

Is It Feasible to Use Electronic Health Records for Quality Measurement of Adolescent Care?

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Objective: To determine the extent to which it is feasible to implement quality measures on electronic health records (EHRs) as currently implemented in pediatric health centers.

Methods: A survey of information technology professionals at 10 institutions that provide primary care services to adolescents. The survey asked whether data about care was being captured electronically across the nine domains relevant to adolescent well care: Screening, Health Risks, Sexual Health, Diagnosis and History, Laboratory Results, Prescriptions, Referrals, Forms Management, and Patient Demographics. For each domain, we developed a scale of the extent to which the EHR makes quality measurement feasible.

Results: Overall feasibility scores varied across centers from 34% to 85% and from 53% to 80% across care domains. One centre reported 100% feasibility for 8 of 10 care domains.

Conclusions: Electronic health records can facilitate quality improvement, but the feasibility of such use depends on the presence, validity, and accessibility of the quality data in the EHR. Even among the largest and most sophisticated pediatric EHR systems, quality of care measurement is not possible yet for all aspects of adolescent well care without manual effort to review and code data. Nevertheless, almost all quality measures were reported to be feasible in some systems.

surement is constrained by “the lack of an information infrastructure to support it” (Chassin and Galvin, 1998). By quantifying the services delivered to patients, health-care organizations can attack problems of underuse of necessary services, overuse of unnecessary services, and reduction of preventable complications in treatment.

Quality measurement often relies on administrative claims data, but measures evaluating the clinical content of preventive care have not been widely implemented because they need more detailed clinical data than are available in administrative claims (Iezzoni, 1997; MacLean et al., 2006). Claims lack specificity about care practices and changes in health status. Manual review of charts extracts clinical details, but the expense limits routine use.

The rapid diffusion of EHRs, accelerated by the federal Meaningful Use incentive payments to providers (Blumenthal and Tavenner, 2010), offers an alternative source of quality measurement data through the automated extraction of relevant data. Compared with claims or survey data, EHRs include significantly more detail than do claims or survey data. These details include timing information about clinical interactions between patients and the healthcare system, laboratory results, and details on patient complications and severity of illness. Recognizing the potential of EHRs to improve quality measurement, the Office of the National Coordinator (US Department of Health and Human Services, 2011), the National Quality Forum (National Quality Forum, 2011), and others have called for the respecification of existing quality measures for use in EHRs and the

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The United States is investing in electronic health records (EHRs) to improve the quality of care and the ability to monitor it (US Department of Health and Human Services, 2011). The Institute of Medicine (IOM) defined quality of care as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge” (Lohr and Schroeder, 1990). Quality measurement quantifies the degree to which these services are being delivered. However, as observed by another panel of the IOM, quality mea-

development of new clinical quality measures that would be calculated from information automatically extracted from EHRs. These criteria require that the data used for quality measurement must be available in structured fields using standardized health terminologies (US Department of Health and Human Services, 2012).

The problem of measuring the quality of children's healthcare is acute. The Children's Health Insurance Program Reauthorization Act (CHIPRA) called for states to report the quality of care for children in Medicaid and CHIP (US Congress, 2009). Because there are few validated quality measures for children's healthcare (Kavanagh et al., 2009), CHIPRA supplied historic investment in measures development through the establishment of the Pediatric Quality Measures Program (PQMP), which supported the research undertaken here. Although the underlying EHR technology may be the same in adult and pediatric care settings, local factors determine the setup, configuration, and use of the software capabilities. Order sets, checklists, use of structured fields for data entry, and other details of EHR implementation may reflect the unique needs of pediatric practices, limiting the standardization of terms and structured fields necessary for the EHR to harness the detailed data for quality measurement.

