paper medical records. Interestingly, we also found that the more chronic conditions a patient has, the higher the congruence between the PCP medication list and the pharmacy claims data. Because
we found no association between congruence and three common primary care diagnoses (diabetes, hypertension, and psychiatric diagnoses), we believe that the higher congruence associated with increasing number of chronic conditions is likely due to the complexity of the patients themselves rather than to any common individual medical condition. Although we were unable to identify any studies that examined this association, we speculate that these complex patients may receive more frequent and thorough evaluation by their PCP. In support of this hypothesis, on bivariate analysis we found that more chronic conditions was correlated with more PCP visits in the preceding year (p = 0.002).

In addition, we saw that community health centers in our study had significantly better rates of congruence than private practice, while academic clinics were not significantly different from either. While our finding that community health centers had better medication documentation than private practices should be interpreted cautiously due to our relatively small sample size, we nonetheless believe that our findings may well hold up to larger analysis. In support of this finding, the 24 community health center patients in our sample all had paper charts, while roughly half of the 52 private practice patients had an EMR; therefore, the improved congruence we found overall for community health centers is likely due to as yet unidentified processes within the centers themselves. Of note, the two community health centers we examined were independent clinics within a single organization (Piedmont Health Services, Inc., of North Carolina), so the higher congruence at these two clinics may be due to processes within the larger organization rather than these clinics’ status as community health centers. For example, both of these clinics have onsite pharmacies that readily permit collaboration between the PCP and pharmacist to ensure up-to-date medication lists.
The finding of higher congruence in community health centers with onsite pharmacies is consistent with high rates of congruence found in an earlier study of a similarly integrated clinic. In that study, agreement between pharmacy records and physician charts of antihypertensive medication documentation was evaluated in a study of 982 subjects from two HMOs. (11) The study compared drug order notations in the medical chart with prescription records for patients treated for hypertension, and found very high consistency in documentation of medication name for antihypertensive medications, but somewhat lower consistency when dosage was also considered. The medical chart documented prescribed medications more than 90% of the time at the different sites studied, while dose was correctly annotated in just fewer than 70% of the charts. The authors concluded that medication documentation is generally better than has been reported by other studies, but their findings must be considered in light of a few limitations of their study. In particular, this study evaluated only one class of medication, and it was performed within two HMOs that had a prepaid drug plan, onsite pharmacies, and integrated computer records. Therefore, its high reported rate of documentation is not likely generalizable to the health care system as a whole; however, it does highlight the improved congruence that can be achieved in highly integrated systems of care.

Because of our relatively small sample size, our findings are useful for hypothesis generating and need confirmation with larger studies. Future studies should focus on establishing causal relationships between medication congruence and some of the factors we identified as being associated with variations in congruence. Such studies could employ similar network-wide samples as ours, but use larger samples and state a priori hypotheses. For example, because our study only found an association between higher medication congruence and use of an electronic medical record, an important future study would be one that would study
the potential causal relationship between chart type and congruence to establish that switching to an electronic medical record alone causes higher congruence. Such a study could be accomplished by studying medication congruence in outpatient clinics before and after conversion to an electronic medical record, and comparing to clinics that did not convert. Also of interest would be characteristics of specific medical record applications that are associated with improved congruence—such distinctions were beyond the scope of this study. An important variable that could not be collected in this study was whether or not subjects were hospitalized during the evaluation period. Because the PCP medical record is valuable in establishing medication orders on hospital admission and because the PCP medical record may fall out of synch with patient medications after hospital discharge, understanding the effect of hospitalization on outpatient medication congruence would be a valuable future study. Finally, the data we collected could also be analyzed in the future to determine which classes of medications were most likely to be incongruent between the pharmacy claims and the PCP medication list. Such a study could be used to highlight particularly risky medication classes (those that have both serious potential for adverse events and are poorly documented) for increased scrutiny in outpatient documentation quality improvement initiatives.

Our study adds breadth and detail to the literature on outpatient medication documentation. To our knowledge, this is the first study to describe medication congruence across multiple independent practices. Furthermore, because the practices studied are part of a statewide Medicaid network, we were able to use pharmacy claims data to gather information on what patients were actually having filled rather than relying on patient interviews. In addition, we were able to contrast the completeness of the current medication list in the PCP chart with the
completeness of medications documented in the chart as a whole, including visit notes and correspondence.

