Published in final edited form as:

Health Informatics J. 2010 June ; 16(2): 115–128. doi:10.1177/1460458210364036.

Agreement between structured checklists and Medicaid claims for preventive dental visits in primary care medical offices

Bhavna T. Pahel,

Cecil G. Sheps Center for Health Services Research, University of North Carolina

R. Gary Rozier, and

UNC Gillings School of Global Public Health, University of North Carolina

Sally C. Stearns

UNC Gillings School of Global Public Health, University of North Carolina

Abstract

For program evaluation purposes, the feasibility of matching Medicaid claims with physician-completed structured checklists (encounter forms, EFs) was assessed in a pediatric office-based preventive dental program. We examined agreement on visits (weighted kappa) and predictors of a match between EFs and claims (multinomial logit model with practice-level clustering). In total, 34,171 matches occurred between 41,252 EFs and 40,909 claims, representing 82.8 per cent of EFs and 83.5 per cent of claims. Agreement on visits was 56 per cent (weighted kappa = 0.66). Pediatric practices provided the majority of visits (82.4%) and matches. Increasing age of child and residence in same county as the medical practice increased the likelihood of a match. Structured checklists can be combined with claims to better assess provision of preventive dental services in pediatric primary care. However, future research should examine strategies to improve the completion of structured checklists by primary care providers if data beyond claims are to be used for program evaluation.

Keywords

agreement; Medicaid claims; pediatric primary care; preventive oral health; structured checklists

Corresponding author: Bhavna T. Pahel, BDS MPH PhD NRSA/AHRQ Postdoctoral Fellow, Cecil G. Sheps Center for Health Services Research, 725 Martin Luther King, Jr Blvd, Campus Box 7590, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA. Tel: 919 966 0904, Fax: 919 966 5764, bhavna_pahel@unc.edu.

Competing interests

The authors declare no competing interests.

Authors' contributions

BTP participated in study design, constructed the analytic files, conducted the analyses, interpreted the results and wrote the first draft of the manuscript. RGR and SCS participated in the design of the study, contributed to interpretation of study results and revised the manuscript. All authors read and approved the final manuscript.

Introduction

Large computerized administrative databases such as those derived from insurance claims are widely used to study healthcare use and related costs [1–3], healthcare outcomes [4] and most recently, quality of care and patient safety [5]. However, administrative data lack information important for some types of observational studies, such as assessments requiring patient-level risk factors, and the reliability of available diagnostic information may be limited. Patient medical records can provide important information on risk factors, disease status and outcomes not available in claims files, so linking claims with medical records or other sources of patient information can increase the richness of available data [6]. A key methodological issue in using these multiple sources of data for information about patients is the feasibility of linking information contained in these different data sources. If feasible, such links may result in benefits to research and public health practice.

Agreement between administrative claims data, patient records and other data sources has been studied extensively in medicine [1, 4, 7–12]. Most of this research has focused on the validity of claims information, with the conclusion that, in general, claims can accurately represent medical procedures and visits and thus can be used to study large populations. Although a moderate to high level of agreement is observed between claims and medical records, another general conclusion from this research is that important information occurs in one source and not the other, particularly for some preventive services such as immunizations, and thus neither source can be considered as a gold standard [1, 7]. Thus, information about the provision of healthcare services is more accurate when administrative data are supplemented with information from other sources [8, 10].

Clinical practice guidelines have become an important part of initiatives to help ensure that patients receive care that is appropriate, safe and effective. Dissemination of these guidelines often is accompanied by tools to facilitate their implementation in practice. For example, a structured checklist is a commonly used tool during patient care by providers because of their demonstrated effectiveness in some areas of care [13]. When they provide information about the patient’s condition and its management, these checklists could be another source of information about patients that could enhance administrative databases. This information could be particularly useful because it is based on scientific evidence and is recorded according to a structured format.

The linkage of administrative data with information generated by quality improvement tools, such as checklists, is an extension of studies examining the linkage of administrative data with medical records. Medical records have been linked to claims to determine the feasibility of using claims for studying guideline adherence, but to our knowledge, agreement between guideline checklists and claims has not been studied specifically for determining the value of using checklists to supplement claims [1]. Further, no studies have linked dental claims with tools to support the implementation of practice guidelines in the medical home [2]. In this study we explore the feasibility of linking clinical care checklists with Medicaid claims for a preventive dentistry program based in primary care medical offices.

The North Carolina Medicaid program began reimbursing pediatricians and family physicians to provide pediatric preventive oral health services in 2000 [14]. This initiative, known as 'Into the Mouths of Babes (IMB)', was a response to the increasing prevalence of an already high level of tooth decay among young, low-income children, and severe limitations in their access to dental care. Physicians can be reimbursed for oral health risk assessment, parent counseling, topical fluoride therapy, and referrals to dentists when provided for children younger than 3 years of age. Services in this program usually are provided in conjunction with a well-child visit and are aligned with guidelines provided by the American Academy of Pediatrics (AAP) for oral healthcare in 2003. Several other states also have instituted similar programs for their Medicaid-enrolled children.

