# Quality Measurement Engine (QME) at UC Irvine Health

Larry L. Sautter Award Application

Richard Kelly, Data Engineer
UC Irvine Health, Enterprise Data & Analytics

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> Things get done only if the data we gather can inform and inspire those in a position to make [a] difference.
> - *Mike Schmoker*

## Healthcare Quality Measurement

Good healthcare is a vital human need, and every healthcare organization strives to perform as well as possible. One way to effectively track healthcare quality is through the use of standardized value/quality measures.

UC Irvine Health (UCI) participates in many programs oriented around these measures. Programs are often funded by payers such as Centers for Medicare and Medicaid Services (CMS), California Department of Health Care Services (DHCS), and commercial payers such as HealthNet. Achieving performance targets can earn UCI incentives of tens of millions of dollars annually.

Several years ago, frustrated by the lack of scalability of our existing quality reporting system, we set upon a rewrite. Utilizing lessons learned from Physician Quality Reporting System (PQRS) and prior programs, we started building Quality Measure Engine (QME) to calculate results for the California PRIME program.

With plans underway for an EMR migration from Allscripts to Epic in late 2017, it was recognized that there was an opportunity to move quality reporting to use our new enterprise data warehouse[1]. Also planned at that time was to leverage a new data governance tool[2] to maintain a central authority of data value sets, and that all coding would be managed using distributed version control[3].

QME receives some benefits that come simply from cleverly leveraging the new enterprise tools. The data governance tool allows data stewards to help maintain value sets. The data warehouse means that coding can now use standardized terminologies (eg. ICD10, CPT4), hewing closer to standard specifications.

**MSSP ACO** Medicare Shared Savings Program - Accountable Care Organization (CMS)

**PRIME** Public Hospital Redesign & Incentives in Medi-Cal Program (DHCS)

**QIP** Quality Incentive Program (DHCS)

**UDS** Uniform Data Set - Health Resources & Services Administration (HRSA)

**Figure 1:** Some of the programs targeted by UC Irvine Health

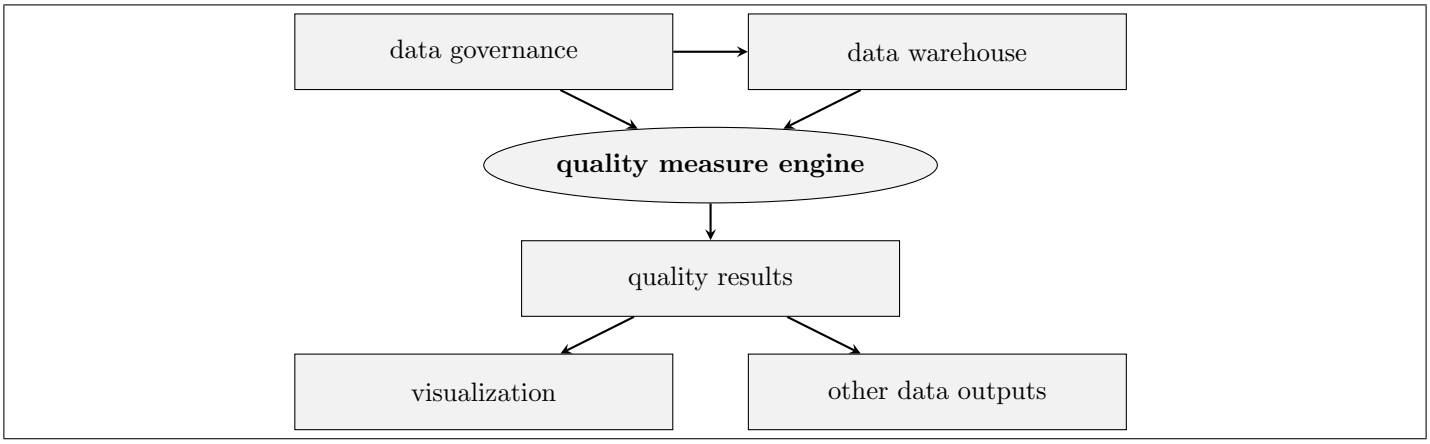


**Figure 2:** QME block diagram

# Legacy Challenges

The legacy quality measure system suffered from several issues:

- Measures were coded directly against the EMR data model. So code for Allscripts would not work post-migration.
- When different programs called for the same standard measure, it had to be coded multiple times.
- Measures were coded with embedded local ID codes (eg. for procedures), and text search. Thus, a measure coded for UCI would not work at another school.
- Differently-shaped measure results had to be stored in separate tables (eg. a diabetes control measure needing three facts/events, and an INR measure needing two).
- The system was designed around the reporting submission deadline, so usually run annually. This didn't encourage improvement during the measurement period.
- Slow calculation frequency, and lack of code improvement mechanisms led to reduced trust by clinicians in the system accuracy, and a bit of an adversarial relationship between stakeholders.