Our study has some important limitations. Most important, our pharmacy claims data provided only medication name and dosage form—it gave no information on dose, route, and frequency. Thorough medication documentation should include dose, route, and frequency, and we were unable to accurately match on these parameters. Because we only matched on medication name, it is very likely that our estimates of medication congruence are, in fact, overly optimistic. However, we believe that using pharmacy claims data as a proxy for patient medication list avoided some sources of error—especially recall bias that may come into play with patient interviews. Another implication of matching only on generic medication name is that extended-release and non-extended release medications were not considered equivalent; this could actually decrease congruence in a small number of cases—whether this is a significant medication error is dependent on the nature of the individual medication. Matching only on pharmacy claims precluded measurement of clinically important OTC medications, most notably aspirin. It was rarely possible to ascertain from the PCP chart exact start and stop dates for prescriptions, so we might have found medications in the chart that had actually been discontinued (with or without the physician’s knowledge) but which had been filled at some point months earlier. This would result in a medication no longer being taken by the patient but still in the PCP chart—clearly a medication documentation error—but we would have counted this as a congruent medication. Again, this limitation actually may have the effect of overestimating congruence. In addition, our study had a relatively small sample size and was limited to a small geographic location.
The wider implications of our study are clear. First, the primary medical record of many patients is deficient, which may be an open invitation to medical errors—especially at points of transition, such as hospital admission or transfer of care to another physician. Our findings do not support the hypothesis that complex patients and poor medical records go hand in hand—indeed, we found that increasing number of chronic conditions was weakly associated with improved medication congruence. Rather, our study suggests that processes in place within the individual practice are likely to be the most important factors affecting medication congruence. For example, we found that practices using an electronic medical record had a 52.9% higher mean congruence compared to practices using a paper medical record. This study bolsters the argument that moving toward electronic medical records may help prevent medication errors and adverse events. Also of interest, we found that the type of medical practice was associated with improved medication congruence, with community health centers showing a 34.5% higher mean congruence than private practices. Because our study included only Medicaid beneficiaries and we controlled for a wide range of possible covariates, we believe it is likely that the patients are similar enough between these two types of practices that the practice organization itself is likely to be the major factor in establishing level of congruence. Thus, it seems that further evaluation of what community health centers are doing to improve medication documentation could yield valuable lessons to the primary care world.
ADDENDUM TO INTRODUCTION

Congruence versus Concordance

Although others have used the term concordance to describe the degree of agreement between sources, (24-27) we prefer to use the term congruence because concordance is sometimes used to describe the degree of “trust” and “harmony” in the patient-physician relationship (26) while congruence more plainly describes the degree of agreement between two lists regardless of the reason.

Improving Medication List Congruence

Medication list errors can be reduced dramatically by implementing medication reconciliation procedures, as demonstrated in a 2007 study of outpatients at an academic comprehensive cancer center. (28) This study of 104 patients found that medication list errors were reduced by 90% by using the following reconciliation procedure. The clinic provided patients with medication lists from the electronic medical record prior to their appointment, allowed them to make corrections to the list and return the list to their physician during the encounter, then the medication list was corrected in the electronic medical record by either the physician or a staff pharmacist.

A 2007 study of the outpatient medical records of 104 patients—54 of whom received standard of care medication list reconciliation, and 50 of whom received an intervention designed to reduce errors in medication documentation—examined one method to reduce documentation errors. (4) The intervention consisted of reminding patients to bring medication bottles and lists to their appointment and allowing them to update their own medication list in the electronic medical record. In addition, providers were given education and feedback on medication reconciliation. Agreement between the patient medication list and the medication list
maintained in the electronic medical record was determined at the time of the clinic visit. The study was conducted in an academic primary care outpatient clinic. Patients receiving the intervention had significantly improved medication documentation, though overall documentation was suboptimal in both groups; 84% who received the intervention had discrepancies in their medication lists compared to 98.2% in the control group (p = 0.0134), and 49.1% of individual medications in the intervention arm had discrepancies compared to 88.5% in the control arm (p-value not reported).