There is substantial evidence that current EHR implementations do not adequately support quality measurement of several aspects of care (Baker et al., 2007; Fuhlbrigge et al., 2008; Hazelhurst et al., 2012; Linder et al., 2009; Persell et al., 2006; Weiner et al., 2005), including in pediatrics (Gardner et al., 2014; Gold et al., 2012). Yet, specific domains of implementation in large health systems have not been considered. There have been few attempts to measure the feasibility of electronic quality measurement through surveys of health information technologists and none to our knowledge in pediatric care. Although information technology (IT) specialists may have a bias toward positive reporting on their own EHRs, they also have uniquely

detailed, expert, and first-hand knowledge of their strengths and limitations.

This article reports data from a survey of health information technologists at leading pediatric health centers on the extent to which information about care required for quality measurement is present in the EHR for computer queries. Our question concerns the degree to which it is feasible to calculate quality measures from EHRs. Electronic health records have enormous potential for facilitating quality improvement, but the feasibility of such use depends on the presence, validity, and accessibility of the quality data in the EHR (Wasserman, 2011). "Feasibility" means the extent to which the data required for quality measurement are readily available or could be captured without undue burden (National Quality Forum, 2012). For clinical measures, the required data elements should be routinely generated during care delivery and available in EHRs.

Our purpose was to learn whether EHRs currently used in pediatric institutions contained information about routine adolescent outpatient care. As part of the PQMP's effort to develop quality standards for pediatric care, we reviewed consensus-based (e.g., American Academy of Pediatrics, 2014) and evidence-based guidelines (e.g., US Preventive Services Task Force, 2014) for that care. This review informed our judgments about elements that should be documented in an EHR. For adolescent well care, these included (1) health risk behavior counseling such as injury prevention, driving, sleep and diet; (2) immunizations or reasons for nonadministration of the immunization; (3) screening and early identification tools such as brief assessments for depression and drug use; and (4) the collection of data on patients' sexual activity. The EHR must also capture data about the ordering of laboratory tests and the management of laboratory results; the ordering of prescriptions; recording visits, diagnoses, and the results of physical examinations; and management of referrals of patients to specialists. To calculate measures of the quality of these aspects of care, data about them must be in the

EHR. It is also necessary that the EHR include data on patient demographics, so that quality can be reported separately by demographic group.

To help determine how feasible it is to measure the quality of care from queries of pediatric EHRs, we surveyed IT professionals at a set of leading pediatric health systems about how well their EHRs captured data about these care domains. We used the survey responses to calculate a set of "Feasibility" scores and used those scores to describe the extent to which EHRs hold the clinical and other information required for implementing comprehensive quality measures in pediatric EHRs.

Study Design and Methods

We designed a survey about the documentation of adolescent well care in pediatric EHRs. To identify sites to be surveyed, we began with five institutions that varied in practice type, population demographics, and EHR systems. We then added six sites from PEDSNET (Bailey et al., 2013), a learning collaborative of large pediatric healthcare institutions focused on EHR measurement. Seven of these 11 sites responded to our survey. Two of the nonresponding sites said that their staff were too busy. The other two did not provide a reason. These sites did not respond to individual calls or offers of training help and did not subsequently participate in PEDSNET research. Additionally, one site relayed the survey invitation to three independent sites with whom it collaborated on implementing the EHR, all of which responded. This resulted in a total of 10 completed site surveys.

All 10 institutions provide primary care services to adolescents and had implemented an EHR system at least before 2 years. Most of the sites were large health systems or freestanding children's hospitals. The average number of primary care patients seen annually at these sites was 18,979 ($SD = 36,373$). The organizations used EHR systems developed by eClinicalWorks ($n = 5$), Epic ($n = 4$), and Allscripts ($n = 1$). Sites identified a lead respondent who could

comment on the clinical workflow and the database structure of the EHR system. The survey was administered during the period from December 2011 through February 2012. An electronic survey (using Survey Monkey) was distributed by e-mail and included questions about the capacity of the EHR to capture various types of data elements. Technical assistance was provided to the respondents to clarify questions.

Measures

The survey asked about essential domains of adolescent well care. We also asked about the components of EHRs where, based on our experience with EHRs, we knew that information about these care domains was typically stored. The choice of domains was informed by our review of care guidelines and input from many stakeholders obtained during the PQMP measurement development process. In addition, the National Committee for Quality Assurance (the employer of several authors) had extensive experience in developing the Healthcare Effectiveness Data and Information Set (HEDIS) measures, including the electronic specification of many quality measures. This experience informed us about the domains necessary for well care measurement in primary care. This article reports the first formal data collection using this survey.