As part of the North Carolina IMB program, participating providers are asked to complete a structured sheet (encounter form, EF) for each visit. Physicians use the EFs to record results of their assessments of risk for dental diseases and the preventive dental services provided for each child. Information in the completed forms is used by physicians to guide care decisions during the child visit, and the form becomes a permanent part of patients' records. In the current study, we examine agreement on preventive dental visits between encounter forms produced as part of the child visit and administrative claims files generated through reimbursement of physicians for services provided to Medicaid-enrolled children.

The specific objectives of the study are twofold. First, we assess the feasibility of matching the EFs to Medicaid claims. Second, we assess agreement on the frequency of preventive dental visits in these two data sources, and identify child and medical practice characteristics that are associated with agreement in the two data sources. The results will add to knowledge about the significance of using administrative claims with known advantages for studying large, diverse populations in combination with structured checklists that are becoming an increasingly important part of clinical practice guideline dissemination. In particular, this study provides insights into research methods that can be used to study the adoption of preventive dental services by healthcare providers who usually do not provide dental care, and their adherence to recommended guidelines for provision of these services [14].

Methods

NC Medicaid enrollment and claims files were matched with patient records of preventive dental visits (EFs) using individual-level information in both data sources. We compared preventive dental visits in the linked dataset for those medical practices that provided a total of at least 10 EFs and claims for preventive dental visits. We chose this threshold to eliminate practices that might have experimented with IMB program implementation but never adopted the provision of services. This criterion resulted in 41,252 EFs for 30,606 children and 40,909 claims for 27,607 children being available to be matched.

NC Medicaid enrollment and claims files

We secured enrollment and claims files for all children from birth through 6 years of age who were enrolled in the NC Medicaid program from 2000 through 2002. The files include the child's name, date of birth, Medicaid identification number (ID), race, sex, and a record

of the preventive dental services provided to children by participating medical practitioners (pediatricians and family physicians) in NC. In order to receive any reimbursement from NC Medicaid for providing preventive dental services during an office visit, medical practitioners were required to provide three services: (1) screening the child for dental disease and referral to a dentist if needed, (2) topical fluoride therapy for the child's teeth, and (3) parent education about preventive oral healthcare practices for their child. According to NC Medicaid policy for the period studied, participating providers could submit claims for preventive dental services provided during well-visits or other office visits for a maximum of six visits before the child's third birthday, and a provider could be reimbursed for one preventive dental visit every 90 days.

Preventive dental patient records (encounter forms, EFs)

Physicians who provided preventive dental services to children in the IMB program were trained in a 2 hour continuing medical education course to document the oral health risk assessments and services provided at each visit through completion of an encounter form. The risk assessment followed recommendations provided in professional guidelines [15, 16]. During the demonstration phase of the program (January 2000 through December 2002) the EFs were completed in duplicate and one copy was mailed to the project office for data entry. In addition to information that is also available from the claims (name, birthday, gender, age, race and Hispanic ethnicity and provider address), the EFs include: the child's dental disease and risk status, parental reports about feeding and oral hygiene practices, and whether the child was referred to a dentist. A child could have up to six EFs, one for each of the total of six reimbursable visits allowed by the NC Medicaid program.

Linkage of data files

The data linkage process for this study involved two steps, the first to identify children common to the two databases, the second to identify visits. In the first step, the EF database was linked to NC Medicaid enrollment information using the child's name, date of birth and Medicaid ID. In the second step, the child's ID and date of visit were used to match preventive dental visits in the EF and claims databases. These data linkages are described in more detail in the following paragraphs.

Step 1: linkage of EFs with Medicaid enrollment and claims information—

Although both claims files and EFs contain the child's name, date of birth and Medicaid ID, the variables were missing for some EFs or were potentially subject to errors (e.g. misspellings of the name in either source). The two primary methods are recommended for merging different data sources when a common identifier is incomplete or contains errors. One is to use a merge algorithm based on data linkage theory (probabilistic method) [17]. The other recommended method is to use a set of variables (e.g. name, data of birth, sex, county of residence, patient identifier when available) common to both data sets (deterministic approach) [7, 18]. Roos and colleagues found that the deterministic approach can be used successfully to match more than 95 per cent of medical procedure records recorded in multiple data sources [9]. We therefore used a deterministic approach to identify children whose information occurred both in the EF and Medicaid enrollment databases (see Figure 1).

For a majority of children (88%) who received preventive dental services, the Medicaid ID alone matched children in the EF database with Medicaid enrollment information. For the remaining 12 per cent with missing, incomplete or inaccurate IDs we used the deterministic approach to match EFs to enrollment information by creating merge variables on these two datasets using various combinations of the child's full name, date of birth and parts of the Medicaid ID (when available in the EFs).