**Primary Care Physician Records Importance at Hospital Admission**

The importance of a complete medication history—including documentation from the primary care physician—in preventing medication errors on hospital admission has been described previously. A 2005 systematic review of 22 studies with 3755 patients compared physician-acquired medication histories at the time of hospital admission with a comprehensive medication history, which includes a physician interview, review of medication lists and/or bottles provided by the patient, and contact with the primary care physician or community pharmacies.(3) This review identified differences between the two types of medication histories in 67% percent of admissions and medication errors in 54% of admissions. Errors identified varied by study, but included errors of omission, commission, frequency, and dosing. The clinical importance of these errors also varied by study but was estimated to be clinically important 11-59% of the time. Cardiovascular agents, sedatives, and analgesics were found to be the medications most commonly involved in errors at admission. This review found that a comprehensive history, which augments the physician interview with consultation with the primary care physician or community pharmacies as well as a review of patient medication lists and bottles, provides a more complete and accurate medication list. Therefore, the medication
documentation of the primary care physician is of critical importance to an accurate medication history at the time of hospital admission.

ADDENDUM TO METHODS

Methods for systematic literature search

We searched the MEDLINE/PubMed database for articles on agreement of medication lists among different sources in both outpatient and inpatient settings using the following keywords: “medication” AND “congruence” (limited to English language, and with links to full text), “medication” AND “concordance” (limited to English language, published in the past 5 years, with links to full text, and involving only adult subjects), and “mediation” AND “reconciliation” (limited to English language, published in the past 10 years, and with links to full text). Our original search yielded 195 articles. We excluded 118 articles based on the title, then reviewed all available abstracts for the remaining 77 articles and excluded 37 more articles based on the abstract. The full text was not available for 1 article, and a review of the full text of the remaining 39 revealed that 20 did not describe research on medication list agreement or issues associated with medication list agreement. Thus, we had 19 articles available for full review, and identified 9 additional articles from the reference lists of articles from our original search as well as from the recommendations of other researchers, giving us a total of 28 references for this study.

ADDENDUM TO DISCUSSION

Congruence Among Physician Charts, Pharmacy Records, and Patient Lists

We identified two studies that examined agreement among three different medication lists for a particular patient. The first study examined medication adherence within a single class of medications, while the second evaluated congruence among these three lists based on
medication name, dose, route, and frequency. The latter study differed from ours in that it calculated overall congruence of the medication list for a particular patient rather than on a per medication basis.

In one study that was conducted to develop methods to measure adherence to glaucoma medications, pharmacy claims, chart review, and interviews of patients and physicians were used to generate and compare three separate medication lists for each patient. (8) This study concluded that large pharmacy databases provide a useful tool to evaluate use of prescription medications because they permit the use of very large patient samples; however, there are a number of pitfalls associated with this method. (8) For example, filling a prescription does not necessarily mean the prescription was taken, and medications will not be captured if a patient is using samples or filling without insurance or outside the pharmacy plan from which the data is extracted. This study used pharmacy data to determine adherence to chronic medication rather than congruence between two medication lists; thus, the medication possession ratio (MPR) was used. This ratio is the total number of days' supply of a medication filled divided by the number of days between the first and last prescription fill, so that an MPR of one represents perfect adherence. This measure was not applicable to our study, since we were measuring any exposure to medication to indicate that the patient considered it a current medication on their list. If we had been able to ascertain from the PCP chart the exact start and stop days of medications, the MPR along with fill dates would have given a very precise measure of congruence.

A second study that was conducted in an academic clinic setting determined congruence between three pairs of medication lists: physician-patient, pharmacy-patient, and physician-pharmacy. Matches were based on drug name, dose, route, and frequency. (20) For 26 patients with 107 prescription medications, the patient list was congruent with the physician list for 73%
of medications and also with the pharmacy records for 73% of medications. The 96 medications for these 26 patients that were found in the physician and pharmacy lists were congruent 70% of the time.

**Congruence of Pharmacy Records with Physician Charts**

We identified two studies that evaluated congruence between pharmacy records and physician charts within health maintenance organizations (HMOs). Both studies were larger than ours, but evaluated only a single medication class—NSAIDs in one, and antihypertensives in the other.