From the survey items, we constructed 9 measures, including Diagnosis and History (6 items), Forms Management (5 items), Health Risks (3 items), Laboratory Results (4 items), Patient Demographics (12 items), Prescriptions (4 items), Referrals (8 items), Screening (4 items), and Sexual Health (8 items). These scales were designed to capture a sample of the domains of care activity indicated for adolescent well care, including screening, assessments of health risks, assessment and counseling concerning sexual health, recording of diagnoses, capture of patient history, and management of laboratory results, prescriptions, and referrals. In addition, we asked about the ability of patients and staff to enter questionnaire data into the EHR,

which is important to using the EHR as a means of collecting patient-reported outcomes. Finally, we asked whether the EHR captured patient demographic data, which are essential to determine the equity of care provided.

Table 1 describes the items in each scale. For each item, we scored the response as positive if the respondent indicated that the EHR was ready to fully capture the data electronically. For example, for the question about how laboratory orders are captured, the positive answer was that they were captured “Electronically only.” Other questions asked the respondent whether the information was captured electronically, and if so, how well does that work? The positive answer was “Yes and works well.” Each scale is the proportion of items where the respondent answered positively. This proportion was taken as an indicator of whether the institution could feasibly measure quality of care for that clinical domain.

Institutional Review Board Approval

The Nationwide Children’s Hospital Internal Review Board considered this work exempt from human subjects review.

Results

Table 2 presents the minimum, maximum, and average organizational feasibility scores on the scales. The average performance scores for domains ranged from 52.5% to 80.0%. The number of institutions was too small to permit statistical comparisons between performance rates on different scales.

Figure 1 presents a box plot of the dispersion of feasibility scores across the measures, grouped by organizations. The organizations are sorted along the horizontal axis by their mean feasibility score (the “diamond” shapes in Figure 1). These averages ranged from 28% (Unit A) to 81% (Unit J). Half of the organizations have a 70% or better feasibility.

We examined whether average feasibility scores were associated with the brand of EHR deployed at the organization, the

number of years that the organization had deployed the EHR, and the size of the organization. We found no statistically significant associations.

Discussion

Quality measurement in pediatrics lags behind adult quality assessment in the number of vetted measures and the scope of health concerns addressed. As such, it is urgent to develop new measures for assessing clinician and system performance especially for state Medicaid programs. The advent of measures from EHRs is especially important for pediatrics and well care because clinicians caring for children and adolescents spend far more time on preventive counseling and anticipatory guidance than their adult counterparts, and these types of activities are poorly captured in traditional claims-based quality measures. To date, there has been no information on how well EHRs will capture more than a few individual measures at single sites.

Unfortunately, quality measures from computer queries of EHRs are limited by the content and technical capability of current information systems (Gold et al., 2012). The responses to our survey of a group of leading pediatric health centers suggest that automated EHR-based quality measurement for many adolescent well care measures is not ready for high stakes uses, such as multisite quality improvement, provider comparisons, public reporting, and performance-based payment. No institution would be able to automatically retrieve all items from its EHR necessary for quality measurement in adolescents, but for almost all the care domains, there was at least one center that reported itself as having perfect feasibility in that domain. However, none of the pediatric health centers were completely ready on all scales, suggesting that none of them could implement these measures in a comprehensive quality measurement program at this time. Finally, a wide range of feasibility was reported across individual sites. It is a standard practice to implement EHRs incrementally, adding tools to support specific elements of