Step 2: match between EF visits and Medicaid claim visits—Payment revenue codes from the Medicaid claims were used to construct a preventive dental visit indicator comparable to the one available in the EFs. To assess the match on preventive dental visits between EFs and claims, we first generated a subsample of 'perfect matches' (N = 33,458) based on perfect agreement on the child's ID and date of visit in these two databases (see Figure 2). Because physicians can be reimbursed for services only once in 90 days, it is possible for non-matches on visits within that time frame to occur due to errors in recording visit dates. Therefore, in the second step, we allowed the claim visit date to occur either 89 days before or after the visit date recorded on the EF to generate the second category of 'approximate matches' (N = 713) for claims and EFs not included in the 'perfect matches' category. Using the 89-day criterion, we found 16 instances of more than one claim and seven instances of more than one EF for the same visit. After retaining the EF visit with the closest matching claim visit, the remaining observations were deleted because they represented multiple visits within the same 3 month period. After the perfect and the approximate matches had been identified, the remaining visits in the EFs and claims databases were considered non-matches, i.e. as either unmatched EFs (N = 7081) or unmatched claims (N = 6738).

Data analysis

Overall agreement on the number of preventive dental visits between EFs and claims was assessed using the weighted kappa (k) statistic [19]. A multinomial logit regression model was estimated to investigate correlates of a record being classified as a match (being either a perfect or an approximate match) versus being an unmatched EF or unmatched claim. Standard errors in the model were adjusted for the clustering of observations within medical practices.

Child characteristics included the child's age (in months centered at the mean for the sample, 16.5 months), sex, race (American Indian, Asian, black, Hispanic, other or white), and whether the child resided in the same county as the medical practice where care was received. Practice characteristics included type of primary care practice (health department, family medicine, pediatrics), the intensity of participation in the preventive dentistry program (based on number of preventive dental visit claims per month per county from January 2000 through December 2002), urban–rural classification for the county (seven categories ranging from central or fringe counties of metropolitan areas with ≥ 1 million population to counties with populations of 2500 to 19,999 not adjacent to a metropolitan area) [20], and the quarter during 2000–2002 in which the practice started providing preventive dental services to Medicaid patients. These child and practice characteristics were chosen because of availability as well as evidence that characteristics of patients and

providers are associated with quality of care, and potentially the completion of guideline checklists such as those used in this study [21].

All analyses were conducted using SAS® version 9 (SAS, Cary, NC, USA) and Stata® version 9 (Stata Corp., College Station, TX, USA). The study was approved by the Institutional Review Board of the University of North Carolina at Chapel Hill.

Results

Descriptive results for the match on preventive dental visits

The study population included Medicaid-enrolled children (birth through 36 months of age) with one or more preventive dental visits during 2000 through 2002 in 153 primary care medical practices that completed 10 or more claims and encounter forms. In total, 34,171 visit matches were found between the 41,252 EFs and 40,909 claims, representing 82.8 per cent of total EFs and 83.5 per cent of claims (see Figure 2). Seventeen per cent of EFs and 16.5 per cent of claims did not have corresponding records in the claims and EFs, respectively. The number of visits per child was 1.5 for the claims and 1.4 for the EF, and 87 per cent of children had at least one match. For children who had more than one EF, the EF representing the first visit was found to match to a corresponding claim more often. Overall, agreement between EFs and claims on the number of visits was 56 per cent (weighted kappa = 0.66).

Of the 34,171 matches on visits, 33,458 (97.9%) were perfect matches where the date of visit matched exactly in the two data sources. An additional 713 (2.1%) were approximate matches where the date of visit recorded on the claim occurred within 89 days before or after the date recorded on the EF for that child. For the majority of the 713 approximate matches, the date recorded on the EF occurred up to 3 days prior to the visit recorded on the respective claim. A total of 7081 EFs and 6738 claims were classified as non-matches using the 89-day rule.

Overall, there were more unmatched EFs ($N = 7081$) than unmatched claims ($N = 6738$). In considering practices individually, 71.5 per cent of practices had at least one instance of a match between an EF and a claim. Pediatric practices provided the majority of the IMB visits (82.4%), followed by health departments (11.7%) and family medicine practices (5.9%). Family medicine practices had more unmatched EFs (30.8%) than either health departments (20.7%) or pediatric practices (13.1%).

Predictors of a match between EFs and claims on preventive dental visits

Figure 3 provides a visual as well as quantitative depiction of whether child or practice characteristics increased or decreased the odds (risk) of a non-match – unmatched claims (C), unmatched EF (E) – relative to a match (M). The horizontal position of outcome categories (C and E) depicts the relative magnitude of the risk ratios associated with either of these outcomes compared to the match category. For ease of interpretation, only results that are significant for at least one of the two comparisons are displayed in Figure 3 (complete output for the multinomial logit model is available in the Appendix). Inclusion of either the

'C' or the 'E' in a box with the 'M' indicates lack of a statistically significant difference [22].