Pharmacy data were used to evaluate the completeness of medication documentation in the medical chart of an HMO. (10) This study focused on one class of medication, non-steroidal anti-inflammatory drugs (NSAIDS); using HMO pharmacy dispensing records, the authors identified 501 HMO patients aged 50 years or older who had been dispensed an NSAID, then reviewed outpatient clinic and emergency department charts to determine if there was documentation of the NSAID as well as the condition for which it was prescribed. The study found that the NSAID was documented in 89% of charts, and determined that a specific diagnosis for which the NSAID was prescribed was strongly associated with completeness of documentation with a relative risk (RR) of 20.3 (95% CI 13.2-30.3) compared to vague or missing diagnosis. The study further concluded that none of the following were risk factors for missing documentation: age (over versus under 65 years), sex, visit location (clinic versus emergency department), and chronicity of disease (acute versus chronic). The authors commented that with a 95% CI of 0.9-2.5, the RR of 1.5 for age had a “suggestion” of less complete documentation among the older subjects. (10)
In a second study, agreement between pharmacy records and physician charts of antihypertensive medication documentation was evaluated in a study of 982 subjects from two HMOs. (11) The study compared drug order notations in the medical chart with prescription records for patients treated for hypertension, and found very high consistency in documentation of medication name for antihypertensive medications, but somewhat lower consistency when dosage was also considered. The medical chart documented prescribed medications more than 90% of the time at the different sites studied, while dose was correctly annotated in just fewer than 70% of the charts. The authors conclude that medication documentation is generally better than has been reported by other studies, but their findings must be considered in light of a few limitations of their study. In particular, this study evaluated only one class of medication, and it was performed within two HMOs that had a prepaid drug plan, onsite pharmacies, and integrated computer records. Therefore, its high reported rate of documentation is not likely generalizable to the health care system as a whole; however, it does highlight the improved congruence that can be achieved in highly integrated systems of care.

**Congruence of Physician Charts with Patient Lists**

We identified six studies that directly compared medication congruence between the physician chart and the patient list. Most of these studies calculated congruence on a per chart basis rather than on a per medication basis like ours.

In a study that—like ours—calculated congruence on a per medication basis rather than a per chart basis, the medication lists of 50 patients seen by 15 physicians (five faculty and 10 second and third year residents) in a family medicine residency program were compared to the lists maintained by the primary physician. (17) Patients were included in this study if they were aged 65 years or older, non-institutionalized, being seen in clinic for routine care on the day of
selection, had been seen by their primary physician three or more times in the previous year, and were taking at least four prescription medications. The primary physician was then asked to extract a complete list of medications for their patient, and 10 days after the visit the patient was visited by medical students trained in conducting home visits to determine medication lists. The 50 subjects in this cohort had a total of 375 medications, with antihypertensive agents being the most common (36% of overall medications). The study looked at both prescription and nonprescription medications, and matched on name, dose, and frequency. The mean congruence for all physicians was 65% (SD 23.3%, range 41-89%); faculty had a non-significant higher congruence (70%, range 54-89%) than residents (58%, range 41-81%) with a p-value of 0.08. The study found complete congruence in 14% of charts, with an additional 12% of charts that matched on all medication names, but differed in dose or frequency. Congruence was highest for diabetic (73%), other endocrine medications (74%), and antihypertensives (66%), and lowest for pain medications that included NSAIDs (29%). While this study showed a reasonably high congruence, the authors note that 86% of charts had incomplete agreement between the patient and physician. Importantly, the authors note that this study evaluated patients’ understanding of what they should be taking, not what they were actually taking. Thus, as with our study, this study sought to characterize medication congruence rather than adherence.

A 2000 study of 312 patients presenting for follow-up care to the private office of one of two internists or five cardiologists reviewed patient medication bottles and interviewed patients to obtain patient medication list, then compared this patient medication list to the medication list maintained in the physician's chart. (29) The study outcome was completeness of medication list including name and dosage of prescription and over-the-counter medications, and 24% of medication lists were fully congruent with the patient medication list. The most common error
was patients taking medications not on the physician list (51% of errors), and the remainder of the errors were due to differences in dosage (20% of errors) and medications on the physician list that the patient was not taking (29%). The study found that age and number of recorded medications were independently predictive of worse congruence.

A single geriatric medicine practice with 30 providers using an electronic medical record determined the accuracy of the medical list in the electronic medical record by comparing it to the patient medication list. (30) The patient list was determined by provider interview during a clinical encounter, and the study was unblinded in that the provider had the medication list from the medical record during the interview. The study measured both correctness and completeness of medication documentation. Correctness is a measure of whether medications are fully documented and is measured on a per medication basis, while completeness is a measure of whether the medication list contains all medications and is measured on a per patient basis. The study found that 83% of 663 medications were correctly recorded, while only 37% of 117 patient medication lists were complete.

