Web-only Appendix 1. Retooling paper-based quality measures for automated reporting

1. Measure interpretation

Despite delineated data elements, measures require interpretation. The first step in interpretation is ensuring that our e-measure development is based on the current version of the Measure Information Form, which is updated every six months.

We then solicit assistance from various domain experts: TJC abstractors and analysts, physician and nurse informaticists, legal and compliance staff, and content experts. For example, to interpret IMM-1 (pneumococcal immunization), we consulted with physicians and nurses, pharmacists, and project managers from two regions. Physicians and nurses identified relevant documentation work flows, pharmacists identified individual pharmaceuticals involved in the measure and the corresponding pharmacy class (to capture variations in individual pharmaceuticals), and project managers identified local variations in documentation workflows.

Similarly, experts advised a rigorous interpretation of the VTE-2 measure. The data elements required for the denominator included patients transferred to the ICU during an admission; a discrete data element, a physician order for transfer, documents this. However, to avoid transfers that were ordered but not completed, our experts advised specifying the population with both a physician order and a substantiating admission/discharge/transfer (A/D/T) event.

Interpretation of measures must agree throughout Kaiser Permanente. For instance, when TJC published a change in the age range for IMM-1, local implementation dates varied. These differences required time and attention to resolve.

2. Mapping

Mapping links the conceptual specifications of the interpreted measure to specific data tables stored in the EHR system. Often a complex, iterative , and time-consuming process, mapping requires understanding both how providers enter data into the EHR—a function of work flows and the user interface—and how data are stored in tables—a function of vendor database design. One of the challenges inherent in mapping is the huge, growing, and complex database design in the EHR. Kaiser Permanente is currently using a 2010 Epic Systems Corporation® build, for which there are 14,442 data tables; the 2012 release includes 16,534 tables providing hundreds of thousands of data elements.

Similar information can be stored in different tables. Data pertaining to inpatient medications can be stored in tables related to medication orders, medication administration, inpatient medication reconciliation, and intravenous medication mixtures. To accurately report medication-related measures, each relevant data table must be discovered and taken into account.

A second challenge to mapping is that programmers and analysts responsible for reporting are unfamiliar with the user interface and clinical workflows and providers are unfamiliar with EHR data tables. The relationship between the user interface and data tables is often obscure, and terminology in each may vary. For instance, physicians document in an order entitled, “Contraindications for mechanical VTE device.” However, the resulting data are stored as, “Reason for not applying antithrombotic event.” Vendor data table documentation facilitates translation to some degree; however, it does not correlate data tables to Kaiser Permanente organizational work flows, configurations, and naming conventions.

A third challenge is that regional configurations and local work flows vary. For example, to document the reason for not administering immunizations, one region uses a physician order

set labeled, “Do not give,” and another uses a physician order set labeled, “Contraindication.” The table in which the same data are stored can also vary between regions. Project managers and configuration designers can implement automation and streamline data capture for EHR builds, and aligning these efforts with reporting goals can make reporting much easier and more efficient. For example, all data elements in the IMM measure are discrete, so the goal was full automation. Project managers reduced customization and designed documentation work flows to support 100% automated reporting of this measure.

Finally, the integrated nature of KP HealthConnect poses a unique challenge. Information about care across all settings is available to providers with a single click, but only information in the legal medical record for the inpatient stay can be used for TJC extracts. For example, the administration of chemotherapy before a hospital admission is grounds for exclusion from the denominator for the IMM-1 measures. This information may only be used for TJC measures if it is documented again in the inpatient record, contrary to a core concept related to EHRs—minimizing duplication of user effort

3. Coding

Once mapping is complete, coding ensues (currently performed at Kaiser Permanente in SAS version 9.1). Medications are particularly challenging to “hard code” because of the very large number of individual pharmaceuticals, each of which has a unique identifier. There may be dozens of identifiers for ampicillin in the Kaiser Permanente formulary; each must be identified to assure complete data capture. In addition, the formulary changes over time. Convergent Medical Terminology (CMT) “groupers”—lists of similar medications that are maintained over time—are intended to simplify the process of coding.[10] Groupers are essential to incorporating changes for many medications without needing to code them individually. Pharmacy experts

maintain the EHR formulary, and a TJC specification reviewer works with the grouper maintenance team to ensure that groupers are accurate and up to date. Groupers are also available for similar codes for diagnoses and procedures. However, our experience is that more complex sets of groupers have suboptimal accuracy at release and over time.

4. Quality assurance/validation

After coding is complete, validation of automated quality reports ensures accuracy. First, we share with TJC abstractors the reporting output for a time period that has already been abstracted, comparing automated results to the official submission. Mapping and coding are often correct the first time. However, we analyze any differences and adjust mapping and coding to true the automated report to the manual abstraction results. We repeat the process to achieve 100% accuracy, typically in one to three iterative cycles. Occasionally, validation uncovers minor inaccuracies in manual abstracting, and we are unable to achieve total agreement.

Although we have described the process of automating quality reporting as linear, it is more typically an iterative process. For example, the AMI "Prescribed at Discharge" measures apply to five types of medications: aspirin, angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, beta blockers, and statins. We initially mapped the specifications to new orders of these medications at the time of discharge and coded accordingly.

The first validation run was less than 10% accurate. We contacted TJC abstractors, who provided an image of their data source, the "Discharge Instructions" EHR screen. Our next step was to search the vendor enterprise data warehouse for tables associated with terminology in the screenshot or the abstractor's description. We then examined each potential vendor entity/relationship table to identify links to the patient- and encounter-level tables that typically form the basis of our queries.

Armed with the patient medical record number from the screen shot, we iteratively queried the list of tables, modifying the queries until we obtained the data values that appeared on the screen shot. We performed additional validations, viewing the same screens for other patients and comparing the results to our data warehouse queries. When this process was completed, we were able to accurately use the previously unidentified medication tables.

5. Maintaining code over time

Over time, changes arising from several sources require updated interpretation, mapping, coding, and validation. As noted earlier, TJC measure definitions can change in biannual updates; these changes generally result from evolving evidence and clinical practice. Documentation requires close reading to identify needed changes to automated extraction. In addition, two to five annual interim updates and new releases from the EHR vendor can change the database design. For example, in the case of medications, entire data tables were relocated. The timing of uptake of changes varies across regions, posing additional challenges to national reporting.

Other sources of change include revised or updated nomenclature, such as transitioning from ICD-9 to ICD-10. Current procedural terminology (CPT) codes may also change over time, as can medication identifiers. As new medications become available, groupers need updating. Finally, changes in facilities within Kaiser Permanente regions can create the necessity for modifying code to include new entities.