Table 1. EHR Feasibility Scales

Measure	Definition	Elements
Diagnosis and History	Does the EHR capture information on histories and diagnoses?	<p>Are diagnoses records managed exclusively electronically?</p> <p>Does your EHR capture data on the patient's diagnoses in the patient history section in structured fields and using standard vocabularies, and does it work well?</p> <p>Does your EHR capture data on the patient's diagnoses in the diagnosis section in structured fields and using standard vocabularies, and does it work well?</p> <p>Does your EHR capture patient history in structured fields and using standard vocabularies, and does it work well?</p> <p>Can your EHR discriminate current and past patient problems, and does it work well?</p> <p>Does your EHR capture data on the patient's diagnoses in the encounter form in structured fields and using standard vocabularies, and does it work well?</p>
Forms Management	How are patient questionnaires and other forms managed?	<p>Are records of face-to-face visits exclusively handled electronically?</p> <p>Are records of other visits exclusively handled electronically?</p> <p>Are records of physical exams exclusively handled electronically?</p> <p>Can patients complete questionnaires and forms electronically?</p> <p>Can staff enter patient questionnaires and forms electronically?</p>
Health Risks	Are health risk assessments captured?	<p>Does your EHR capture all health risk assessment data electronically?</p> <p>Does your EHR capture outpatient health risk assessments, and does it work well?</p> <p>Does your EHR capture all records of counseling electronically?</p>
Laboratory Results	Laboratory orders and results	<p>Are lab orders acquired exclusively electronically?</p> <p>Are lab results acquired exclusively electronically?</p> <p>What proportion of your lab results are captured via a lab to EHR interface?</p>

(Continued)

Table 1. (Continued)

Measure	Definition	Elements
Patient Demographics	Data characterizing the patient	<p>Do you have a system for automatically capturing lab results?</p> <p>Can the EHR record patient status as American Indian?</p> <p>Can the EHR record patient status as Asian American?</p> <p>Can the EHR record patient status as Pacific Islander?</p> <p>Can the EHR record patient status as African American?</p> <p>Can the EHR record patient status as White American?</p> <p>Can the EHR record patient status as Hispanic American?</p> <p>Can the EHR capture subcategory status on race?</p> <p>Can the EHR capture subcategory status on ethnicity?</p> <p>Can the EHR capture the patient's language preference?</p> <p>Does the system capture patient's self-reported race?</p> <p>Does the system capture patient's self-reported ethnicity?</p> <p>Does the system capture patient's self-reported language?</p>
Prescriptions	Can the EHR capture prescription orders and patient fulfillments?	<p>Are prescription data captured electronically?</p> <p>Does your EHR document that a prescription has been filled, and does it do it well?</p> <p>Does your EHR document that a prescription has been sent, and does it do it well?</p> <p>Does your EHR capture all warnings of drug interactions or contraindications electronically?</p>
Referrals	Can the EHR capture orders and completions of referrals?	<p>Does your EHR capture all specialist referrals electronically?</p> <p>Does your EHR capture all requests for referrals?</p> <p>Does your EHR document that a referral was given, and does it do it well?</p> <p>Does your EHR document that a referral was made, and does it do it well?</p> <p>Does your EHR document the reason for a referral, and does it do it well?</p>

(Continued)

Table 1. (*Continued*)

Measure	Definition	Elements
Screening	Results of screening questionnaires	<p>Does your EHR document a specialist's report, and does it do it well?</p> <p>Does your EHR document the review of a specialist's report, and does it do it well?</p> <p>Does your EHR document discussion of a specialist's report, and does it do it well?</p> <p>Does your EHR have electronic versions of screening results?</p> <p>Does your EHR have electronic versions of screening records?</p> <p>Can your EHR capture screening results and does it work well?</p> <p>Can your EHR system capture electronic questionnaires and patient data collection forms used in an outpatient setting?</p>
Sexual Health	Patient sexual activity	<p>Does your EHR capture data on the patient's current sexual activity, and does it work well?</p> <p>Does your EHR capture data on the patient's past sexual activity, and does it work well?</p> <p>Does your EHR capture data on the patient's number of sexual partners, and does it work well?</p> <p>Does your EHR capture data on the patient's gender of sexual partners, and does it work well?</p> <p>Does your EHR capture data on the patient's type of sexual activities, and does it work well?</p> <p>Does your EHR capture data on the patient's Tanner stage, and does it work well?</p> <p>Does your EHR capture data on the patient's use of birth control medications, and does it work well?</p> <p>Does your EHR capture data on the patient's use of other birth control methods, and does it work well?</p>
EHR, electronic health record.		