The correctness measure of this study is most analogous to our congruence measure, and at 83% was substantially higher than our findings, even when considering that this single practice used an electronic medical record. As with the HMO studies discussed earlier, this study suggests that higher congruence rates can be achieved within highly integrated care systems. This study determined that the major causes of documentation errors were limited access to the electronic medical record by providers and limited availability of data entry stations for the electronic medical record. (30)

A limitation of this study was that it allowed the treating clinician to determine the accuracy of each individual medication record, introducing the potential for measurement bias,
and the authors comment that clinicians may be likely to undercount their own errors. The authors further state that: “An ideal gold standard for this type of study would be an independent, blinded observer using multiple sources of information such as pharmacy records, patient interviews, and chart reviews.” (30) We feel that a strength of our study was the use of pharmacy records and chart reviews independent of one another, thus limiting the potential for such bias. Furthermore, we agree with the assertion of these authors that including patient interviews would further strengthen such a study; unfortunately, such interviews were impractical with the resources of our study.

A 2007 study of the accuracy of medical list maintenance for 100 patients in a single academic general medicine clinic using an electronic medical record found that 9.7% of medications were complete and 59.6% were correct at baseline. (31) The study, which included prescription, over-the-counter, and PRN medications, compared patient report of medications being taken to the medication list maintained in the electronic medical record. Completeness of an individual medication was defined as full documentation of name, dose, route, and frequency, while correctness of an individual medication was defined as having no discrepancy in name, dose, and frequency between the electronic medical record and the patient report. Correctness of individual medications is analogous to our congruence measure, though it is more detailed as this study included medication name, dose, route, and frequency, while ours only matched on medication name. After an intervention that included training all clinic staff in medication documentation as well as changes in clinic rooming procedures, medication completeness improved to 62.3% but medication correctness had a small but insignificant decrease to 54.6%. (5)
A 1996 study assessed overall congruence between medication lists in the physician chart (as assessed by reviewing case notes) and patient lists (as assessed by viewing patient medication bottles) of 100 patients in a single academic geriatric clinic who were taking at least three medications. (32) This study, which included both prescription and over-the-counter medications, found that 72% of the charts were incongruent with the patient list. Three fourths of the discrepancies were due to patients taking medications that were not in the chart. Importantly, major medication errors were documented in 20% of the subjects, and included polypharmacy that increased the risk of drug interaction and/or toxicity, two-fold overdose of prescribed medications, and non-adherence to a clinically important medication. The authors concluded that most errors were caused by prescribing of too many medications, inadequate physician supervision of chronic medications, communication issues between inpatient and outpatient physicians, as well as poor communication between physicians and patients. They argue that improved electronic medical records could reduce errors of medication documentation. (32)

A study of 119 patients with diagnosed hypertension was conducted to determine the association of health literacy on rates of medication reconciliation—defined as processes to improve agreement on medication name and directions for use between patient and providers—in three federally qualified community health centers. (5) Participants were determined to have either inadequate or marginal/adequate health literacy using the short version of the Test of Functional Health Literacy in Adults. Next, they were asked to name their antihypertensive medications and their list of medications was compared to a list obtained by independent chart abstraction. Agreement between patient and medical chart for antihypertensive medications was generally low, with only 29.4% of the lists being identical for this class of medication; in
addition, those with inadequate health literacy had significantly lower agreement (18.9\%) compared to subjects with marginal/adequate agreement (34.2\%).

**Congruence of Pharmacy Records with Patient Lists**

We identified three studies that correlated pharmacy records with patient medication lists. One limitation of all of these studies was their evaluation of only a single class of medications rather than the patients’ complete medication list.

A study of 294 elderly adults in a state pharmaceutical assistance program was conducted to determine the congruence of self-reported medications with pharmacy records obtained from the assistance program. (6) The study matched by major class of medication, and found 91\% congruence between patient self-report and pharmacy records for the ten major classes of medications studied; furthermore, 49\% of subjects had 100\% congruence for major classes of medications and 92\% had perfect agreement for at least eight out of ten classes. This study also evaluated the sources of errors and found that pharmacy record omissions were more common than patient omissions. In addition, the study concluded that better health status and medications for serious conditions (e.g., cardiovascular conditions) were both associated with better congruence.