In general, practice characteristics were more strongly associated with failure to match (E or C) than were child characteristics, as shown in the top half of Figure 3. Family medicine practices were 2.3 times more likely to have unmatched EFs and 1.6 times more likely to have unmatched claims relative to a match than pediatric practices. Practices located in urban counties with a population of 20,000 or more were more likely to have unmatched claims than a match. Children residing in the same county as the medical practice were less likely to have EFs unmatched than a match. Older children were less likely to have either unmatched claims or unmatched EFs than younger children. Asians, black, and Hispanic children were more likely than white children to have EFs unmatched, whereas other race children were more likely to have both EFs and claims unmatched. As shown in the bottom half of Figure 3, time since program initiation also mattered. Practices that started providing preventive dental services during the last calendar quarter of 2002 had fewer unmatched claims compared to those that began in 2000 and 2001.

Discussion

Given the rising cost of collecting primary data, and the growing number of health-related databases, more researchers are using data linkage strategies to enrich available data [18]. In this study, we explored the feasibility of linking clinical care checklists with Medicaid claims for a preventive dentistry program based in primary care medical offices. Similar to studies in other fields, we found that provider records and Medicaid data can be combined with a reasonable degree of accuracy even in the absence of one or more person-level identifiers [6, 18, 23]. Of the available EFs, we were able to identify about 88 per cent of children in the enrollment file using only the child's Medicaid ID (after certain restrictions for level of practice participation in the preventive dentistry program). Almost all of the remaining EFs were identified using a combination of the child's name, date of birth, and parts of the ID when available.

Overall, more visits were recorded in the EF database than in the claims. However, the number of EFs per child was lower than the number of claims available for each child in this study. This result is to be expected because of the financial incentive for submitting claims, and claims probably are a better source of information for establishing patterns of use of preventive dental services over time. A recent study comparing the validity of three different measures of emergency department use (patient self-report, claims data and hospital medical charts) found that claims were the most accurate source of information of the three for identifying individual visits as well as tracking multiple visits [8]. Our results provide further evidence for the value of using administrative data to track healthcare services use over time.

Completion and tracking of EFs for each child, on the other hand, likely represents added paperwork for the provider, particularly when copies had to be mailed to the project office. These reasons could contribute to why we found fewer children with two or more completed EFs. However, EFs provide dental disease and related referral information and therefore may

be an important mechanism for physicians to improve their quality and continuity of care, thereby justifying the additional paperwork. There are many possible reasons for the claims that remained unmatched in this study because of missing EFs. Completion of these clinical guideline checklists may have been less than optimal because of high patient volume or the shortage of staff to help with the needed paperwork.

We also are aware that during the early implementation phase of the preventive dental program in NC some family physician practices experimented with adoption over a longer period of time than pediatric practices and thus completed EFs without submitting claims, which may account for their unmatched EFs. Evidence suggests that guideline dissemination and implementation strategies, including the distribution of printed materials, audit and feedback, reminders and educational outreach, can improve the delivery of care in the healthcare setting [24]. Future research therefore should examine whether these and other strategies can help improve the completion of guideline checklists during delivery of preventive services, including preventive dental care, in the pediatric primary care setting.

The multinomial regression model provided correlates of finding a match between EFs and claims. The greater likelihood of a match for older children suggests that behavioral factors or presence of dental disease (which tends to increase with age) might influence completion of dental health records by physicians. Given that pediatric primary care providers have a limited amount of time in which to provide well-child checkups and anticipatory guidance, it is conceivable that paperwork beyond that needed for follow-up care or for reimbursement of services may go uncompleted.

In such a scenario, providers may be more likely to complete patient records for children who have signs of dental decay or are considered to be at high risk for future disease in keeping with a risk-based approach to the provision of preventive dental services. However, data generated under such a scenario are likely to provide biased estimates if used without other methods for addressing bias such as multiple imputation of missing data, propensity scores or instrumental variable analysis [25]. Our results suggest that successfully matching records in two or more databases is not enough. It also is important to explore the non-matches to examine whether, for example, individuals with certain characteristics had records that failed to match more often than individuals without those characteristics.

Several limitations of this study are worth noting. Because of its observational nature, findings from this study should be interpreted with caution. Providers were asked to voluntarily complete encounter forms for all children during the demonstration phase of the North Carolina preventive dentistry program. Further, because of the nature of the available data, we are limited in having access to only practice-level information and no provider-level information. Therefore, if some providers in a medical practice were more diligent in completing patient records than others in the same practice, we would be unable to identify those providers individually.

Conclusions

Guideline tools such as structured checklists can provide important disease-related information that is often lacking in administrative claims databases. Our findings indicate that administrative claims may be the most complete data source for assessing preventive dental visit patterns in the medical primary care setting. However, claims can be combined with structured checklists to increase the richness of the data. Guideline checklists for preventive dental visits for young children in medical offices were found to be more likely to be complete and to agree with claims for the child's first preventive dental visit. Hence, when implementing the use of structured checklists in primary care, special efforts may be needed to ensure that services provided are documented thoroughly at each visit [24].