Table 2. Minimum, Maximum, and Average EHR Feasibility Across Organizations

Measure	Feasibility (%)		
	Minimum	Maximum	Average
Diagnosis and History	16.7	100.0	80.0
Forms Management	20.0	100.0	72.0
Health Risks	0.0	100.0	76.7
Laboratory Results	18.8	75.0	56.4
Patient Demographics	58.3	83.3	73.3
Prescriptions	25.0	100.0	52.5
Referrals	12.5	100.0	57.5
Screening	0.0	100.0	57.5
Sexual Health	0.0	100.0	70.0
EHR, electronic health record.			

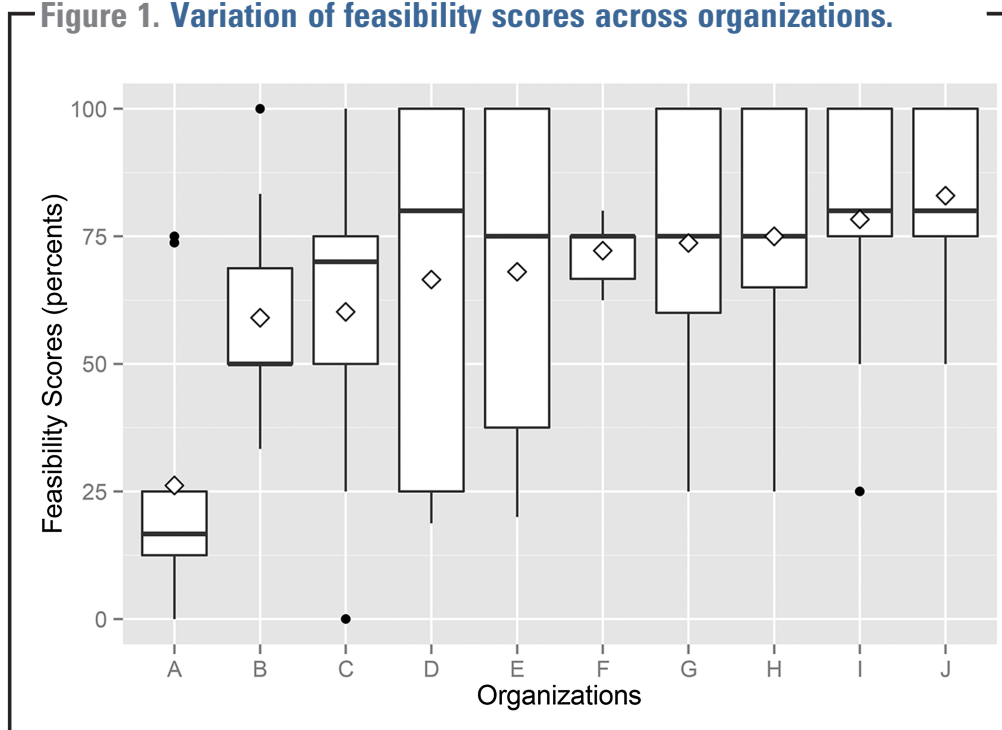
clinical practice. As of this survey, however, the level of EHR implementation that would support a robust uniform quality measurement system had not been achieved. Thus, institutional quality improvement activities are possible now through individual measures and monitoring, but comparative activities will await greater implementation.

Limitations

Our data represent a best-case scenario for the feasibility of EHR quality measurement. First, we surveyed a small convenience sample of pediatric hospitals with significant IT resources. These institutions were among the largest pediatric centers. They had demonstrated interest in the topic of EHR measurement and some were engaged in EHR-related research. These sites may have been further advanced in the implementation of their EHRs than most pediatric institutions. These factors suggest that these data may overestimate the quality of pediatric EHRs. However, these data were collected in late 2011 and early 2012. The Affordable Care Act mandated improvement of EHRs, and EHR systems may have progressed since then, suggesting that our estimate of feasibility may be conservative. We did not find site or EHR characteristics that were associated with the feasibility scores, but this may be an artifact of the

small number of sites that we surveyed. It would be valuable to extend this work in a larger more representative survey.