The association between pharmacy claims and self-reported use of lipid-lowering medications was compared in a 2007 study of 7918 adults in a managed care network, which found a strong association between self-report and pharmacy claims of this class of medication. (7) Self-report was measured by asking subjects if they had been told to take a lipid-lowering medication, then checking pharmacy claims in the Kaiser system within 60 days of the self-report measure. The study found good correlation between pharmacy claims and self-reports: accuracy (true positives plus true negatives) of self-report was 96\%, kappa was 0.67 (95\% CI
0.63-0.70, sensitivity was 93.9% (95% CI 91.0%-95.9%), and specificity was 96.0% (95% CI 95.6%-96.5%).

The Rotterdam elderly study evaluated the percent agreement (congruence) between patient interview and pharmacy claims for cardiovascular medications among 7983 patients over 55, the majority of whom have their prescriptions filled at a single large pharmacy with computerized records. (9) This study found 80.4% agreement between patient interview and pharmacy records among the 3365 cardiovascular prescriptions identified. The authors point out that while pharmacy data present an accurate picture of the medications the patient believes they are taking, they do not readily indicate adherence to therapy. (9) However, as noted by others, use of the medication possession ratio (MPR) can be gleaned from pharmacy data and is indicative of medication adherence. (8)

**Congruence of Serum Medication Levels with Patient Self-Report**

In addition to pharmacy dispensing records, serum levels of drugs have been studied to determine their ability to predict the validity of patient self-reported medications. In a study of 110 subjects the reliability of a patient medication list reported by the inventory method, in which the patient supplies all medication containers, was tested by measuring serum levels of four cardiovascular medications--aspirin, hydrochlorothiazide, propranolol, and digoxin. (33) The study concluded that serum levels were a sensitive and reliable means to determine use of the three prescription medications, with kappa values of 0.43 (95% CI 0.27-0.59) for propranolol, 0.62 (95% CI 0.53-0.91) for hydrochlorothiazide, and 0.94 (95% CI 0.74-1.) for digoxin. With a kappa value of 0.16 (95% CI 0.0-0.32) aspirin was not detected in sensitive and reliable manner by serum assay. Lack of agreement was mostly due to patient report of medication use that was not confirmed by serum assay. The study concluded that some of these
discrepancies could be accounted for by low daily doses, short medication half-lives, once daily
doses taken long before the blood sample was drawn, and contamination from blood collection
tubes. (33)
Box 1. Sample Congruence Calculation

<table>
<thead>
<tr>
<th>PCP Chart (Current Medication List)</th>
<th>PCP Chart (Thorough Chart Review)</th>
<th>Pharmacy Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 medications</td>
<td>11 medications</td>
<td>10 medications</td>
</tr>
<tr>
<td>Enalapril</td>
<td>Enalapril</td>
<td>Enalapril</td>
</tr>
<tr>
<td>Hydrochlorothiazide</td>
<td>Hydrochlorothiazide</td>
<td>Hydrochlorothiazide</td>
</tr>
<tr>
<td>Metformin</td>
<td>Metformin</td>
<td>Metformin</td>
</tr>
<tr>
<td>Lovastatin</td>
<td>Lovastatin</td>
<td>Lovastatin</td>
</tr>
<tr>
<td>Fluoxetine</td>
<td>Fluoxetine</td>
<td>Fluoxetine</td>
</tr>
<tr>
<td>Omeprazole</td>
<td>Omeprazole</td>
<td>Omeprazole</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>Gabapentin</td>
<td>Gabapentin</td>
</tr>
<tr>
<td>Cyclobenzaprine</td>
<td>Cyclobenzaprine</td>
<td>Cyclobenzaprine</td>
</tr>
</tbody>
</table>

PCP Chart (Current Medication List)
- PCP List = 8 medications
- Pharmacy Claims = 10 medications
- Total medications (appear in either PCP or pharmacy list) = 11
  - Enalapril
  - Hydrochlorothiazide
  - Metformin
  - Lovastatin
  - Fluoxetine
  - Omeprazole
  - Gabapentin
  - Cyclobenzaprine

PCP Chart (Current Medication List)
- Matches (appear in both PCP and pharmacy list) = 7
  - Enalapril
  - Hydrochlorothiazide
  - Metformin
  - Lovastatin
  - Fluoxetine
  - Gabapentin
  - Cyclobenzaprine