One way of streamlining care and improving healthcare quality that is gaining momentum in many countries is the implementation of electronic health records (EHRs). The move towards EHRs has led to the development of standards for the exchange of health information by many organizations [26]. Organizations including Health Level 7 (HL7) and the American Society for Testing Materials (ASTM International) have proposed, respectively, the clinical document architecture (CDA) and the continuity of care record (CCR) [27]. The wider adoption of these standards will likely improve the quality of health records and make them more interoperable [26, 27]. Findings from this study can help inform attempts to develop such interoperable electronic health records in pediatric primary care where guideline checklists are often used to guide care decisions and conduct referrals. The costs of such efforts should of course be justified by the benefits. The benefits include increasing the physician's ability to provide better quality care through documentation as well as combining checklists with claims to improve evaluation of interventions designed to increase access to preventive dental care in the pediatric primary care setting.

Acknowledgments

The project described was support by Award Numbers R03 DE017350 and R01 DE013949 from the National Institute of Dental and Craniofacial Research. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Dental and Craniofacial Research or the National Institutes of Health.

References

1. Cooper GS, Schultz L, Simpkins J, Lafata JE. The utility of administrative data for measuring adherence to cancer surveillance care guidelines. Medical Care. 2007; 45(1):66–72. [PubMed: 17279022]
2. Leake JL, Werneck RI. The use of administrative databases to assess oral health care. Journal of Public Health Dentistry. 2005; 65(1):21–35. [PubMed: 15751492]
3. Warren JL, Harlan LC, Fahey A, Virnig BA, Freeman JL, Klabunde CN, et al. Utility of the SEER–Medicare data to identify chemotherapy use. Medical Care. 2002; 40(8 suppl):IV-55–IV-61.
4. Bullano MF, Kamat S, Willey VJ, Barlas S, Watson DJ, Brenneman SK. Agreement between administrative claims and the medical record in identifying patients with a diagnosis of hypertension. Medical Care. 2006; 44(5):486–90. [PubMed: 16641668]
5. Zhan C, Miller MR. Administrative data based patient safety research: a critical review. Quality & Safety in Health Care. 2003; 12(suppl 2):58–63. [PubMed: 12571347]

6. Weiner M, Stump TE, Callahan CM, Lewis JN, McDonald CJ. A practical method of linking data from Medicare claims and a comprehensive electronic medical records system. International Journal of Medical Informatics. 2003; 71(1):57–69. [PubMed: 12909159]
7. Cotter JJ, Smith WR, Rossiter LF, Pugh CB, Bramble JD. Combining state administrative databases and provider records to assess the quality of care for children enrolled in Medicaid. American Journal of Medical Quality. 1999; 14(2):98–104. [PubMed: 10446671]
8. Dendukuri N, McCusker J, Bellavance F, Cardin S, Verdon J, Karp I, et al. Comparing the validity of different sources of information on emergency department visits: a latent class analysis. Medical Care. 43(3):266–75.
9. Roos LL, Walld R, Wajda A, Bond R, Hartford K. Record linkage strategies, outpatient procedures, and administrative data. Medical Care. 1996; 34(6):570–82. [PubMed: 8656723]
10. Steinwachs DM, Stuart ME, Scholle S, Starfield B, Fox MH, Weiner JP. A comparison of ambulatory Medicaid claims to medical records: a reliability assessment. American Journal of Medical Quality. 1998; 13(2):63–9. [PubMed: 9611835]
11. MacLean CH, Louie R, Shekelle PG, Roth CP, Saliba D, Higashi T, et al. Comparison of administrative data and medical records to measure the quality of medical care provided to vulnerable older patients. Medical Care. 2006; 44(2):141–8. [PubMed: 16434913]
12. Du XL, Key CR, Dickie L, Darling R, Geraci JM, Zhang D. External validation of medicare claims for breast cancer chemotherapy compared with medical chart reviews. Medical Care. 2006; 44(2): 124–31. [PubMed: 16434911]
13. Grimshaw JM, Winkens RAG, Shirran L, Cunningham C, Mayhew A, Thomas R, et al. Interventions to improve outpatient referrals from primary care to secondary care. Cochrane Database of Systematic Reviews. 2005; 3:CD005471.doi: 10.1002/14651858
14. Rozier RG, Sutton BK, Bawden JW, Haupt K, Slade GD, King RS. Prevention of early childhood caries in North Carolina medical practices: implications for research and practice. Journal of Dental Education. 2003; 67(8):876–85. [PubMed: 12959161]
15. Nowak, AJ.; Warren, J. Preventive dental care and counseling for infants and young children. UpToDate®. Jun 30. 2008 http://www.utdol.com/application/topic.asp?file=ped_oral/5207&type=P&selectedTitle=12~15
16. American Academy of Pediatrics. Policy statement. Oral health risk assessment timing and establishment of the dental home. Pediatrics. 2003; 111:1113–16. [PubMed: 12728101]
17. Blakely T, Salmond C. Probabilistic record linkage and a method to calculate the positive predictive value. International Journal of Epidemiology. 2002; 31(6):1246–52. [PubMed: 12540730]
18. Clark DE. Practical introduction to record linkage for injury research. Injury Prevention. 2004; 10(3):186–91. [PubMed: 15178677]
19. Fleiss, J. Statistical Methods for Rates and Proportions. New York: Wiley; 1981.
20. Economic Research Service. Measuring rurality: rural–urban continuum. United States Department of Agriculture; Nov. 2006 http://www.ers:usda.gov/briefing/rurality
21. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. Journal of the American Medical Association. 1999; 282(15):1458–65. [PubMed: 10535437]
22. Long, JS.; Freese, J. Regression Models for Categorical Dependent Variables using Stata. 2. College Station, TX: Stata; 2006.
23. Gyllstrom ME, Jensen JL, Vaughan JN, Castellano SE, Oswald JW. Linking birth certificates with Medicaid data to enhance population health assessment: methodological issues addressed. Journal Public Health Management Practice. 2002; 8(4):38–44.
24. Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay C, Vale L. Effectiveness and efficiency of guideline dissemination and implementation strategies. Health Technology Assessment. 2004; 8:1–72.
25. Klungel OH, Martens EP, Psaty BM, Grobbee DE, Sullivan SD, Stricker BHC, et al. Methods to assess intended effects of drug treatment in observational studies are reviewed. Journal of Clinical Epidemiology. 2004; 57(12):1223–31. [PubMed: 15617947]