Second, subjective reports from IT specialists provide only limited information about the feasibility of quality measurement. When IT specialists say that information relevant to a quality dimension is not present in the EHR, they are likely right and measurement is infeasible. These specialists know how the EHR is implemented and have no incentive to understate its capabilities. However, even if the IT specialists believe that the information is in the system, they may not accurately estimate the extent to which clinicians may or may not use system capabilities. For example, respondents may have been unaware of the degree to which clinicians recorded data in unstructured fields, even when structured fields were available. Similarly, it is possible that a portion of the system that an engineer might evaluate as working well, a clinician might experience as working poorly. It would have been valuable to have multiple respondents complete the survey, but we were concerned about the burden on responding institutions, which were also providing extensive data support for other components of a larger study. However, even subjective evaluations of feasibility from multiple viewpoints have limits. It is also important to objectively test the validity

Figure 1. Variation of feasibility scores across organizations.

Note: The diamonds represent the average of the feasibility scale scores for each organization. The horizontal bars represent the medians. The top and the bottom of the boxes correspond to the first and third quartiles (the 25th and 75th percentiles). The upper whisker extends from the top of the box to the highest value that is within $1.5 \times \text{IQR}$ of the top, where IQR is the interquartile range or distance between the first and third quartiles. The lower whisker extends from the bottom of the box to the lowest value within $1.5 \times \text{IQR}$ of the hinge. Data beyond the end of the whiskers are outliers and plotted as points.

of quality measures calculated from EHRs (Gardner et al., 2014).

Finally, we looked only at well care. Other aspects of adolescent care focusing on acute illness would center on other features.

Implications for Practice

Electronic health record feasibility is one step in comprehensive quality measurement. There is insufficient agreement on detailed content for quality indicators from pediatric and adolescent care guidelines, and, thus, quality measure developers have produced a limited set of measures for pediatric health system accountability that are computable on EHRs. Efforts are underway to expand the number of such measures. There is also resistance against more accountability measures by providers

struggling with current documentation demands. Finally, routine quality measurement will likely require data extracted from the EHR by a computer query rather than by costly manual chart extraction (Roth et al., 2009). Hence, the value of EHR-based measures may only be realized when clinicians and pediatric health systems themselves see true worth in automating EHR-based quality indicators for improvement processes and pay-for-performance systems, so that they find it valuable to completely document care and outcomes in EHRs. Better-designed measures and stronger organizational incentives supporting quality improvement may be necessary for the full implementation of EHR-based quality measurement in pediatrics.

The promise of EHR quality measurement remains unfulfilled (Gardner et al., 2014; Parsons et al., 2012; Wasserman,

2011). However, it is clear that at least for adolescent well care, large pediatric institutions are developing the capacity to report on quality measurement from health records. Refinement of measures, standardization of reporting fields, incentives for systems and clinicians for documentation of required quality data elements, and evaluating completeness of records will all be important next steps. Further work is needed to describe and quantify the gap between current state and ideal state.