Congruence based on current medication list ($C_1$)

$$C_1 = \frac{\text{matches}}{\text{total}} = \frac{7}{11} = 0.636 = 63.6\%$$

PCP Chart (Thorough Chart Review)
- PCP List = 11 medications
- Pharmacy Claims = 10 medications
- Total medications (appear in either PCP or pharmacy list) = 12
  - Enalapril
  - Hydrochlorothiazide
  - Metformin
  - Lovastatin
  - Fluoxetine
  - Omeprazole
  - Gabapentin
  - Cyclobenzaprine
  - Metoprolol
  - Levothyroxine
  - Rosiglitazone
  - Cimetidine

PCP Chart (Thorough Chart Review)
- Matches (appear in both PCP and pharmacy list) = 10
  - Enalapril
  - Hydrochlorothiazide
  - Metformin
  - Lovastatin
  - Fluoxetine
  - Gabapentin
  - Cyclobenzaprine
  - Metoprolol
  - Levothyroxine
  - Cimetidine

Congruence based on current medication list ($C_1$)

$$C_2 = \frac{\text{matches}}{\text{total}} = \frac{10}{12} = 0.833 = 83.3\%$$
Table 1. Patient and Practice Characteristics (n = 100)

<table>
<thead>
<tr>
<th></th>
<th>Total n = 100</th>
<th>≥15 prescription fills in 3 months n = 88</th>
<th>≥3 providers in 3 months N = 36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>46.2 (12.3)</td>
<td>46.9 (11.0)</td>
<td>41.9 (14.7)</td>
</tr>
<tr>
<td>Female sex, %</td>
<td>74.0%</td>
<td>72.8%</td>
<td>86.1%</td>
</tr>
<tr>
<td># of PCP visits past 12 months, mean (SD)</td>
<td>6.7 (5.0)</td>
<td>7.0 (5.2)</td>
<td>7.2 (5.4)</td>
</tr>
<tr>
<td>Days since last PCP visit, mean (SD)</td>
<td>95.3 (152.8)</td>
<td>96.8 (158.5)</td>
<td>81.6 (94.0)</td>
</tr>
<tr>
<td>Number of chronic conditions in PCP chart, mean (SD)</td>
<td>5.7 (2.9)</td>
<td>5.8 (2.8)</td>
<td>5.6 (2.9)</td>
</tr>
<tr>
<td>Psychiatric Dx (including substance abuse), %</td>
<td>70.0%</td>
<td>71.6%</td>
<td>80.6%</td>
</tr>
<tr>
<td>Diabetes Dx, %</td>
<td>35.0%</td>
<td>37.5%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>50.0%</td>
<td>52.3%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Medications in PCP chart, mean (SD)</td>
<td>7.3 (4.4)</td>
<td>7.6 (4.3)</td>
<td>7.6 (5.4)</td>
</tr>
<tr>
<td>Med list only</td>
<td>9.6 (5.0)</td>
<td>10.0 (4.8)</td>
<td>10.6 (6.2)</td>
</tr>
<tr>
<td>Medications in pharmacy claims, mean (SD)</td>
<td>10.2 (5.4)</td>
<td>10.8 (5.2)</td>
<td>11.3 (6.5)</td>
</tr>
<tr>
<td>Total medications in chart and claims, mean (SD)</td>
<td>11.4 (5.5)</td>
<td>11.9 (5.3)</td>
<td>12.5 (6.6)</td>
</tr>
<tr>
<td>PCP chart includes med list only</td>
<td>12.0 (5.8)</td>
<td>12.6 (5.7)</td>
<td>13.4 (7.0)</td>
</tr>
<tr>
<td>Type of practice, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Health Center</td>
<td>24.0%</td>
<td>22.7%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Academic Practice</td>
<td>24.0%</td>
<td>26.1%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Private Practice</td>
<td>52.0%</td>
<td>51.1%</td>
<td>52.8%</td>
</tr>
<tr>
<td>Number of providers in practice, %</td>
<td>13.0%</td>
<td>14.8%</td>
<td>8.3%</td>
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<tr>
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<td>28.0%</td>
<td>27.3%</td>
<td>33.3%</td>
</tr>
<tr>
<td>&gt;5</td>
<td>59.0%</td>
<td>58.0%</td>
<td>58.3%</td>
</tr>
<tr>
<td>Medical record, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic</td>
<td>48.0%</td>
<td>48.9%</td>
<td>44.4%</td>
</tr>
<tr>
<td>Paper</td>
<td>52.0%</td>
<td>51.1%</td>
<td>55.6%</td>
</tr>
</tbody>
</table>