26. Aspden, P.; Corrigan, J.; Wolcott, J.; Erickson, SM. Patient Safety: Achieving a New Standard for Care. Washington, D C: National Academies Press; 2004.

27. Ferranti JM, Musser RC, Kawamoto K, Hammond WE. The clinical document architecture and the continuity of care record: a critical analysis. Journal of the American Medical Informatics Association. 2006; 13(3):245–52. [PubMed: 16501180]

Appendix: results of the multinomial logit model for predictors of a match between EF and claims

Unmatched EF (v. match)	Relative risk ratio	95% confidence interval		z	P > z
Age in months	0.99*	0.98	0.99	−2.44	0.015
Male (v. female)	0.99	0.95	1.04	−0.29	0.772
Child's race (v. white):					
Asian	1.69***	1.30	2.18	3.98	0.000
Black	1.16**	1.04	1.29	2.69	0.007
Hispanic	1.39***	1.19	1.61	4.40	0.000
American Indian	0.96	0.67	1.36	−0.24	0.810
Other	1.29**	1.09	1.54	3.08	0.002
Child's residence county and provider county are the same	0.84**	0.75	0.91	−4.00	0.000
Type of practice (v. pediatric practice):					
Health department	1.31	0.86	2.01	1.24	0.215
Family physician practice	2.28***	1.59	3.26	4.50	0.000
Low or medium intensity of participation (v. high)	0.97	0.74	1.26	−0.26	0.793
Rural–urban classification of provider county (v. central or fringe counties of metropolitan areas of 1 million pop. or more:					
Counties in metropolitan areas of 250,000 to 1,000,000 pop.	0.77	0.46	1.27	−1.04	0.298
Counties in metropolitan areas of less than 250,000 pop.	0.74	0.43	1.27	−1.09	0.277
Urban pop. of 20,000 or more, adjacent to a metropolitan area	0.44**	0.25	0.80	−2.68	0.007
Urban pop. of 20,000 or more, not adjacent to a metropolitan area	0.78	0.46	1.33	−0.92	0.359
Rural or urban pop. of 2500 to 19,999, adjacent to a metropolitan area	0.64	0.41	1.01	−1.93	0.053
Rural or urban pop. of 2500 to 19,999, not adjacent to a metropolitan area	0.69	0.46	1.03	−1.84	0.066
Quarter in which practice first started providing preventive dental services (v. fourth quarter, 2002):					
First quarter, 2000	1.24	0.60	2.55	0.58	0.564
Second quarter, 2000	0.99	0.47	2.09	−0.01	0.988
Third quarter, 2000	1.62	0.86	3.05	1.50	0.133
Fourth quarter, 2000	1.55	0.63	3.82	0.96	0.338
First quarter, 2001	0.86	0.46	1.59	−0.49	0.623
Second quarter, 2001	1.31	0.70	2.44	0.85	0.393
Third quarter, 2001	1.52	0.86	2.72	1.43	0.153