# New Approach

## New Architecture

QME is composed of a library of reusable standardized quality measures, and controllers and metadata for each quality program. All are implemented as SQL Server Stored Procedures, and other technology that is standard at all schools. At a high level:

The *QME library* contains measure code `NQF␣0032␣CMS124v7`. The *UDS controller* selects the patient cohort, and calls the measure with seven value sets specified by the UDS program. The *APG controller* runs in parallel, calling the measure with its own cohort, and seven different value sets specified by the APG program.

## Versatility - Separation of Concerns

QME allows a patient cohort to be selected once, and reused across an entire project. This reduces server load and calculation time versus having each measure request the same patient data.

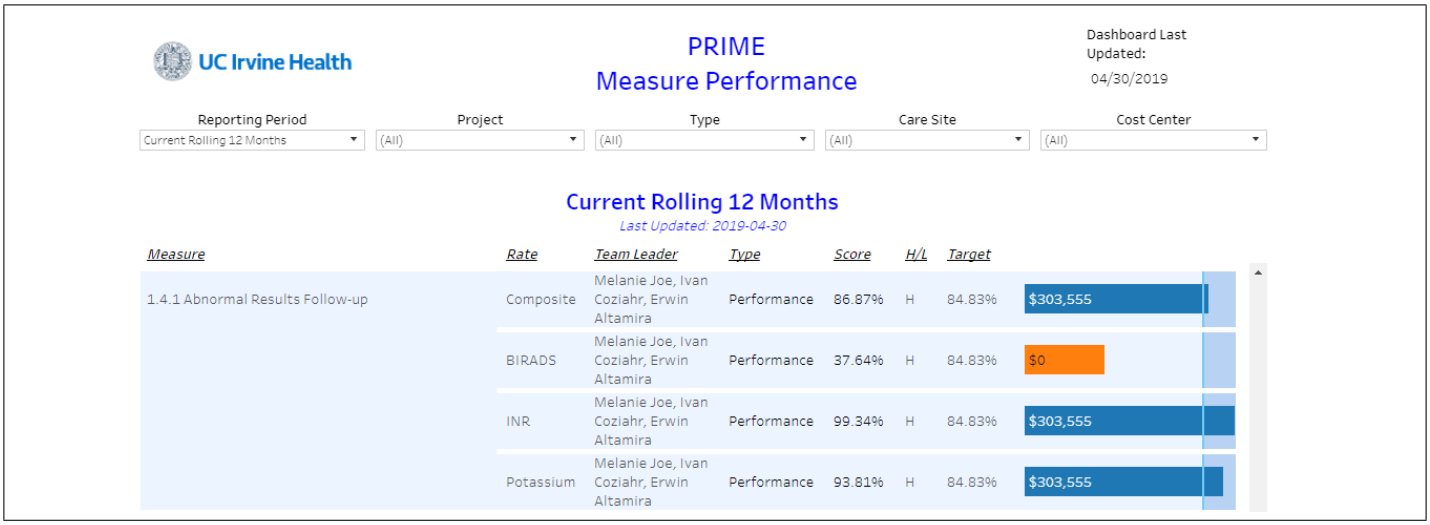


**Figure 3:** PRIME Performance screen (detail screen shows patient narratives and categorization)

QME allows one project to call a measure with one set of standardized value sets. And then another project can call the same measure with a different set of value sets. Measure code re-usability reduces maintenance through reduction of lines of code.

## Uniformity - Serialization of Details

To solve the problem of differently-shaped data for different measures, evidence collected during calculation is serialized in two ways. In plain English for clinicians and validators (actual dates masked):

```
Age␣50␣at␣start␣of␣measurement␣period.␣Unspecified␣essential␣hypertension␣on␣M/D/YY␣
(ICD9CM␣401.9,␣UCI␣Invision␣4).␣Office␣or␣other␣outpatient␣visit..␣on␣M/D/YY␣(CPT4␣99214,␣
UCSD␣Epic␣Billing␣Procedures).␣BP␣systolic␣of␣134␣on␣M/D/YY␣(LOINC␣8480-6,␣UCSD␣Epic␣Flowsheets).␣
BP␣diastolic␣of␣56␣on␣M/D/YY␣(LOINC␣8462-4,␣UCSD␣Epic␣Flowsheets).␣No␣denominator␣exclusion.␣
```

These narratives have been of greater help than originally anticipated. Validators quickly follow the reasoning of the categorization logic, and see what needs to happen, or suggest corrections.

And certain details are serialized in JSON, for use in more detailed dashboards or analysis. Serializing details allows result data for all measures to fit in a single data model. JSON example:

```
{"measurement_date":"YYYY-MM-DD","systolic_value":134.0,"diastolic_value":56.0}␣
```

## Legibility - Semantic Programming

Poorly written measure code can read like an old-time data processing task. Grab records; delete those with certain characteristics; join a table, calculate performance rate. It's easy to forget the intent when thinking in this way.

QME emphasizes coding in simple, set-based steps. For example, find female patients who have had an office visit. Of those patients, find those who've had a mammogram in the past two years.