Table 2. Congruence

<table>
<thead>
<tr>
<th>Congruence (SD)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁ = percent agreement between pharmacy claims and medications found only in current medication list section of PCP chart</td>
<td>53.8% (23.9%)</td>
</tr>
<tr>
<td>C₂ = percent agreement between pharmacy claims and medications found in current medication list, visit notes, or correspondence sections of PCP chart</td>
<td>64.6% (21.6%)</td>
</tr>
</tbody>
</table>

*Paired t-test.
Table 3. Bivariate Analysis: Congruence by Independent Variables

<table>
<thead>
<tr>
<th></th>
<th>C1* (SD)</th>
<th>p-value</th>
<th>C2† (SD)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>53.8% (23.9%)</td>
<td>n/a</td>
<td>64.6% (21.6%)</td>
<td>n/a</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>55.0% (24.7%)</td>
<td>p = 0.393†</td>
<td>65.4% (23.4%)</td>
<td>p = 0.557‡</td>
</tr>
<tr>
<td>Male</td>
<td>50.3% (21.5%)</td>
<td></td>
<td>62.5% (15.5%)</td>
<td></td>
</tr>
<tr>
<td>Psych Dx (including substance abuse)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>55.0% (24.7%)</td>
<td>p = 0.443‡</td>
<td>66.2% (20.0%)</td>
<td>p = 0.262‡</td>
</tr>
<tr>
<td>No</td>
<td>51.1% (21.9%)</td>
<td></td>
<td>61.9% (25.0%)</td>
<td></td>
</tr>
<tr>
<td>Hypertension Dx</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>57.2% (22.2%)</td>
<td>p = 0.147†</td>
<td>68.2% (17.3%)</td>
<td>p = 0.095‡</td>
</tr>
<tr>
<td>No</td>
<td>50.3% (25.1%)</td>
<td></td>
<td>61.0% (24.9%)</td>
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<tr>
<td>Diabetes Dx</td>
<td></td>
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<tr>
<td>Yes</td>
<td>56.4% (21.5%)</td>
<td>p = 0.427†</td>
<td>69.0% (17.5%)</td>
<td>p = 0.142‡</td>
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<td>No</td>
<td>52.4% (25.1%)</td>
<td></td>
<td>62.3% (23.4%)</td>
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</tr>
<tr>
<td>Medical record</td>
<td></td>
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</tr>
<tr>
<td>Electronic</td>
<td>60.5% (21.7%)</td>
<td>p = 0.006†</td>
<td>65.6% (22.6%)</td>
<td>p = 0.655‡</td>
</tr>
<tr>
<td>Paper</td>
<td>47.5% (24.2%)</td>
<td></td>
<td>63.7% (20.9%)</td>
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</tr>
<tr>
<td>Type of practice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Health Center</td>
<td>55.4% (24.6%)</td>
<td>p = 0.055§</td>
<td>66.1% (25.1%)</td>
<td>p = 0.911§</td>
</tr>
<tr>
<td>Academic Practice</td>
<td>62.8% (21.4%)</td>
<td></td>
<td>64.9% (22.2%)</td>
<td></td>
</tr>
<tr>
<td>Private Practice</td>
<td>48.9% (23.7%)</td>
<td></td>
<td>63.8% (20.0%)</td>
<td></td>
</tr>
<tr>
<td>Number of providers in practice</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>37.1% (20.7%)</td>
<td>p = 0.009§</td>
<td>57.9% (17.5%)</td>
<td>p = 0.489§</td>
</tr>
<tr>
<td>2-5</td>
<td>51.2% (23.6%)</td>
<td></td>
<td>65.7% (18.2%)</td>
<td></td>
</tr>
<tr>
<td>&gt;5</td>
<td>58.7% (23.1%)</td>
<td></td>
<td>63.6% (23.9%)</td>
<td></td>
</tr>
</tbody>
</table>

*C1 = percent agreement between pharmacy claims and medications found only in current medication list section of PCP chart
†C2 = percent agreement between pharmacy claims and medications found in current medication list, visit notes, or correspondence sections of PCP chart
‡ Two-sample t-test
§ One-way ANOVA
REFERENCES