Unmatched EF (v. match)	Relative risk ratio	95% confidence interval		z	P > z
Fourth quarter, 2001	1.10	0.59	2.07	0.30	0.765
First quarter, 2002	1.51	0.76	2.97	1.18	0.236
Second quarter, 2002	1.22	0.58	2.55	0.53	0.598
Third quarter, 2002	0.75	0.29	1.91	−0.61	0.545
Age in months	0.97***	0.96	0.99	−4.12	0.000
Male (v. female)	0.99	0.95	1.04	−0.29	0.770
Child's race (v. white):					
Asian	0.87	0.60	1.27	−0.71	0.479
Black	1.07	0.96	1.18	1.22	0.221
Hispanic	1.04	0.81	1.34	0.32	0.752
American Indian	0.85	0.65	1.12	−1.14	0.253
Other	1.28**	1.10	1.47	3.29	0.001
Child's residence county and provider county are the same	1.00	0.89	1.13	0.06	0.953
Type of practice (v. pediatric practice):					
Health department	1.05	0.66	1.67	0.22	0.830
Family physician practice	1.63*	1.02	2.61	2.04	0.041
Low or medium intensity of participation (v. high)	0.98	0.61	1.55	−0.11	0.915
Rural–urban classification of provider county (v. central or fringe counties of metropolitan areas of 1 million pop. or more):					
Counties in metropolitan areas of 250,000 to 1,000,000 pop.	1.23	0.73	2.09	0.78	0.435
Counties in metropolitan areas of less than 250,000 pop.	1.07	0.59	1.92	0.22	0.828
Urban pop. of 20,000 or more, adjacent to a metropolitan area	1.56	0.79	3.05	1.29	0.199
Urban pop. of 20,000 or more, not adjacent to a metropolitan area	2.17***	1.44	3.28	3.69	0.000
Rural or urban pop. of 2500 to 19,999, adjacent to a metropolitan area	1.49	0.68	3.25	0.99	0.321
Rural or urban pop. of 2500 to 19,999, not adjacent to a metropolitan area	1.27	0.66	2.42	0.72	0.472
First month in which practice started providing preventive dental services:					
First quarter, 2000	36.14***	6.63	197.07	4.15	0.000
Second quarter, 2000	35.32***	4.87	256.04	3.53	0.000
Third quarter, 2000	12.68**	2.10	76.46	2.77	0.006
Fourth quarter, 2000	42.49***	7.51	24.39	4.24	0.000
First quarter, 2001	19.25**	3.25	114.00	3.26	0.001
Second quarter, 2001	11.51**	2.16	61.45	2.86	0.004
Third quarter, 2001	12.36**	2.24	68.19	2.88	0.004
Fourth quarter, 2001	9.99**	1.83	54.43	2.66	0.008
First quarter, 2002	5.49	0.86	35.34	1.80	0.072
Second quarter, 2002	6.45*	1.18	35.24	2.15	0.031
Third quarter, 2002	2.46	0.34	17.92	0.89	0.376

N = 47,990. Match is the base outcome.

*
Significant at $P \leq 0.05$;
**
significant at $P \leq 0.001$;
***
significant at $P \leq 0.0001$.

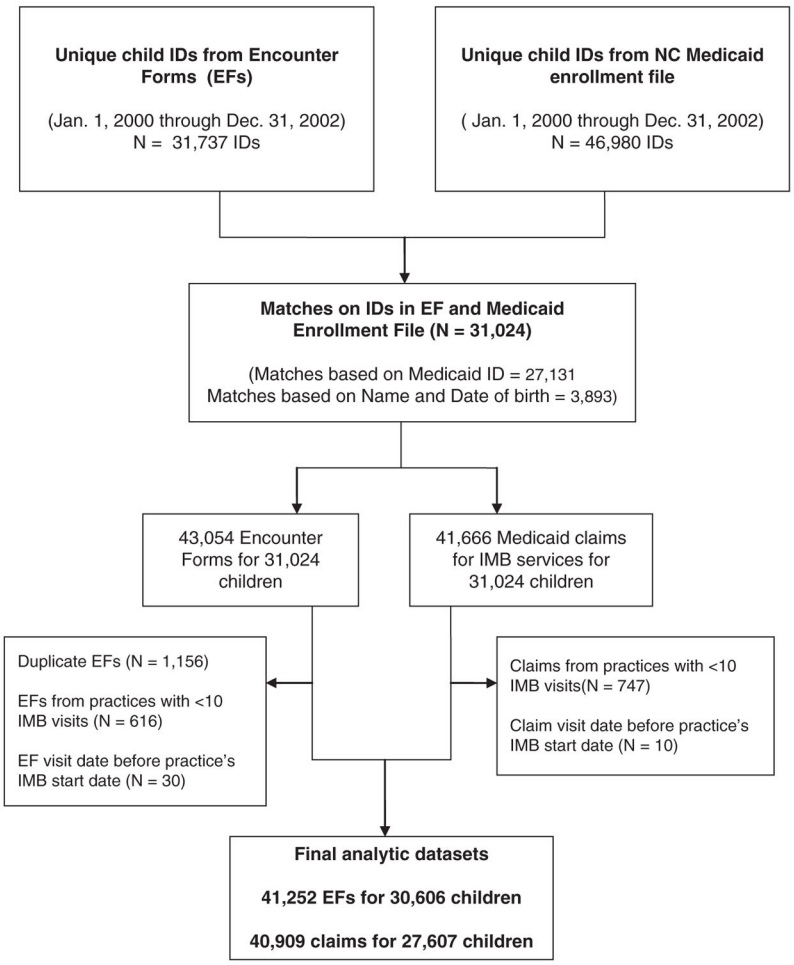


Figure 1.