The end result is that categorization logic can become very easy to read, as this example demonstrates:

```
WHEN␣#age_gender_encounter.person_id␣IS␣NULL␣THEN␣'Initial␣Population'
WHEN␣#exclusion.person_id␣IS␣NOT␣NULL␣THEN␣'Denominator␣Exclusion'
```

```
WHEN␣#screen_mammogram.person_id␣IS␣NOT␣NULL␣THEN␣'Numerator'
ELSE␣'Denominator'
```

### Verification Baked In

The QME data model and programming style lead the way to stricter verification of results.

All patients calculated by a measure are categorized, even those that ultimately do not qualify for the denominator. If the input is 100 patients, the output must be 100 patients.

Retention of evidence for all measures allows for better manual validation, and opens the door to other forms of automatic validation in the future.

## New Reality

### Timely Information - New Use Cases

QME is now used to calculate all measures daily for seven quality programs—145 measures (155 distinct rates) in about 3 hours. This includes multiple measurement periods per program.

This speed makes intervention possible. For example, the `PRIME␣1.4.1␣Abnormal␣Results␣- Potassium␣`measure looks for follow-up within 14-28 days after a serum Potassium test. Whereas annual or monthly reporting would report past performance only, daily calculation gives clinicians a chance to catch out-of-compliance cases before it is too late, and intervene to turn performance around.

Running multiple measurement periods per project allows managers to compare today's performance to that projected at submission time, seeing the trend rather than just a snapshot.

Measure calculations rely on a broad array of value sets, clinical data extraction and mapping, with hundred, even thousands of potential points where system or human error can bring incomplete or inaccurate data into the process. Running QME daily has allowed us to develop automated systems to monitor and track the flow of data from live Epic charting, through the Epic Cogito platform, and the OMOP ETL, and the QME calculation processes. This enables the timely identification and mitigation of process problems as they occur.

Daily results for four programs are fed into our QRMIT dashboard. QRMIT brings together the outstanding list of patient gaps in care identified by QME, with the daily provider schedule of patients with appointments in all ambulatory clinics. QRMIT reporting brings notification of gaps in care directly to the provider during the patient encounter.

### Scalability - Reusable Code

When we have multiple quality programs calling for the same standard measure (but with different patients or value sets), the same measure code can be reused. With fewer lines of code, we can focus our efforts better. Improvements made in one measure codebase can improve accuracy simultaneously in multiple quality programs.

Because measures are now written against our data warehouse whenever possible, any other school with a similar data warehouse can run our measure code with few modifications. This has already been capitalized upon by the UC Health Data Warehouse (UCHDW) project, which was established around the same time as a new program, QIP, was being initiated. UCHDW worked with UCSD, UCLA, and UCSF to use QME to calculate their first year QIP submission. Collaboration at all sites is growing.

### Usability Leads to Continuous Improvement

Code is now legible enough that we can have weekly code review/validation meetings between programmers and clinicians, with excellent understanding and participation across disciplines. The plain English narrative text is readily understood by clinicians and validators. Many iterative improvements have come from validators studying the narrative and pointing out a bit of data in the EMR that was initially missed.

### Marks of Success

Launched in 2017, QME provided continuity of measurement during our migration from Allscripts to Epic, with reduced disruption and rework.

QME allowed UCI to upgrade existing measure code to keep up with published updates to program specifications at the same time as we were launching the new QIP program in the year following the Epic migration. And this was done without significant additional staffing resources or cost.

QME provides a common data model and reporting platform, that has enabled UC Irvine Health leadership to build a single, coordinated approach to more than 100 targeted measures. This has enabled clinical leadership to organize workflows, management goals, and processes to target all identified gaps in care at the same time, instead of having individualized teams and approaches for each program.

QME has resulted in an increase in clinician trust in our quality measurement accuracy. It has fostered closer collaboration between clinicians and developers. It has been a catalyst for improvement, and a base upon which we can build.

The Quality Measure Engine implemented by UC Irvine Health demonstrates many qualities celebrated by the Larry L. Sautter Award. QME was born from a spirit of innovation, and collaboration between many disciplines working toward a common goal. Thank you for your consideration.

### Project Team Members

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| Jamie Anand | Kurt McArthur | Daniel Phillips | Tami Wiley |
| Aiden Barin | Chaya Mohn | Kathy Pickell | Charles Wilson |
| Lisa Dahm | Ayan Patel | Jila Rouhi | Tara Zamansani |
| Richard Kelly (Project Lead) | Ray Pablo | Scott Thompson | |

## References


[1] Observational Health Data Sciences and Informatics (OHDSI). *OMOP Common Data Model*. `https://www.ohdsi.org/data-standardization/␣`

[2] Collibra. *Collibra Data Governance Center*. `https://www.collibra.com/data-governance-solutions/data-governance-center␣`

[3] Linus Torvalds, original author. *git*. `https://git-scm.com/␣`