References

- American Academy of Pediatrics. *Bright futures: adolescence 11–21 years*. Elk Grove, IL: 2014.
- Bailey, L.C., Milov, D.E., & Kelleher, K.J., et al. Multi-Institutional Sharing of Electronic Health Record Data to Assess Childhood Obesity. *PLoS One* 2013;8:e66192. doi:10.1371/journal.pone.0066192.
- Baker, D.W., Persell, S.D., & Thompson, J.A., et al. Automated review of electronic health records to assess quality of care for outpatients with heart failure. *Ann Intern Med* 2007;146:270–277.
- Blumenthal, D., & Tavenner, M. The “meaningful use” regulation for electronic health records. *New Engl J Med* 2010;363:501–505.
- Chassin, M.R., & Galvin, R.W. The urgent need to improve health care quality. Institute of Medicine National Roundtable on Health Care Quality. *JAMA* 1998;280:1000–1005.
- Fuhlbrigge, A., Carey, V.J., & Finkelstein, J.A., et al. Are performance measures based on automated medical records valid for physician/practice profiling of asthma care? *Med Care* 2008;46:620–626.
- Gardner, W., Morton, S., & Byron, S.C., et al. Using computer-extracted data from electronic health records to measure the quality of adolescent well-care. *Health Serv Res* 2014;49:1226–1248. doi:10.1111/1475-6773.12159.
- Gold, R., Angier, H., & Mangione-Smith, R., et al. Feasibility of evaluating the CHIPRA care quality measures in electronic health record data. *Pediatrics* 2012;130:139–149.
- Hazelhurst, B., McBurnie, M.A., & Mularski, R.A., et al. Automating care quality measurement with health information technology. *Am J Manag Care* 2012;166:313–319.
- Iezzoni, L.I. Assessing quality using administrative data. *Ann Intern Med* 1997;127:666–674.
- Kavanagh, P.L., Adams, W.G., & Wang, C.J. Quality indicators and quality assessment in child health. *Arch Dis Child* 2009;94:458–463.
- Linder, J.A., Kaleba, E.O., & Kmetik, K.S. Using electronic health records to measure physician performance for acute conditions in primary care. *Med Care* 2009;47:208–216.
- Lohr, K.N., & Schroeder, S.A. A strategy for quality assurance in Medicare. *NEJM* 1990;322:707–712.
- MacLean, C.H., Louie, R., & Shekelle, P.G., et al. Comparison of administrative data and medical records to measure the quality of medical care provided to vulnerable older patients. *Med Care* 2006;44:141–148.
- National Quality Forum. Electronic quality measures (eMeasures). 2011. Available at: www.qualityforum.org/Projects/e-g/eMeasures/Electronic_Quality_Measures.aspx. Accessed March 31, 2014.
- National Quality Forum. Measure evaluation criteria. 2012. Available at: www.qualityforum.org/docs/measure_evaluation_criteria.aspx. Accessed April 01, 2014.
- Parsons, A., McCullough, C., Wang, J., & Shih, S. Validity of electronic health record-derived quality measurement for performance monitoring. *J Am Med Inform Assoc* 2012;19:604–609.
- Persell, S.D., Wright, J.M., & Thompson, J.A., et al. Assessing the validity of national quality measures for coronary artery disease using an electronic health record. *Arch Intern Med* 2006;166:2272–2277.
- Roth, C.P., Lim, Y-W., & Pevnick, J.M., et al. The challenge of measuring quality of care from the electronic health record. *Am J Med Qual* 2009;24:385–394.
- US Congress. Children’s health insurance program reauthorization act of 2009. 2009. Pub. L. No. 123 Stat 8.
- US Department of Health and Human Services. *Report to Congress: National strategy for quality improvement in health care*. Rockville, MD: 2011. Available at: www.healthcare.gov/law/resources/reports/nationalqualitystrategy032011.pdf. Accessed March 17, 2015.
- US Department of Health and Human Services. Meaningful use stage 2—clinical quality measures. Meaningful use—stage 2. 2012. Available at: www.healthit.gov/policy-researchers-implementers/clinical-quality-measures. Accessed February 26, 2013.
- US Preventive Services Task Force. *Child and adolescent recommendations—clinical categories*. Rockville, MD: 2014. Available at: www.uspreventiveservicestaskforce.org/tfchildcat.htm. Accessed March 17, 2015.
- Wasserman, R.C. Electronic medical records (EMRs), epidemiology, and epistemology: Reflections on EMRs and future pediatric clinical research. *Acad Pediatr* 2011;11:280–287.
- Weiner, M., Stump, T.E., & Callahan, C.M., et al. Pursuing integration of performance measures into electronic medical records: beta-adrenergic receptor antagonist medications. *Qual Saf Health Care* 2005;14:99–106.

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