Process of matching patient encounter forms (EFs) with Medicaid enrollment and claims data

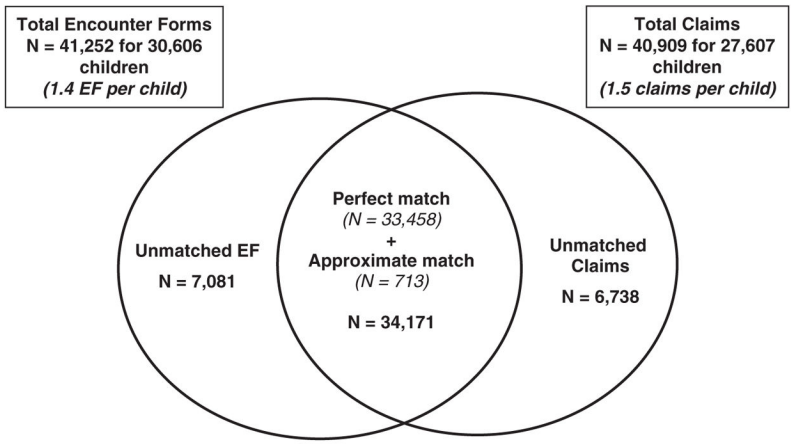
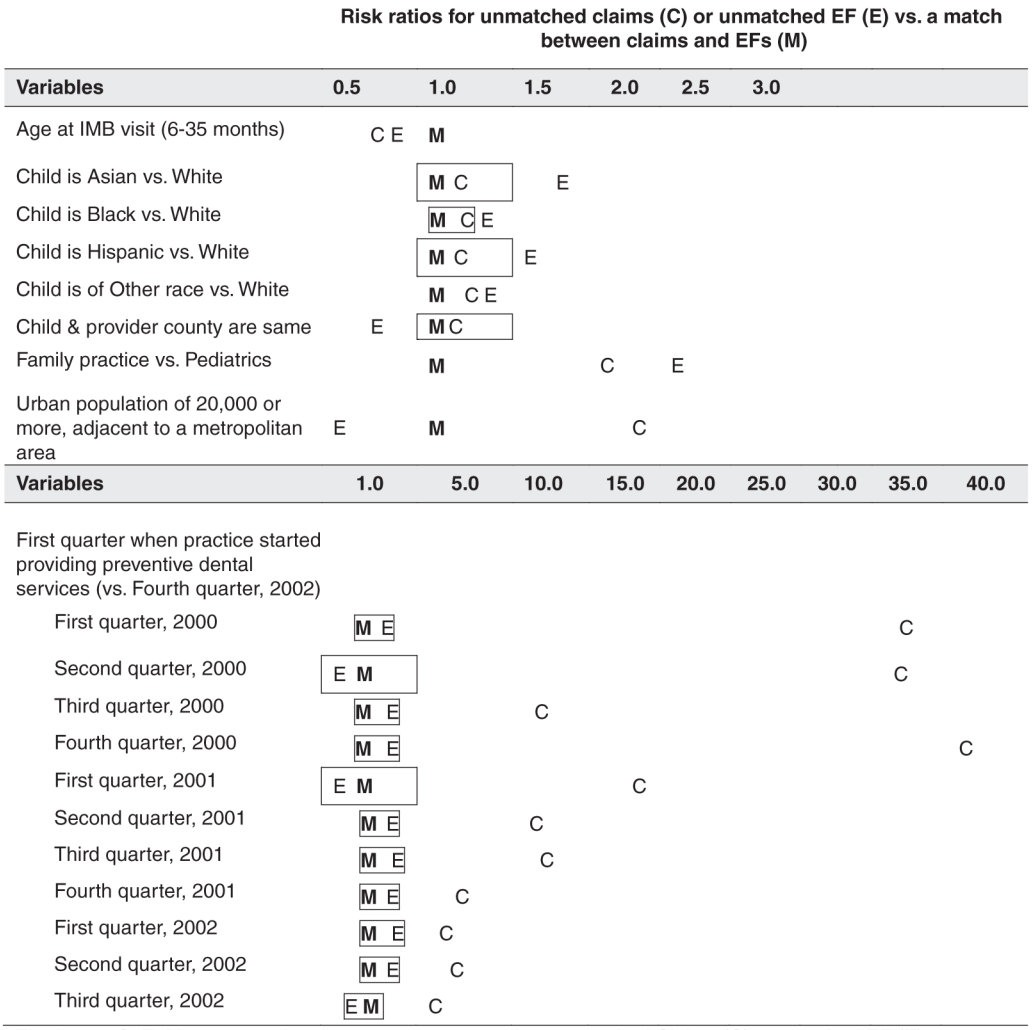


Figure 2.
Match on preventive dental visits between patient encounter forms and Medicaid claims



The letters C, E, M correspond to the 3 outcome categories: unmatched Claims (C), unmatched EF (E) and Match (M).
The 'M's are stacked on top of one another because M is the base category.
Only variables significant at $P \leq .05$ for at least one comparison are presented.
Inclusion of either the "C" or "E" in a box with the "M" indicates lack of a statistically significant difference between those two outcomes.

Figure 3.

Results of the multinomial logit model for predictors of a match between Medicaid claims and patient encounter forms